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Mr. Brian Jankauskas, P.E.
New York State Department of Environmental Conservation
Remedial Bureau A, 11th Floor
625 Broadway
Albany, New York 12233-7015

Subject: **Final Remedial Action Work Plan**
Sites 3 and 6, 109th Airlift Wing, Schenectady Air National Guard Base, Scotia, NY
Site No.: 447022

Mr. Jankauskus:

Attached is the Final Remedial Action Work Plan (RAWP) for Sites 3 and 6, 109th Airlift Wing (AW), New York (NY) Air National Guard (ANG), Schenectady Air National Guard Base (SANGB), Scotia, NY. This RAWP provides information on the remedial activities intended to remediate the petroleum-impacted soils associated with Site 3 and chlorinated impacted soils and groundwater associated with Site 6. The RAWP was prepared in accordance with the NY State Department of Environmental Conservation (NYSDEC) Program Policy, Division of Environmental Remediation (DER)-10; Chapter 5, Section 5.3.

A Final Record of Decision (ROD) was issued by the ANG in March 2012 for the remediation of soils at Site 3 and Site 6 and remediation of groundwater at Site 6. The remedy selected in the ROD includes the excavation of impacted-soils and the injection of chemical oxidant to treat the dissolved phase groundwater plume. This RAWP has been prepared to meet the Remedial Action Objectives as outlined in the ROD and also to incorporate the comments provided by the NYSDEC.

If you have any questions or need additional information, please feel free to call me at (908) 598-2600, extension 134 or by email at chuang@bemsys.com.

Sincerely,

BEM Systems, Inc.

Chun-Ti Huang, P.E.
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Remedial Action Work Plan
For Sites 3 and 6
Schenectady Air National Guard Base

FINAL

Site:
Schenectady Air National Guard Base
DERP Scotia, New York

Prepared for:
NGB/A7OR
Conaway Hall
3500 Fetchet Avenue
Joint Base Andrews, MD 20762-5157

Contract #: W9133L-05-D-0007
Delivery Order #: 0021

April 2013

Work Plan Certification

I, Chun-Ti Huang, certify that I am currently a New York State registered Professional Engineer and that this Remedial Action Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for site Investigation and Remediation (DER-10).

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List of Acronyms

AGWQS	Ambient Groundwater Quality Standards
ANG	Air National Guard
ARAR	Applicable or Relevant and Appropriate Requirements
AW	Airlift Wing
BEM	BEM Systems, Inc.
BEM Team	BEM Systems, Inc. and AECOM
bgs	Below Ground Surface
CAMP	Community Air Monitoring Plan
cis-1,2-DCE	cis-1,2-dichloroethene
COC	Constituent of Concern
CVOCs	chlorinated volatile organic compounds
CY	cubic yards
DER	Division of Environmental Remediation
DERP	Defense Environmental Restoration Program
DGI	Data Gap Investigation
DoD	Department of Defense
DRO	Diesel Range Organics
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EOS	Edible Oil Substrate
EPA	US Environmental Protection Agency
ERP	Environmental Restoration Program
ERPIMS	Environmental Resources Program Information Management System
ESMI	Environmental Soil Management Companies
FSP	Field Sampling Plan
ft	feet
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HMMP	Hazardous Materials Management Process
in	inch
IRA	Interim Remedial Action
ISCO	In-Situ Chemical Oxidation
MSDS	Material Safety Data Sheet
mg/kg	milligrams per kilogram
NGB	National Guard Bureau

NY	New York
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OP-TECH	OP-TECH Environmental Services, Inc.
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
pH	Pondus Hydrogenii
PID	Photo Ionization Detector
ppb	parts per billion
PPE	Personal Protection Equipment
ppm	parts per million
PRAP	Proposed Remedial Action Plan
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QPP	Quality Project Plan
RACR	Remedial Action Closure Report
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSCO	Recommended Soil Cleanup Objective
ROD	Record of Decision
SANGB	Schenectady Air National Guard Base
SDC	supplemental data collection
SCA	Scotia County Airport
SCG	soil cleanup goals
SPDES	State Pollutant Discharge Elimination System
SSO	Site Safety Officer
SWPPP	Stormwater Pollution Prevention Plan
TCE	trichloroethene
TCL	target compound list
TCLP	toxicity leaching procedure
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers
USAF	United States Air Force
VOC	Volatile Organic Compound

1 Introduction

This Remedial Action Work Plan (RAWP) provides information on the remedial activities intended to remediate the petroleum-impacted soils associated with Site 3 and chlorinated impacted soils and groundwater associated with Site 6 at the 109th Airlift Wing (AW), New York (NY) Air National Guard (ANG), Schenectady Air National Guard Base (SANGB), Scotia, NY. BEM Systems, Inc. (BEM) and AECOM (BEM Team) will perform the soil and groundwater remedial activities, as described in this RAWP. A Final Record of Decision (ROD) 447022 was issued by the ANG on March 14, 2012 for the remediation of soils at Site 3 and Site 6 and remediation of groundwater at Site 6. The remedy selected in the ROD includes the excavation of impacted-soils and the injection of chemical oxidant to treat the dissolved phase groundwater plume.

This RAWP has been prepared under a Performance Based Remediation contract number in accordance with the NY State Department of Environmental Conservation (NYSDEC) Program Policy, Division of Environmental Remediation (DER)-10; Chapter 5, Section 5.3. The remedial activities proposed in this plan should meet the Remedial Action Objectives as outlined in the ROD.

The five appendices supporting this RAWP are:

Appendix A Field Sampling Plan (FSP)

Appendix B Quality Assurance Project Plan (QAPP)

Appendix C Anticipated Project Schedule

Appendix D Health and Safety Plan (HASP), including NY State Department of Health (NYSDOH) Generic Community Air Monitoring Plan

Appendix E Permanganate Calculations for Site 6 In-Situ Chemical Oxidation (ISCO)

1.1 Site Description

The SANGB is located in the southeast portion of Scotia County Airport (SCA) in Scotia, NY. The federal government leases the land from the SCA and licenses the land back to the New York Air National Guard (NYANG). The lease extends through 30 June 2042. The Base covers an area of approximately 106 acres, located approximately 2 miles northeast of Scotia, NY (Figure 1).

Site 3 (Drum Burial Area) is located near the former sewage treatment plant and sand filter. This area was identified when buried drums were discovered during construction activities. Site 3 covers a small area of approximately 0.68 acre and is bounded to the north by a drainage ditch and to the south and west by chain link fence.

Site 6 (Suspected Spill Area) consists of an area of contaminated soil and groundwater located northwest of the former sewage treatment plant and sand filter. Site 6 covers an area of approximately 0.96 acres and is bounded

by the drainage ditch to the west, to the north by monitoring well 6MW-21, and to the south by monitoring well 6MW-20.

The total area of these two sites is approximately 1.64 acres as shown in Figure 1. Soil and groundwater has been impacted at these sites by past releases from aircraft fueling, maintenance, operation activities, and training exercises. Cleanup of contaminated areas has taken place over the last decade in order to prevent further environmental impacts. The focus of this remedial action is to cleanup chlorinated volatile organic compound (CVOC) impacted groundwater at Site 6, tetrachloroethene (PCE) impacted soils at Site 6 and xylene impacted soils at Site 3 along the drainage ditch.

1.1.1 Site Geology

1.1.1.1 Surficial Geology

The unconsolidated deposits in eastern Schenectady County are not uniform in character; rather they consist of interbedded layers of different materials. The majority of all soils are glacial deposits. The soils consist of glacial till (clays, silts and sands) that were deposited by temporary glacial lakes; and coarse sands and gravel deposited by glaciofluvial streams sourced in the receding glaciers.

As the glaciers advanced over the area, the topography was modified; parallel ridges and valleys were formed by the movement of ice. Glacial till was deposited directly from the sheet of moving ice. Till is one of the most widespread deposits in the region. The till in the Schenectady region contains cobble and boulder of igneous and metamorphic origin that were transported from the Adirondack Mountains. The till deposit underlying the Base typically consists of a gray to dark gray, silty to sandy clay containing varying amounts of cobbles and boulders. Thin sand and/or gravel deposits are scattered through the till. The thinnest deposits of till are present on the uplands surrounding the Base with thicker deposits found in bedrock depressions. During the retreat of the ice, Glacial Lake Albany was formed in the lowland regions confined by the upland boundaries of the Hudson Valley. Deposits in the lake included clays, silts and sands.

1.1.1.2 Bedrock Geology

Bedrock units underlying Schenectady County consist of the Schenectady Formation, Canajoharie Shale, as well as the Trenton and Black River Groups. Smaller portions of the Beekmantown Group are also found in the northwestern corner of the County.

The Schenectady Formation underlying the Base is composed of layers of black to gray shale with coarse-grained sandstone deposits, greywacke, and siltstones. In some localities the alternation of beds of shale and sandstone follow a coarsening upward sequence. The Schenectady Formation is estimated to have a thickness of 2,000 feet (ft) and a gentle south to southwest dip of up to 5 degrees. The Canajoharie Shale, which underlies the Schenectady Formation, is comprised of fine grained black shales estimated to be at least 1,000 ft thick in areas of the Mohawk Valley.

The rocks of the Schenectady Formation are dense and relatively impermeable. The bedrock may yield small amounts of water from fractures and bedding planes but low yield and poor water quality generally characterize

the bedrock aquifer. The direction of groundwater flow in the bedrock aquifer is controlled by fracture orientation, size, density of joints and bedding planes, and by the interconnection with the glacial soil aquifer.

1.1.2 Site Hydrogeology

1.1.2.1 Local Hydrogeology

Glacial deposits at the Base consist predominately of clay and silt overlying a shallow fractured bedrock zone. Groundwater depths reported in monitoring wells screened at the soil/bedrock interface ranged between 6 and 11 ft below ground surface (bgs). Hydraulic conductivity tests conducted in these monitoring wells reported groundwater flow velocities estimated between 2 and 25 ft per year consistent with typical groundwater flow velocities found in fractured bedrock (BEM 2012b) or a silt/clayey fine sand.

As part of the site investigations performed in 1999, four bedrock borings were advanced to a depth of 100 ft or deeper. Groundwater was not encountered and the borings were abandoned. A bedrock monitoring well (MW-27D) was installed as part of the 2007 Interim Remedial Action (IRA) with an open interval extending from 5-ft into the competent rock (15-ft bgs) to 40-ft bgs. Bedrock well MW-27D does yield limited quantities of water, though no pump tests have been performed (BEM 2012b).

1.1.2.2 Regional Hydrogeology

The Schenectady Aquifer (also referred to as the Great Flats Aquifer, the Schenectady Sole Source Aquifer, and other names) is the sole source of potable water to five municipalities and approximately 90 percent of Schenectady County residents. Municipal well fields utilizing this groundwater resource include the City of Schenectady, Town of Rotterdam (including a separate well field at Rotterdam Junction), Town of Glenville, Village of Scotia and part of the Town of Niskayuna. Pumping wells are approximately 50 ft deep and located over four miles west of the Base. The SANGB is situated near, but not over, the eastern end of the Schenectady Aquifer. The aquifer underlying the site is in general finer grained, less productive, and less subject to recharge when compared to Schenectady Aquifer. The SANGB and surrounding residents are all connected to the Town of Glenville public water system; no residents adjacent to the Base use private wells as a potable water supply.

Regionally, groundwater flow tends to follow topographic controls flowing to the south and southeast towards the Mohawk River. Most of the water supplies are from groundwater encountered in the highly permeable unconsolidated glacial deposits which overlie somewhat impermeable bedrock.

Groundwater recharge occurs almost wholly from precipitation. Under natural conditions, the water table fluctuates on a seasonal basis depending on precipitation and discharge. Both consolidated and unconsolidated deposits in Schenectady County are aquifers, even though their saturation and production characteristics vary greatly.

Regional bedrock formations are relatively poor sources of groundwater and normally only yield enough water for domestic use. The rocks are relatively impermeable, and groundwater occurs principally in open fractures along joints in the rock. The most common water-bearing zone lies within the top few ft of the bedrock surface.

The regional soil consists of glacial deposits containing irregularly spaced deposits of sand and gravel from glaciofluvial streams. These relatively coarse grained deposits are the most productive sources of water in the area. These productive zones range greatly in aerial extent and thickness due to changing depositional conditions. At many locations, a thin permeable zone of gravel is present between the till and the underlying bedrock that is capable of producing water at a rate measured in thousands of gallons per minute (BEM 2012b).

1.1.3 Previous Remedial Activities

Previous actions have been taken to reduce the contamination at Sites 3 and 6. The following subsections summarize previous investigations and remedial actions that have been completed at the SANGB.

1.1.3.1 Remedial Investigation

In June 1999, a Remedial Investigation (RI) was completed at the Base (BEM 2012b). The RI initially included installation of groundwater monitoring wells, hydraulic conductivity testing of the shallow overburden, and two rounds of groundwater sampling. The investigation at Site 3 also included the collection of soil and sediment samples, and the excavation of 49 test pits to identify the types and extent of buried debris/wastes.

During the RI, CVOCs were detected in groundwater samples collected from monitoring wells upgradient of Site 3. Subsequent investigations reported a distinct dissolved CVOC plume in the groundwater that was determined to be unrelated to historical activity at Site 3. This area was added to the Environmental Restoration Program (ERP) and designated Site 6.

1.1.3.2 Supplemental Data Collection

A supplemental data collection (SDC) program for Site 6 was conducted in 2002 that consisted of monitoring well installation, collection and analysis of subsurface soil samples, and collection and analysis of groundwater samples. Results from the SDC indicated that CVOCs in excess of NYSDEC Recommended Soil Cleanup Objective for Unrestricted Use (RSCO Unrestricted) soil cleanup goals (SCGs) remained in the soils and that a dissolved-phase CVOC plume existed at Site 6. The SDC report recommended that further remedial measures be performed for Site 6 soils and groundwater.

1.1.3.3 Interim Remedial Actions

Between May and September 2007, the ANG completed IRAs at Site 3 and Site 6. The objectives of the IRAs were to remove and treat all unconsolidated material from both sites and to perform an in situ pilot test to evaluate the use of enhanced bioremediation to treat the CVOC plume at Site 6.

During excavation activities, Site 3 was broken into five excavation areas. Approximately 390 tons of contaminated soils were removed from the five areas. During excavation, buried drums, automobile parts, and scrap metal were uncovered and disposed of accordingly.

Site 6 soils that were previously identified as within the CVOC groundwater 50 parts per billion (ppb) plume were excavated. All of the soil in the area was removed from the ground surface to the top of competent bedrock which was encountered at a depth interval of 5 to 7 ft and field screened. A total of six sections of Site 6 were

excavated sequentially, tested, and backfilled beginning with the furthest upgradient area and advancing downgradient towards the creek. The total volume of soil excavated in Site 6 for field screening of CVOCs was 4,790 cubic yards (CY), based on measured in-situ volume. A mechanical screener was brought onto the site to physically separate the larger material (2-inch [in] plus) from the smaller material, with the smaller material being segregated into stockpiles based on Photo Ionization Detector (PID) readings. The total estimated volume of soil with PID readings less than 5 parts per million (ppm) was approximately 2,870 CY. The volume of soil removed with PID measurements greater than 5 ppm but less than 50 ppm was approximately 1,920 yards. No stockpiled soil reported PID readings greater than 50 ppm. All 4,790 CY of stockpiled soils were screened, sampled and returned to the excavation as backfill based on the analytical results which indicated all analyzed CVOCs were below NYSDEC RSCO SCGs.

During the soil removal activities at Site 6, a horizontal infusion gallery was constructed to perform ISCO injections. The layout of the infusion gallery is shown in Figure 2, and a detailed cross section of a typical horizontal injection well lateral is included in Figure 3. The infusion gallery consists of four horizontal laterals (Lateral 1 through 4) constructed of slotted polyvinyl chloride (PVC) pipe aligned somewhat perpendicular to the assumed groundwater flow direction.

Based on the sequencing and final limits of the excavation and apparent local groundwater flow direction the final length of the lateral piping sections varied from 45-ft to 120-ft, with the longer laterals located near the center of Site 6.

The laterals were constructed of 4-in diameter, Schedule 40 PVC 0.010-slot screen placed along the top of competent bedrock at the base of the excavation with solid vertical risers to grade at each end and in the middle of the horizontal well. The lateral well screens were covered with approximately a one-foot-thick layer of the highly permeable material (2-in plus aggregate) that had been screened from the excavation materials. A permeable woven geotextile liner was placed over the aggregate and the remaining excavation(s) backfilled to grade with the screened stockpiled soils that were less than 2-in diameter.

1.1.3.4 Enhanced Bio Remediation Pilot Test

An enhanced bioremediation pilot test was conducted at Site 6 August 8, 2007. Edible Oil Substrate (EOS) and Vitamin B12 supplement was gravity fed sequentially into each of the 12 vertical riser pipes of the infusion gallery constructed as part of the Site 6 IRA beginning with the furthest upgradient riser and advancing progressively downgradient. The infusion was prepared by mixing one drum of EOS and one quart of Vitamin B12 supplement with 10,000 gallons of treated groundwater. The objectives of the pilot test were to decrease concentrations of volatile organic compounds (VOCs) in the groundwater, and prevent CVOC plume migration through increased biological activity.

Five groundwater monitoring events were performed to assess groundwater quality. One round of groundwater samples were collected prior to the infusion activities while four quarterly rounds of groundwater samples were collected post-infusion. The overall conclusions were the injection of EOS and the Vitamin B12 Supplement had a beneficial effect on decreasing the concentration of CVOCs in the groundwater at Site 6. The amount of

contaminants in Site 6 has been reduced as a result of the initial infusion of the substrate, and is expected to be further reduced by continued infusion of the substrate or chemical oxidant. An increase in CVOC concentrations was identified in two of the wells (6MW-22 and 6MW-25) in the infusion gallery area during the final sampling event in September 2008. This increase is attributable to CVOCs being flushed from the coarse aggregate which was separated by screening from the fine grained material, then reintroduced into the excavation. Despite this increase in CVOCs, the overall trend was contaminant reduction and breakdown through de-chlorination.

1.1.3.5 Soil Gas Sampling

Two soil gas samples were collected to characterize the potential for soil vapor migration from the dissolved CVOC plume at Site 6 to the closest indoor air receptor. The closest indoor air receptor is Building 18, located 475-ft cross-gradient to the Site 6 groundwater plume. The locations of the two soil gas sampling points are shown in Figure 2. The soil gas samples were analyzed using modified Method TO-15 (chlorinated hydrocarbons only). No CVOCs were reported above their respective laboratory method detection limit for either soil gas sample. While there were no detections for the soil gas samples, indicating there is not a vapor intrusion concern for Building 18, if a building is constructed closer to Site 6 while groundwater indicates CVOC impacts persist, soil gas will need to be reevaluated.

1.1.3.6 Data Gap Investigation

A Data Gap Investigation (DGI) was conducted on 31 October 2011 to delineate soil impacted with exceeding concentrations of xylenes at Site 3 and soil impacted with exceeding concentrations of CVOCs at Site 6 that would require future excavation. Soil borings were advanced at each site using direct push technology. Site 3 delineation results indicated that soil samples obtained from three of the fourteen boring locations were reported above the NYSDEC RSCO Unrestricted level of 0.26 ppm or milligrams per kilogram (mg/kg) for xylene in soil. Site 6 delineation results indicated that soil samples obtained from two of the five boring locations were reported above the NYSDEC RSCO Unrestricted level for multiple CVOCs in soil (BEM, 2012a).

1.2 Remedial Action Objectives

Based on the ROD for Sites 3 and 6 and the final NYSDEC guidance for development of remedial action objectives (RAOs) in DER-10 (NYSDEC 2010), the soil and groundwater RAOs at Sites 3 and 6 include:

Site 3:

- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.
- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Prevent migration in surface water of upgradient contaminants associated with the drainage ditch weir system from impacting soils.

Site 6:

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.
- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

Achieving the RAOs through the application of the selected soil and groundwater remedial actions should allow for the unrestricted future uses of Defense Environmental Restoration Program (DERP) Sites 3 and 6. The selected remedy consists of actions that will mitigate the potential risks to human health that result from constituents of concern (COCs) that exceed the chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs), as detailed in Section 2.

2 Components of Remedial Actions

The ROD presents soil excavation at Site 3 and Site 6 and ISCO at Site 6 as the applicable remedial alternatives. The following sections describe the major components of the selected remedial actions for soil and groundwater. Sections 3 and 4 provide further detail of the proposed remedial actions for soil and groundwater, respectively.

2.1 Site 3 Soils

Based upon the limits of excavation as defined by the Site 3 DGI, xylene impacted soils will be excavated and sent off-site for treatment at the Environmental Soil Management Companies (ESMI) facility in Fort Edward, New York. The anticipated limits of the Site 3 soil excavation cover a 1,500 ft^2 area southeast of the drainage ditch where all soil will be removed down to bedrock at approximately 9 ft bgs, resulting in the removal of 13,500 ft^3 or 500 CY. Prior to treating the excavated soil, additional disposal samples will be collected and analyzed. Four post-excavation soil samples will be collected from Site 3 (Figure 4); two from along the fence line/property boundary to the southeast, and one from the southern corner of the excavation area. The fourth sample will be collected from the northeast portion of the excavation perimeter. These confirmation samples will be collected to ensure that the concentration of xylene potentially remaining in the soil is below NYSDEC RSCO Unrestricted level of 0.26 mg/Kg or ppm. The excavation will be backfilled with virgin or certified material to pre-existing conditions. A geomembrane will be installed along southern bank of drainage ditch, and then the area will be restored with topsoil and seeding to match the surrounding ground surface. Additional information describing the specific details of the proposed Site 3 soil excavation is detailed in Section 3 – Soil Excavation – Site 3 and Site 6.

2.2 Site 6 Soils

Based upon the limits of excavation as defined by the Site 6 DGI (Figure 5), approximately 2,900 ft^3 or 110 CY of PCE impacted soils will be excavated and sent off-site for treatment or disposal as non-hazardous waste. Prior to soil treatment, additional samples will be collected for various total and disposal analyses. Based on the contaminant levels of CVOCs detected in the soil as part of the DGI, the soil may not be accepted for treatment at the ESMI facility in Fort Edward, NY unless NYSDEC approves a “contained in ruling” that the soil can be thermally treated by ESMI. If the soil cannot be treated, it will be sent off-site for disposal as non-hazardous waste to permitted facility Rapp Road Landfill in Albany, NY.

The anticipated limits of the Site 6 soil excavation cover a 10.5-ft by 64-ft area along the drainage ditch where all soil will be removed down to competent bedrock at an approximate depth of 4.5 ft bgs. Three post-excavation soil samples will be collected from Site 6 (Figure 5); one from the most southeast extent of the excavation (S6-PE02), one from along the northeast edge of the excavation area (S6-PE01), and one from the southern boundary of the excavation, along the drainage ditch (S6-PE03). These confirmation samples will be collected to ensure that the concentrations of CVOCs potentially remaining in the soil are below NYSDEC RSCO Unrestricted levels, specifically, below 0.47 mg/Kg for trichloroethene (TCE), 1.3 mg/Kg for PCE, 0.25 mg/Kg for cis-1,2-

dichloroethene (cis-1,2-DCE), and 0.02 mg/Kg for vinyl chloride. The excavation will then be backfilled with certified clean fill immediately following excavation. The area will then be restored with topsoil and seeding to match the surrounding ground surface. Additional information describing the specific details of the proposed Site 6 soil excavation is detailed in Section 3 – Soil Excavation – Site 3 and Site 6.

2.3 Site 6 Groundwater

CVOCs including PCE and breakdown by-products have been detected in groundwater samples from monitoring wells at Site 6 at concentrations exceeding NYSDEC Ambient Groundwater Quality Standards (AGWQS). ISCO utilizing sodium permanganate is the selected remedy for addressing the elevated concentrations of dissolved CVOCs at Site 6. Chemical oxidation using permanganate will oxidize the CVOCs into carbon dioxide, water and chloride ions. Permanganate is expected to meet cleanup goals for all dissolved phase compounds within a two year period.

The permanganate will be injected through the infusion gallery created during the enhanced bioremediation pilot test at Site 6 in August 2007. A collection sump will be installed downgradient of the injection area (Figure 6) and the collected groundwater containing the permanganate will be recirculated to the injection gallery. Recirculation rates and injection locations may be adjusted weekly to ensure complete coverage of the treatment area.

During the last round of groundwater sampling (August 2008), two monitoring wells (6MW-20 and 6MW-21) reported low PCE concentrations for the first time. 6MW-20 also had multiple exceedences of site contamination (PCE, TCE, VC) and a detection of cis-1,2-DCE up to 330 parts per billion. Since these wells are located outside of the Site 6 injection network, permanganate will be injected in these areas using a direct push drill rig to mitigate CVOC concentrations in these areas. The injection will be performed using 14 direct push locations in a 15-ft by 15-ft grid around 6MW-21 and four direct push injection locations surrounding 6MW-20 (Figure 6).

Groundwater quality will be monitored by sampling all 11 existing groundwater monitoring wells at Site 6 (Figure 7) approximately three months after the injection. If CVOC concentrations are found to exceed the AGWQS, the next round of injection will be carried out three months after sampling. Up to three rounds of permanganate injections are anticipated. Additional information describing the specific details of the proposed ISCO injections is detailed in Section 4 - In Situ Chemical Oxidation – Site 6.

3 Soil Excavation – Site 3 and Site 6

Soil excavation is the selected remedy for soil at Sites 3 and 6 to achieve the RAOs and future unrestricted land use (BEM 2012b). Excavation activities to be performed by the BEM Team for both sites are detailed in this section of the RAWP. All work will be performed in accordance with the approved FSP (Appendix A), QAPP (Appendix B), and HASP (Appendix D). Proposed soil excavation areas are depicted for Site 3 in Figure 4, and for Site 6 in Figure 5.

The BEM Team has subcontracted OP-TECH Environmental Services, Inc. (OP-TECH) of Schenectady, NY to perform excavation and subsequent site restoration activities at Sites 3 and 6. The BEM Team will provide oversight for excavation activities, as well as perform analytical sample collection, as outlined in this RAWP.

3.1 Mobilization Activities

Before beginning the field work, there will be a base pre-construction ("PRE-CON") meeting to go over topics such as security, safety, emergency response, and site access. A site visit and pre-construction meeting will be conducted at least one week before commencing work.

3.1.1 Mobilization

All areas around Sites 3 and 6 where excavation, drilling or other intrusive activity may occur will be cleared for all utilities. Site 3 contains buried electrical line that will require caution. Base personnel, Dig Safely NY and potentially affected private utility companies will be notified to identify their utilities. Base personnel will mark utilities owned by SANGB. If a dispute arises over the ownership of utilities in a certain area, or if the available information is insufficient to locate a utility within safety limits, a utility locater firm may be used to locate and mark the utility within that particular area. In addition, information regarding equipment height and the duration of the remedial activities on Site 3 will be coordinated with base personnel at least one week prior to the start of the remedial activities field event. Based on the proximity of Site 3 to the flight path of SANGB, the field schedule and associated equipment will be discussed with base personnel and revised as appropriate on a daily to weekly basis as needed.

Field personnel, equipment and supplies will be mobilized from BEM in Chatham, NJ and OP-TECH in Schenectady, NY to the 109th AW, SANGB in Scotia, NY once written approval of the final RAWP has been received from NYSDEC and verbal or written approval to proceed with RAWP field activities is received from National Guard Bureau (NGB)/A7OR and SANGB base environmental manager. Set up and excavation will occur first at Site 3, and then Site 6.

3.1.2 Erosion and Sediment Controls

Excavation activities performed at Sites 3 and 6 will be in accordance with the NYSDEC State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharge from Construction Activity, Permit No.

GP-0-10-00I, Section 402 of the Clean Water Act, and Article 17, Titles 7, 8 and Article 70 of the Environmental Conservation Law. The BEM Team will review and ensure that all erosion and sediment control practices and all post-construction stormwater management practices identified in the current 109th AW Stormwater Pollution Prevention Plan (SWPPP) are maintained in effective operating condition at all times.

In order to minimize stream and sediment disturbance, the BEM Team will implement stream diversion and sediment control measures during the excavation activities. Before implementing remedial activities at Site 3, which is directly upgradient of the dam, the valve on the dam will be opened to reduce the volume of stream that requires management. The dam will remain open during excavation activities at both Site 3 and 6 to keep the water to a minimum. Sandbags will be placed in the middle of the stream bed to isolate the northern and southern stream banks. During the excavation activities, the flow will be diverted to the northern bank away from the excavation along the southern bank. Any water that may seep around the sandbags will be pumped out of the area onto a sediment collection surface which will drain into the stream. A schematic of the bypass system proposed for Site 3 is provided in Figure 4A.

A passive gravity diversion system will be used at Site 6 to divert the stream around the work area during excavation activities. The system will include appropriate size diversion piping (assumed 12-inch diameter piping however may change based on stream conditions) in order for storm water to flow through and beyond the excavation area. The stream will be dammed upstream of the excavation area with sand bags. The dammed water will then flow through the piping past the excavation area. A sediment collection surface will be placed at the outlet of the piping to remove sediment from the diverted water. A pump may be used if there is an excess of water dammed upstream of Site 6. A schematic of the bypass system proposed for Site 6 is provided in Figure 5A.

The construction activities will include the visual inspection of the discharge point and field turbidity readings daily with an United States Environmental Protection Agency (EPA) compliant turbidity meter. Upon commencement of construction activities visual inspections will be performed 3 times a day along with turbidity readings taken from an upgradient and downgradient location taken daily. Should the downgradient recording exceed 10% greater than the upgradient level and/or baseline value corrective actions will be taken. Baseline turbidity will be established prior to any remedial activities and by recording turbidity values at three points along the stream. The location of the baseline and construction monitoring locations are included in Figure 1 of the Field Sampling Plan (Appendix A). Extra inspections and measurements will be taken during a rain event to document any changes.

All excavation, backfill, and site restoration activities will also be performed in accordance with NY regulations, as provided in the August 2005 NYSDEC guidance document *New York State Standards and Specifics for Erosion and Sediment Control*. The physical characteristics of Sites 3 and 6 will be assessed to assure the lowest risk of environmental damage. Grading will be minimized by utilizing the existing topography wherever possible. As described above, care will be taken to avoid contributing sediment or runoff to the canal which cuts through Sites 3 and 6. Natural vegetation at the sites will be preserved to the maximum extent possible. Impacts to surrounding areas will be minimized by maintaining vegetative buffer strips between disturbed and adjacent areas (NYSDEC 2005) in addition to proposed sediment control measures described above.

3.1.3 Surveying

The BEM Team will conduct surveying of the excavation extent using a hand-held Global Positioning System (GPS) device prior to and following soil removal at Sites 3 and 6. The planned excavation extents are provided in Section 3.3, as well as Figures 4 and 5. Survey coordinates will be reported in the New York State Plane NAD83 coordinate system. The post-excavation survey results will be included on figures within the Sites 3 and 6 Soil Remedial Action Closure Report (RACR).

3.2 Technical Approach

The BEM Team plans to perform soil excavation activities for each site, as detailed below:

Site 3 excavation (Figure 4) will be completed first, and will include the following tasks:

- Set-up bypass pumping to drain work area (Figure 4A).
- Collect additional samples from the soil excavation area required for soil treatment.
- Excavate, transport, and dispose of 500 CY of soil.
- Collect post-excavation confirmation soil samples at four locations (S3-PE01 through S3-PE04) where DGI delineation is incomplete.
- Backfill excavation with virgin material or certified clean material to pre-existing conditions.
- Compaction with excavator bucket.
- Install 150 linear ft of geomembrane parallel to the southern bank of drainage ditch.
- Apply topsoil and seed.

Four post-excavation soil samples will be collected from Site 3 (Figure 4); two from along the fence line/property boundary to the southeast, and one from the southern corner of the excavation area. The fourth sample will be collected from the northeast portion of the excavation perimeter. These samples will be collected from a six inches above the saturated zone or bedrock if the soils are not saturated, and submitted to TestAmerica Inc. laboratories in Burlington, Vermont for xylenes by method SW846 8260B to confirm remaining soil is below NYSDEC RSCO Unrestricted level for xylenes of 0.26 mg/kg in soil. TestAmerica, Inc. is a New York State certified laboratory (Certification No. 10391).

Site 6 excavation (Figure 5) will include the following tasks:

- Set-up bypass pumping to drain work area (Figure 5A).
- Collect additional samples from the soil excavation area required for soil treatment.
- Excavate, transport, and dispose of 110 CY of soil.
- Collect post-excavation confirmation soil samples at three locations (S6-PE01 through S6-PE03).
- Backfill with virgin material or certified clean material to pre-existing conditions.
- Compaction with excavator bucket.
- Place 4 inches of topsoil and seed, and cover with a vegetative mat.

Anchor vegetative mat with 6-in stakes every 5 ft on top of bank and sides of embankment. Three post-excavation soil samples will be collected from Site 6 (Figure 5); one from the most southeast extent of the excavation (S6-PE02), one from along the northeast edge of the excavation area (S6-PE01), and one from the southern boundary of the excavation, along the drainage ditch (S6-PE03). These samples will be collected from six inches above the saturated zone or bedrock if the soils are not saturated, and submitted to TestAmerica Inc. laboratories in Burlington, Vermont for a target analyte list of CVOCs by method SW846 8260B to confirm remaining soil is below NYSDEC RSCO Unrestricted levels, specifically, below 0.47 mg/Kg TCE, 1.3 mg/Kg PCE, 0.25 mg/Kg cis-1,2-DCE, and 0.02 mg/Kg vinyl chloride.

Prior to disposal activities, the excavated soil will be sampled for additional analyses in order to determine if the soil can be treated. Site 3 soils will be analyzed for Resource Conservation and Recovery Act (RCRA) 8 Metals, EPA Methods SW846 8015 Diesel Range Organics (DRO). In addition, Site 6 soils will be analyzed for EPA Methods SW846 8260, 8270, RCRA 8 Metals, and 8015 DRO/Gas Range Organics (GRO). Site 3 soil and Site 6 soil (if NYSDEC approves the contained-in ruling for thermal treatment) will be transported under manifest by OP-TECH to ESMI in Fort Edward, New York. Excavated non-hazardous soil from Site 6 unable to be treated will be transported under manifest by OP-TECH to Rapp Road Landfill in Albany, NY for final disposal. Based upon conversation with the disposal facility, the characterization results from the October 2011 DGI are sufficient for completing the waste profile for Site 3 and 6 excavated soil disposal.

3.3 Basis of Design – Excavation Limits

Results of the DGI conducted October 2011 at Sites 3 and 6 provided soil contaminant delineation as well as a basis for design of excavation areas at each site. Project objectives were set by the March 2012 ROD, where Sites 3 and 6 RAOs were defined, as detailed in Section 1. Until these soils are removed, land use will be limited to industrial/commercial use. Prior to excavation activities, a bypass system will be set up at Sites 3 and 6 as detailed in Section 3.1.2 above.

The Site 3 soil excavation will extend along the former excavation limits to the east and west to areas of confirmed delineation. The excavation will be extended south, past borings where contamination was detected (S3-DB09 and S3-DB10). The excavation will extend to the border of Site 3 to the south, but cannot extend further at this time, due to the current fence line/ property boundary. Three of the Post-excavation soil samples (S3-PE01 to S3-PE03) will be collected from along the southern border of the excavation to document the concentration of soils remaining at the southern Site 3 border. A fourth sample (S3-PE04) will be collected from the northeast portion of the excavation perimeter. The post-excavation soil samples will be analyzed for xylenes by method SW846 8260B. The planned excavation area and sampling locations are included in Figure 4. The planned excavation area for Site 3 will result in the removal of approximately 13,500 ft^3 or 500 CY of xylene impacted soil based on the surface area of approximately 1500 ft^2 and the depth of the excavation to bedrock at 9 ft bgs.

The Site 6 soil excavation will extend from post excavation sample location EX-6-1-SW-08 approximately 11 ft to the stream bank on the west, 64 ft toward S6-DB03 to the north, extend 10 ft to the former excavation limits to the

east, and approximately 64 ft toward the post excavation boring EX-6-1-SW-08 located to the southeast. The planned excavation area is included in Figure 5. Post-excavation soil samples (S6-PE01 and S6-PE02) will be collected from along the eastern border of the excavation to document the concentration of soils remaining at the eastern Site 6 border. Post excavation sample S6-PE03 will be collected from the southern border of the excavation, along the drainage ditch. The post-excavation soil samples will be analyzed for target analyte list of CVOCs by method SW846 8260B. The planned excavation area for Site 6 will result in the removal of approximately 2,900ft^3 or 110 CY of CVOC impacted soil based on the excavation surface area of 645 ft^2 and the depth of the excavation to bedrock at 4.5 ft bgs.

Due to excavation of VOC contamination soils along the waterway at Site 6, testing for PCE, TCE, DCE and VC in the surface water will be performed where possible to determine if construction activities are impacting waterway. The sample location will be determined based on field observations.

3.4 Geomembrane Installation

A non-permeable geomembrane will be installed at Site 3 on the southern bank of the drainage ditch. The purpose of the geomembrane is to isolate the Site 3 soils from any potential recontamination from potential upgradient sources, as the drainage ditch drains the upgradient aircraft ramp and any releases upgradient of the ERP sites enter the drainage ditch. The geomembrane will be installed adjacent (approximately 3 feet side-gradient of the weir) to the dam and extending east along the stream until the stream bends north towards Site 6, an estimated 150 linear feet. The geomembrane material is non-permeable and will be at least 20-mil thickness. The installation design features are included in Figure 4B.

The excavated soil during trench installation will be temporarily stockpiled on-site. The soil will be screened with a PID to ensure contamination is not present within the trench. If the soil shows no presence of contamination, it will be used to backfill the trench after the geomembrane is installed. A silt fence will be in-place during excavation activities as a sediment control measure. After the installation is complete, the site will be restored to pre-existing conditions. The geomembrane installation will last approximately one day and will be conducted after Site 3 soil excavation activities are complete.

3.5 Waste Management

3.5.1 Pre-Remediation Waste Characterization Sampling

Excavated soil will be disposed of by sample collection and analysis as required by the treatment facility and also by utilizing the approved waste characterization profiles from the October 2011 DGI field activity as permitted by the waste disposal facility. During the DGI activities, Sites 3 and 6 soils were characterized by collection of 1 grab sample from a boring at each of the sites. The Site 3 waste characterization sample was collected from S3-DB01 (original CREEK-Bank-B sample location). The Site 6 waste characterization sample was collected from S6-DB02. This sample frequency was determined by the receiving landfill characterization and disposal requirements of 1 grab sample per 1,000 CY. The waste characterization samples were collected and analyzed for full toxicity leaching procedure (TCLP) analysis, target compound list (TCL) polychlorinated biphenyls (PCBs)

analysis, and RCRA parameters. The TCLP analysis and some of the RCRA parameters were performed by Test America, Inc. laboratories in Pittsburgh, Pennsylvania, while the balance of the parameters were performed by Test America in Burlington, Vermont (BEM 2012a).

In order to thermally treat the excavated soils, additional samples will be collected and analyzed prior to disposal. Site 3 soils will be analyzed for RCRA 8 Metals, EPA Methods SW846 8015 DRO. In addition, Site 6 soils will be analyzed for EPA Methods SW846 8260, 8270, RCRA 8 Metals, and 8015 DRO/GRO. Upon receipt of the analytical results, ESMI will submit them to their NYSDEC regional contact, Henry Wilkie. Within two days, Mr. Wilkie will either approve the contained in ruling permit for thermal treatment of the soil, the excavated soil will be transported under manifest by OP-TECH to ESMI in Fort Edward, New York. The samples will be submitted to Test America, Inc., a laboratory that is both approved by the Department of Defense (DoD) and the NYSDOH Environmental Laboratory Accreditation Program (ELAP), for analysis.

3.5.2 Off-Site Transportation

Excavated non-hazardous soil from Site 3 will be characterized and transported off-site to ESMI in Fort Edward, New York by OP-TECH. Excavated non-hazardous soil from Site 6 will be characterized (as described above) and transported off-site for treatment at ESMI facility if the NYSDEC approves a contained-in ruling for the soil to be thermally treated at ESMI. If not, the excavated will be transported off-site to the Rapp Road Landfill in Albany, NY by OP-TECH. Department of Transportation regulations for transportation of non-hazardous materials will be adhered to, including use of an approved non-hazardous waste manifest to document contents of material in transport. All waste shall be tracked with the weights recorded and waste manifests supplied to base.

3.5.3 Off-Site Disposal

Excavated non-hazardous soil from Site 3 and potentially from Site 6 will be characterized and transported off-site to ESMI in Fort Edward, New York. This facility conducts contaminated soil treatment via low thermal temperature desorption. ESMI is permitted to accept non-hazardous soils contaminated with the following: MGP Waste (Coal Tar), Conventional Fuels, Oils (Animal, Vegetable, Tall, Used, Electrical, Transformer), and Urban Fill.

If the excavated soil from Site 6 cannot be treated, it will be transported off-site and disposed of at Rapp Road Landfill in Albany, NY. The City of Albany utilizes non-hazardous contaminated soil as daily cover material at the Rapp Road Landfill. To be in compliance with all NYSDEC and local regulations, analytical sampling was conducted as presented in Section 3.4.1.

3.5.4 Water Management

Site water will be managed through a bypass pumping system which will include construction of a berm upgradient of the work site where surface water can be diverted to downstream of the work area. This should prevent accumulation of water into the excavation area since it is understood that the drainage ditch is a losing reach in this area, meaning surface water contributes to groundwater. Schematic details of the bypass pumping system for Sites 3 and 6 are included as Figure 4A and 5A, respectively.

3.6 Site Restoration

Sites 3 and 6 will be restored to pre-existing conditions following excavation, trench installation and confirmation sampling. Sites 3 and 6 excavation areas will be backfilled with virgin material or certified clean material. As stated in Section 3.1.1, Site 3 contains buried electrical line that will require caution. At the request of the base, BEM will coordinate the backfilling activities at Site 3 with the base in order to allow for the installation of a catch basin and associated piping along the side of the stream. The surface of both excavation areas will be compacted, covered in 4 inches of topsoil, and seeded to promote the growth of natural vegetation. The trench excavation to install the geomembrane will also be restored to pre-existing conditions, and covered in 4-inches of topsoil and seeded.

4 In Situ Chemical Oxidation – Site 6

This section presents the basic design and the methods for implementing the remedial action for the treatment of the dissolved-phase CVOC plume at Site 6. The remedial action will consist of the direct injection of sodium permanganate using the injection gallery as well as direct push borings. Prior to the start of the sampling the underground injection control (UIC) notification form will be completed and sent to the EPA.

4.1 Technical Approach

As prescribed in the ROD, the primary remedy for the treatment of CVOC impacted groundwater at Site 6 is ISCO utilizing sodium permanganate. The ISCO approach has been selected because ISCO can oxidize the CVOCs into carbon dioxide, water and chloride, thereby increasing the potential for achieving cleanup goals for dissolved phase compounds.

Injection of sodium permanganate into the soils will be accomplished through the infusion gallery network (see Figures 2 and 3) and direct push points around 6MW-20 and 6MW-21 (see Figure 6). Due to the small size of the plume and layout of the infusion network a full scale implementation will be used. A phased approach will be taken by performing the gravity fed injections in the IP4 injection well network prior to any pressurized fed injection locations. During the gravity injections the stream will be observed for any impact from the sodium permanganate. Prior to the start of injection the underground injection control (UIC) notification form will be completed and sent to the EPA. Testing will be performed if any visible changes occur to the waterway. Sampling frequency and location will be based on field observation as necessary.

Groundwater sampling will be performed to monitor the performance of the remedial measure for continued application of permanganate, as well as quantify the rates of groundwater contaminant reduction. Groundwater samples will be collected from all monitoring wells at Site 6 three months after each injection event (see Figure 7). If the results of the groundwater samples indicate that CVOCs persist above the AGWQS additional injections of permanganate will be performed. If post-injection sampling results indicate a reduction of CVOCs below the AGWQS, an additional four quarterly rounds of samples will be collected. If the five consecutive groundwater sampling results are all below the AGWQS, closure of Site 6 will be requested.

Upon completion of the remedial actions, the methods and the results of the injections will be reported in the Site 6 Groundwater Remedial Action Closure Report.

4.2 Basis of Design

As described in the technical approach (Section 4.1), CVOCs will be degraded utilizing sodium permanganate. This full-scale remedial approach is designed to achieve the following RAOs:

1. Prevent current or future potential human exposure due to ingestion of groundwater with contaminant levels exceeding drinking water standards.

2. To the extent practicable restore the aquifer to pre-disposal conditions.

Achieving the RAOs through the application of the selected remedial approach should allow for the unrestricted use of Site 6. Historic groundwater sampling results were used to determine the section of injection locations. The existing injection gallery will also be used to inject sodium permanganate into the former excavation areas and direct push injection will be used to remediate areas outside the boundary of the injection gallery (near 6MW-20 and 6MW-21), where elevated CVOC concentrations were detected during the August 2008 sampling event.

4.3 Mobilization and Site Preparation

4.3.1 Mobilization

All areas around Site 6 where excavation, drilling or other intrusive activity may occur will be cleared for all utilities one week prior to intrusive activities. Base personnel, Dig Safely NY and potentially affected private utility companies will be notified to identify their utilities. Base personnel will mark utilities owned by SANGB. If a dispute arises over the ownership of utilities in a certain area, or if the available information is insufficient to locate a utility within safety limits, a utility locater firm may be used to locate and mark that utility within that area.

Temporary facilities will be installed at the site during mobilization including the chemical storage area, decontamination pad, and equipment storage area. The drill rig will be brought to the Site by the drilling subcontractor for chemical injection using direct push methods. Any other equipment to prepare, mix, store or inject the oxidants will be brought to the site and stored in the equipment storage area when not in use. The 40% sodium permanganate solution will be delivered in 275 gallon totes and 55 gallon drums. The permanganate will be stored on-site in the designated chemical storage area. All incoming hazardous materials (including the sodium permanganate) will be pre-approved by the base Hazardous Material Management Process (HMMP) team and recorded as “contractor usage of chemicals.” A copy of the material safety data sheet (MSDS) for sodium permanaganate is included in the HASP (Appendix D). In the event that chemicals will be stored on-site for more than one week the chemicals will be stored in a locked area. Individual totes will be closed tightly and covered with a tarp.

4.3.2 Repairing of Site Infusion Wells and Monitoring Wells

The monitoring wells and infiltration gallery points at Site 6 were assessed for integrity during a recent Site visit. Infiltration points IP1-1, IP1-3, IP2-1, IP2-2, and IP4-3 and monitoring wells 6MW-22, 6MW-25, and 6MW-27S have been compromised and will be repaired prior to the start of the remedial action. Based upon our initial observations of the infiltration points and monitoring wells, most repairs will be conducted on the upper portion of the riser pipe. However, some wells have cracked casings, and it is unclear if the damage has extended to the screen interval. Additional repairs/replacement will be conducted of any injection points or wells that are found to have damaged well screens that render them unusable. Construction details and global positioning system coordinates will be recorded for all wells and submitted to NGB/A7OR in accordance with *A7O 11-01, Policy on Collection of Digital Spatial Data for Monitoring Wells During Environmental Investigations at Air National Guard Sites*.

4.3.3 Installation of Collection Sump

A collection sump will be installed at the downgradient end of the injection area to intercept and recirculate unused oxidant to maximize oxidant utilization. The sump will be constructed by installing a 24-in slotted pipe within a 4-ft by 4-ft excavation to bedrock downgradient of the horizontal infusion wells. The proposed location of the injection sump is depicted on Figure 6. The sump will be constructed by placing the slotted pipe on bedrock, and backfilling with 2-in stone for two ft and excavated material to ground surface around the vertical pipe. The site location for the sump is depicted on Figure 6.

Groundwater will be extracted from the sump using a submersible pump with a float switch. The groundwater will be recirculated, at approximately 1 gallon per minute, to the horizontal injection wells through a flexible hose placed on the ground surface. The recirculation injection locations will be adjusted weekly to optimize performance. Recirculation will continue until colorimetric testing no longer shows the presence of permanganate or three months, which ever happens first. It is anticipated that injections will be done in the Spring/Summer, such that recirculation will not be performed during freezing conditions.

4.4 Chemical Oxidation Delivery

The chemical oxidant injection will consist of distributing upwards of 715 gallons of 40% sodium permanganate through the horizontal injection well network. Sodium permanganate will be delivered to the site at this solution percentage. The 40% sodium permanganate solution will be delivered to the Site in a combination of 275 gallon totes and 55 gallon drums. The solution will then be diluted to a 10% solution on-site in a larger container.. Approximately 2,865 gallons of water will be required to dilute the 40% permanganate solution to 10% (3,580 gallons total). Calculations are provided as Appendix E. The amount is more than sufficient to oxidize the mass of CVOCs in the groundwater. The solution will be infused equally into the 12 horizontal wells stand-pipes at a rate of 298 gallons each. Infusion to horizontal wells will be gravity fed through chemical resistant hose. The injection will require approximately one week of field time to distribute the oxidant through the injection gallery. A technician will visit the site weekly to adjust the locations of the recirculation points. The drainage ditch will be continually observed for permanganate during all injection/infusion activities. Spills will be minimized during injections by using continuous hoses between the pump and injection locations. All fittings will be checked for tightness and have water run through as a check prior to injections.

The remedy also includes four direct push injections surrounding 6MW-20 and 14 direct push injections within the vicinity of 6MW-21 placed within a 15 foot by 15 foot grid pattern in two parallel rows. The anticipated radius of influence for the direct push points is 5 to 10 feet. Proposed locations of the direct push injection points are depicted on Figure 6. Approximately 25 gallons of 10% sodium permanganate will injected at each of the direct push injection points. Hence, approximately 100 gallons of 10% sodium permanganate will injected near 6MW-21 and 350 gallons of 10% sodium permanganate will be injected in the vicinity of 6MW-20. During injections, colorimetric testing for permanganate will be conducted if the injection activities are observed to be impacting the stream. The tests will be conducted on surface water from the stream.

4.5 Evaluation of Chemical Oxidation Injection Effectiveness and Subsequent Injections

Performance monitoring is intended to optimize treatment efficiency by ensuring that favorable treatment conditions are established and maintained and the COCs are remediated in the treatment area. Three months after the first round of injection, all 11 existing monitoring wells at Site 6 will be sampled. Each sample will be analyzed by a DoD/NYSDOH ELAP approved laboratory for CVOCs by EPA Method 8260 and chloride by EPA Method 9056. During groundwater sampling colorimetric testing will be conducted to determine concentrations of permanganate remaining in the groundwater.

If the results of the groundwater sampling indicate that CVOC concentrations are still above AGWQS, then a second round of injections will be performed as discussed in Section 4.1. Three months after the second injection round, the Site 6 groundwater monitoring well network will be sampled. The specifics of the groundwater sampling are discussed in Section 6. If these results indicate that CVOC concentrations are above AGWQS, then a third round of injections and monitoring will be performed.

Once the post-injection groundwater results show all CVOCs below AGWQS, the wells will be sampled for four additional quarters. The goal of site closure will be realized when all CVOCs remain below AGWQS for five consecutive quarters of groundwater sampling.

5 Remedial Activities

The remedial activities involved in the remediation of xylene-impacted soils associated with Site 3 and CVOC-impacted soils and groundwater associated with Site 6 at the 109th AW, SANGB are detailed in this RAWP. The remedy selected in the ROD includes the excavation of impacted-soils and the injection of chemical oxidant to treat the dissolved phase groundwater plume. The project schedule, as included in Appendix C, provides the proposed remedial sequence of tasks to be completed at Sites 3 and 6.

5.1 Remediation Sequence

The remedial action sequence of events for the current Performance Based Remediation at Sites 3 and 6 began with regulatory approval of the Proposed Remedial Action Plan (PRAP) in September 2011. Project planning was initiated in September 2010. Project plans included: an initial DGI Work Plan and Quality Project Plan (QPP) (inclusive of a HASP, FSP, and QAPP), followed by the preparation and approval of a ROD, and finally submission of this RAWP.

Following approval of this RAWP, remedial action field activities are planned as follows:

Table 1 Planned Remedial Activities

Sequence Number	Planned Remedial Activity	Estimated Duration (days)
Task 1	Soil Excavation and Confirmation Sampling - Sites 3 & 6	10
Task 1	Installation of Geomembrane	1
Task 2	Groundwater Treatment and Monitoring – Site 6	583
Task 2.1	1st Injection	5
Task 2.2	1st Round of Groundwater Sampling	2
Task 2.3	2nd Injection	5
Task 2.4	2nd Round of Groundwater Sampling	2
Task 2.5	3rd Injection	5
Task 2.6	1st Quarterly Sampling Event	2

Sequence Number	Planned Remedial Activity	Estimated Duration (days)
Task 2.7	2nd Quarterly Sampling Event	2
Task 2.8	3rd Quarterly Sampling Event	2
Task 2.9	4th Quarterly Sampling Event	2
Task 2.10	5th Quarterly Sampling Event	2

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6 Groundwater Monitoring

Groundwater samples will be collected from all 11 of the Site 6 monitoring wells three months following each injection as described in Section 4. The following sections present the proposed monitoring plan including methods and laboratory analyses. The sampling protocol and frequencies can be altered in response to changing site conditions, or parameters may be eliminated if they are not providing useful information. NYSDEC approval will be obtained prior to implementing any changes to the groundwater monitoring program. The groundwater samples will be collected and analyzed in accordance with the FSP (Appendix A) and QAPP (Appendix B).

6.1 Sampling Strategy

Groundwater samples will be collected from all Site 6 monitoring wells three months following each ISCO injection. If the CVOC concentrations are below AGWQS based upon the results of a post-injection monitoring event, then four rounds of quarterly sampling will be conducted to evaluate site closure. A petition would then be made to NYSDEC for the closure of Site 6. If the CVOC concentrations are at or above AGWQS for any one of the four rounds of quarterly sampling, additional ISCO injections will occur immediately, with continued sampling to confirm concentrations are below AGWQS based upon the results of a post-injection monitoring event.

The proposed sample locations are listed in Table 2 and shown in Figure 7. Table 2 also includes list of field parameters that will be collected during sampling, analysis, and frequency of groundwater sample collection from these wells.

Table 2 Proposed Groundwater Sampling

Wells To Be Sampled	Laboratory Analysis	Field Parameters	Frequency
6MW-11 6MW-19 6MW-20 6MW-21 6MW-22 6MW-23 6MW-24 6MW-25 6MW-26 6MW-27S 6MW-27SD	▪ EPA Method 8260 (TAL-CVOCs only): PCE TCE Cis-1,2-DCE VC ▪ EPA Method 9056: Chloride	▪ Temperature ▪ Pondus Hydrogenii (pH) ▪ Oxidation/Reduction Potential ▪ Dissolved Oxygen ▪ Turbidity ▪ Specific Conductance ▪ Permanganate Colorimetric Testing	▪ Three months following each injection ▪ Quarterly sampling once AGWQS have been met (four consecutive rounds)
6MW-19 6MW-20 6MW-21	▪ EPA Method 6010: Metals (TAL- Full)		▪ Three months following each injection

6.2 Groundwater Sampling Equipment and Procedures

Groundwater samples will be collected from monitoring wells beginning in areas known or assumed to be least contaminated (6MW-11, 6MW-27S/SD, 6MW-21) and progress to areas known or assumed to be the most contaminated (6MW-20, 6MW-22, 6MW-25). All sampling and purging equipment (pumps, water level indicators, etc.) that come into contact with groundwater will be decontaminated before use and between sampling locations. Groundwater geochemical parameters and collection of groundwater samples will be documented on a monitoring well sample collection form. Low-flow groundwater sampling will be the initial method of groundwater sampling. If low-flow sampling is not possible, the well will be purged of three well volumes or until dry and sampled with a disposable bailer after allowing the well to recharge. The procedures for collecting samples using bailers are presented in further detail in the FSP.

The low-flow (minimum drawdown) sampling method is based on the premise that a pump or pump intake placed within the screened interval of a well and pumped at a rate corresponding to the hydraulic conductivity of the formation will rapidly establish a horizontal laminar flow of groundwater and withdraw fresh formation water without significant mixing or dewatering of the stagnant casing water in the well and without mobilizing naturally occurring colloidal material within the aquifer. Field personnel conducting groundwater sampling will be trained in low-flow sampling procedures and will be provided a copy of the sampling protocols. Groundwater geochemical parameters will be monitored during well purging to determine well stabilization for sampling. The procedures for collecting groundwater samples using low-flow techniques are presented in further detail in the FSP (Appendix A).

7 Health and Safety

The remedial activities outlined within this RAWP will be performed in accordance with the Site Specific HASP presented in Appendix D and the Community Air Monitoring Plan (CAMP) which is included as Appendix J of the HASP.

7.1 Site Specific Health and Safety Plan

The Site Specific HASP presented in Appendix D was been prepared by BEM in accordance with the regulatory requirements of 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER), 29 CFR 1926 "Construction Health and Safety", and the United States Army Corps of Engineers (USACE) Engineer Manual (EM) 385-1-1 Safety Requirements Manual for activities scheduled at SANGB, NY. The HASP has been prepared for NY Air National Guard and Headquarters, Air National Guard Restoration Branch.

The HASP provides the following information, as required under 29 CFR 1910.120 and applicable standards:

- identification of tasks and potential hazards associated with each task,
- list of key personnel,
- personal protective equipment (PPE) that may be used at the site,
- employee health and safety training requirements,
- emergency contingency information,
- medical surveillance program,
- identification of confined space entry procedures,
- procedures for spill containment,
- list site control measures, as necessary, and
- decontamination procedures.

The HASP will be implemented by the Site Safety Officer (SSO) during site work. All BEM Team personnel and subcontractors who work on projects under this contract are required to comply with this HASP.

7.2 Community Air Monitoring Plan

A community air monitoring program will be implemented in accordance with DER-10. The Generic NYSDOH CAMP (DER-10, Appendix 1A) is attached as Appendix J of the HASP (Appendix D). The generic CAMP includes methods for the continuous monitoring of VOCs and dust particulates during intrusive site work including soil excavation and handling, as well as for periodic monitoring of VOCs during non-intrusive site work including the collection of soil samples by direct push methods or the collection of groundwater samples from existing wells (NYSDEC. 2010).

The CAMP is intended to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities performed on site. The CAMP action levels require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability (NYSDEC 2010).

8 Reporting

Reports prepared as a component of the remediation will consist of RACRs and Chemical Oxidation Performance Monitoring Reports. The reports are discussed in the sections below.

8.1 Remedial Action Closure Reports

Two RACRs will be prepared and submitted to the ANG and NYSDEC; one upon completion of the Site 3 and Site 6 soil remediation, and one for the Site 6 groundwater remediation. The purpose of the RACRs is to document the remedial actions taken to achieve the RAOs at the Sites and request no further action from the NYSDEC. The reports will include summaries of the remedial activities, completed waste disposal manifests and excavation confirmation soil results, and groundwater results and trend analysis as applicable.

At the completion of the soil removal, the Sites 3 and 6 RACR will be prepared and will serve as the Final Engineering Report for Site 3. At the completion of the Site 6 groundwater remediation, the Site 6 RACR will be prepared and will also serve as the Final Engineering Report.

8.2 Chemical Oxidation Performance Monitoring Reports

Chemical Oxidation Performance Monitoring Reports will be generated 30 days following receipt of the analytical data package from the three month post-injection sampling event. The monitoring report will include a summary of the injection event, sampling results and a recommendation for either an additional injection or initiation of quarterly groundwater sampling.

8.3 Analytical Data Reporting Requirements

The BEM Team will complete validation of the field and analytical data, and upload the Environmental Resources Program Information Management System (ERPIMS) data for this contract consistent with the specifications and timeframes provided in the ERPIMS 2008 Data Loading Handbook Version 5.1.1222, December 2009 (United States Air Force [USAF] 2009). Data will be loaded in real-time using the prevailing version of ERPToolsX. ERPIMS reporting will be performed in accordance with the ANG A7O 10-1 Policy on ERPIMS (NGB 2010). The analytical data will also be submitted as an electronic data deliverable to NYSDEC via their database software program EQuIS™.

9 References

National Guard Bureau [NGB] 2010. A7O 10-1, Environmental Resources Program Information Management System (ERPIMS) Memorandum for NGB / A7OR National Contractors, September 2010.

New York State Department of Environmental Conservation (NYSDEC). 1998. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. NYSDEC Division of Water Technical and Operational Guidance Series Memorandum Number 1.1.1., June 1998 (latest amendment April 2000).

NYSDEC. 2005. New York State Standards and Specifics for Erosion and Sediment Control. August 2005.

NYSDEC. 2010. DER-10, Final Technical Guidance for Site Investigation and Remediation, Division of Environmental Remediation, May 2010.

BEM Systems, Inc. (BEM), 2012a. Data Gap Investigation Technical Memorandum for Sites 3 and 6 for the 109th Airlift Wing, Schenectady Air National Guard Base (SANGB), Scotia, New York, February 2012.

BEM, 2012b. Record of Decision for Sites 3 and 6 for the 109th Airlift Wing, Schenectady Air National Guard Base (SANGB), Scotia, New York, March 2012.

USAF, 2009. ERPIMS 2008 Data Loading Handbook Version 5.1.1222, December 2009.

Figures

Legend

- ANG Facilities Boundary
- Site 3
- Site 6

0 1,000 2,000 Feet

Data Sources:
Aerial: (c) 2010 Microsoft Corporation and its data suppliers
Design: Earth Tech / AECOM (2008)
Roads: (c) 2010 Microsoft Corporation and its data suppliers

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE 1:
SITE LOCATION MAP

PROJECT No.:
07-ANG21CNEF

DATE:
APRIL 2013

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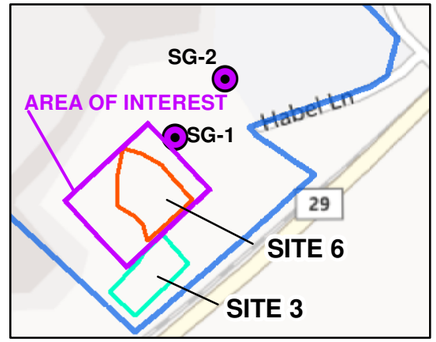
U:\Projects\Schenectady_ANG\Report_Specific\RemedialActionWorkplan\MXD\FINAL\Figure1_SiteLocationMap_RAWP_ANGSchenectady_11x17_20120314.mxd



LEGEND

- EXISTING INFUSION WELL
- EXISTING MONITORING WELL
- FORMER SOIL GAS
- FORMER SOIL BORING
- FENCE
- HORIZONTAL INFUSION WELL
- AIR NATIONAL GUARD FACILITIES BOUNDARIES
- FORMER SOIL EXCAVATION
- SITE 6

0 30 60 FEET

DATA SOURCES:
AERIAL: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
ROADS: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
DESIGN: EARTH TECH / AECOM (2008)

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE: 2
EXISTING SITE CONDITIONS

PROJECT No.:
07-ANG21CNEF

DATE:
APRIL 2013

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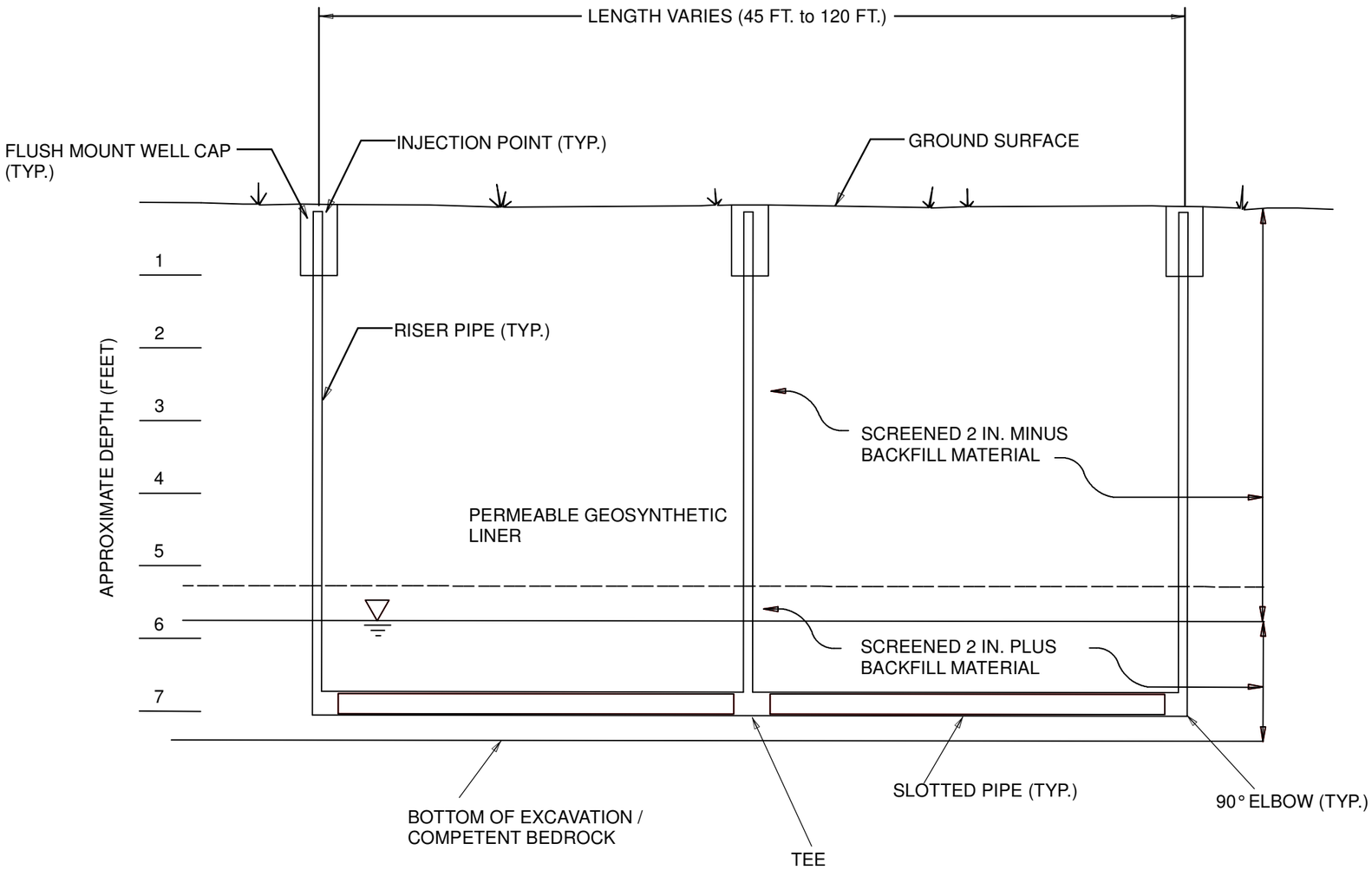
U:\Projects\Schenectady_ANG\Report_Specific\RemedialActionWorkplan\MXD\FINAL\Figure2_Site6ExistingSiteConditions_RAWP_ANGSchenectady_11x17_20120314.mxd



NOTE:

DEPTHS SHOWN ARE APPROXIMATE. WELL DEPTH BASED ON ELEVATION OF COMPETENT BEDROCK.

DATA SOURCES:
DESIGN: EARTH TECH / AECOM (2008)

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE: 3
CROSS-SECTION OF EXISTING
HORIZONTAL INJECTION WELLS

PROJECT No.:
07-ANG21CNEF

DATE:
APRIL 2013

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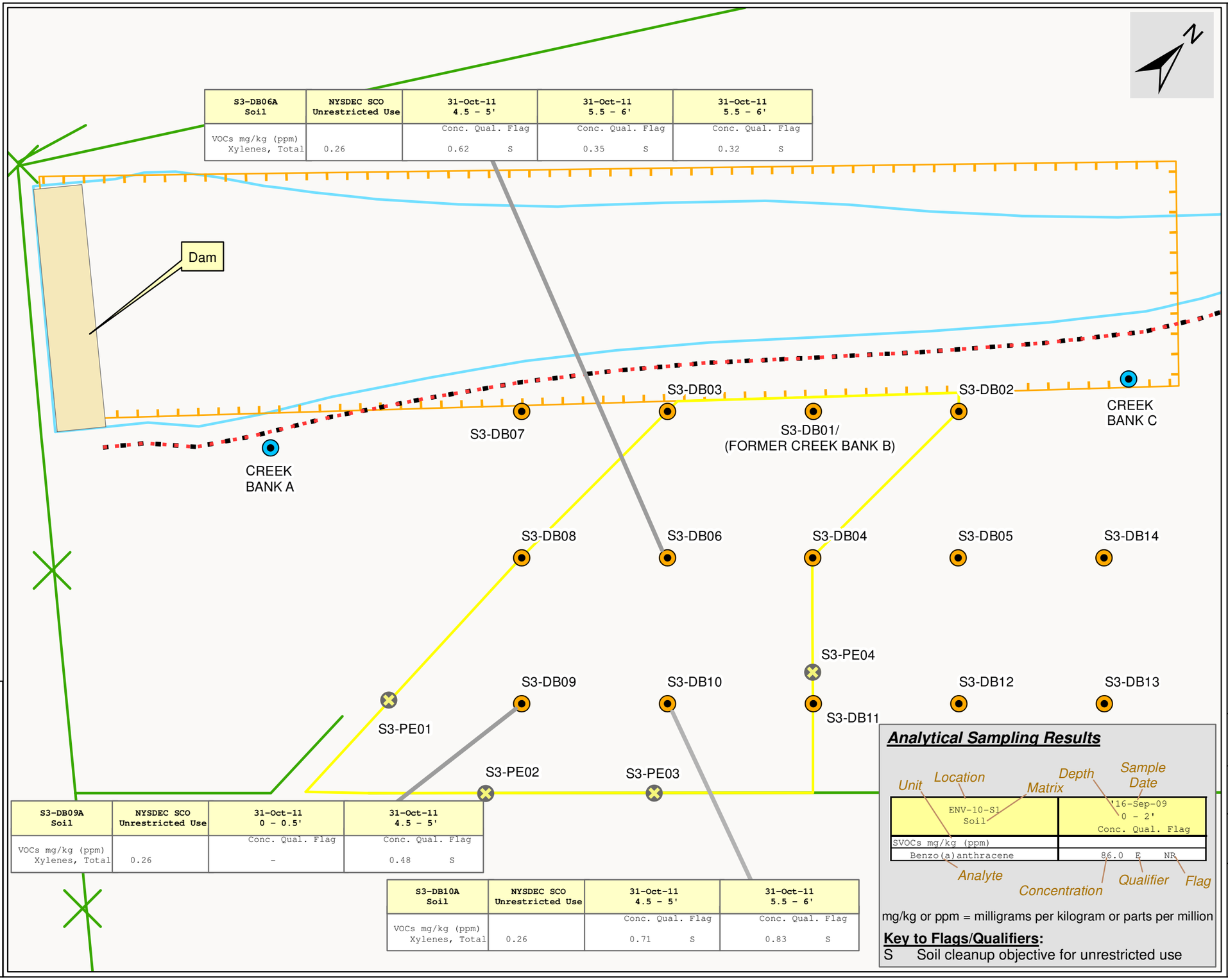
U:\Projects\Schenectady_ANG\Report_Specific\RemedialActionWorkplan\MXD\FINAL\Figure3_TypicalCrossSectionOfExistingHorizontalInjectionWell_RAWP_ANGSchenectady_11x17_20120314.mxd

S3-DB06A Soil	NYSDEC SCO Unrestricted Use	31-Oct-11 4.5 - 5'		31-Oct-11 5.5 - 6'		31-Oct-11 5.5 - 6'	
		Conc.	Qual. Flag	Conc.	Qual. Flag	Conc.	Qual. Flag
VOCs mg/kg (ppm)							
Xylenes, Total	0.26	0.62	S	0.35	S	0.32	S



S3-DB09A Soil	NYSDEC SCO Unrestricted Use	31-Oct-11 0 - 0.5'		31-Oct-11 4.5 - 5'	
		Conc.	Qual. Flag	Conc.	Qual. Flag
VOCs mg/kg (ppm)					
Xylenes, Total	0.26	-		0.48	S

S3-DB10A Soil	NYSDEC SCO Unrestricted Use	31-Oct-11 4.5 - 5'		31-Oct-11 5.5 - 6'	
		Conc.	Qual. Flag	Conc.	Qual. Flag
VOCs mg/kg (ppm)					
Xylenes, Total	0.26	0.71	S	0.83	S

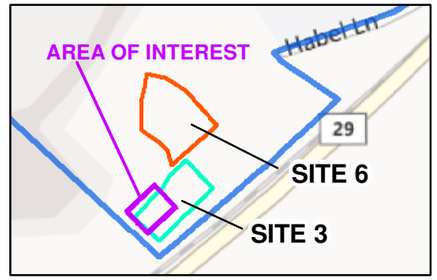
Analytical Sampling Results

Unit	Location	Matrix	Depth	Sample Date
	ENV-10-S1	Soil	0 - 2'	16-Sep-09
SVOCs mg/kg (ppm)			Conc.	Qual. Flag
Benzo(a)anthracene			86.0	E NR

Analyte | Concentration | Qualifier | Flag

mg/kg or ppm = milligrams per kilogram or parts per million

Key to Flags/Qualifiers:
S Soil cleanup objective for unrestricted use



Legend

- PROPOSED POST EXCAVATION SOIL SAMPLES
- FORMER IRM POST EXCAVATION SAMPLE LOCATIONS BY AECOM
- DGI SOIL BORING LOCATIONS
- PROPOSED GEOMEMBRANE
- CREEK
- FENCE
- PROPOSED SOIL EXCAVATION AREA
- FORMER SOIL EXCAVATION AREA
- SITE 3 DAM

Notes:
Delineation Boring S3-DB01 was reinstalled at previous location: CREEK BANK B.
Geomembrane installation details are included on Figure 4B.

0 10 20 Feet

Data Sources:
Design: Earth Tech / AECOM (2008)

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109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE 4:
SITE 3 PROPOSED SOIL EXCAVATION AREA

PROJECT No.:
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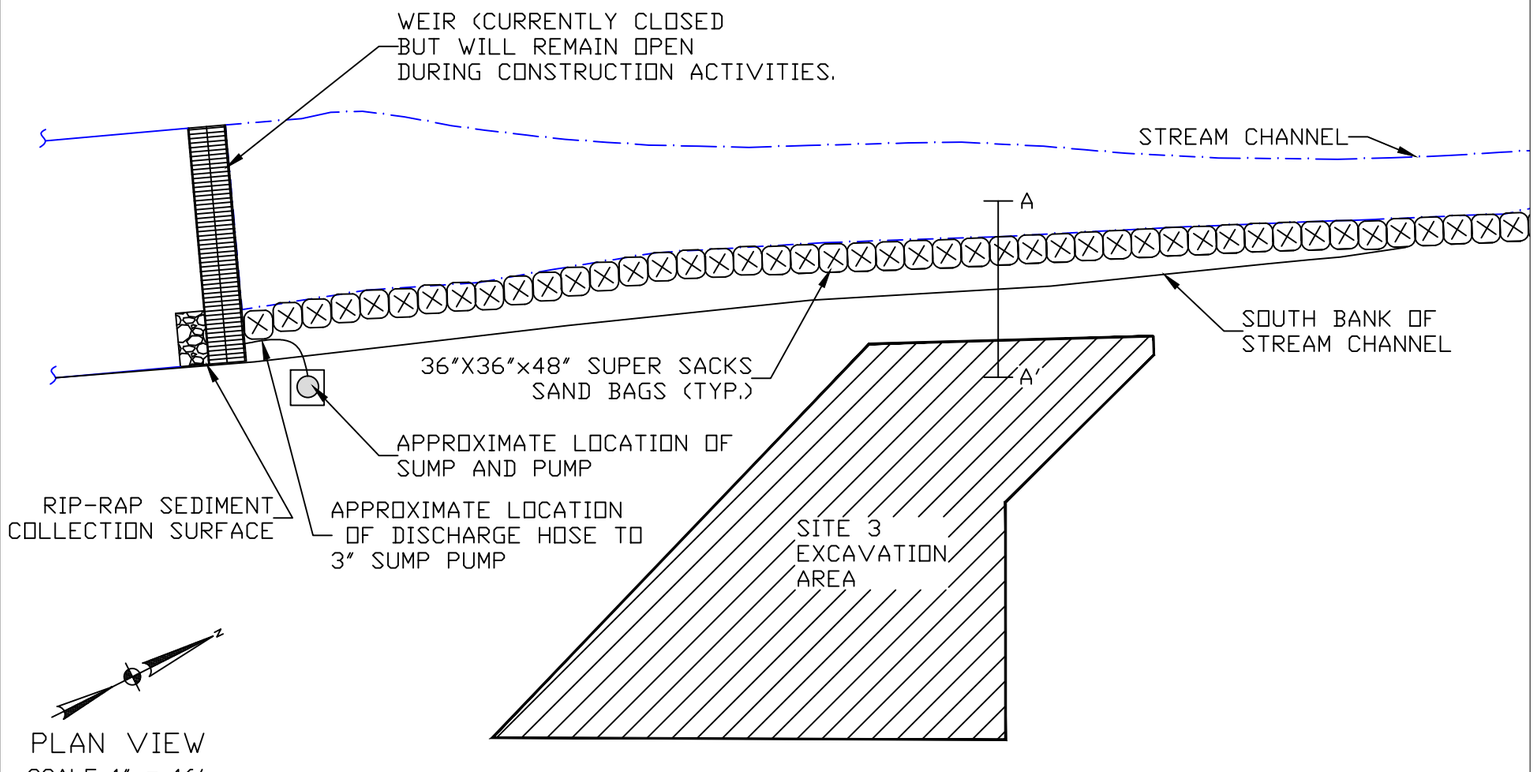
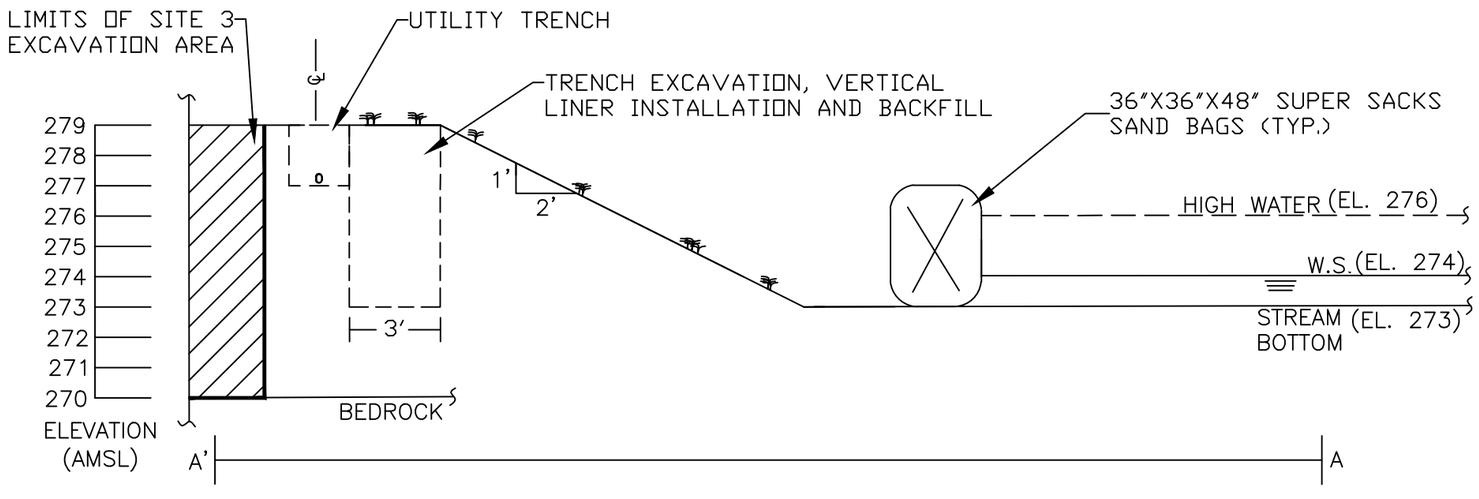
U:\Projects\Schenectady_ANG\Report_Specific\RemedialActionWorkplan\MXD\2012_FieldSampling_Plan\MXD\Figure4_Site3_ProposedSoilExcavationsREVISED_RAWP_ANGSchenectady_11x17_20121116.mxd



PLAN VIEW
SCALE 1" = 16'



Notes:

1.0 Prior to Site 3 excavation activities, the site shall be prepared for construction. The site will be staked out prior to excavation to confirm that the Site 3 excavation yields approximately 500 cubic yards (CY) of benzene impacted soil and the remedy follows the requirements set forth in the New York State Department of Environmental Conservation (NYSDEC) Record of Decision 447022 dated March 14, 2012. The stream shall be diverted by the contractor and sand bags shall be placed up and downstream of the stream flanking the excavation site. The site shall be cleared and grubbed and all utilities shall be identified including the electric conduit at the top of stream bank of Site 3. The Contractor shall make all required utility pre-notifications in accordance with Federal, State and local requirements.

1.1 The excavation area will be staked out by the contractor.

2.0 The sand bags shall consist of three (3) foot x three (3) foot x 48-inch, two (2) lift loops Barrel Bags each containing approximately 3,600 pounds of SP sands. The sand bags shall be placed:

2.1 Parallel to the down slope face of Site 3 and approximately 150 feet along the stream channel (Site 3).

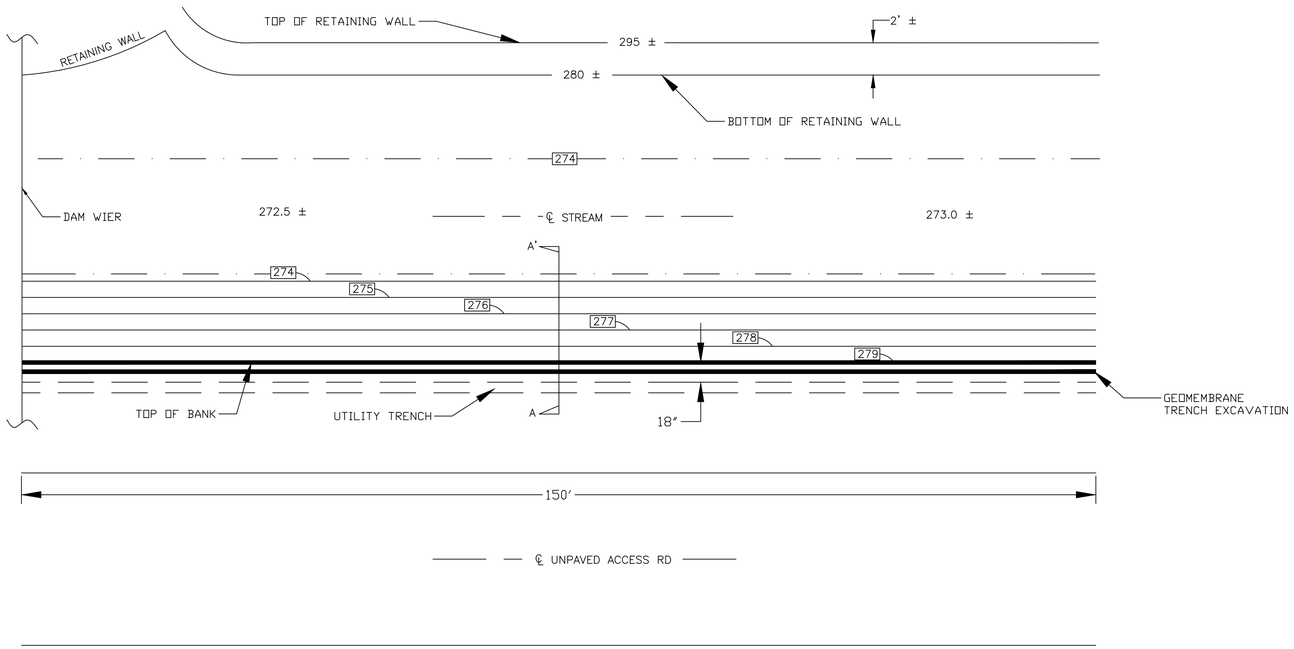
3.0 The sediment collection surface at Site 3 shall consist of a three (3) foot x three (3) foot x 18 inch thick stone apron, with a D_{50} stone size of 10-inches (50 pounds). The stone should be composed of a well-graded mixture down to the one-inch size particle such that 50 percent of the mixture by weight is larger than the D_{50} size as determined from the design procedure. For the purposes of this best management practice (BMP), a well-graded mixture is defined as a mixture composed primarily of the larger stone sizes but with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones. The diameter of the largest stone size in such a mixture should not be more than 1.5 times the D_{50} stone size.

4.0 The Contractor shall provide a sump pump and generator capable of pumping a minimum of 25 gallons per minute at a total discharge head (TDH) of 25 feet with a three (3) inch discharge opening for these purposes and 25 feet of three (3) inch diameter rubber wire reinforced discharge hose. The pump shall be used for the sump located for sand bag seepage at the Site 3 excavation.

5.0 The stream channel bypass system shall be set-up prior to excavation activities and will be operational for approximately one week or less at Site 3. All activities shall be conducted in accordance with the NYSDEC approved Remedial Action Work Plan.

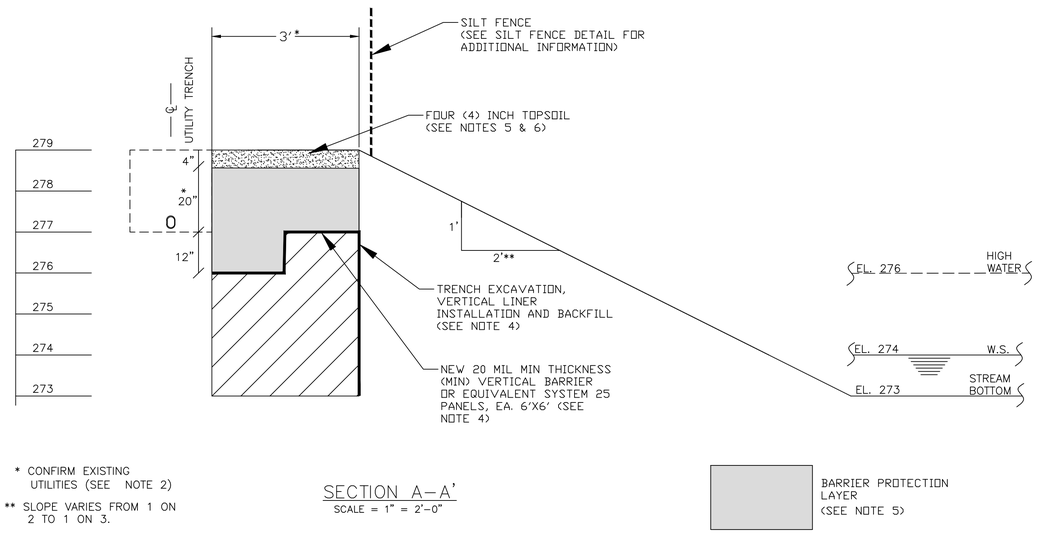
NEW YORK AIR NATIONAL GUARD 109TH AIRLIFT WING SCOTIA, NEW YORK	4-15-13	FOR REGULATORY APPROVAL BY NYSDEC FOR CONFORMANCE WITH RECORD OF DECISION SITE 447022, MARCH 14, 2012.		DESIGNED: BG DRAWN: BJ CHECKED: BG APPROVED: CH		STREAM CHANNEL BYPASS SYSTEM SITE 3
REMEDIAL ACTION WORK PLAN FOR SITES 3 AND 6	6-03-13	FOR CONSTRUCTION				
	DATE:	REVISIONS	No.			

SCALE: AS SHOWN
FILE NAME: 07-ANG21CNEF
DRAWING No.: 4A
REV:
DATE: 04/15/13
CONTRACT No.
ISSUE
SHEET No. 1 OF 1



PLAN OF VERTICAL GEOMEMBRANE CAP

SCALE = 1" = 1'-10"



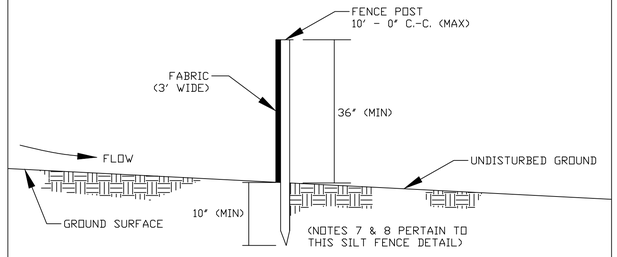
* CONFIRM EXISTING UTILITIES (SEE NOTE 2)

** SLOPE VARIES FROM 1 ON 2 TO 1 ON 3.

SECTION A-A'

SCALE = 1" = 2'-0"

BARRIER PROTECTION LAYER (SEE NOTE 5)



SILT FENCE DETAIL

SCALE = 1" = 1'-6"

NOTES:

1.0 THE CONTRACTOR SHALL PROVIDE A PRE-CONSTRUCTION STAKE OUT OF THE TRENCH, UTILITIES, AND PROPOSED EXCAVATION FOOTPRINT.

2.0 PRIOR TO CAP PLACEMENT ACTIVITIES THE SITE SHALL BE PREPARED FOR CONSTRUCTION. THE STREAM SHALL BE TEMPORARILY ISOLATED BY PLACEMENT OF SAND BAGS AT THE BASE OF THE EMBANKMENT AND SILT FENCING SHALL BE PLACED AROUND THE PROPOSED CAP PLACEMENT AREA. THE SITE SHALL BE CLEARED AND GRUBBED AND ALL UTILITIES SHALL BE IDENTIFIED INCLUDING THE 2-INCH DIAMETER PVC ELECTRIC CONDUIT AT THE TOP OF STREAM BANK. THE CONTRACTOR SHALL MAKE ALL REQUIRED UTILITY PRE-NOTIFICATIONS IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REQUIREMENTS.

3.0 THE SITE SHALL BE EXCAVATED WITHIN THE EXCAVATION LIMIT LINES SIX (6) FEET BELOW GRADE LEVEL (BGL) AS SHOWN IN PLAN AND SECTION A-A.' THE CLEARED AND GRUBBED EXCAVATED MATERIAL SHALL BE TEMPORARILY STOCKPILED AT THE TOP OF BANK AND COVERED WITH 10-MIL VISQUEEN OR OTHER SUITABLE MATERIAL.

3.1 ALL EXCAVATED SOIL DURING TRENCHING ACTIVITIES WILL BE SCREENED WITH A PID TO ENSURE CONTAMINATION IS NOT PRESENT OUTSIDE THE EXCAVATION AREA.

4.0 SECTION A-A' DESCRIBES THE VERTICAL GEOMEMBRANE CAP INSTALLATION WHICH REQUIRES THE EXCAVATION OF A THREE (3) FOOT WIDE TRENCH TO SIX (6) FEET BGL, AND PLACEMENT OF A MINIMUM 20 MIL THICKNESS REINFORCED POLYETHYLENE SHEETING INTO THE TRENCH WITH ANCHORAGE SHOWN. A REINFORCED 20 MIL POLYETHYLENE VERTICAL GEOMEMBRANE; HIGH DENSITY POLYETHYLENE (HDPE) OR EQUIVALENT WILL BE CONSIDERED FOR THIS APPLICATION. THE THICKNESS OF THE POLYETHYLENE OR HDPE SHALL BE DETERMINED BASED ON ABILITY OF CONTRACTOR TO INSTALL GEOMEMBRANE WITH MINIMUM AMOUNT OF SEAMS. THE TRENCH WILL BE BACKFILLED WITH SOILS FROM THE TEMPORARY STOCKPILE AFTER SCREENING THE BACKFILL FOR OVERSIZED STONES. THE TRENCH SHALL BE BACKFILLED BY COMPACTING BACKFILL USING SUITABLE COMPACTION EQUIPMENT.

5.0 THE BPL AND TOPSOIL SHALL HAVE A MINIMUM ORGANIC CONTENT OF FIVE (5)% USING PROCEDURES DESCRIBED IN ASTM D2974 WITH A PH VARYING BETWEEN 5.5 AND 6.8 CONFORMING TO THE FOLLOWING:

SIEVE SIZE	PERCENT PASSING BY WEIGHT
2-INCH	100
1-INCH	85-100
¼-INCH	65-100
NO. 200	20-80

6.0 THE TOP SOIL SHALL BE SEEDED WITH A MIXTURE OF 50% PERENNIAL RYE GRASS AND 50% FESCUE OR KENTUCKY BLUE GRASS SEED, APPLIED AT A RATE OF ONE (1) POUND PER 1,000 SQ.FT.

7.0 THE SILT FENCE SHALL BE INSTALLED AROUND THE PERIMETER OF THE SITE PRIOR TO ANY INTRUSIVE OR SITE DISTURBANCE ACTIVITIES. THE SILT FENCE POST SHALL BE SOUND QUALITY HARDWOOD FOUR (4) FEET IN LENGTH HAVING A MINIMUM CROSS SECTIONAL AREA OF THREE (3) SQUARE INCHES. THE FABRIC SHALL HAVE AN EQUIVALENT OPENING SIZE (EOS) RANGING FROM 40 TO 80 US STANDARD SIEVE CW 02215 AND CONFORM TO FABRIC PROPERTIES, MINIMAL ACCEPTABLE VALUES AND TEST PROCEDURES DESCRIBED IN NEW YORK STATE STANDARDS AND SPECIFICATION FOR EROSION AND SEDIMENT CONTROL (NYSSSESC) PAGES 7A.19 AND 7A.20. FILTER FABRIC MAY BE MIRAFI 100X OR EQUIVALENT OR A SUITABLE PREFABRICATED UNIT ACCEPTED BY THE ENGINEER. WHEN TWO SECTIONS OF FILTER FABRIC ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX (6) INCHES AND FOLDED. FABRIC OVERLAPPING SHALL BE STAPLED SECURE.

8.0 THE SILT FENCE SHALL BE MAINTAINED UNTIL DISTURBED AREAS ARE PERMANENTLY STABILIZED. SEDIMENT RETAINED BY THE SILT FENCE AT TIME OF REMOVAL SHALL BE SPREAD ON-SITE AT A LOCATION DIRECTED BY THE ENGINEER AND REVEGETATED.

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

DATE:	REVISIONS	No.
4-15-13	FOR REGULATORY APPROVAL BY NYSDEC FOR CONFORMANCE WITH RECORD OF DECISION SITE 44702, MARCH 14, 2012.	
6-03-13	FOR CONSTRUCTION	

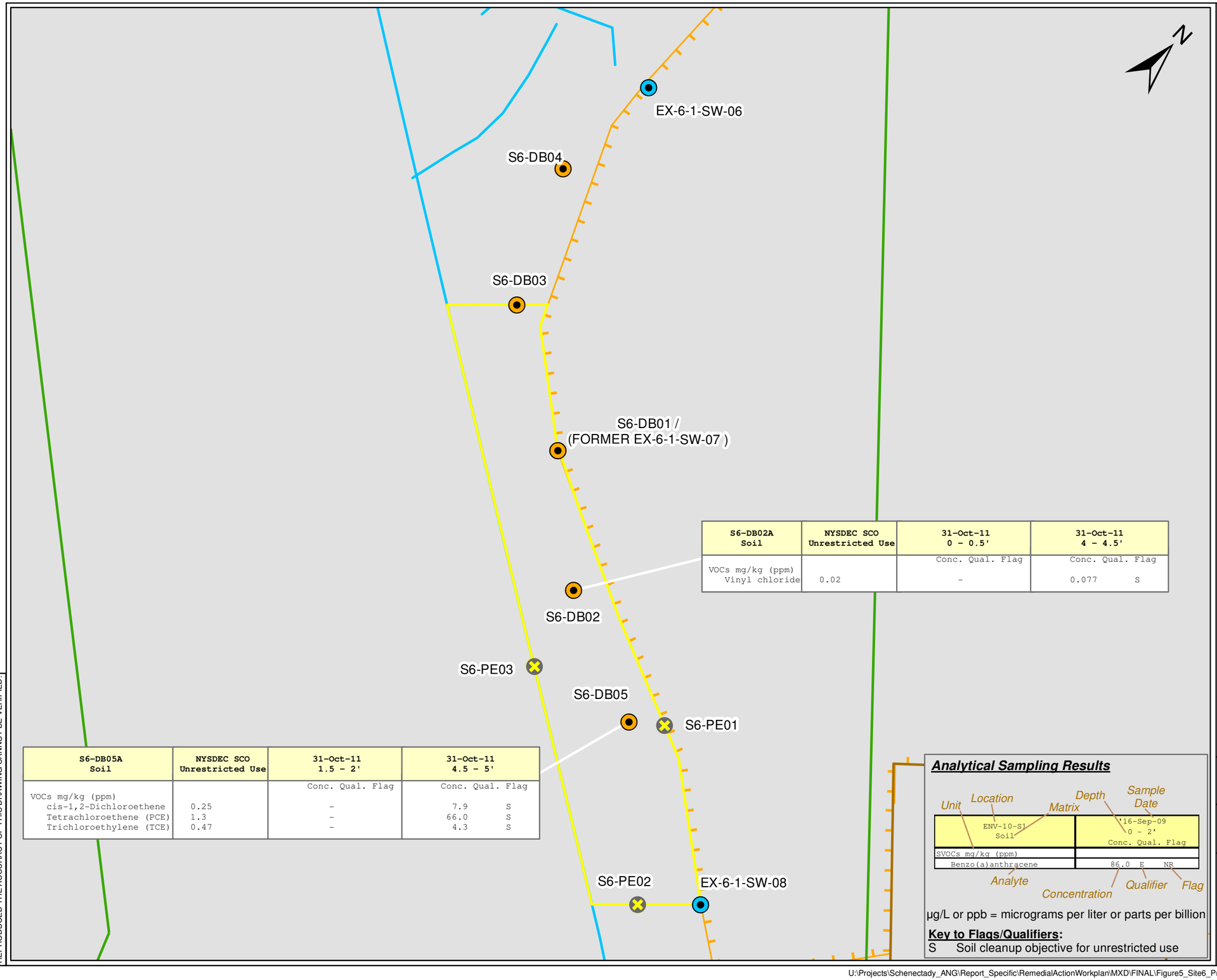
DESIGNED: BG
DRAWN: BJ
CHECKED: BG
APPROVED: CH

PROFESSIONAL ENGINEER
N.Y. LIC. No.
CHUN-TI HUANG
088409
DATE: --/--/--

VERTICAL GEOMEMBRANE CAP AND PLAN - SECTIONS

SCALE: AS SHOWN
FILE NAME: 07-ANG21CNEF
DRAWING No.: 4B
REV:
DATE: 04/15/13

CONTRACT No.
ISSUE
SHEET No. 1 OF 1



S6-DB02A Soil	NYSDEC SCO Unrestricted Use	31-Oct-11 0 - 0.5'		31-Oct-11 4 - 4.5'	
		Conc.	Qual. Flag	Conc.	Qual. Flag
VOCs mg/kg (ppm)					
Vinyl chloride	0.02	-		0.077	S

S6-DB05A Soil	NYSDEC SCO Unrestricted Use	31-Oct-11 1.5 - 2'		31-Oct-11 4.5 - 5'	
		Conc.	Qual. Flag	Conc.	Qual. Flag
VOCs mg/kg (ppm)					
cis-1,2-Dichloroethene	0.25	-		7.9	S
Tetrachloroethene (PCE)	1.3	-		66.0	S
Trichloroethylene (TCE)	0.47	-		4.3	S

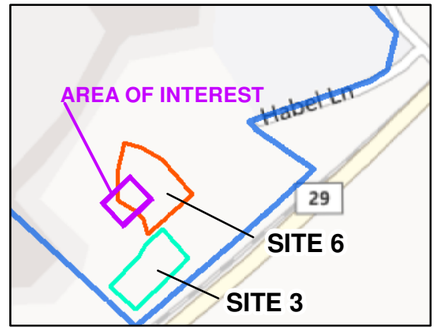
Analytical Sampling Results

Unit / Location / Matrix	Depth / Sample Date		
ENV-10-S1 Soil	'16-Sep-09 0 - 2'		
	Conc.	Qual.	Flag
SVOCs mg/kg (ppm)			
Benzo(a)anthracene	86.0	E	NR

Analyte / *Concentration* / *Qualifier* / *Flag*

µg/L or ppb = micrograms per liter or parts per billion

Key to Flags/Qualifiers:
S Soil cleanup objective for unrestricted use



Legend

- Proposed Post Excavation Soil Samples
- Former IRM Post Excavation Sample Locations by AECOM
- DGI Soil Boring Locations
- Proposed Soil Excavation Area
- Concrete Slab
- Creek
- Fence
- Former Soil Excavation Area

0 10 20 Feet

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE: 5
SITE 6 PROPOSED SOIL EXCAVATION

PROJECT No.:
07-ANG21CNEF

DATE:
APRIL 2013

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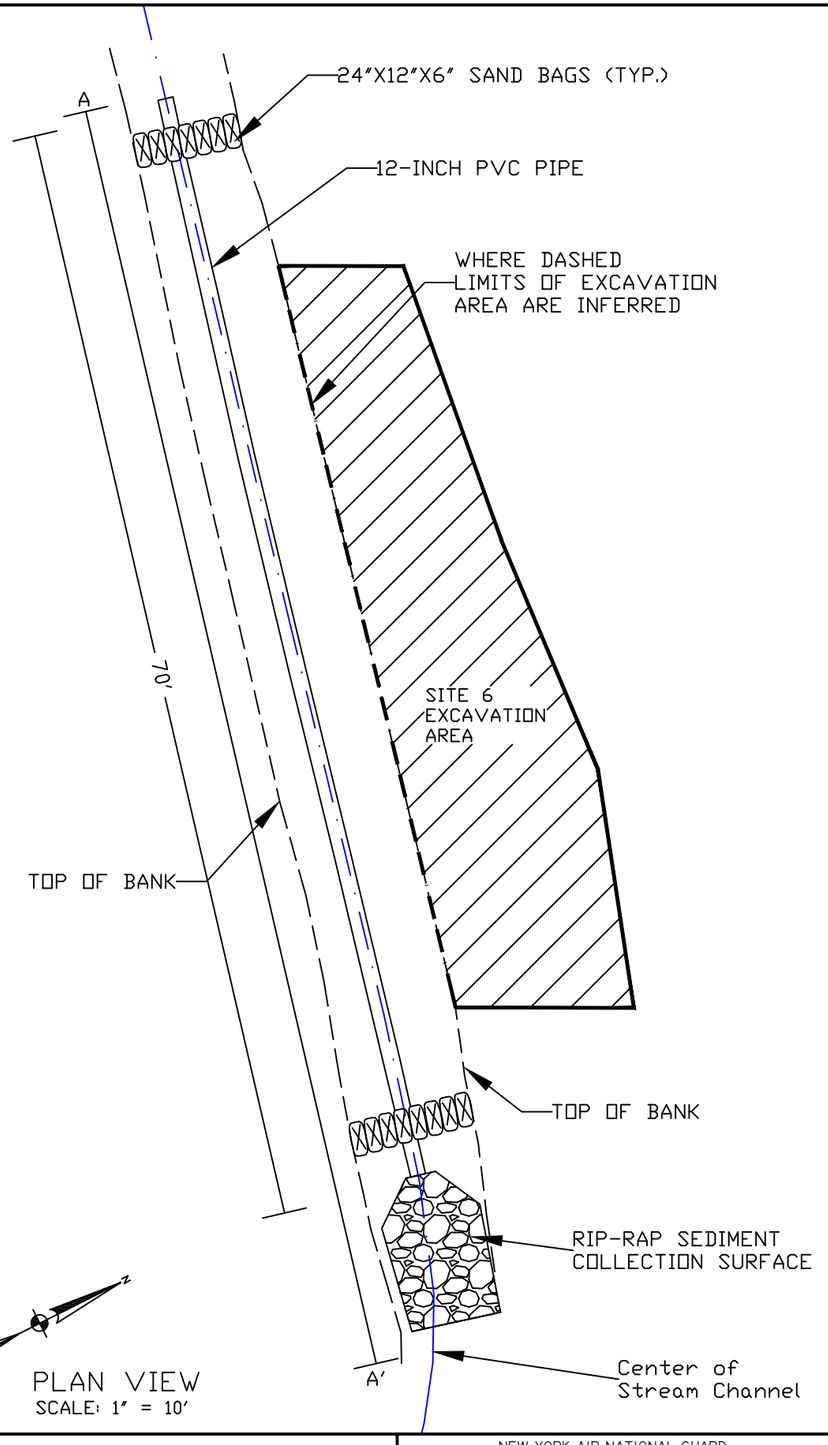
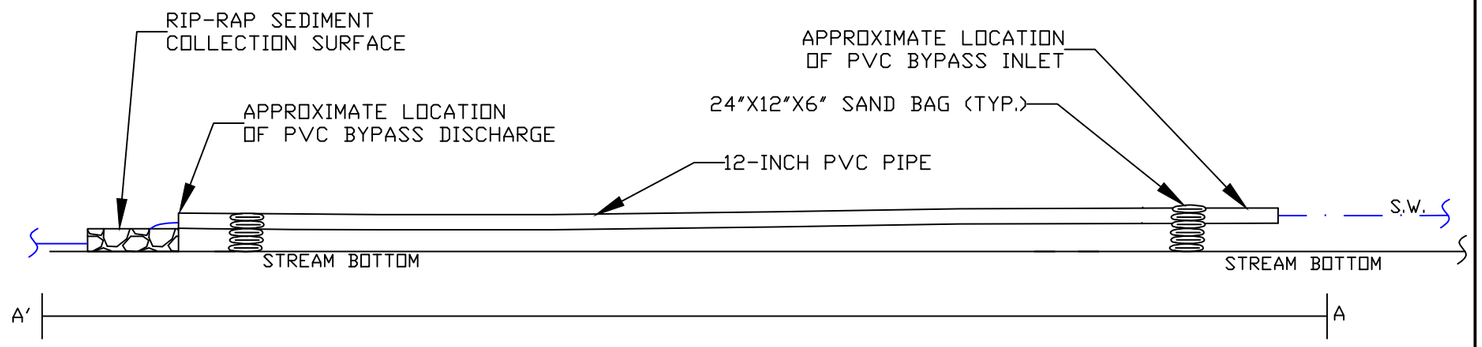


PLAN VIEW
SCALE: 1" = 10'



CROSS-SECTION VIEW
SCALE: 1" = 10'

Notes:

1.0 Prior to Site 6 excavation activities, the sites shall be prepared for construction. The site will be staked out prior to excavation to confirm that the excavation yields 110 CY of volatile organic compound (VOC) impacted soil and the remedy follows the requirements set forth in the New York State Department of Environmental Conservation (NYSDEC) Record of Decision 447022 dated March 14, 2012. The stream shall be diverted by the contractor and sand bags shall be placed up and downstream of the stream flanking the excavation site. The site shall be cleared and grubbed and all utilities shall be identified. The Contractor shall make all required utility pre-notifications in accordance with Federal, State and local requirements.

1.1 The excavation area will be staked out by the contractor.

2.0 The sand bags will measure approximately two (2) foot x one (1) foot x six inches. The sand bags shall be placed:

2.1 Longitudinally to provide a vertical coverage of at least four (4) feet on the upstream side of the stream diversion contiguous to Site 6 and at least two (2) feet on the downstream side of the diversion (Site 6), and

3.0 The Contractor shall provide 70 linear feet of 12 inch schedule 40 PVC diversion pipe for purposes of diverting the stream through the stream channel as shown on the drawings at Site 6. The diversion pipe shall discharge into a rip rap sediment collection surface as shown on the Drawings.

4.0 The sediment collection surface at Site 6 shall consist of a six (6) foot x 10 foot x 6 inch thick stone apron, with a D_{50} stone size of 10 inches (50 pounds). The stone should be composed of a well-graded mixture down to the one-inch size particle such that 50 percent of the mixture by weight is larger than the D_{50} size as determined from the design procedure. For the purposes of this BMP, a well-graded mixture is defined as a mixture composed primarily of the larger stone sizes but with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones. The diameter of the largest stone size in such a mixture should not be more than 1.5 times the D_{50} stone size.

5.0 The stream channel bypass system shall be set-up prior to excavation activities and will be operational for approximately one week or less at Site 6. All activities shall be conducted in accordance with the NYSDEC approved Remedial Action Work Plan.

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

DATE:	REVISIONS	No.
4-15-13	FOR REGULATORY APPROVAL BY NYSDEC FOR CONFORMANCE WITH RECORD OF DECISION SITE 447022, MARCH 14, 2012.	
6-03-13	FOR CONSTRUCTION	

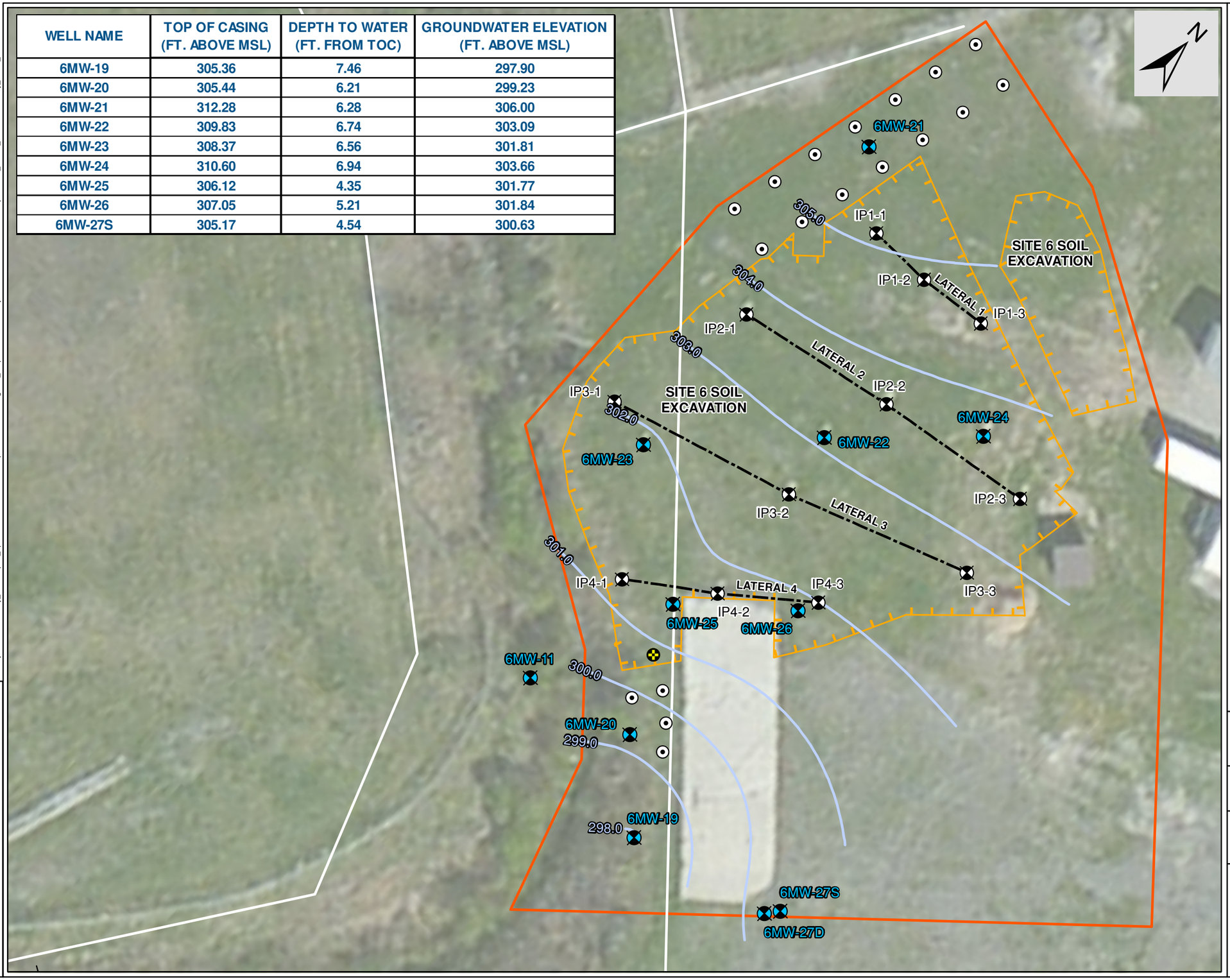
DESIGNED: BG
DRAWN: BJ
CHECKED: BG
APPROVED: CH

STREAM CHANNEL BYPASS SYSTEM
SITE 6

SCALE: AS SHOWN
FILE NAME: 07-ANG21CNEF
DRAWING No.: 5A
REV:
DATE: 04/15/13

CONTRACT No.
ISSUE
SHEET No. 1 OF 1

WELL NAME	TOP OF CASING (FT. ABOVE MSL)	DEPTH TO WATER (FT. FROM TOC)	GROUNDWATER ELEVATION (FT. ABOVE MSL)
6MW-19	305.36	7.46	297.90
6MW-20	305.44	6.21	299.23
6MW-21	312.28	6.28	306.00
6MW-22	309.83	6.74	303.09
6MW-23	308.37	6.56	301.81
6MW-24	310.60	6.94	303.66
6MW-25	306.12	4.35	301.77
6MW-26	307.05	5.21	301.84
6MW-27S	305.17	4.54	300.63



LEGEND

- PROPOSED COLLECTION SUMP
- PROPOSED INJECTION NETWORK BORINGS
- MONITORING WELL
- INFUSION WELL
- GROUNDWATER CONTOUR LINES
- FENCE
- HORIZONTAL INFUSION WELL
- FORMER SOIL EXCAVATION
- SITE 6

NOTES:
MONITORING WELLS INCLUDED IN TABLE WERE UTILIZED FOR CONTOURS.
6MW-11 AND 6MW-27D WERE NOT USED TO GENERATE THE GROUNDWATER CONTOURS.
GROUNDWATER LEVEL MEASURED ON 08/04/2008.

0 30 60 FEET

DATA SOURCES:
AERIAL: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
ROADS: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
DESIGN: EARTH TECH / AECOM (2008)

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE: 6
PROPOSED DIRECT-PUSH INJECTION POINTS AND COLLECTION SUMP LOCATION

PROJECT No.:
07-ANG21CNEF

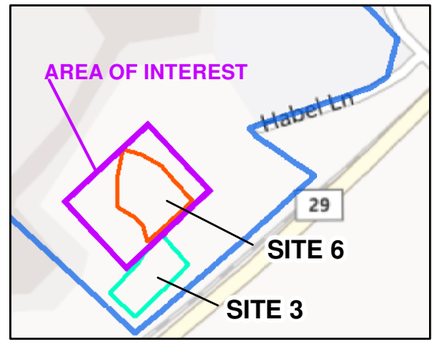
DATE:
APRIL 2013

THIS MAP AND ALL INFORMATION CONTAINED HEREIN IS AUTHORIZED FOR USE BY OUR CLIENT AND CLIENT-DESIGNATED PARTIES. ONCE REPRODUCED THE ACCURACY OF THIS DRAWING CANNOT BE VERIFIED.

U:\Projects\Schenectady_ANG\Report_Specific\RemedialActionWorkplan\MXD\FINAL\Figure6_ProposedDirectPushInjectionPointsAndCollectionSumpLocation_RAWP_ANGSchenectady_11x17_20120314.mxd

THIS MAP AND ALL INFORMATION CONTAINED HEREIN IS AUTHORIZED FOR USE BY OUR CLIENT AND CLIENT-DESIGNATED PARTIES. ONCE REPRODUCED THE ACCURACY OF THIS DRAWING CANNOT BE VERIFIED.

U:\Projects\Schenectady_ANG\Report_Specific\RemedialActionWorkplan\MXD\FINAL\Figure7_SiteProposedLongTermMonitoringWellNetwork_RAWP_ANGSchenectady_11x17_20120314.mxd



LEGEND

- EXISTING MONITORING WELLS
- FENCE
- AIR NATIONAL GUARD FACILITIES BOUNDARIES
- FORMER SOIL EXCAVATION
- SITE 6

0 30 60 FEET

DATA SOURCES:
AERIAL: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
ROADS: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
DESIGN: EARTH TECH / AECOM (2008)

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

REMEDIAL ACTION WORK PLAN
FOR SITES 3 AND 6

FIGURE: 7
PROPOSED LONG TERM
MONITORING WELL NETWORK

PROJECT No.:
07-ANG21CNEF

DATE:
APRIL 2013

Appendix A.
Field Sampling Plan

FINAL
FIELD SAMPLING PLAN

New York Air National Guard
Schenectady Air National Guard Base
1 Air National Guard Road
Scotia, New York 12302

Prepared for:

Air National Guard Headquarters
3500 Fetchet Avenue
Andrews Air Force Base, Maryland 20762-5157

Prepared by:

BEM Systems, Inc.
100 Passaic Avenue
Chatham, New Jersey 07928

April 2013

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LIST OF ABBREVIATIONS AND ACRONYMS

AB	Ambient Blank
AGWQS	Ambient Groundwater Quality Standards
ANG	Air National Guard
ASTM	American Society for Testing and Materials
BEM	BEM Systems, Inc.
BEM Team	BEM and AECOM partnership
BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CoC	Chain-of-Custody
CVOC	Chlorinated Volatile Organic Compound
CY	Cubic Yards
DGI	Data Gap Investigation
DO	Dissolved Oxygen
DoD	Department of Defense
DOT	Department of Transportation
DTW	Depth To Water
DQO	Data Quality Objective
DRO	Diesel Range Organics
EB	Equipment Blank
ELAP	Environmental Laboratory Accreditation Program
EPA	United State Environmental Protection Agency
ERP	Environmental Restoration Program
ESMI	Environmental Soil Management Companies
FSP	Field Sampling Plan
FT	Feet
FT^2	Squared Feet
FT^3	Cubic Feet
GPS	Global Positioning System
GRO	Gasoline Range Organics
HASP	Health and Safety Plan
IDW	Investigation Derived Waste
IRA	Interim Removal Action
ISCO	In-Situ Chemical Oxidation
LPM	Liters Per Minutes
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NGB	National Guard Bureau

NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OP-TECH	OP-TECH Environmental Services, Inc.
ORP	Oxidation Reduction Potential
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RACR	Remedial Action Closure Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SANGB	Schenectady Air National Guard Base
SARA	Superfund Amendments Reauthorization Act
SCA	Schenectady County Airport
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TB	Trip Blank
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TPHC	Total Petroleum Hydrocarbons
UFPO	Underground Facilities Protective Organization
UIC	Underground Injection Control
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound

1.0 INTRODUCTION

A Field Sampling Plan (FSP) presents, in specific terms, the requirements and procedures for conducting field operations and investigations. This FSP was produced for project specifications regarding the Sites 3 and 6 Remedial Action Work Plan (RAWP) at the Schenectady Air National Guard Base (SANGB). The purpose of this FSP is to ensure (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible.

This FSP is required reading for all staff participating in the work effort. The FSP will be in the possession of field teams performing the field work. All contractors and subcontractors will comply with the procedures documented in this FSP in order to maintain comparability and representativeness of the collected and generated data.

The BEM Systems, Inc. (BEM) and AECOM partnership (BEM Team), will control the distribution of the FSP to ensure that the current and correct version is being used. A sequential numbering system will be used to identify copies of the FSP. Controlled copies shall be provided to applicable Air National Guard (ANG) managers, regulatory agencies, remedial project managers, project managers, and quality assurance (QA) coordinators. Whenever revisions are made or addenda added to the FSP, a document control system will be put into place to assure that all parties holding a controlled copy of the FSP receive the revisions/addenda and that outdated material is removed from circulation. The document control system does not preclude making and using copies of the FSP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations.

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2.0 PROJECT BACKGROUND

The SANGB is located in the southeast portion of Schenectady County Airport (SCA) in Scotia, New York. Since the 1950s, the Base has operated an array of military aircraft under numerous assignments. These have included the B-6, C-47, the C-97A and C-97G Stratocrusiers, various models of the C-130 Hercules, F-94 Starfire jets, P-47 Thunderbolt, P-51 Mustang, and the T-6. In 1991 the unit was redesignated to the 109th Airlift Wing and has since continued operations of the C-130H Aircraft.

The Department of Defense (DoD) has initiated the Environmental Restoration Program (ERP) for evaluating suspected problems associated with historic waste disposal and spill sites at DoD facilities. As part of this program, three sites on the Base have been evaluated: Site 2, the Drum Storage Area; Site 3, the Drum Burial Area; and Site 6, the Suspected Spill Area. Based on the results of a Remedial Investigation (RI) performed in 2000 (ANEPTEK, 2000), the New York State Department of Environmental Conservation (NYSDEC) concurred that No Further Action was warranted at Site 2 (NYSDEC, 2000). However, the two sites being addressed are Site 3, located in the southeast corner of the Base near the former sewage treatment facility, and Site 6 located upgradient from Site 3 (Figure 1of the RAWP).

In accordance with the goals and objectives of the ERP, the BEM Team has been contracted by the National Guard Bureau (NGB)/A7OR to perform remedial actions in accordance with the Record of Decision (ROD) at the 109th Airlift Wing, Schenectady ANGB in Scotia, New York, under Contract Number W9133L-05-D-0007, delivery order 0021. The remedial actions will be performed in accordance with federal guidelines of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments Reauthorization Act (SARA). This FSP presents the requirements and procedures for conducting field operations and media sampling.

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3.0 PROJECT SCOPE AND OBJECTIVES

3.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are quantitative and qualitative goals that specify the amount and quality of data to be collected to support the decision-making process during the RAWP field work.

3.2 SAMPLE ANALYSIS SUMMARY

The analyses performed on a sample will depend on the sample media, the manner in which the sample was collected, and the purpose of collecting the sample. Table 3.2-1 summarizes the proposed laboratory analyses, methods, number of samples, trip blanks, and field duplicates for each sampling method/media.

Soil samples from Site 3 will be analyzed for xylene and soil samples from Site 6 will be analyzed for target analyte list chlorinated volatile organic compounds (CVOCs). Groundwater samples collected from monitoring wells following in-situ chemical oxidation (ISCO) will be analyzed for CVOCs by United States Environmental Protection Agency (EPA) Method 8260 and chloride by EPA Method 9056. Post-injection groundwater sampling will include target analyte list for metals (target analyte list [TAL]-Metals) by EPA Method 6010 on wells 6MW-19 (upgradient), 6MW-21 (source) and 6MW-22 (downgradient) only.

If the injection activities are observed to have impacted the stream, surface water samples will be collected for permanganate analysis (via colorimetric test) and for CVOCs.

All samples will be analyzed using US EPA *Contract Laboratory Program* (CLP) methods and/or SW-846 (*"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods")* methods.

Quality Assurance/Quality Control (QA/QC) samples will be collected in accordance with the approved the Quality Assurance Project Plan (QAPP). A Final QAPP is included in Appendix B of the RAWP. In addition to the environmental media samples, the following QA/QC samples will be collected:

- Trip Blanks
- Duplicate Samples
- Equipment Blanks
- Matrix Spike/Matrix Spike Duplicate (MS/MSD)
- Ambient Blanks

A detailed discussion of QA/QC sampling methods, procedures, frequency, and usage is included in the QAPP. A summary of the estimated number of samples to be collected for analyses is presented in Table 3.2-1.

Excavated soil will be disposed of by sample collection and analysis as required by the treatment facility and also by utilizing the approved waste characterization profiles from the October 2011 Data Gap Investigation (DGI) field activity as permitted by the waste disposal facility. During the DGI activities, Sites 3 and 6 soils were characterized by collection of 1 grab sample from a

boring at each of the sites. The Site 3 waste characterization sample was collected from S3-DB01 (original CREEK-Bank-B sample location). The Site 6 waste characterization sample was collected from S6-DB02. This sample frequency was determined by the receiving landfill characterization and disposal requirements of 1 grab sample per 1,000 cubic yards (CY). The waste characterization samples were collected and analyzed for full toxicity leaching procedure (TCLP) analysis, target compound list (TCL) polychlorinated biphenyls (PCBs) analysis, and Resource Conservation and Recovery Act (RCRA) parameters. The TCLP analysis and some of the RCRA parameters were performed by Test America, Inc. laboratories in Pittsburgh, Pennsylvania, while the balance of the parameters were performed by Test America in Burlington, Vermont (NYSDEC 2012a).

In order to thermally treat the excavated soils, additional samples will be collected and analyzed prior to disposal. Site 3 soils will be analyzed for RCRA 8 Metals, EPA Methods SW846 8015 diesel range organics (DRO). In addition, Site 6 soils will be analyzed for EPA Methods SW846 8260, 8270, RCRA 8 Metals, and 8015 DRO/Gasoline Range Organics (GRO). Site 3 soils will be transported under manifest by OP-TECH Environmental Services, Inc. (OP-TECH) to Environmental Soil Management Companies (ESMI) in Fort Edward, New York, If NYSDEC approves the contained-in ruling for thermal treatment of Site 6 soil, the excavated soil will also be treated at ESMI's facility. The samples will be submitted to Test America, Inc., a laboratory that is both approved by the DoD and the New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP), for analysis.

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Table 3.2-1
Sample Analysis Summary

Analysis	Method	Number of Samples						Total Number of Samples
		Media Samples		QA/QC Samples				
		Groundwater/ Surface Water[+]	Soil	Equip Blanks	MS/MSD	Trip Blanks	Duplicates	
Contaminants		#	#	#	#	#	#	
Xylene	SW846 8260B	0	4	0	0	0	1	5
CVOCs	SW846 8260B	77*	2	8	8	7	8	110*
Post-Injection Performance Parameters								
TAL- Metals	SW846 6010B	9*	0	3	3	0	3	18
Natural Attenuation Parameter								
Chloride	SW846 9056	68*	0	7	7	0	7	89*
Field Parameters (e.g., DO, conductivity, pH, turbidity, Fe^{2+} permanganate)	Field Measurements (YSI meter / colorimeter)	77*	0	0	0	0	0	77*
Investigative Derived Waste								
RCRA 8 Metals	SW846 6010B/7470A	0	2	0	0	0	0	2
Total petroleum hydrocarbons (TPHC)- Diesel	SW846 8015B DRO	0	3	0	0	0	0	3
VOCs	SW846 8260B	0	1	0	0	0	0	1
Semi-volatile organic compounds (SVOCs)	SW846 8270C	0	1	0	0	0	0	1
TPHC- Gasoline	SW846 8260B GRO	0	2	0	0	0	0	2

Note: * - number of samples could vary, depending upon post-ISCO monitoring results. Estimate of # of samples is assuming that three rounds of injection will be required. See the Final RAWP, section 4.5 for complete detail.

[+] - Surface water samples for CVOCs will be collected if injection activities were observed to have impacted the stream. Number of samples are not included in the table above. QA/QC samples will not be collected for these samples with the exception of a trip blank.

Number of trip blanks may differ, based upon sample packaging and field schedule. Trip blanks will be collected at a rate of 1 per sample cooler.

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3.3 FIELD ACTIVITIES

The field sampling activities to be conducted primarily consist of soil and groundwater sampling to confirm completion of removal actions and evaluate the efficacy of ISCO treatment of groundwater. All planned field activities are summarized in Table 3.3-1.

Table 3.3-1
Field Activities

Sequence Number	Planned Remedial Activity	Estimated # of Samples (if any)
Task 1	Soil Excavation - Sites 3 & 6. Post-ex soil sampling.	7 post-ex soil samples
Task 1	Investigative Derived Waste	9 samples
Task 2	Groundwater Treatment and Monitoring – Site 6	77
Task 2.1	1st Injection	
Task 2.2	1st Round of Groundwater Sampling (Performance Monitoring)	11
Task 2.3	2nd Injection	
Task 2.4	2nd Round of Groundwater Sampling (Performance Monitoring)	11
Task 2.5	3rd Injection	
Task 2.6	1st Quarterly Sampling Event (Performance Monitoring)	11
Task 2.7	2nd Quarterly Sampling Event	11
Task 2.8	3rd Quarterly Sampling Event	11
Task 2.9	4th Quarterly Sampling Event	11
Task 2.10	5th Quarterly Sampling Event	11

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4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The BEM Team will manage all field activities, including the sample collection, data analysis, site characterization, and reporting. The project team will be comprised of the BEM Team personnel and BEM Team-approved subcontractors. The BEM Team has identified key management and technical personnel who will participate in this project. Guidance will be provided to individuals to ensure that overall project goals and objectives are met. Additional technical staff will be available throughout the course of the project if needed. Chart 4-1 presents the project organization chart.

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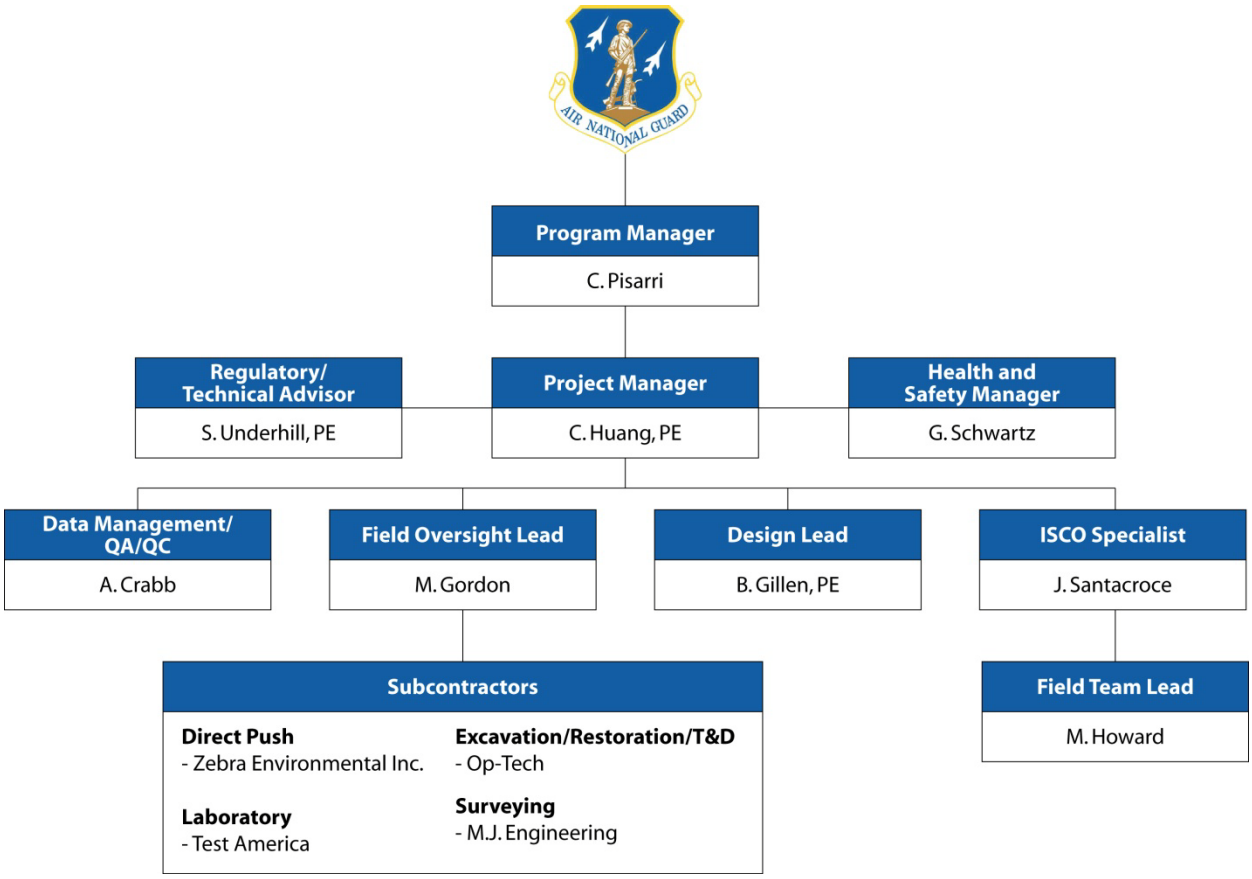
Chart 4-1
Project Organization Chart



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5.0 FIELD OPERATIONS

The following field activities will be performed in completion of the RAWP:

- Mobilization and Site Preparation
- Site 3 and 6 Soil Excavations
- Site 3 Geomembrane Installation
- Groundwater Injection of Chemical Oxidant
- Groundwater Monitoring (1-3 post-injection sampling events and four quarterly sampling events)
- Equipment Decontamination
- Surveying
- Waste Handling, Transport, and Disposal

The following sections specify the methods, procedures, and materials (where applicable) to be used to perform these identified field activities.

5.1 MOBILIZATION AND SITE PREPARATION

5.1.1 Permits

Permits required for the Interim Removal Actions (IRAs) include the SANGB digging permit to perform intrusive work at Sites 3 and 6. The digging permit will be obtained in conjunction with the utility clearance markout described in Section 5.1.2.

Based on the proximity of Site 3 to the flight path of SANGB, the flight line will be closed, except for use by small aircraft, during the soil excavation at Site 3. If the flightline needs to be opened to larger aircraft during the Site 3 excavation activities, the field schedule will be discussed with base personnel and revised as appropriate. A permit will not be required to close the flightline, however, prior permission from SANGB will be needed.

Prior to the start of the sampling the underground injection control (UIC) notification form will be completed and sent to the EPA.

5.1.2 Utility Clearance

Prior to conducting any intrusive activities, base personnel will identify and demarcate any owned (or leased) utilities that may transect the areas of intended work In the event that a utility cannot be located but is known or suspected to transect the areas of work, a utility locator service provider may be necessary to properly locate the underground facilities and minimize potential hazards during the site work. An Underground Facilities Protective Organization (UFPO) will be contacted and provided an address, location map, and scope of work for all intrusive activities. The UFPO covering New York State is DigSafetlyNY at 1-800-962-7962.

The UFPO will notify the facility owners, typically a utility, cable or telephone company, or municipality with underground water or sewer lines, or traffic control cables. The facility owner will evaluate the plan and determine their involvement. If the owner believes their facilities are

at risk, they can stake or mark the area, or call a meeting to further discuss the proposed excavation. Regardless, owners are required to notify excavators within two full working days of the notification date. Excavators cannot start digging and must wait until all utilities identified by the UFPO contact them to indicate they have no facilities affected by the intended work, or have demarcated all of their utilities in the area that may be impacted.

5.1.3 Site Preparation

Included in the Health and Safety Plan (HASP) in Appendix D of the RAWP is a general plan for the layout of work zones in accordance with 129 Code of Federal Regulations (CFR) 1910. A detailed site layout plan is included as Figure 1. The site-layout will include, but not limited to, proposed soil stockpile areas, engineering runoff controls, containerized waste storage areas, equipment and material storage areas, decontamination facilities, ingress and egress routes, portable restrooms, and emergency stations.

The presumed limits of the Site 3 and 6 excavation areas will be pre-located and staked/flagged using a portable global positioning system (GPS) array.

5.1.4 Equipment Contamination Reduction Pad

An equipment contamination reduction pad, with a minimum size of 20 feet (ft) by 20 ft, will be constructed and maintained inside the Contamination Reduction Zone. The interior of the pad will be sloped to an internal sump so that the wash water and sediment can be collected and removed for disposal. A high-pressure washer will be maintained to clean all vehicles and equipment exiting the Exclusion Zone.

A submersible pump will be placed in the sump to transfer the decontamination water via hose to a frac tank or 55-gallon Department of Transportation (DOT) drums for disposal. The equipment contamination reduction pad will be covered with polyethylene sheeting when not in use. The sheeting will be secured with sandbags. At the completion of the remediation project, the sand, stone, and sediment will be sampled, analyzed and disposed of at a permitted facility.

The equipment contamination reduction pad will be constructed as follows: the existing ground will be graded and compacted as required; medium sand will be placed over the proposed area; 10-inch x 10-inch timbers, held in place by #5 rebar, will be placed around the perimeter; sand will be bermed around the inside of the timbers to protect the liner a minimum 30-mil thick high density polyethylene liner will be placed over the sand and timbers; liner will be secured by nailing wooden battens on the outside of the timbers; two inches of medium sand will be placed above the liner; a sump will be constructed in the lowest area by using a slotted polyvinyl chloride (PVC) pipe and will be set in stone to collect water, remaining area within the timbers will be filled with course stone, and a stone or earthen ramp will be constructed to allow equipment to drive onto the pad. A cover of 6-mil polyethylene sheeting will be placed over the equipment contamination reduction pad. The cover will be secured with sandbags.

5.1.5 Stockpile Management Area

Stockpile management areas will be prepared for stockpiling excavated soils. The areas will be prepared as follows: the existing ground surface will be graded and compacted as required, a sump will be constructed in the lowest area; medium sand will be placed over the proposed storage area; 8-inch x 8-inch timbers, held in place by #5 rebar, will be placed around the perimeter; sand will be bermed around the inside of the timbers to protect the sheeting; a minimum, 30-mil thick reinforced polyethylene sheeting will be placed over sand and timbers; sheeting will be secured by nailing wooden battens on the outside of the timbers; and three inches of medium sand will be placed on the sheeting. A cover of 6-mil thick polyethylene

sheeting will be placed over the stockpile management area. The cover will be secured with sandbags. Stockpile location is included in Figure 1.

5.1.6 Erosion and Sediment Control

Siltation fence and hay bales will be placed along the drainage ditch and downgradient of Sites 3 and 6. Additional erosion and sedimentation controls for surface water runoff (i.e., haybales and or earth berm) may be used to prevent runoff from entering open excavations or interfering with construction activities. The integrity of the silt fence and earth berm shall be checked daily. Erosion and sediment controls are described in detail in Section 3.1.2 of the RAWP.

5.2 EXCAVATION AND RESTORATION

Excavation activities will be phased to minimize potential cross-contamination of work zones. Since the Site 3 removal action is likely to require the largest amount of soil removal, and has sufficient area for stockpiling all excavated soils to be removed from all areas, work will commence in Site 3, until all excavation work is completed, then relocated to Site 6 and conclude with excavation. It should be noted that prior to construction activities, a project meeting will be held on base. During this time, the stockpiling area will be confirmed. The stockpile area will be placed in an area that is accessible to both Site 3 and 6 yet out of the way from construction activities.

The Site 3 soil excavation will extend along the former excavation limits to the east and west to areas of confirmed delineation. The excavation will be extended south, past borings where contamination was detected (S3-DB09 and S3-DB10). The excavation will extend to the border of Site 3 to the south, but cannot extend further at this time, due to the current fence line/ property boundary. Post-excavation soil samples (S3-PE01 to S3-PE03) will be collected from along the southern border of the excavation to document the concentration of soils remaining at the southern Site 3 border. The post-excavation soil samples will be analyzed for xylenes by method SW846 8260B. The planned excavation area and sampling locations are included in Figure 4 of the RAWP. The planned excavation area for Site 3 will result in the removal of approximately 13,500 cubic feet (ft^3) or 500 CY of xylene impacted soil based on the surface area of approximately 1500 square feet (ft^2) and the depth of the excavation to bedrock at 9 ft below ground surface (bgs). The Site 6 soil excavation will extend from post excavation sample location EX-6-1-SW-08 approximately 11 ft to the stream bank on the west, 64 ft toward S6-DB03 to the north, extend 10 ft to the former excavation limits to the east, and approximately 64 ft toward the post excavation boring EX-6-1-SW-08 located to the southeast. The planned excavation area is included in Figure 5 of the RAWP. Post-excavation soil samples (S6-PE01 and S6-PE02) will be collected from along the eastern border of the excavation to document the concentration of soils remaining at the eastern Site 6 border. Post excavation sample S6-PE03 will be collected from the southern border of the excavation, along the stream. The post-excavation soil samples will be analyzed for target analyte list of CVOCs by method SW846 8260B. The planned excavation area for Site 6 will result in the removal of approximately 2,900 ft^3 or 110 CY of CVOC impacted soil based on the excavation surface area of 645 ft^2 and the depth of the excavation to bedrock at 4.5 ft bgs.

Excavation of any soils and sapprolitic bedrock will be conducted in one lift commencing at the upgradient most point in the excavation and proceeding downgradient. Soils/weathered rock will

be dragged back toward the down gradient most limit of excavation and left in the excavation until drained of free water before staging in the stockpiled soils area(s).

Prior to disposal activities, the excavated soil will be sampled for additional analyses in order to determine if the soil can be treated. Site 3 soils will be analyzed for RCRA 8 Metals, EPA Methods SW846 8015 DRO. In addition, Site 6 soils will be analyzed for EPA Methods SW846 8260, 8270, RCRA 8 Metals, and 8015 DRO/GRO. Site 3 soils will be transported under manifest by OP-TECH to ESMI in Fort Edward, New York, If NYSDEC approves the contained-in ruling for thermal treatment of Site 6 soil, the excavated soil will also be treated at ESMI's facility. Excavated non-hazardous soil from Site 6 that can't be treated will be transported under manifest by OP-TECH to Rapp Road Landfill in Albany, NY for final disposal. Based upon conversation with the disposal facility, the characterization results from the October 2011 DGI are sufficient for completing the waste profile for Site 3 and 6 excavated soil disposal.

5.3 GROUNDWATER, STORMWATER, AND WASTEWATER MANAGEMENT

The degree of groundwater infiltration into the excavation will depend on the influx of groundwater and runoff at the time of remediation. Also, groundwater present within the soil column will need to be managed as part of the remediation effort. Surface water management activities will primarily address the volume of water present within the excavation area and, to a lesser extent, upwards groundwater flow and precipitation.

The BEM Team will use sandbags, hay bales and siltation fencing readily available to construction berms around the excavations when the need arises to control rain water entering the excavation in order to accomplish the goals of the RAWP.

Site water will be managed through a bypass system. Pumps will be implemented in the case of a storm event as necessary. The bypass system will include construction of a berm upgradient of the work site with piping to remove water from the work area and continue stream flow downgradient. This should prevent accumulation of water into the excavation area since it is understood that the drainage ditch is a losing reach in this area, meaning surface water contributes to groundwater. The design details of the bypass pumping system are included in the RAWP, and specifically Figures 4A and 5A.

5.4 EQUIPMENT DECONTAMINATION

All non-dedicated reusable equipment that can potentially contaminate samples must be decontaminated before it can be used. This includes but is not limited to: excavation machinery, non-dedicated groundwater injection and sampling equipment, and bypass pumping equipment.

All equipment entering the site for the first time will have been decontaminated prior to mobilization.

All downhole equipment or excavation machinery will be steam cleaned prior to each use at a new location, as necessary during operations based on the determination of the site manager, and prior to final demobilization.

Equipment decontamination will be performed in the designated decontamination area on a prepared pad as specified in the site layout plans. All decontamination water will be containerized in properly labeled 55-gallon DOT drums and staged on site pending disposal.

The following process will be used for decontaminating hand-held equipment:

1. Wearing nitrile gloves, remove any large debris from the equipment (e.g., clumps of mud). Inspect the equipment for damage. Disassemble the piece of equipment if it has multiple components.
2. Wash and scrub the equipment in a detergent solution such as Alconox or Liquinox and water. Take care to clean all crevices and other areas that can trap and hold material.
3. Rinse the equipment with distilled water.
4. Allow the equipment to dry. Reassemble if necessary. Reuse immediately or wrap in foil or seal in plastic baggie for storage until next usage.

5.5 SURVEYING

The BEM Team will conduct surveying of the excavation extent and direct push locations using a hand-held GPS device prior to and following soil removal and injection activities at Sites 3 and 6. The planned excavation extents are provided in the RAWP, Section 3.3, as well as Figures 4 and 5. Survey coordinates will be reported in the New York State Plane NAD83 coordinate system. The post-excavation and post injection location survey results will be included on figures within the Sites 3 and 6 Soil Remedial Action Closure Report (RACR).

5.6 WASTE HANDLING

All excavated soils, investigation derived waste, containerized wastes, purge water, and decontamination water requiring off-site disposal will be handled in accordance with the specifications in detailed in Section 7.0 (Waste Management Plan).

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6.0 ENVIRONMENTAL SAMPLING

6.1 SOIL SAMPLING

During the performance of the activities detailed in the RAWP, soil samples will be collected for confirmation of completion of removal actions. All soil sampling will be performed using dedicated disposable hand sampling tools. The following sections detail the specific sampling procedures used for soil sampling based on the purpose of the sample and type of analysis.

6.1.1 Post-Excavation Confirmation Samples

All post-excavation soil samples collected for CVOC analysis will be collected using EnCore® dedicated disposable sampling devices recommended by ANG guidance. The following procedures will be used to collect all post-excavation soil samples:

1. Select location of sample collection points.
2. Clear loose soil away from surface with straight edge of dedicated disposable sampling spoon/trowel to gently remove approximately 4-inches of surface and create a shallow depression in the natural soil of the sidewall or base of the excavation.
3. Remove a new encore sampler from the sealed shipping package (carefully so as not to break the resealable ziplock bag)
4. Hold coring body and push plunger rod down until small o-ring rests against tabs. This will assure that plunger moves freely.
5. Depress locking lever on En Core T-Handle. Place coring body, plunger end first, into open end of T-Handle, *aligning the (2) slots on the coring body with the (2) locking pins in the T-Handle*. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.
6. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle viewing hole. Remove Sampler from soil. Wipe excess soil from coring body exterior.
7. Cap coring body while it is still on T-handle. Push cap over flat area of ridge. Push and twist cap to lock arm in place. Cap must be seated to seal sampler.
8. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.
9. Complete Sample Identification Label on sampler bag
10. Attach completed label (from En Core Sampler bag) to cap on coring body.
11. Return Sampler to zipper bag. Seal bag and place in ice filled cooler for shipment to laboratory.
12. Record Sample identification on chain-of-custody.
13. Place labeled pin flag in sample location for subsequent survey.

For single point grab samples, one (1) EnCore® sample will be collected. Samples will be biased towards any observed contamination or photoionization detector (PID) readings detected in the soil.

6.2 GROUNDWATER SAMPLING

As prescribed in the ROD, the primary remedy for the treatment of CVOC impacted groundwater at Site 6 is ISCO utilizing sodium permanganate.

Injection of sodium permanganate into the soils will be accomplished through the infusion gallery network (see Figures 2 and 3 of the RAWP) and direct push points around 6MW-20 and 6MW-21 (see Figure 6 of the RAWP). Groundwater sampling will be performed in 11 existing groundwater monitoring wells to monitor the performance of the remedial measure for continued application of permanganate, as well as quantify the rates of groundwater contaminant reduction. All groundwater samples will be collected using the low-flow sampling technique that is the preferred method per ANG guidance. Groundwater samples will be analyzed for CVOCs and chloride (a natural attenuation parameter). Post-injection (performance monitoring) sampling which is taken after each injection will include the collection of [TAL] metals from wells 6MW-19, 6MW-21 and 6MW-22 only. Groundwater samples will be collected from 11 monitoring wells at Site 6 three months after each injection event (see Figure 7 of the RAWP). If the results of the groundwater samples indicate that CVOCs persist above the Ambient Groundwater Quality Standards (AGWQS) additional injections of permanganate will be performed. If post-injection sampling results indicate a reduction of CVOCs below the AGWQS, an additional four quarterly rounds of samples will be collected. If the five consecutive groundwater sampling results are all below the AGWQS, closure of Site 6 will be requested.

6.2.1 Low Flow Groundwater Sampling Procedures

Monitoring wells will be sampled using low flow techniques. The techniques employed will conform to the guidance established in the EPA Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures (Barcelona and Puls, 1996) and American Society for Testing and Materials (ASTM) Standard D6771-02. Personnel collecting groundwater samples will be familiar with and have access to both guidance documents.

Groundwater samples will be collected using the following equipment:

- A peristaltic pump with disposable polyethylene sample tubing;
- A power source for the pump;
- A YSI-6920 water quality meter with probes for measuring temperature, pH, dissolved oxygen (DO), specific conductivity, oxidation reduction potential (ORP), and turbidity; and
- A water level indicator for measuring the depth to water and total well depth.

Water quality meters will be calibrated in accordance with the manufacturers' instructions on a daily basis prior to the start of sampling activities. Additional calibration checks/calibration will be performed during the course of sampling if there is reason to suspect that instrument readings are not accurate.

Equipment that will come in contact with groundwater (water level indicator) will be decontaminated prior to sampling. Equipment will be decontaminated following sample

collection. Disposable tubing will be used in order to prevent cross-contamination. The procedure for collecting low flow groundwater samples are as follows:

1. Nitrile gloves will be worn while sampling.
2. Determine the well location. Record the following information on a Monitoring Well Sample Collection Form.
    a. Project and location
    b. Date
    c. Sampler name
    d. Well ID
    e. Weather
    f. Sampling equipment models
    g. Casing diameter
3. Using the water level indicator determine the initial depth to water (DTW) in the well and the total depth of the well. If the water level is rising or falling allow it to equilibrate. Record the initial DTW and the total well depth on the Monitoring Well Sample Collection Form.
4. Insert disposable tubing down the well to approximately 6 inches from the bottom.
5. Connect disposable tubing to the pump and connect the pump to its power source.
6. Connect the disposable tubing from the pump to the inlet port on the lower portion of the flow cell of the water quality meter. Attach a length of tubing to the discharge port at the top of the flow cell so that water will be discharged into a bucket.
7. Turn on the peristaltic pump and adjust the flow rate while monitoring the water level. Follow the recommendations for flow adjustment in the manual supplied with the pump.
    a. If the water level has stabilized at a flow rate between 0.050-liters per minute (Lpm) and 0.500-Lpm, begin taking readings with the water quality meter. Readings should be collected at 5 minute intervals. The time of reading, depth to water, volume purged, flow rate, temperature, pH, DO, specific conductivity, ORP, and turbidity shall be recorded on the Monitoring Well Sample Collection Form for each reading as well as any observations as to the clarity, odor, or other characteristics of the groundwater. Wells should be purged until the monitoring parameters have stabilized. Stabilization criteria for the monitoring parameters are presented in Table 6-1.
    b. If the water level will not stabilize at a flow rate above 0.050-Lpm, the well will be pumped dry, allowed to recharge, then sampled with a bailer.

8. The sample can be collected once stabilization has been achieved or after 1 hour of low-flow purging. In order to collect the sample, disconnect the water tubing from the inlet port of the water quality meter. Water that has passed through the flow cell must not be sampled. Fill sample bottles at the same flow rate at which the well was purged. Samples shall be placed on ice as soon as they are collected. Sample information shall be recorded on a chain of custody form.

9. Decontaminate equipment as necessary according to the procedures in Section 6.2.2 and dispose of used tubing and personal protective equipment (PPE).

Table 6-1
Groundwater Sampling Stabilization Parameters

Parameter	Units	Stabilization Criteria
Temperature	^{o}C	+/- 0.50
pH	pH	+/- 0.10
Dissolved Oxygen	mg/L	10%
Specific Conductivity	uS/cm	2%
Oxidation-Reduction Potential	mV	+/- 10
Turbidity	Nephelometric Turbidity Unit (NTU)	+/- 10

Note: Parameters are considered stabilized when they fall within the specified ranges for 3 consecutive readings

6.2.2 Groundwater Sampling Equipment Decontamination

All equipment that can potentially contaminate a groundwater sample must be decontaminated before it can be used. Equipment that may potentially contaminate a sample includes: pumps, water level indicators, and water quality meters. All groundwater sampling equipment should be washed and scrubbed in a detergent solution such as Alconox or Liquinox and water and rinsed with distilled water. The procedure for decontaminating groundwater sampling equipment varies greatly with the type of equipment in question. The specific procedures are outlined below.

The procedure for decontaminating a water level indicator is as follows:

1. Wearing a pair of nitrile gloves, layer several paper towels on top of one another. Apply detergent solution to one half of the face of the towels and distilled water to the other.
2. Fold the moistened towel around the tape of the water level indicator so that the portion saturated with distilled water is nearest to you.
3. Reel in the tape of the water quality meter.
4. When the tape has been completely reeled in scrub and rinse the probe.

The procedure for decontaminating a water quality meter is as follows:

1. Disconnect the flow through cell from the unit containing the probes.
2. Wash the flow through cell with detergent solution and rinse with distilled water.
3. Thoroughly rinse the probes with distilled water. The probes should be immersed in tap water for storage (Type II water should not be used as it is deficient in minerals).

6.3 FIELD QUALITY CONTROL

6.3.1 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent grade water poured into, over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. The frequency of collection for equipment blanks is specified in Section 3.2. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

6.3.2 Trip Blank

The trip blank consists of a volatile organic compound (VOC) sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

6.3.3 Ambient Blank

The ambient blank consists of ASTM Type II reagent grade water poured into a VOC sample vial at the sampling site. It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOCs. The frequency of collection for ambient blanks is specified in Section 3.2.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection. Ambient blanks shall be collected downwind of possible VOC sources. The frequency of collection for ambient blanks is specified in Section 3.2.

6.3.4 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest. The frequency of collection for field duplicates is specified in Section 3.2.

6.4 SAMPLE HANDLING

All aspects of sample handling for this project are described below. Refer to Table 3.2-1 for a summary of the sample analysis to be performed.

6.4.1 Sample Containers

Sample containers are supplied by the analytical laboratory precleaned and treated according to EPA specifications for the methods. Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants.

6.4.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on samples are listed in Table 6.5.2-1. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times are specified in Table 6.5.2-1. Samples not preserved or analyzed in accordance with these requirements shall be resampled and analyzed.

6.4.3 Sample Identification

All samples will be given a unique identifier. The date and time of sampling will be listed on the sample container. The date, time, and sample identifier will be recorded on the groundwater sample collection form for water samples, the borehole log for soil samples and in the logbook.

6.4.3.1 Soil Sample Identification

Soil samples will have a two-part identifier. The first component will be the site location identifier (e.g., 03S or 06S). The second component of a soil sample identifier will consist of an S to indicate a soil sample and a two-digit number indicating the top or upper depth of the sample collected. No punctuation marks will be used for the sample numbers. Soil samples will be labeled in the form PE### for post excavation samples.

6.4.3.2 Groundwater Sample Identification

Water samples from monitoring wells will have a two-part identifier. The first component will be the site location identifier (e.g. 03MW or 06MW). The second portion of a groundwater sample identifier will consist of a MW to indicate that it is groundwater sample taken from a monitoring well, and the depth to the top of the screened interval.

The second portion of a groundwater sample identifier for a monitoring well will indicate the date on which the sample was collected. The date identifier will be in the form mmddyy and contain no punctuation. A groundwater sample collected from monitoring well 06MW-21 on March 10, 2012 will be identified as 06MW2131012.

Table 6.5.2-1
Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container	Preservation[a]	Minimum Sample Volume or Weight	Maximum Holding Time
CVOCs	Water - SW846 8260B Soil – SW846 8260B	Water - Teflon®-lined septum vial Soil - EnCore™ sampler	Water - 4°C, HCl to pH < 2 Soil - EnCore™ sampler	Water - 2 x 40 mL or 4 ounces Soil - 5 g (EnCore™)	Water - 14 days; 7 days if unpreserved by acid Soil - 2 days to lab, 14 days to analysis
Chloride	Water-SW846 9056	Water-Polyethylene or glass	Water-4°C	Water-200 mL	Water-28 days
Xylene	Soil- SW846 8260B	Soil - EnCore™ sampler	Soil - EnCore™ sampler	Soil - 5 g (EnCore™)	Soil – 2 days to lab, 14 days to analysis
Metals	Water-SW846 6010B	Water-1 x 100 mL high-density polyethylene	Water- HNO_3 to pH <2, 4 °C	Water-50 mL	Water-180 days for all elements except mercury, which is 28 days
RCRA 8 Metals (Sodium and Manganese)	Soil – SW846 6010B/7471A	Soil – 1 x 4 oz soil jar	Soil – 4 °C	Soil -10 g	Soil – 180 days for all elements except mercury, which is 28 days
Diesel Range Organics [1]	Soil - SW846 8015B	Soil – 1 x 4 or 8 oz soil jar	Soil: 4 °C	Soil- 50g	Soil- 14 days to extraction, 40 days to analysis.
Semivolatile Organic Compounds	Soil - SW846 8270C	Soil – 1 x 4 or 8 oz soil jar	Soil: 4 °C	Soil - 50g	Soil – 14 days to extraction, 40 days to analysis.
Gasoline Range Organics [2]	Soil - SW846 8015B	Soil – 1 x 2 oz septa soil jar	Soil – 4 °C	Soil – 10g	Soil – 14 days

a. No pH adjustment for soil.
[1]Site 3only
[2] Site 6 only

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6.4.3.3 Quality Control Sample Identification

Field duplicates will be blind duplicates. A matrix spike will be indicated by adding "MS" to the end of the sample identifier. Likewise, a matrix spike duplicate will be indicated by adding "MSD" to the end of the sample identifier. No punctuation marks will be used for the sample numbers.

QA/QC samples corresponding to the soil samples cited in the Soil Sample Identification section above will have the following formats:

- Field Duplicate: S3-PE05;
- Matrix Spike: S3-PE01MS; S3-PE04MS
- Matrix Spike Duplicate: S3-PE01MSD S3-PE04MSD

QA/QC samples corresponding to the groundwater samples cited in the Groundwater Sample Identification section above will have the following formats:

- Field Duplicate: 06MW2831012;
- Matrix Spike: 06MW1131012MS; 06MW2731012DMS
- Matrix Spike Duplicate: 06MW1131012MSD; 06MW2731012DMSD

6.4.3.4 Equipment Blank Identification

Equipment blanks will have a two-part identifier. The letters EB will indicate that the sample is an equipment blank. The second part of the identifier indicates the sample date. The sampling date identifier consists of the sampling date in the form mmddyy. No punctuation marks will be used for the sample numbers. An equipment blank collected on October 17, 2012 will be identified as EB101712.

6.4.3.5 Trip Blank Identification

Trip blank identifiers will consist of three parts: the letters TB to indicate that the sample container is a trip blank; a date identifier; and a shipping container indicator. A trip blank must be included with any cooler containing samples intended for VOC analysis. The date identifier is the date in the form mmddyy. No punctuation marks will be used for the sample numbers. If more than one cooler is being sent for VOC analysis in a single day, the sampler will include their initials at the end of the trip blank identifier. For a cooler containing samples intended for VOC analysis that were sampled on December 19, 2012, the trip blank identifier will be TB121912. If two coolers were collected that day for VOC analysis, by John Doe and Mary Buck, the trip blank identifiers will be TB121912JD and TB121912MB

6.4.3.6 Ambient Blank Identification

Ambient blank identifiers will consist of two parts: the letters AB to indicate that the sample container is an ambient blank and a date indicator. The date indicator is in the form mmddyy. No punctuation marks will be used for the sample numbers. An ambient blank used during the course of sampling on April 20, 2012 will be identified as AB042012.

6.4.4 Sample Preservation, Packing, and Shipping

In order to ensure the integrity of samples transferred to the analytical laboratory all samples will be shipped in coolers. Coolers should only contain samples from one matrix; therefore, soil and groundwater samples will be shipped in separate coolers. Packing materials such as foam blocks (for volatile organic analysis [VOA] bottles) and bubble wrap should be utilized to minimize the potential for damage of samples during transit. All coolers will contain an adequate amount of ice to maintain samples at the temperature specified by the analytical laboratory. Temperature blanks will be placed in coolers to ensure samples are received at an appropriate temperature for analysis. Coolers containing samples intended for VOA will include a trip blank.

A chain of custody (CoC) form will be completed for each cooler as described in Section 6.6.1 (Field Custody Procedures). The BEM Team will retain a record of the completed CoC. The remaining copies will be placed in a watertight plastic bag and packaged inside the cooler. The cooler will then be secured with signed and dated custody seals and packing tape. At this time the samples shall be ready for delivery to the laboratory's courier or an approved shipping company (e.g., Fed Ex). If samples are to be shipped by Fed Ex they shall be insured at a value sufficient to cover the cost of re-sampling should they be lost or corrupted in transit.

6.5 SAMPLE CUSTODY

During field sampling activities, traceability of the samples must be maintained from the time that the samples are generated until laboratory data are issued. Information concerning collection of the samples will be recorded in the field notebook and sample log. Information on the custody, transfer, handling, and shipping of samples will be recorded on the CoC forms.

6.5.1 Field Custody Procedures

In order to ensure the integrity of samples in transit the following procedure shall be followed:

1. All samples should be clearly labeled according to the methods outlined in Section 6.4.3. The date and time of sampling should be recorded on the sample collection form or borehole log, the CoC, and in the logbook.
2. The number of containers for each sample being shipped in a cooler shall be recorded on the CoC.
3. The analyses requested for each sample shall be recorded on the CoC.
4. The project name, project manager, sampler name, and state of origin shall be recorded on the CoC.
5. The date and time of the transfer of custody shall be recorded on the CoC, as should the name of the BEM Team employee relinquishing custody and the laboratory employee assuming custody. In the event that the samples are shipped via Fed Ex, the name of the laboratory employee will be replaced by "Fed Ex."
6. When the cooler has been packed in accordance with the methods described in Section 6.4.4 (Sample Preservation, Packing and Shipping), the CoC shall be placed in a water tight bag in the cooler and the cooler secured with signed, dated custody seals and packing tape.

6.5.2 Transfer of Custody and Shipment

The BEM Team personnel shall record the date and time at which they relinquished samples and their name on the CoC. The name of the laboratory representative assuming custody of the samples will also be recorded.

6.5.3 Laboratory Receipt and Entry of Samples

The BEM Team requires notification of receipt of samples from the analytical laboratory. If there are any discrepancies with the samples (e.g., analysis requests, sample temperature, etc.), the BEM Team shall be informed of them upon receipt of the samples by the laboratory.

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7.0 WASTE MANAGEMENT PLAN

7.1 WASTE MANAGEMENT PLAN PURPOSE AND OBJECTIVES

This Waste Management Plan was developed to ensure that investigation derived wastes (IDW) generated during the Field program at the SANGB are managed in accordance to the *ANG Investigation and Remediation Derived Waste Management Policy* dated March 2005.

SANGB operates under generator status pursuant to 40 CFR 262. As such this plan was developed to assure that IDW will be disposed of within 90 days of generation. The objectives of this plan are to provide the SANGB an operation that includes sample consolidation, sample analysis, waste characterization/profiling, waste inventory control, waste minimization, and appropriate disposal of all wastes within 90 days of generation. Generation is defined as the date the material is containerized.

7.1.1 Schenectady ANG Waste Management Practices

SANGB environmental management officials and other operational supervisors implement appropriate waste management practices. This is accomplished through close attention to the details of their waste management plans. A key component of the plan is to focus on timely disposal. Drums and other containers of waste are identified by markings and storage logs when on Base, and should be disposed of in the prescribed manner as soon as possible (i.e., within a 90 day period for hazardous waste, and at the completion of field sampling or sooner for all other). If questions regarding waste management are not addressed in this plan, they should be directed to the Base Environmental Manager.

7.1.2 Regulatory Considerations

The following State and Federal regulations and guidance documents were examined to identify applicable hazardous waste and/or special waste classification criteria, and other relevant waste characterization information.

- EPA/9345.3-03FS: EPA, 1992, Guide to Management of Investigation-Derived Wastes.
- 40 CFR 262.11: Hazardous Waste Determination (New York Solid and Hazardous Waste Management Laws New York Conservation Law Section, Environmental Conservation Law, Title 6 of the New York Compilation of Rule and Regulations (6 NYCRR), Part 372)
- 40 CFR 261.2: Identification and Listing of Hazardous Waste. (6 NYCRR Part 371)
- 40 CFR 280.62(a)(4): Guidance for contaminated soil generated during an investigation.
- DER-10, Technical Guidance for Site Investigation and Remediation, NYSDEC, May 2010.

7.1.3 IDW Management Plan Outline

IDW is generated as leftover material such as soil cuttings, well development water, purge water, decontamination fluids, and used personal protection equipment.

The following outlines the steps to be used in handling IDW at SANGB:

1. Liquids (e.g., well development water, drilling fluids) and solids (soils) are separated at the generation point. Purged groundwater will be dumped into a sump on-site.
2. IDW is temporarily containerized for transport and labeled as to its type and origin. Containers will include:
   - Fluid storage vessels,
   - Roll-off bins,
   - Drums, and
   - Various other storage devices.
3. Containers are removed from the worksite at the completion of the day's activities. No IDW is stored at the worksite overnight.
4. Containers are transferred to a central storage area designated by SANGB where IDW is placed in the appropriate bulk storage container. Temporary containers will be relabeled and reused for IDW storage.
5. Bulk containers will be sampled and tested as required by the disposal facility to determine disposal method.
6. If solid IDW is classified as hazardous it shall be disposed of within 90 days of generation.
7. Water will be managed through a bypass system with pumping as necessary which will include construction of a berm upgradient of the work site where surface water can be diverted through a pipe to downstream of the work area.

7.2 GENERAL IDW MANAGEMENT PLAN

This waste management plan governs the disposal of all liquid and solid waste materials generated during the course of the proposed field activities of this program.

7.2.1 Types of Waste Anticipated

The proposed field activities of this program will generate both liquid and solid IDW. The wastes that will be encountered are:

- Soil removed during excavation,
- Purge water,
- Decontamination water, and
- Used PPE.

7.3 WASTE MINIMIZATION

Waste minimization is a key component of the waste management plan. The following measures will be implemented to minimize waste generation.

7.3.1 Avoiding Unnecessary Contamination

The sampling areas will be secured, and only necessary equipment items will contact potentially contaminated media.

7.3.2 Reusable Materials

Reusable materials will be utilized whenever it is possible and appropriate. Examples of reusable materials include sampling equipment that can be decontaminated and used again, drums that can be emptied and decontaminated for future use, and reusable PPE.

7.3.3 Volume Reduction

Visible material will be scraped and brushed off of large equipment prior to decontamination. Hot spray washing will be used to minimize the quantity of water required.

7.4 HANDLING AND CONTAINERIZATION

All IDW will be placed into labeled containers and transported to the central staging area for bulk storage.

7.4.1 Waste Container Designation

Soil removed during excavation activities will be stockpiled on-site or stockpiled into labeled roll-offs for temporary storage and transport. Roll-offs will be located in the staging area while awaiting off-site disposal. Purged groundwater will be dumped into a sump on-site. Water will not be discharged onto the ground during drilling or development activities. All water, including groundwater, removed from excavations and runoff from the stockpile will be containerized.

Water generated from the decontamination of excavation equipment, sampling equipment, and personnel will be collected in labeled temporary storage containers for transport to the bulk storage area.

Used PPE generated during the field activities will be collected in plastic garbage bags.

7.4.2 Labeling of Waste Containers

All containers being used for temporary storage and transport of IDW must have a label. The label should include the following information:

- A sequential or site specific container number;
- Location. This should include the site name and boring or well number;
- Date that the IDW was generated;
- Contents of container. If soil cuttings are being stored in the container the depth at which they were generated must be included;
- Field Personnel's name; and
- Base contact and phone number.

7.4.3 Transporting Containers

Sealed, labeled containers will be transported to the temporary storage area on a daily basis, as practical. Containers will be emptied into the appropriate bulk storage unit and entered into a logbook. Prior to transporting excavation material offsite soil will be stockpiled on site for at least three days for drying.

7.5 TEMPORARY STORAGE LOCATIONS

SANGB will designate a centralized storage area for IDW generated during field activities. The storage location must to be secure and properly managed. Relevant objectives for the centralized storage are as follows:

- Assure that SANGB waste management requirements are met;
- Avoid inclusion of other contractors' waste from previous activities at the Base;
- Ensure that SANGB and the contractor can accurately and easily identify wastes for disposal, sampling, and matching with test results;
- Preventing unauthorized handling or distribution of the waste, including removal for use by others;
- Bulk soils stored in the centralized storage area will be subject to the following additional requirements:
    - The location chosen for bulk soil storage must be conducive to storm water drainage; and
    - A water resistant cover must be affixed to the bulk roll-off bin. This cover should be constructed of a rigid material that allows rainwater to easily drain off of the bin and to the ground surface. If it is necessary to utilize a non-rigid material for the cover a support system must be developed that will eliminate sagging and puddle formation and allow for proper drainage.
- A daily inspection will be made of the temporary storage area to ensure that wastes are secure. A part of this inspection will be to check the bulk soil storage container for visible moisture. If liquid is visible in the roll-off box it will be solidified with fly ash or other inert material to prevent liquid build-up.

7.6 WASTE CHARACTERIZATION

Prior to disposal it must be demonstrated that the characteristics of the IDW meet chemical and physical requirements for the disposal selected. This waste characterization can be expedited through the proper management of the IDW in the field. SANGB must keep records of any test results, waste analyses, or waste sent off-site for treatment, storage, or disposal. The BEM Team will collect waste samples and will be responsible for final disposal and will provide all necessary waste manifests to the Base Environmental Manager.

Excavated soil from Sites 3 and 6 will undergo additional analyses in order to determine if the soil can be treated. Site 3 soils will be analyzed for RCRA 8 Metals, EPA Methods SW846 8015 DRO. In addition, Site 6 soils will be analyzed for EPA Methods SW846 8260, 8270, RCRA 8 Metals, and 8015 DRO/GRO.

7.6.1 Excavated Soils

Soils that have been determined to be "industrial" wastes will be containerized in the field and sent to the bulk temporary storage area where they will be dumped into the roll-off bin for off-site disposal. If liquid is visible in the bucket of soil before deposition in the bulk container it should be decanted or otherwise transferred to a separate container for inclusion with the bulk

liquid storage. It is important to avoid build-up of liquid in the bulk soil container (see Section 7.5 on Temporary Storage Locations).

Bulk soils will be sent to an approved waste handling facility for disposal. As described in the RAWP, excavated soil will be disposed of by sample collection and analysis as required by the treatment facility and also by utilizing the approved waste characterization profiles from the October 2011 DGI field activity as permitted by the waste disposal facility. During the DGI activities, Sites 3 and 6 soils were characterized by collection of 1 grab sample from a boring at each of the sites. The Site 3 waste characterization sample was collected from S3-DB01 (original CREEK-Bank-B sample location). The Site 6 waste characterization sample was collected from S6-DB02. This sample frequency was determined by the receiving landfill characterization and disposal requirements of 1 grab sample per 1,000 CY. The waste characterization samples were collected and analyzed for full TCLP analysis, TCL PCBs analysis, and RCRA parameters. The TCLP analysis and some of the RCRA parameters were performed by Test America, Inc. laboratories in Pittsburgh, Pennsylvania, while the balance of the parameters were performed by Test America in Burlington, Vermont (NYSDEC 2012).

In order to thermally treat the excavated soils, additional samples will be collected and analyzed prior to disposal. Site 3 soils will be analyzed for RCRA 8 Metals, EPA Methods SW846 8015 DRO. In addition, Site 6 soils will be analyzed for EPA Methods SW846 8260, 8270, RCRA 8 Metals, and 8015 DRO/GRO. Site 3 soils will be transported under manifest by OP-TECH to ESMI in Fort Edward, New York. If NYSDEC approves the contained-in ruling for thermal treatment of Site 6 soil, the excavated soil will also be treated at ESMI's facility. The samples will be submitted to Test America, Inc., a laboratory that is both approved by the DoD and the NYSDOH ELAP, for analysis.

7.6.2 Site Water Management

Surface water within the stream will be managed through a bypass pumping system which will include construction of a berm upgradient of the work site where surface water can be diverted to downstream of the work area. This should prevent accumulation of water into the excavation area since it is understood that the drainage ditch is a losing reach in this area, meaning surface water contributes to groundwater. Site water from monitoring well development, dewatering and stockpile runoff will be containerized and/or put into the circulation sump on-site. Well purge water will be dumped into the circulation sump on-site.

7.6.3 Decontamination Fluids

Water generated through decontamination will be treated of in the same manner as well purge water as described in Section 7.6.2. Decontamination fluids will be bulked with other IDW water.

7.6.4 PPE

Used PPE will be bagged in plastic and disposed of in a domestic refuse receptacle.

7.6.5 Disposable Sampling Equipment and Decontamination Pad

These materials will be rinsed with clean water and disposed of with the bulk "industrial" waste soils.

7.7 IDW DISPOSAL

7.7.1 Non-hazardous IDW

The IDW generated during field activities is not expected to require management as hazardous waste. It is expected that the IDW will not contain a listed waste pursuant to 40 CFR 261, Subpart D, and will not exhibit characteristics (Ignitability, Corrosivity, Reactivity, Toxicity) of a hazardous waste pursuant to 40 CFR 261, Subpart C. All wastes will be bulked and disposed of as follows:

- Bulked soils will be tested for compliance as non-hazardous “industrial” wastes by the subcontracted hauler/disposer and disposed of off-site. The BEM Team will collect IDW samples. Analysis and disposal of the samples will be the responsibility of the ANG.
- Water in bulk storage will either be reintroduced into the sump located on Site 6 or disposed of off-site.
- PPE will be disposed of off-site.

7.7.2 Manifesting and Record Keeping

The last component of the on-site management of the IDW is preparation for off-site disposal. This preparation is completed through the waste profile and waste manifest process.

All materials to be shipped off site must have a completed waste profile form. This includes bulk (non-hazardous) materials. Waste profile forms can be obtained from the transporter or receiving facility. In addition, all materials to be shipped off site will be accompanied by a waste manifest. These manifest forms can be obtained from the transporter or receiving facility and will be used for bulked materials.

All waste manifests must be completed and submitted to the Environmental Management Office, along with the appropriate analysis, at least 72 hours prior to disposal. Unless otherwise determined by SANGB, Kim Kotkoskie or David Guest from the Environmental Management Office will be the signature on the waste manifest. The waste manifests must be obtained from the consignment (receiving) state, or the generator (source) state.

SANGB (the generator) must have a sufficient number of copies of the manifest for the generator, each transporter, the owner or operator of the designated treatment, storage, or disposal facility, and a copy to be returned to the generator by the designated facility. The manifest must be signed by hand by one of the above persons and the transporter’s representative upon delivery to the transporter. SANGB retains one copy; the rest of the copies are given to the transporter. SANGB will also keep the returned copy from the designated facility for its files and is required to keep them for three years.

Within 45 days of shipment, SANGB must receive a copy of the signed manifest from the designated facility. To ensure that this 45-day deadline is met, SANGB is to notify the

contractor if they have not received a copy of the signed manifest from the owner or operator of the designated facility within 35 days of delivery to the initial transporter. The contractor must then contact the transporter and/or the designated facility and attempt to locate the manifest. If the signed manifest cannot be located or SANGB does not receive the signed manifest copy within 45 days an exception report will be filed with the EPA. The report must include the following:

- A legible copy of the manifest for which the confirmation of delivery is missing; and
- A cover letter signed by one of the above SANGB representatives explaining efforts to locate the hazardous waste and the results of those efforts.

This exception report must be maintained for three years.

8.0 PROJECT DOCUMENTATION

8.1 PROJECT LOGBOOK

Field data collection activities will be documented in a logbook as described in the QAPP. Entries will be described at a level of detail such that situations can be reconstructed by all parties without the aid of memory. All logbooks will be kept in the project files. Project files will be turned over to the client if requested at the completion of the project contract.

A variety of activities will be recorded in the logbook. The information to be documented shall include:

- Project identification;
- Field activity subject;
- General work activity;
- Personnel on site identified by company or affiliation;
- Weather conditions;
- Time and topics of tailgate safety meetings;
- Unusual events;
- Visitors on site;
- Subcontractor progress or problems;
- Communication with the co-workers, laboratory, client or others;
- All sample numbers, collection times, sample amount, analysis, CoC numbers;
- Accomplishment of required calibration and calibration checks;
- Disposition of decontamination fluids;
- Variances from project plans and procedures;
- Photographs taken and identification numbers; and
- Air monitoring readings, as appropriate.

8.2 FIELD FORMS

A variety of forms will be used to document field activities. Forms to be used on this project are:

- Equipment calibration forms;
- Decon records;
- Groundwater level forms;
- Monitor well sample collection forms; and
- Chain-of-Custody forms.

Each completed form (a copy of original depending on the type of form) will be kept on site in chronological order with other completed forms of the same type until the field activity is completed. Copies of completed forms will be sent to the Project Manager. Upon completion of the field investigation, all original field records will be transferred to the project files. Working

copies of all forms will be retained by project personnel for data evaluation and report preparation as necessary.

8.3 PHOTOGRAPHS

All photographs will include documentation of the date and time at which they were taken as well as a brief description of the subject matter. This information will be recorded in the field notebook.

9.0 REFERENCES

40 CFR 262.11: Hazardous Waste Determination (New York Solid and Hazardous Waste Management Laws New York Conservation Law Section, Environmental Conservation Law, Title 6 of the New York Compilation of Rule and Regulations (6 NYCRR), Part 372)

40 CFR 261.2: Identification and Listing of Hazardous Waste. (6 NYCRR Part 371)

40 CFR 280.62(a)(4): Guidance for contaminated soil generated during an investigation.

NYSDEC 2012. Data Gap Investigation Technical Memorandum for Sites 3 and 6 for the 109th Airlift Wing, Schenectady Air National Guard Base (SANGB), Scotia, New York, February 2012.

NYSDEC 2012. DER-10. Technical Guidance for Site Investigation and Remediation. May 3, 2010.

United States Environmental Protection Agency (EPA), 2010. Low stress (low flow) purging and sampling procedure for the collection of groundwater samples from monitoring wells. U.S. Environmental Protection Agency Region 1. North Chelmsford, Massachusetts.

EPA 1996. Standard Operating Procedure No. 2042. Soil Gas Sampling. USEPA Environmental Response Team, Edison, New Jersey. http://epa.gov/neerqa/qa/qa_docs.html.

EPA, 1992. EPA/9345.3-03FS:, Guide to Management of Investigation-Derived Wastes.

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Figure

LEGEND

- TURBIDITY READINGS
- MONITORING WELL
- INFUSION WELL
- PROPOSED COLLECTION SUMP
- PROPOSED INJECTION DIRECT PUSH LOCATIONS
- INFUSION WELL
- HORIZONTAL INFUSION WELL
- AIR NATIONAL GUARD FACILITIES BOUNDARIES
- PROPOSED GEOMEMBRANE
- SITE 6
- SITE 3
- PROPOSED SITE 3 SOIL EXCAVATION AREA
- PROPOSED SITE 6 SOIL EXCAVATION AREA
- CHEMICAL STORAGE
- DECON AREA
- STAGING AREA
- STOCKPILE AREA
- WORK ZONE

0 50 100 FEET

DATA SOURCES:
AERIAL: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
ROADS: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
DESIGN: EARTH TECH / AECOM (2008)

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

FIELD SAMPLING PLAN

FIGURE: 1
SITE PLAN

PROJECT No.:
07-ANG21CNEF

DATE:
APRIL 2013

THIS MAP AND ALL INFORMATION CONTAINED HEREIN IS AUTHORIZED FOR USE BY OUR CLIENT AND CLIENT-DESIGNATED PARTIES. ONCE REPRODUCED THE ACCURACY OF THIS DRAWING CANNOT BE VERIFIED.

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Appendix B.
Quality Assurance Project Plan

FINAL
QUALITY ASSURANCE PROJECT PLAN

New York Air National Guard
Schenectady Air National Guard Base
1 Air National Guard Road
Scotia, New York 12302

Prepared for:

Air National Guard Headquarters
3500 Fetchet Avenue
Andrews Air Force Base, Maryland 20762-5157

Prepared by:

BEM Systems, Inc.
100 Passaic Avenue
Chatham, New Jersey 07928

April 2013

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LIST OF ATTACHMENTS

LIST OF ABBREVIATIONS AND ACRONYMS

ANG	Air National Guard
ASTM	American Society for Testing and Materials
ASP	Analytical Services Protocol
AGWQS	Ambient Groundwater Quality Standards
BEM	BEM Systems, Inc.
BEM Team	BEM / AECOM parternship
BS	Blank Spike
CFR	Code of Federal Regulations
CoC	Chain-of-Custody
CVOCs	Chlorinated Volatile Organic Compounds
CY	Cubic Yard
DCE	Dichloroethene
DoD	Department of Defense
DGI	Data Gap Investigation
DQO	Data Quality Objective
DVR	Data Validation Report
ELAP	Environmental Laboratory Approval Program
ESMI	Environmental Soil Management Company
FSP	Field Sampling Plan
IDL	Instrument Detection Limit
IRA	Interim Removal Action
ISCO	In-Situ Chemical Oxidation
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
mL	milliliter
mg/kg	milligram per kilogram
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NCR	Nonconformance Report
NYSDEC	New York State Department of Environmental Conservation
PARCC	Precision, Accuracy, Representativeness, Comparability and Completeness
PCE	Tetrachloroethylene
PE	Performance Evaluation
PID	photoionization detector
ppm	parts per million
PQL	Practical Quantitaion Limit
QA	Quality Assurance
QAO	Quality Assurance Officer

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remediation Investigation
RL	Reporting Limit
ROD	Record of Decision
RPD	Relative Percent Difference
RSCO	Recommended Soil Cleanup Objective
RSD	Relative Standard Deviation
SCGs	Standard, Criteria, and Guidance
SDC	Supplemental Data Collection
SOP	Standard Operating Procedure
TCE	Trichloroethene
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
°C	Degrees Celsius
HCl	Hydrochloric Acid
H_2SO_4	Sulfuric Acid
≤	Less than or equal to
≥	Greater than or equal to
±	Plus or minus
%R	Percent Recovery
%	Percent
SANG	Schenectady Air National Guard Base

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared by BEM Systems, Inc. (BEM) and AECOM together (BEM Team) according to the United States Environmental Protection Agency's (USEPA) guidance and requirements for preparing QAPPs (USEPA, 2000, USEPA, 2001) and the New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP, July 2005) for use in conjunction with the Remedial Action for Site 3 – Waste Drum Dump and Site 6 – Spill Area at Schenectady Air National Guard Base (SANGB) located at 1 Air National Guard Road, Scotia, Schenectady County, New York. This work is being performed under Contract Number W9133L-05-D-0007-0021.

This QAPP contains quality assurance/quality control (QA/QC) procedures necessary to ensure that analytical data collected in support of the remedial action at Sites 3 and 6 are planned and executed in a manner consistent with the projects' quality assurance objectives. The objective of the QAPP is to ensure the technical data generated during the remedial activities are of sufficient quality for making informed decisions regarding Base groundwater and soil quality. This QAPP is being prepared to support the Remedial Action for soil at Sites 3 and 6, and groundwater at Site 6.

FACILITY DESCRIPTION AND HISTORY

The Schenectady ANGB is located in the southeast portion of Schenectady County Airport in Scotia, New York. The Base covers an area of approximately 106 acres, located approximately 2 miles northeast of Scotia, NY. The land located to the north, east, and west of the Base is primarily residential and agricultural. South of the Base is the Mohawk River, a railway, and commercial and residential properties. Prior to the construction of the Base, the property was used for agricultural purposes.

SITE DESCRIPTION AND HISTORY

Site 3 (Drum Burial Area) is located near the former sewage treatment plant and sand filter. This area was identified when buried drums were discovered during construction activities. Site 6 (Suspected Spill Area) consists of an area of contaminated groundwater north of the former sewage treatment plant and sand filter. Site 3 covers an area of approximately 0.68 acres and is bounded to the south by the chain link fence, to the west by the chain link fence and extending approximately 250-ft to the east from the chain link fence, along the drainage ditch which bounds the north of Site 3. Site 6 covers an area of approximately 0.96 acres and is bounded by the drainage ditch to the west, to the east by Building 22, to the north by monitoring well 6MW-21, and to the south by monitoring well 6MW-20. During the 1999 Remedial Investigation (RI), Chlorinated Volatile Organic Compound (CVOCs) were detected in groundwater samples collected from monitoring wells upgradient of Site 3. The contamination was determined to be unrelated to historical activity at Site 3. Therefore, the area was designated as Site 6. The contamination associated with Site 6 consisted of a plume of dissolved phase CVOCs in the glacial soil aquifer as well as three areas with residual soil contamination in excess of the NYSDEC Standard, Criteria, and Guidance (SCGs).

In April of 2002, a Time Critical Removal Action was performed consisting of the excavation and off-site disposal of 173 cubic yards (CYs) of soil from the three areas of residual soil

contamination. Post-excavation soil sampling results reported no remaining contamination in two areas while one post-excavation sidewall sample collected from the third area contained tetrachloroethylene (PCE) at concentrations in excess of the SCGs.

A supplemental data collection (SDC) program for Site 6 was conducted in 2002 that consisted of monitoring well installation, collection and analysis of subsurface soil samples, and collection and analysis of groundwater samples. Results from the SDC indicated that CVOCs in excess of SCGs remained in the soils and that a dissolved-phase CVOC plume existed at Site 6. The SDC report recommended that further remedial measures be performed for Site 6 soils and groundwater.

Between May and September 2007, Interim Remedial Actions (IRAs) were completed at Site 3 and Site 6. The objectives of the IRAs were to remove and treat all unconsolidated material from both sites and to perform an in situ pilot test to evaluate the use of enhanced bioremediation to treat the chlorinated hydrocarbon plume at Site 6. The results of the bioremediation pilot test concluded that the pilot test was successful, but other means of remediating the groundwater contamination were available for consideration (AECOM, 2010).

A Data Gap Investigation (DGI) was conducted on 31 October 2011 to delineate soil impacted with exceeding concentrations of xylenes at Site 3 and soil impacted with exceeding concentrations of CVOCs at Site 6 that would require future excavation. Soil borings were advanced at each site using direct push technology. Site 3 delineation results indicated that soil samples obtained from three of the fourteen boring locations were reported above the NYSDEC Recommended Soil Cleanup Objective for Unrestricted Use (RSCO Unrestricted) level of 0.26 parts per million (ppm) or milligrams per kilogram (mg/Kg) for xylene in soil. Site 6 delineation results indicated that soil samples obtained from two of the five boring locations were reported above the NYSDEC RSCO Unrestricted level for multiple CVOCs in soil (BEM 2012).

PROJECT SCOPE AND OBJECTIVES

The Record of Decision (ROD) presents soil excavation at Site 3 and Site 6 and in-situ chemical oxidation (ISCO) at Site 6 as the applicable remedial alternatives. The following sections describe the major components of the selected remedial actions for soil and groundwater. Sections 3 and 4 provide further detail of the proposed remedial actions for soil and groundwater, respectively.

Site 3 Soils

Based upon the limits of excavation as defined by the Site 3 DGI, xylene impacted soils will be excavated and sent off-site for treatment at the Environmental Soil Management Companies (ESMI) facility in Fort Edward, New York. The anticipated limits of the Site 3 soil excavation cover a 1,500 ft^2 area southeast of the drainage ditch where all soil will be removed down to bedrock at approximately 9 ft bgs, resulting in the removal of 13,500 ft^3or 500 CY. Prior to treating the excavated soil, additional disposal samples will be collected and analyzed. Four post-excavation soil samples will be collected from Site 3 (Figure 4); two from along the fence line/property boundary to the southeast, and one from the southern corner of the excavation area. The fourth sample will be collected from the northeast portion of the excavation perimeter. These confirmation samples will be collected to ensure that the concentration of xylene potentially remaining in the soil is below NYSDEC RSCO Unrestricted level of 0.26 mg/Kg or

ppm. The excavation will be backfilled with virgin or certified material to pre-existing conditions. A geo-membrane will be installed along southern bank of drainage ditch, and then the area will be restored with topsoil and seeding to match the surrounding ground surface.

SITE 6 SOILS

Based upon the limits of excavation as defined by the Site 6 DGI (Figure 5), approximately 2,900 ft^3 or 110 CY of PCE impacted soils will be excavated and sent off-site for treatment or disposal as non-hazardous waste. Prior to soil treatment, additional samples will be collected for various total and disposal analyses. Based on the contaminant levels of CVOCs detected in the soil as part of the DGI, the soil may not be accepted for treatment at the ESMI facility in Fort Edward, NY unless NYSDEC approves a "contained in ruling" that the soil can be thermally treated by ESMI. If the soil cannot be treated, it will be sent off-site for disposal as non-hazardous waste to permitted facility Rapp Road Landfill in Albany, NY.

The anticipated limits of the Site 6 soil excavation cover a 10.5-ft by 64-ft area along the drainage ditch where all soil will be removed down to competent bedrock at an approximate depth of 4.5 ft bgs. Three post-excavation soil samples will be collected from Site 6 (Figure 5); one from the most southeast extent of the excavation (S6-PE02), one from along the northeast edge of the excavation area (S6-PE01), and one from the southern boundary of the excavation, along the drainage ditch (S6-PE03). These confirmation samples will be collected to ensure that the concentrations of CVOCs potentially remaining in the soil are below NYSDEC RSCO Unrestricted levels, specifically, below 0.47 mg/Kg trichloroethene (TCE), 1.3 mg/Kg PCE, 0.25 mg/Kg cis-1,2-dichloroethene (cis-1,2-DCE), and 0.02 mg/Kg vinyl chloride. The excavation will then be backfilled with certified clean fill immediately following excavation. The area will then be restored with topsoil and seeding to match the surrounding ground surface.

SITE 6 GROUNDWATER

CVOCs including PCE and breakdown by-products have been detected in groundwater samples from monitoring wells at Site 6 at concentrations exceeding NYSDEC Ambient Groundwater Quality Standards (AGWQS). ISCO utilizing sodium permanganate is the selected remedy for addressing the elevated concentrations of dissolved CVOCs at Site 6. Chemical oxidation using permanganate will oxidize the CVOCs into carbon dioxide, water and chloride ions. Permanganate is expected to meet cleanup goals for all dissolved phase compounds within a two year period.

The permanganate will be injected through the infusion gallery created during the enhanced bioremediation pilot test at Site 6 in August 2007. A collection sump will be installed downgradient of the injection area (Figure 6) and the collected groundwater containing the permanganate will be recirculated to the injection gallery. Recirculation rates and injection locations may be adjusted weekly to ensure complete coverage of the treatment area.

During the last round of groundwater sampling (August 2008), two monitoring wells (6MW-20 and 6MW-21) reported low PCE concentrations for the first time. MW-20 also had multiple exceedences of site contamination and a detection of DCE up to 330 parts per billion (ppb). Since these wells are located outside of the Site 6 injection network, permanganate will be injected in these areas using a direct push drill rig to mitigate CVOC concentrations in these

areas. The injection will be performed using 14 direct push locations in a 15-ft by 15-ft grid around 6MW-21 and four direct push injection locations surrounding 6MW-20 (Figure 6).

Groundwater quality will be monitored by sampling all 11 existing groundwater monitoring wells at Site 6 (Figure 7) approximately three months after the injection. If CVOC concentrations are found to exceed the AGWQS, the next round of injection will be carried out three months after sampling. Up to three rounds of permanganate injections are anticipated. Additional information describing the specific details of the proposed ISCO injections is detailed in Section 4 - In Situ Chemical Oxidation – Site 6 of the Remedial Action Work Plan.

OVERVIEW OF QAPP

The body of this QAPP is required reading for all project personnel, including field and laboratory personnel, and is organized as follows:

Section 1.0	Introduction
Section 2.0	Analytical Laboratory/Analytical Methods
Section 3.0	Data Quality Objectives
Section 4.0	Project Organization, Responsibilities, and Schedule
Section 5.0	Documents and Records
Section 6.0	Sample Handling, Labeling, Shipping, and Custody Requirements
Section 7.0	Quality Assurance /Quality Control
Section 8.0	Equipment Calibration and Maintenance
Section 9.0	Assessment and Oversight
Section 10.0	Data Verification, Review, and Validation
Section 11.0	References

2.0 ANALYTICAL LABORATORY/ANALYTICAL METHODS

The analytical laboratory contracted to perform the sample analyses is a Department of Defense (DoD) New York State Department of Health, Environmental Laboratory Approval Program (ELAP) certified laboratory with. The Quality Assurance Manual (QAM) for the selected laboratory will be included as Attachment A to this document.

TestAmerica's Burlington, Vermont laboratory (New York Certification No. 10391) has been selected as the primary analytical sub-contractor for the project-wide environmental investigations. The Laboratory Client Service Manager, Steve Timmons, will report directly to the BEM Team's QA/QC Manager and is ultimately responsible for all aspects of laboratory related project support. The laboratory will assign Project Managers to serve as the day-to-day laboratory contact that will support routine technical and administrative project requirements.

All samples will be analyzed following the NYSDEC, Analytical Services Protocol (ASP, July 2005) and USEPA procedures with complete NYSDEC Category B deliverables. Required samples and methods are presented in Table 6-1.

3.0 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are established to generate usable data of known and acceptable quality and maximum integrity. Data that meet the DQOs will support the overall project objectives. This is accomplished by conforming with applicable regulatory guidance and requirements that outline standard operation procedures (SOPs) for the conduct of field sampling and data collection, and selecting appropriate analytical methodologies that will culminate in the production of data that satisfy the intended objectives of the environmental investigation.
Establishment of DQOs and the DQO process allow decision-makers to define their data requirements and acceptable levels of decision errors before data are collected. By applying the DQO process, data collection designs should yield data of the quality needed for defensible decision-making. The DQO process also allows for the linkage of specific QA/QC procedures to the intended use of the data, mainly through the decision-makers establishing limits on acceptable errors.

Specific DQOs are defined in terms of obtaining data sets that (are):

- Sufficient to characterize soil and/or groundwater contamination in the study area;
- Identify contaminant levels adequate to make appropriate decisions regarding disposal;
- Adequate to support decisions regarding remedial options;
- Generate scientifically defensible data (data generated will be of sufficient quality to withstand scientific scrutiny); and
- Ensure that method detection limits (MDLs) achieve cleanup criteria or toxicity characteristic leaching procedure Regulatory Levels (for waste characterization and disposal).

Data collection activities will adhere to the appropriate QA/QC protocols for sample collection, preservation, documentation and custody. The quality of measurements made throughout the investigation will be determined by the following characteristics: precision, accuracy, representativeness, completeness, and comparability. Technical data validation will be conducted to ensure laboratory compliance with selected methodologies and to verify the accuracy of the determinations. Adherence to this QAPP, the analytical laboratory's QAM, NYSDEC ASP (July 2005), and the selected analytical methods, will maximize the production of usable and legally defensible data of known and acceptable quality with regard to the project objectives and NYSDEC cleanup requirements.

Quality Assurance Objectives for Measurement - PARCC Review

DQOs for data measurement are generally defined in terms of six parameters: precision, accuracy, representativeness, comparability and completeness (PARCC). The following DQOs have been established to ensure the data collected as part of this program are sufficient and of adequate quality for their intended uses. Data collected and analyzed in conformance with the DQO process described in this QAPP are used to assess the uncertainty associated with decisions related to the Base. The basis for assessing each of these elements of data quality is discussed in the following subsections.

PRECISION

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the

same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The blank spike (BS) or laboratory control sample (LCS) may be used to determine the precision of the analytical method. If the recoveries of analytes in the BS or LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches. *Total* precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix spike duplicate (MSD) samples shall be analyzed to assess field and analytical precision. Precision is determined using the relative percent difference (RPD) between the duplicate sample results. The formula for the calculation of precision is provided in Table 3-1 as RPD. For replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of RSD is provided in Table 3-1.

ACCURACY

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Accuracy is measured by comparing the percent recovery of analytes spiked into a BS, LCS, matrix spike (MS), or MSD to a control limit. For organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples may also be used to provide additional information for assessing the accuracy of the analytical data being produced.

The formula for calculation of accuracy is included in Table 3-1 as percent recovery (%R) from pure and sample matrices.

Table 3-1
Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	$\overline{X}$	$\frac{\left(\sum_{i=1}^{n} x_i\right)}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\Sigma(x_i-\overline{x})^2}{(n-1)}\right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S/\overline{X}) \times 100$	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	%D	$\frac{x_1 - x_2}{x_1} \times 100$	Measure of the difference of 2 observations	Used to assess accuracy
Relative Percent Difference	%RPD	$\left(\frac{(X_1 - X_2)}{(X_1 + X_2)/2}\right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery	%R	$\left(\frac{X_{meas}}{X_{true}}\right) \times 100$	Recovery of spiked compound in clean matrix	Used to assess accuracy
Percent Recovery	%R	$\frac{\left(\begin{array}{c}\text{value of}\\ \text{spiked}\\ \text{sample}\end{array} - \begin{array}{c}\text{value of}\\ \text{unspiked}\\ \text{sample}\end{array}\right)}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision

x = Observation (concentration)

n = Number of observations

REPRESENTATIVENESS

Objectives for representativeness are defined for each sampling and analysis task and are a function of DQOs. Representativeness shall be achieved through use of standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations. Decisions regarding sample/well/ boring locations and numbers and the statistical sampling design are documented in the work plan Section 3.0.

COMPLETENESS

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples (e.g. by site). Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag and the requirement for completeness is 90 percent (%). For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of possible results minus the number of possible results not reported.

The formula for calculation of completeness is presented below:

$$\% \text{ completeness} = \frac{\text{number of valid (i.e., non-R flagged) results}}{\text{number of possible results}}$$

COMPARABILITY

Comparability is the confidence with which one data set can be compared to another data set. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Analysis of PE samples and reports from audits shall also be used to provide additional information for assessing the comparability of analytical data produced among laboratories. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

DETECTION AND QUANTITATION LIMITS

Concentrations of Concern

To meet data needs, potential concentrations of concern must be established. The USEPA "Guidance for Data Usability in Risk Assessments" (1992) specifies that, to the extent possible, the analytical detection limit for a contaminant of concern should be no greater than 20% of the concentration of concern (i.e., NYSDEC clean-up standard value or risk-based criterion). Based

on site-specific contaminants of concern (i.e., CVOCs), appropriate analytical methodologies have been selected to ensure that MDLs achieve associated regulatory threshold criteria.

Detection Limits

The MDL is defined as the minimum concentration of an analyte that can be identified, measured, and reported with 99% confidence that the concentration of that analyte is greater than zero. In accordance with 40 Code of Federal Regulations (CFR) Part 136, the MDL is determined by analyzing a minimum of 7 replicates spiked at 1 to 5 times the expected MDL (defined as the concentration that is distinctly detectable above a blank) for a given analyte. The MDL equals the product of the standard deviation of the replicate measurements and the Student t-value at the desired confidence level (99%). A hypothetical example calculation follows:

For benzo(a)pyrene, x_1= 3.0, x_2 = 3.6, x_3 = 3.7, x_4 = 3.2, x_5 = 3.4, x_6 = 2.9, x_7 = 3.8 mg/kg.

MDL = s × t

where: s = standard deviation = $\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i-\bar{x})^2}$ = 0.349

and t = Student's t-value = t alpha = 3.143

where: alpha (level of confidence) = 0.01 and degrees of freedom (df) = (n-1) = 6.

therefore MDL for benzo(a)pyrene= (0.349)(3.143) = 1.1 mg/kg.

MDL values are derived similarly for inorganic analytes.

Quantitation Limits

The practical quantitation limit (PQL) is defined as the lowest level of a given analyte that can be reliably determined within specified limits of precision and accuracy during routine laboratory operations (USEPA SW846). PQLs are derived by inter-laboratory analyses of check samples. Under the Resource Conservation and Recovery Act (RCRA), the PQL is defined as the lowest point of the calibration curve.

The laboratory establishes quantitation limits (reporting limits, RLs) for each analyte in each method. The limits are established by collecting MDL data for organic and wet chemistry analyses and instrument detection limit (IDL) data for metals analyses. The MDL and IDL data are derived in accordance with procedures set forth in 40 CFR Part 136 Appendix B and as outlined in the USEPA SW846 methods as applicable. These data are then compared to PQL data provided by USEPA methodology and regulations (e.g., PQLs published in USEPA SW846 Test Methods for Evaluating Solid Waste; Federal Register Final Rule making on Appendix IX; contract required quantitation limits provided in the NYSDEC ASP; and MDLs found in 40 CFR Part 136.

After this information is considered, the laboratory sets RLs that correspond to the concentration of the lowest calibration standard. The laboratory will routinely report data quantitated below the corresponding RL as "not detected or ND" at the RL. PQLs are adjusted for sample percent moisture and dilution factors. For the purposes of assessing acceptable analytical data, the data will be reviewed to ascertain that the data fall within established QC acceptance criteria as dictated by the associated test methodology and the appropriate corresponding validation protocols (Section 13.2 Data Validation).

The estimated RLs or PQLs desired for each analysis are the Contract Required Detection Limits specified in the NYSDEC ASP (July 2005) and included as Attachment B. All such limits are dependent upon matrix interferences and reporting limits may vary as a result of dilution.

4.0 PROJECT ORGANIZATION, RESPONSIBILITIES, AND SCHEDULE

The purpose of the Project Management Approach is to identify the project management organization, assign project procedures for the various project functions, establish clear quality management procedures, and subcontract management.

PROJECT MANAGEMENT ORGANIZATION

The organizational structure of project management and communication between team members involved in this project are as follows:

- The ANG Project Manager: Jody Ann Murata is a representative of the ANG and is responsible for managing and directing the work and communicating with other agencies.
- The Base Environmental Manager: Kimberley Kotkoskie is the Environmental Management representative on Base and will be responsible for coordinating the project activities on Base.
- The BEM Team Project Manager, Chun-Ti Huang, is the representative for the prime contractor and is responsible for the project implementation in accordance with the scope of work, the work plan, this QAPP, and selection and supervision of subcontractors.

5.0 DOCUMENTS AND RECORDS

The following sections describe the types of documents and records that will be produced for this project.

QUALITY ASSURANCE PROJECT PLAN

The BEM Team's project manager shall be responsible for ensuring all project team members, including subcontractors, have the most current version of this QAPP, by using the distribution list at the beginning of this QAPP. Each project team member identified on the distribution shall be required to sign a controlled distribution list to show that have received the recent version of the QAPP. Upon receipt of the most recent revision of this QAPP, the former version will be returned to the project manager for disposal.

INFORMATION AND RECORDS TO BE INCLUDED IN THE DATA REPORT PACKAGE

Full NYSDEC Category B laboratory data deliverables (as appropriate to the corresponding methodology) will be provided by the analytical sub-contractor in accordance with the NYSDEC ASP Exhibit B Reporting and Deliverables Requirements.

FIELD DOCUMENTS

Field log books, dedicated to each task and/or sampling area will be kept by field personnel to record pertinent information regarding the site and sampling procedures. Each field log book will have a unique identification number that is recorded QA/QC Manager or his designee. The information recorded will be essential to the evaluation and interpretation of sample analytical results. A water-proof, bound book is the only acceptable item in which to record information during an investigation. Pages will be numbered and signed by the person keeping the record. Blank pages will be crossed-out. Each new entry will record the names of the BEM Team field team, the names and affiliation of subcontractors and other persons present at the site.

The following information may be recorded in the field note book:

- Area of work (especially if a multi-site project or multi-location site);
- General purpose of activity;
- Detailed notes of observations, as required by the project;
- Detailed, time-sequential log of activities;
- Calibration data of field equipment;
- Adherence or deviation from work plan;
- Unexpected circumstances;
- General environmental conditions (e.g., weather conditions); and
- Names and affiliations of visitors, reason for visit, events, discussion and actions resulting from the visit.

Field monitoring measurements taken with the photoionization detector (PID), complete description of installations placed within the boring including, but not limited to, top and bottom elevation of installation, screens, sand pack, seals, grout, protective assemblies and problems encountered during the installation;

- Complete description of abandoned borings or rejected installation; and

- Complete description of well development procedures including date, development start and stop times, field measurements and volume of water removed from the well.

To minimize manual data transcription errors, selected field measurements may be entered directly into an electronic data log/database that will reside on a portable personal computer. Limitations will be set on each entry field to minimize the potential of an illogical data type or range being entered. At the end of each day, the data will be downloaded to the project database located at the home office. Depending on the site location, real-time connection to the project database may be maintained rather than doing daily data transfers. A manual data-log may also be maintained for use in the event that the computer stored data is damaged or lost.

CORRECTION TO DOCUMENTATION

If an error (e.g., incorrect date or sample depth) is made on a document, corrections will be made by crossing through the error with a single line so that the original entry can still be read and entering the correct information. All corrections will be initialed and dated.

6.0 SAMPLE HANDLING, LABELING, SHIPPING, AND CUSTODY REQUIREMENTS

SAMPLE CONTAINERS

Sample containers shall be purchased pre-cleaned and treated according to USEPA specifications for the methods. Containers shall be stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles shall be used routinely where glass containers are specified in the sampling protocol.

SAMPLE VOLUMES, CONTAINER TYPES, AND PRESERVATION REQUIREMENTS

All sample containers used will be of traceable quality purchased and supplied by the laboratory. The selection of sample containers used to collect the samples is based on the following considerations:

- sample matrix;
- analytical methods;
- potential contaminants of concern;
- reactivity of container material with sample; and
- QA/QC requirements.

All samples will be collected and preserved, and all analytical holding times will conform to either the NYSDEC ASP (July, 2005) or those required by the approved ELAP laboratory conducting the analyses. Sample volumes, container types, and preservation requirements by analytical method are listed in Table 6-1.

SAMPLE LABELING AND NUMBERING

All samples, including field QC samples, must be labeled and assigned a unique number.

Sample Labeling

Sample labels are required for properly identifying samples and evidence. All samples (i.e., each sample container) must be properly labeled with the label affixed to the container prior to transportation to analytical or geotechnical laboratories. Information on the sample label should include, but not limited to, the following:

- Project Code: BEM project number, and site name;
- Station Number: A unique identifier assigned to a sampling point by the sampling team;
- Unique Sample Identification Number;
- Samplers: Each sampler's name or initials and signature;
- Preservative: Whether a preservative is used and the type of preservative;
- Analysis: The type of analysis requested;
- Date/Time: The date and time the sample was collected; and
- Type of Sample: The type of sample should be identified as discrete or composite.

Table 6-1
Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container	Preservation[a]	Minimum Sample Volume or Weight	Maximum Holding Time
CVOCs	Water - SW846 8260B Soil – SW846 8260B	Water - Teflon®-lined septum vial Soil - EnCore™ sampler	Water - 4°C, HCl to pH < 2 Soil - EnCore™ sampler	Water - 2 x 40 mL or 4 ounces Soil - 5 g (EnCore™)	Water - 14 days; 7 days if unpreserved by acid Soil - 2 days to lab, 14 days to analysis
Chloride	Water-SW846 9056	Water-Polyethylene or glass	Water-4°C	Water-200 mL	Water-28 days
Xylene	Soil- SW846 8260B	Soil - EnCore™ sampler	Soil - EnCore™ sampler	Soil - 5 g (EnCore™)	Soil – 2 days to lab, 14 days to analysis
Metals	Water-SW846 6010B	Water-1 x 100 mL high-density polyethylene	Water- HNO_3 to pH <2, 4 °C	Water-50 mL	Water-180 days for all elements except mercury, which is 28 days
RCRA 8 Metals (Sodium and Manganese)	Soil – SW846 6010B/7471A	Soil – 1 x 4 oz soil jar	Soil – 4 °C	Soil -10 g	Soil – 180 days for all elements except mercury, which is 28 days
Diesel Range Organics [1]	Soil - SW846 8015B	Soil – 1 x 4 or 8 oz soil jar	Soil: 4 °C	Soil- 50g	Soil- 14 days to extraction, 40 days to analysis.
Semivolatile Organic Compounds	Soil - SW846 8270C	Soil – 1 x 4 or 8 oz soil jar	Soil: 4 °C	Soil - 50g	Soil – 14 days to extraction, 40 days to analysis.
Gasoline Range Organics [2]	Soil - SW846 8015B	Soil – 1 x 2 oz septa soil jar	Soil – 4 °C	Soil – 10g	Soil – 14 days

a. No pH adjustment for soil.
[1] Site 3 only
[2] Site 6 only

Sample Numbering

A sample numbering system is used to uniquely identify each sample (including field QC samples) collected and submitted for analysis. The purpose of the numbering system is to assist in the tracking of samples and facilitate retrieval of analytical results. Sample identification numbers should be used on sample labels, chain-of-custody (CoC) forms, field logbooks, and all other applicable documentation. A listing of all sample identification numbers should be recorded in the field logbook.

SAMPLE CHAIN-OF-CUSTODY PROCEDURES

CoC procedures provide documentation of the custody and integrity of the samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records. Records concerning the cleaning of empty sample containers, container shipment from the laboratory to the site, and security of empty containers at the site should also be maintained.

The CoC record serves as a legal record and shall be maintained for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession and they locked it up or, (4) it is in a designated secure area.

The following information concerning the sample shall be documented on the CoC form:

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of matrix spike/matrix spike duplicate (MS/MSD)
- Preservative used
- Analyses required
- Name of collector(s)
- Pertinent field data (pH, temperature, etc.)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

In addition to the CoC record, there is also a CoC (custody) seal. The CoC seal is an adhesive seal placed in areas such that if a sealed container or cooler is opened, the seal would be broken. The CoC seal ensures that no sample tampering occurred during shipment of samples from the field to the laboratories.

Transfer of Custody and Shipment

All sample shipments and transfers, including shipment or transfer between laboratories, must be accompanied by the CoC record. The CoC record must be signed and dated (with time) by the

person (i.e., sampler, sample manager, etc.) relinquishing custody of the samples and the person receiving the samples at the laboratory. A copy of the CoC record should be retained in the field records and the laboratory records. Transfer of custody and shipment are also discussed in 6.6 of the field sampling plan (FSP).

SAMPLING HANDLING AND SHIPPING

Samples collected in the field shall be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a VOCs sampling vial filled with tap water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. The laboratory also may use a temperature infrared gun to determine the temperature of individual samples and the cooler. If the temperature of the samples upon receipt exceeds the temperature requirements, the exceedance shall be documented in laboratory records and discussed with the client. The decision regarding the potentially affected samples shall also be documented.

The original CoC record and one copy shall be placed in a plastic bag and secured to the inside lid of the shipping container (i.e., cooler). A copy of the CoC record shall be retained in the field. The original CoC record shall be transmitted to the project chemist after samples are accepted at the laboratories. This copy shall become part of the project file.

Shipping containers (i.e., coolers) must be secured with strapping tape and custody seals. The custody seals must be placed on the container so that it cannot be opened without breaking the seals. The seal must be signed and dated by the field investigator.

If samples are sent by mail, the containers shall be registered with return receipt requested. If sent by common carrier, an air bill shall be used. Receipts from post offices and air bills shall be retained as part of the CoC documentation. Air bill numbers or registered mail serial numbers shall be recorded in the remarks section of the CoC record.

Sample shipments including methanol preserved samples, hazardous waste samples, radioactive samples, etc. may have special handling and shipping requirements. Check local, state and department of transportation regulations and with the carrier regarding shipping of these types of samples. The handling and shipping of samples is also discussed in 6.5 of the FSP.

SAMPLE RECEIPT

For the safety of the personnel involved, coolers shall be opened in a hood in case there has been any breakage of containers of potentially contaminated sample material. The laboratory shall check the sample shipment for evidence of tampering and be check sample label information and quantities against information on the CoC form for anomalies. The condition, temperature, and appropriate preservation of samples shall be checked and documented on the CoC form. Checking an aliquot of the sample using pH paper is an acceptable procedure except for VOCs where an additional sample is required to check preservation. All sample information shall then be entered into a tracking system, and unique analytical sample identifiers shall be assigned. A

copy of this information shall be reviewed by the laboratory project manager for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times are specified in Table 5-1.

The laboratory shall report occurrences of any anomalies in the received samples to the BEM Team's project chemist as soon as possible and no later than one working day. The laboratory shall document the resolution of the anomaly in their laboratory records.

Subcontracted analyses shall be documented on the CoC form. Procedures ensuring internal laboratory CoC shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

While in the laboratory, samples shall be stored in limited-access, temperature-controlled areas. Refrigerators, coolers and freezers shall be monitored for temperature. Acceptance criterion for the temperatures of the refrigerators and coolers is 4°C± 2°C. Acceptance criterion for the temperatures of the freezers shall be less than 0°C. All of the cold storage areas shall be monitored by thermometers that have been calibrated with a National Institute of Standards and Technology -traceable thermometer. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained. Samples for VOC determination shall be stored separately from other samples, standards, and sample extracts. Samples shall be stored after analysis until disposed of per applicable local, state, and federal regulations. Disposal records shall be maintained by the laboratory. Refrigerators storing VOC samples shall contain a blank that shall be analyzed on a regular schedule.

SOPs describing sample control and custody shall be maintained by the analytical laboratories.

7.0 QUALITY ASSURANCE /QUALITY CONTROL

The two general categories of data are defined as: (1) screening data and (2) definitive data.

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements than are necessary to produce definitive data. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Physical test methods, e.g., dissolved oxygen measurements, temperature and pH measurements, moisture content, turbidity, conductance, etc., have been designated by definition as screening methods.

Definitive data are generated using rigorous analytical methods, such as approved USEPA reference methods. The data can be generated in a mobile or off-site laboratory. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements. Definitive data are not restricted in their use unless quality problems require data qualification.

FIELD AND LABORATORY QUALITY CONTROL SAMPLES

The scope and application of this instruction is to describe the standard QC samples that shall be included in the project data collection program to support the DQOs. The QC samples described include field QC and laboratory QC samples used to assess sources of error at each stage of the sampling and analytical process. The entire sequence of sample collection, preservation, storage, and shipment has unique errors associated with it, as do the events that occur in the analytical laboratory. To assess the impact these errors have on the resulting data, a combination of unique field and laboratory QC samples shall be incorporated into the data collection program.

Field Quality Control Samples

Principle elements of sampling and field QA/QC strategy include developing a sound sampling approach based upon the intended use of the data; using sampling methodologies that allow the collection of representative samples based upon data needs; using sampling devices that minimize the disturbance or alteration to the chemical composition of the media; employing decontamination procedures that reduce cross-contamination potential between sampling points; and using proper sample containers and preservation techniques that maximize the integrity of the samples. The applicability and appropriateness of the field sampling protocol shall be verified by the inclusion the field QC samples listed in Table 7-1.

All field QC samples shall be handled exactly as the environmental samples. With the exception of the MS/MSDs and trip blanks, the identity of the field QC samples shall be blind to the laboratories. .

7.1.1.1 Field Duplicate Samples

Field duplicate samples are used to assess the variability of a matrix at a specific sampling point and to assess the reproducibility of the sampling method. Field duplicate samples are defined as a second sample collected from the same location, at the same time, in the exact same manner as the first and placed into a separate container (with no prior mixing). Field duplicate samples are

collected at a frequency of one per every twenty (20) samples per matrix. Each duplicate sample is analyzed for the same parameters as the samples collected that day. Thus, both field and laboratory variability are evaluated. Although there are no established QC limits for field duplicate RPD data, the BEM Team considers RPD values of 30% or less for water and 50% or less for soil an indication of acceptable sampling and analytical precision. Any deviations in the data with respect to the limits will be discussed in the report.

7.1.1.2 Split Samples

Split samples are usually used for performance audits or inter-laboratory comparability of data. The collection of split samples is not anticipated during the course of this project. However, if the NYSDEC (or other appropriate agency) requests split samples to be collected, then the following applies. A split sample is defined as two separate samples taken from a single aliquot that has been thoroughly mixed or homogenized prior to the formation of the two separate samples.

7.1.1.3 Equipment Blanks

Equipment blanks are not required when dedicated sampling equipment is used. The BEM Team anticipates using dedicated groundwater sample tubing and disposable soil sampling equipment; therefore it is not anticipated that equipment blanks will be collected. However, if non-dedicated sampling equipment is used in the collection of samples, one equipment blank will be collected for each type of equipment used for each day that it is used. Equipment blanks will be produced by pouring de-ionized water over and through the newly decontaminated equipment after it has been used to collect a field sample. Field records will be kept to identify the exact time and location of the equipment-blank sampling event so the blank can be associated with a specific sampling event.

7.1.1.4 Trip Blanks

Trip blanks are used to monitor potential sample volatile organic contamination during shipment to and from the laboratory. It also provides information on laboratory water quality since the laboratory provides the trip blank water. One trip blank will be submitted to the laboratory for analysis for each day aqueous volatile organic samples are collected. A trip blank will be included in each cooler containing volatile organic samples. Therefore, all volatile organic samples and containers will be shipped to and from the laboratory in a minimum number of coolers, minimizing the number of trip blanks required.

Table 7-1
Field Quality Control Samples

Field QC Sample	Description	Frequency of Collection	Evaluation Criteria
Field Duplicate	A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples shall be collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis.	5% of environmental samples per matrix per method	***Water***: RPD ≤ 30% ***Soil and Waste***: RPD ≤ 50%
Matrix Spike/ Matrix Spike Duplicate	A MS and MSD are aliquots of sample spiked with known concentrations of target analytes. Spiking shall occur prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. Only project samples shall be used for spiking. The MS/MSD shall be designated on the chain of custody.	5% of environmental samples per matrix per method	Recovery of target analytes within laboratory control criteria or validation advisory limits
Trip Blank	VOC sample vials filled with American Society for Testing and Materials (ASTM) Type II water or equivalent at the analytical laboratory, shipped with empty VOC sample containers to the sampling site, and shipped back to the laboratory with samples for VOC analysis. Trip blanks shall not be opened in field. Trip blanks shall be analyzed for the same analytes as the VOC samples. Trip blanks are used to assess any potential introduction of cross contamination from sample containers or during the storage or transportation process.	One per sample cooler containing samples for VOC analysis per method.	Target analytes < 1/2 RL, with the exception of acetone, toluene, 2-butanone, and methylene chloride
Equipment Blank	Made by pouring ASTM Type II water or equivalent on non-dedicated or non-disposable field sampling equipment. The equipment blank shall be collected after the field sampling equipment is decontaminated. Equipment blanks shall not be collected from backhoe buckets, shovels, or sample containers. The equipment blank shall be analyzed for the same methods as the environmental samples. The equipment blank is used to assess the effectiveness of the equipment decontamination procedure.	Daily per equipment type, decontamination event, and method if non-dedicated sampling equipment is used.	Target analytes < 1/2 RL, with the exception of phthalate esters, acetone, toluene, 2-butanone, and methylene chloride
Temperature Blank	A sample container filled with water and labeled "Temperature Blank." The temperature blank is used by the laboratory to verify the temperature of the sample cooler at the time of laboratory receipt.	One per sample cooler	2 – 6 °C

7.1.1.5 Field Testing QC

Field QC check control limits (pH, specific conductance, turbidity and temperature) are detailed below. In addition, field determinations of pH, specific conductance, and turbidity, are obtained in duplicate for every 20 samples "analyzed".

- pH: If the pH QC sample (pH 10.0 buffer after initial calibration with pH 4.0 and 7.0 buffers) exceeds ± 0.5 pH units from the true value, the source of the error is determined and the instrument re-calibrated. If a continuing calibration check with pH 7.0 buffer is off by ± 0.5 pH unit, the instrument is re-calibrated.
- Specific conductance: QC samples must be within ±10% of the true values. The specific conductance QC sample is a 0.01 M or 0.1 M potassium chloride solution.
- Turbidity: QC samples must be within ± 10% of the true values. The turbidity QC sample is a commercially prepared polymer standard (Advanced Polymer System Inc. or equivalent).
- Temperature: Temperature measurements are performed with a factory calibrated thermometer or thermocouple.

Laboratory Quality Control Samples

Laboratory quality QC samples are used to assess errors in the analytical process. In order to ensure that quality data are continuously produced during all analyses, and to allow compliance review, laboratory QC samples are analyzed to show that analytical results remain reproducible and that the analytical method is actually measuring the quantity of target analytes in each sample with acceptable bias.

7.1.1.6 Method Blanks

Method blanks are used to assess the background variability of the method and to assess the introduction of contamination to the samples by the method, technique, or instrument as the sample is prepared and analyzed in the laboratory. A method blank is defined as an aliquot of laboratory deionized water on which every step of the method is performed and analyzed along with the samples. Method blanks are analyzed at a frequency of one (1) for every 20 samples analyzed, or every analytical batch, whichever is more frequent.

7.1.1.7 Spiked Samples

Two types of spiked samples are analyzed as part of the analytical QA/QC program, and include MS and MSD. MS samples are analyzed to evaluate instrument and method performance on samples of similar matrix. MSD samples are analyzed to determine the precision of the method and instrument. These samples are analyzed and the percent recovery is determined to assess matrix interferences affects on the methods. One MS/MSD sample pair will be analyzed for every 20 samples.

8.0 EQUIPMENT CALIBRATION AND MAINTENANCE

FIELD EQUIPMENT

Calibration

Field equipment that may be used during collection of environmental samples at the Site includes a peristaltic pump with dedicated tubing, a multi-parameter water quality instrument (HORIBA U-22 or similar) that measures pH, conductivity, turbidity, temperature, and dissolved oxygen, and a colorimeter (LaMotte Model 1200 Single-Test Colorimeter, or similar) that can measure concentrations of permanganate. A PID detector (MultiRAE or equivalent) will also be utilized. Calibration and standardization of the pH, specific conductivity, turbidity and dissolved oxygen meters for low flow sampling is summarized below:

- The pH meter is calibrated in accordance with EPA Method 150.1. It is fully re-calibrated (three points) at least two times daily, and it is checked with pH 7.0 buffer every ten samples, two hours, or every time it has been turned off for more than two hours and then turned on again, whichever occurs first.
- The specific conductance meter is calibrated in accordance with EPA Method 120.1. It is calibrated at the beginning and in the middle of the work day.
- The turbidimeter is calibrated in accordance with EPA Method 180.1. It is calibrated at least twice daily following the manufacturer's operating instructions over a linear, non-drifting range of interest.
- The dissolved oxygen meter is calibrated following the manufacturer's instructions at least daily, and whenever the instrument has been turned off.
- Temperature is measured with a thermometer, or with a platinum electrode that has been factory calibrated and coupled to the pH meter.
- The colorimeter is calibrated following the manufacturer's instructions, at least daily, and whenever the instrument has been turned off.

The PID used for soil screening and health and safety surveys is calibrated following the manufacturer's instructions, at the beginning of the day, whenever the instrument is shut-off for more than two hours and at the field representative's discretion.

Maintenance

Preventive maintenance of field equipment is performed to keep all instruments in proper working order. This maintenance is monitored with a system of logbooks kept for each instrument. All preventative maintenance activities are recorded in the logbooks, along with documentation of any problems and repairs. Review of these logs and internal communication between QA/QC personnel and field personnel allow for identification and correction of potential problems.

Prior to field sampling events, each piece of field equipment is inspected to ensure it is operational. If necessary, the equipment is serviced. Meters requiring charged batteries are fully charged or have fresh batteries.

Cleaning of Field Sampling Equipment

All non-dedicated hand equipment and tools, including split spoons used to collect samples for chemical analyses (including trowels, spatulas, spoons, scoops, hand augers, split-spoons) will be decontaminated using the following procedures:

- Wash with Alconox or a citrus based cleaner;
- Tap water rinse or distilled/de-ionized water rinse;
- 10% nitric acid rinse (sampling equipment used for collecting samples for metals analysis only) and;
- Distilled/de-ionized water rinse.

If equipment is to be stored for future use, allow it to air dry, and then wrap it in aluminum foil (shiny-side out) or seal in plastic bags. Decontamination fluid will be discharged directly to the ground away from any surface water or containerized on-site if necessary.

For aqueous sampling equipment, with the exception of submersible pumps, the following procedures will be followed:

- Scrub with brush using laboratory grade glassware detergent and tap water;
- Rinse with tap water;
- Rinse with distilled, deionized water;
- Rinse with 1 percent nitric acid;
- Rinse with distilled, deionized water;
- Rinse with pesticide grade acetone;
- Air dry; and
- Rinse with distilled, deionized water.

Drilling and Geoprobe equipment will be decontaminated by washing with Alconox and rinsing with tap water. If necessary equipment will be steam cleaned.

LABORATORY EQUIPMENT

All laboratory equipment is calibrated according to the requirements of the respective SW-846, Test Methods For Evaluating Solid Waste and the USEPA Chemical Analysis of Waters and Waste (1983) methods for each analysis and/or in accordance with the manufacturer's specifications.

9.0 ASSESSMENT AND OVERSIGHT

PEER REVIEW

Peer review will be performed on all planning documents and final reports before delivery. The documents will be reviewed for technical adequacy, accuracy, compliance with technical procedures, contract and regulatory requirements, and editorial quality. Peer review will be documented as well as acceptance of responses to comments.

READINESS REVIEW

The Program Manager and QA/QC Manager shall conduct a readiness review before beginning field activities. The review will ensure that all plans have been completed and distributed, permits have been acquired, key personnel have been assigned and field personnel have been adequately trained, equipment is available and calibrated, arrangements have been made for waste disposal, and all possible precautions have been taken to prevent problems.

FIELD AUDITS

The Project Manager and Project QA/QC Officer are responsible for ensuring all field investigations are performed in accordance with the requirements and specifications outlined in this QAPP. The Quality Assurance Officer (QAO) is responsible for providing QA/QC supervision and guidance relative to all work performed by the BEM Team employees and subcontractors assigned to the project.

As part of the BEM Team's field QA/QC program, a field audit is performed by the BEM Team's QAO or a designated representative on projects where sampling activities extend for more than one week. The primary purpose of the field audit is to monitor project sampling practices. The QA/QC field audit is performed during sampling to evaluate the performance of work during the collection of samples for laboratory analysis.

For projects of short duration (i.e., continuous field work of less than one week), a formal audit of field activities is not performed. The field team leader or appropriate task manager monitor field performance and document all work performed in field notes, a narrative, and a checklist of tasks. The Project Manager and/or Project QA/QC Officer review this documentation to ensure the necessary information has been recorded and conducts discussions with field team members to verify field activities were performed according to the project Work Plan, QAPP and Health and Safety Plan. The QAO communicates concerns, if any, to the field team as appropriate. A field audit will be performed in conjunction with this project.

MEETINGS

Periodic meetings between the Project Manager and QAO will be held to review quality assurance procedures, field work, laboratory performance and data documentation and review. Any potential problems identified during the review are documented and addressed. If necessary, they are reported to management for review and appropriate corrective action.

NONCONFORMANCE AND CORRECTIVE ACTION

The following sections describe who will be responsible for taking corrective actions to nonconformances identified during assessments or daily field or laboratory activities.

Field Activities

During the course of this project, it shall be the responsibility of the Project Manager, Field Manager, and field team members to see that all procedures are followed as specified in this QAPP and that measurement data meet the prescribed acceptance criteria. If a problem arises, it is imperative that prompt action be taken to correct the problem. Engineering and scientific calculations will be checked and corrected as required by technical personnel, and normally require no QA reporting. A nonconformance exists if there is a deviation from or noncompliance with contract specifications, the quality assurance program, approved procedures, or this QAPP. A nonconformance can also include major errors in documented analysis, data, or results, and deficiencies in documentation or any other aspect of the project that affects quality.

Personnel who identify a nonconformance should report the condition on a Nonconformance Report (NCR) and distribute the NCR to the Project Manager, and QC Manager. The identification numbers of the samples affected by the nonconformance should be noted on the NCR. The Project Manager and QC Manager shall:

- Review the NCR to determine whether ongoing work should be stopped; the nonconformance involves a major deviation from the contract or QAPP; may significantly impact the cost or schedule of the work; and/or the nonconformance has any impact on previously obtained data or reports submitted to the Client or other organization.
- Notify the Client Project Manager as soon as possible of the nonconformance.
- Note impacts to the project in the remarks section of the NCR and notify in writing all individuals and organizations that may be affected by the nonconformance and resulting data.
- Recommend corrective actions to resolve the nonconformance for review by the Client Project Manager. The approved corrective action will be implemented by appropriate personnel, and reviewed and approved by the Client Project Manager, Project Manager, and QC Manager.
- Ensure return to control by reviewing field activities after corrective actions have been implemented.

Laboratory Activities

Corrective actions shall be dictated by the type and extent of nonconformance. Corrective actions may be initiated and carried out by nonsupervisory staff, but final approval and data review by the laboratory QA Manager and Project Manager are necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection.

During the course of this project, it shall be the responsibility of the Laboratory Project Manager to see that all procedures are followed as specified in this QAPP and that measurement data meet the prescribed acceptance criteria. If a problem arises, it is imperative that prompt action be taken to correct the problem. A nonconformance exists if there is a deviation from or

noncompliance with contract specifications, the laboratory's quality assurance program, approved methods or procedures, or this QAPP. A nonconformance can also include major errors in documented analysis, data or results, and deficiencies in documentation or any other aspect of the project that affects quality.

The Laboratory Project Manager shall prepare a NCR and distribute the NCR to the Project Chemist as soon as possible and no later than one working day after the nonconformance is identified. The identification numbers of the samples affected by the nonconformance should be noted on the NCR. The Project Chemist and QC Manager shall:

- Review the NCR to determine whether resampling is necessary; the nonconformance involves a major deviation from the contract or QAPP; may significantly impact the cost or schedule of the work; and/or the nonconformance has any impact on previously obtained data or reports submitted to the Client or other organization.
- Notify the Client Project Manager and Project Manager as soon as possible of the nonconformance.
- Note impacts to the project in the remarks section of the NCR and notify in writing all individuals and organizations that may be affected by the nonconformance and resulting data.
- Recommend corrective actions to resolve the nonconformance for review by the Client Project Manager and Project Manager. The approved corrective action will be implemented by appropriate personnel, and reviewed and approved by the Client Project Manager, Project Manager, and QC Manager.
- Ensure return to control by reviewing laboratory activities after corrective actions have been implemented.

10.0 DATA VERIFICATION, REVIEW, AND VALIDATION

The data verification, review, and validation process ensures and documents the quality of analytical data by verifying analytical data against method and QAPP specifications. The Project Chemist shall verify, review, and validate the remedial data to assess the quality and usability of definitive data according to the USEPA Region II Hazardous Waste Support Branch for Organics (2006) and the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2008). Based on the results of the verification, review, and validation and review process, data are categorized as fully usable, usable as qualified, or rejected. Full validation will not be performed on analytical data that is not integral to the remedial decisions, such as waste characterization analyses required for disposal.

LABORATORY DATA

The laboratory is required to meet all applicable documentation, data reduction, and reporting protocols as specified in the July 2005 NYSDEC ASP Category B deliverable format. Calculations of sample concentrations are performed using the appropriate regression analysis program, response factors, and dilution factors, where applicable. The laboratory (through its assigned QAO) conducts its own internal review of the analytical data generated for a specific project prior to sending the data to the BEM Team. Deficiencies discovered during the laboratory internal data validation, as well as the corrective actions used to correct the deficiency are documented in the laboratory Case Narrative submitted with each data package.

The laboratory reports the data in tabular form by method and sample. The laboratory is required to submit analytical results supported by a complete NYSDEC ASP Category B data package to enable the quality of the data to be determined. This standard backup data includes supporting documentation (chromatograms, raw data, *etc.*), sample preparation information, and sample handling information (*i.e.*, CoC documentation).

In addition, the laboratory will provide an electronic deliverable in accordance with BEM QC Central Database Management System deliverable file specifications. This deliverable will incorporate, at a minimum, the USEPA Form I equivalent data for analyses performed (some QC data will also accompany this submittal). This deliverable will be transferred to a relational database for subsequent data processing and presentation and to facilitate the data validation and qualifier application process.

BEM uses a proprietary database application to facilitate data management and analytical data validation. In the area of data management, this application is used to import, warehouse and present laboratory data. During the import process, laboratory submissions are fully checked for internal and external consistency. Once part of the BEM data warehouse, the data can be manipulated and viewed for validation purposes. Following validation, the data can be exported in various formats and subjected to automated regulatory threshold criteria comparisons. The data in the BEM data warehouse is also available for analysis using a geographic information system.

DATA VERIFICATION

The project chemist shall verify that all hard copy data packages received from the analytical laboratory are complete. The project chemist or designee shall verify that hard copy results correspond to electronic copy results for 10% of the data.

All hard copy data packages shall be checked to verify that the following items are included:

- Case narrative,
- Result and QC summary sheets,
- Initial and continuing calibrations,
- Method blanks (at least one per analytical batch),
- MS/MSD (one per 20 samples of similar matrix),
- LCS/LCSD (one per analytical batch),
- Duplicate analyses (if applicable),
- Holding times,
- Instrument logs and preparation and extraction bench sheets,
- Linear range calculations (correlation coefficient), and
- Raw data.

DATA REVIEW

The data review process includes reviewing and evaluating 100% of the hard copy data for (1) extraction and analysis holding times, (2) surrogate recoveries, (3) reporting limits, (4) field duplicate RPDs, (5) blank detections, (6) LCS/LCSD recoveries and RPDs, (7) initial and continuing calibrations, (8) MS/MSD recoveries and RPDs, (9) instrument tuning and instrument performance, and (10) laboratory duplicate RPDs.

In addition to the laboratory's in-house review of the data, the BEM Team's chemists will review the laboratory standard quality control summary forms prior to its incorporation into a final report and complete a Data Validation Report (DVR). The data review will follow the NYSDEC Guidance for Development of Data Usability Reports. A complete data validation and associated report will be performed. Upon receipt of the laboratory data analytical package, the data reviewer:

1. **Reviews the data package to determine completeness.** It must contain all sample CoC forms, case narratives including sample/analysis summary forms, QA/QC summaries with supporting documentation, relevant calibration data, instrument and method performance data, documentation of the laboratories ability to attain the method detection limits for target analytes in required matrices, data report forms with examples of calculations, and raw data. The laboratory is promptly notified of any deficiencies, and must produce the documentation necessary to correct the deficiencies within 10 calendar days.
2. **Reviews the data package to determine compliance with the applicable portions of the work plan**. The data reviewer confirms the data is produced and reported consistent with the QAPP and laboratory quality control program,

protocol-required QA/QC criteria are met, instrument performance and calibration requirements were met, protocol required calibration data are present and documented, data reporting forms are complete, and problems encountered during the analytical process and actions taken to correct the problems are reported. Field duplicate data are evaluated to determine field variability.

3. **Prepares a tabular summary of the reported data.** The data reviewer summarizes the data in a tabular format to provide the data in more accessible format.

DATA VALIDATION

In addition to the data review described in Section 10.2, data validation includes validating 10% of hard copy data (per matrix, per method) through (1) recalculating results starting from raw data, (2) verifying identifications through evaluation of spectra and retention times, and (3) checking for omissions, discrepancies, transcription errors, dilution errors, and conversion errors.

DATA QUALIFICATION

Based on the data review and validation, the project chemist shall assign final data validation qualifiers to analytical results in the electronic database. Final data validation qualifiers are based on the letter qualifier recommended in validation protocols identified previously.

DATA VALIDATION REPORTS

Following data review or validation, the project chemist shall prepare a DVR for each hard copy data package. The DVR shall include a list of the samples and analytical methods included in the hard copy data package, a discussion all data qualifiers assigned, and a list of qualified results. The DVR shall also discuss the overall quality of the data, data usability, and any limitations of the data. Justifications for data qualifiers will be presented, as well as justifications for the rejection of any data. The DVR shall reconcile the data collected with the project DQOs.

The QC Manager and Project Manager shall review the DVRs. The Project Manager shall provide the Client Project Manager with a copy of the reviewed DVRs for review and comment.

11.0 REFERENCES

BEM Systems, Inc. (BEM) 2012. Data Gap Investigation Technical Memorandum for Sites 3 and 6 for the 109th Airlift Wing, Schenectady Air National Guard Base (SANGB), Scotia, New York, February 2012.

NYSDEC. 2005. Analytical Service Protocols, September 2005.

NYSDEC 2012. DER-10. Technical Guidance for Site Investigation and Remediation. May 3, 2010.

United States Environmental Protection Agency (USEPA). 1996. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, and its first, second, and third updates.

USEPA. 2008. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, EPA 540-R-08-01. June 2008.

USEPA. 2000. Guidance for the Data Quality Objective Process, EPA QA/G-4. August 2000.

USEPA. 2001. EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. March 2001.

USEPA. 2006. USEPA Region II Hazardous Waste Support Branch for Validating Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry SW-846 Method 8260B, SOP #HW-24. October 2006.

ATTACHMENT A

Laboratory Quality Assurance Manual

Quality Assurance Manual

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Quality Assurance Manual
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Operations Manager, Inorganics Carol Webb	02/20/2013 Date

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CA-Q-S-006	Detection Limits
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SA-AN-100	Laboratory Support Equipment (Verification and Use)
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SA-GE-209	Hexavalent Chromium by IC
SA-LC-070	Carbamate Pesticides by HPLC
SA-LC-071	Glyphosate by HPLC
SA-LC-072	Diquat and Paraquat by HPLC
SA-ME-021	Digestion Procedures for Solids for Hexavalent Chromium
SA-ME-028	Mercury: preparation and Analysis
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SECTION 3. INTRODUCTION, SCOPE, AND APPLICABILITY

3.1 Introduction and Compliance References

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

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

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

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.2, October 2010.*
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005) (DW labs only)*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th and 21st, and on-line Editions.
- 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 the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management

policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 Scope / Fields of Testing

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

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

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP SA-QA-01).

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

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

4.2 Roles and Responsibilities

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

4.2.1 Additional Requirements for Laboratories

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

4.2.1.1 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation and improvement of the quality system based on ISO/IEC 17025, DOD ELAP, and TNI. The QA Manager is independent of production; reports directly to the Laboratory Director; and has access to Corporate QA for advice and resources. The QA Manager is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. The QA Manager directs the activities of the QA Department to accomplish specific responsibilities, which include, but are not limited to:

- Serving as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.

- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities. Ensuring all personnel understand their contributions to the Quality System.
- Having documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- Maintaining records of all ethics-related training, including the type and proof of attendance.
- Maintaining, improving, and evaluating the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitoring standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Reviewing a percentage of all final data reports for consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, format, holding time, sensibility, and completeness of the project file contents.
- Reviewing of external audit reports and data validation requests.
- Following-up with audits to ensure client QAPP requirements are met.
- Establishing of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Developing of suggestions and recommendations to improve quality systems.
- Researching current state and federal requirements and guidelines.
- Managing the QA team to enable communication and to distribute duties and responsibilities.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluating of the thoroughness and effectiveness of training.
- Ensuring compliance with ISO/IEC 17025, DOD ELAP, and TNI.

4.2.1.2 Technical Manager/Director

The Technical Manager reports directly to the Laboratory Director and/or Quality Assurance Manager. He is accountable for all analyses and analysts under their experienced supervision and for compliance with ISO 17025, DOD ELAP, and TNI. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

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

4.2.1.2 Laboratory Director

Specific responsibilities include, but are not limited to, the following:

- Directs and provides guidance to Laboratory Manager and Project Managers
- Develops and maintains company-client relationships
- Reviews proposals
- Supervises project management
- Interviews and hires technical and administrative personnel
- Other administrative and budgetary functions

4.2.1.3 Operations/Laboratory Manager

Specific responsibilities include, but are not limited to, the following:

- Coordinates all production activities
- Works with Project Managers to ensure project objectives are met
- Provides guidance to Department Managers
- Interviews and hires laboratory personnel
- Establishes production priorities and coordinates day-to-day operation of the laboratory

4.2.1.5 Compliance Officer/Environmental Health and Safety Manager

Specific responsibilities include, but are not limited to, the following:

- Provides technical assistance in complying with corporate policies concerning safety, waste, and shipping
- Assists Laboratory Director, Laboratory Manager, and Project Managers in developing appropriate safety precautions for new projects
- Monitors collection and disposal of chemical wastes
- Ensures employees comply with safety and waste disposal plans

4.2.1.6 Department Manager/Supervisor

Specific responsibilities include, but are not limited to, the following:

- Organizes workflow in the department
- Assures adequate inventory of reagents and equipment
- Ensures effective maintenance and repair of instrumentation
- Investigates and evaluates new methodology and equipment
- Ensures proper training is conducted
- Reviews data, assures quality objectives are met for each project, and approves results

4.2.1.7 Analyst/Chemist

Specific responsibilities include, but are not limited to, the following:

- Performs preparation and/or analysis of samples using approved procedures
- Calculates, checks, and reports data in accordance with approved SOP and the Laboratory Quality Manual
- Performs instrument maintenance and maintains instrument logs
- Maintains proper documentation of all analytical steps

4.2.1.8 Lab Technician

Specific responsibilities include, but are not limited to, the following:

- Assists analysts in sample preparation and data collection
- Performs routine checks for data quality objectives - surrogate recoveries, LCS/MS recoveries, initial evaluation of dilutions, internal standards areas, and method blanks
- Assists analysts in maintaining traceability of standards and samples
- Assists analysts in preparing samples, extracts, or digests for analysis
- Checks samples for proper preservation and maintains department sample receipt and chain-of-custody logs

4.2.1.9 Client Services Director

Specific responsibilities include, but are not limited to, the following:

- Coordinates marketing efforts with General Manager, Laboratory Director, Project Managers, and laboratory marketing group
- Supervises Project Managers
- Coordinates proposal and contract review and response process

- Responds to client inquiries

4.2.1.10 Project Manager

Specific responsibilities include, but are not limited to, the following:

- Serves as primary contact with client on individual job tasks
- Prepares work plans; schedules manpower allocations
- Initiates all procurement for each project
- Provides day-to-day coordination of the project team
- Coordinates financial and contractual aspects of the projects
- Provides formatting and technical review of all reports
- Provides day-to-day communication with the client
- Exercises final review and approval on all reports and invoices for the project
- Responds to post project inquiries

4.2.1.11 Custody Supervisor

Specific responsibilities include, but are not limited to, the following:

- Schedules bottle orders and supervises bottle prep staff
- Supervises sample custody staff
- Coordinates with Project Managers and Field/Sampling Supervisor on scheduling field sampling efforts
- Identifies and documents custody discrepancies and notifies Project Managers about custody problems

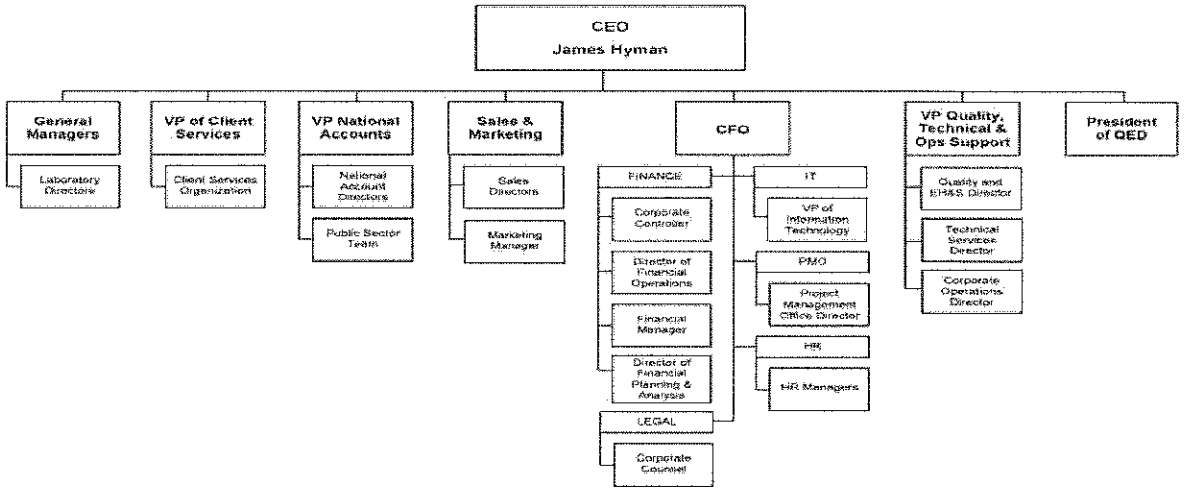
4.3 Deputies

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

Key Personnel	Deputy
Laboratory Director	Client Services Director
QA Manager	Laboratory Director
Operations Manager	Laboratory Director
Technical Director/Manager	Laboratory Director
EHS Coordinator	QA Manager

Figure 4-1. Corporate and Laboratory Organization Charts

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING



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TestAmerica
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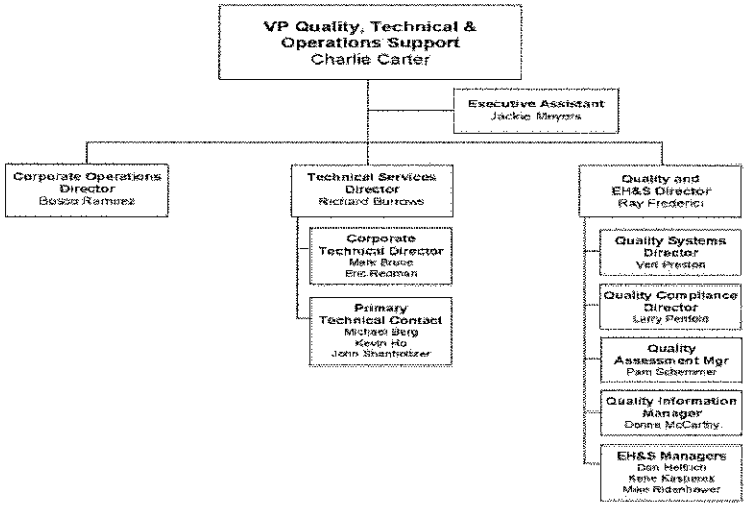
Quality, Technical, EH&S & Operations Support



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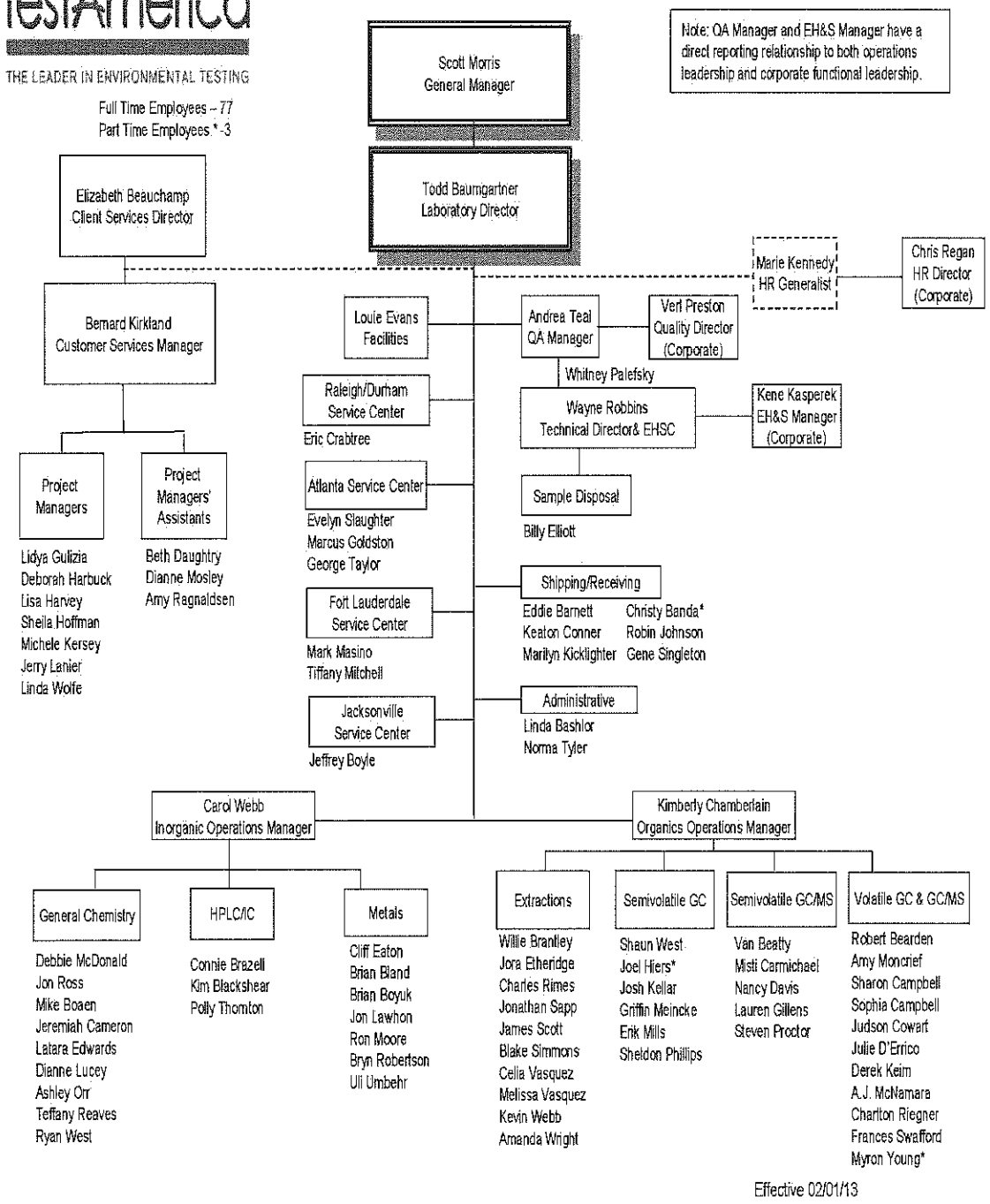
Note: QA Managers and EH&S Coordinators have direct reporting relationship to both operations leadership and corporate functional leadership

Savannah Laboratory Organization

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Full Time Employees – 77
Part Time Employees *-3

Note: QA Manager and EH&S Manager have a direct reporting relationship to both operations leadership and corporate functional leadership.



Effective 02/01/13

SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

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

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

5.2 Ethics and Data Integrity

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

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary. (Corporate SOP No. CW-L-S-002)
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Production of results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Presentation of services in a confidential, honest, and forthright manner.

- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 Quality System Documentation

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

- Quality Assurance Manual – Each laboratory has a lab-specific quality assurance manual.
- Corporate SOPs and Policies – Corporate SOPs and Policies are developed for use by all relevant laboratories. The policies described therein are typically incorporated into laboratory-specific SOPs, or the Corporate documents may be 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

5.3.1 Order of Precedence

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

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

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

5.4 QA/QC Objectives for the Measurement of Data

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

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

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

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

5.4.1 Precision

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

5.4.2 Accuracy

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

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be

documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

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

5.4.4 Comparability

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

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

5.4.5 Completeness

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

5.4.6 Selectivity

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

5.4.7 Sensitivity

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

5.5 Criteria for Quality Indicators

The laboratory maintains Method Limit Groups in TALS that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date,

is updated each time new limits are generated and are managed by the laboratory's QA Department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are contained in SOP SA-QA-17: *Evaluation of Batch QC Data*.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the 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 and stores these values in LIMS. If a method defines the QC limits, the method limits are used.

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

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

5.6.1 QC Charts

Control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (recommended annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.* The QA Manager evaluates control charts 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 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

6.1 Overview

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

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

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP SA-QA-01: *Document Control Program.*

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

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

6.2 Document Approval and Issue

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

Controlled documents are authorized by the QA Department. In order to develop a new document, an employee submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

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

Quality System Policies and Procedures will be reviewed at a minimum of every year and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, refer to SOP refer to SOP SA-QA-01: *Document Control Program.*

Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA Department. Electronic controlled copies are stored on the Public server in the QA folder for the applicable revision.

For changes to SOPs, refer to SOP SA-QA-01: *Document Control Program.*

Electronic copies of current documents (including QA Manuals, SOPs, Forms, Work Instructions, etc.) are maintained by the QA Department distributed electronically via the QA Navigator.

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, for hardcopy distribution, obsolete documents are collected from employees according to distribution lists and are destroyed. At least one copy of the obsolete document is archived according to SOP SA-QA-01: *Document Control Program.*

SECTION 7. SERVICE TO THE CLIENT

7.1 Overview

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

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

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

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

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

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

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

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

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

7.2 Review Sequence and Key Personnel

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

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements, and that the lab has the capacity to meet the clients turn around needs.

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

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above. The Project Manager then submits the final proposal to the client.

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

The Legal & Contracts Director and the local Proposal Coordinator maintain 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. These records are maintained by the Proposal Coordinator.

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.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before

and during the project. QA Department involvement may be needed to assist in the evaluation of custom QC requirements.

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 Project in LIMS 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, email, variance, contract addendum, which has been signed by both parties.

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

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

7.4 Special Services

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

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

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

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.

- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

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

Technical Managers, Operations Managers, Supervisors, and the QA Manager are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

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

7.7 Client Surveys

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

SECTION 8. SUBCONTRACTING OF TESTS

8.1 Overview

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

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOPs on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process (CA-C-S-001).

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

Project Managers (PMs), Customer Service Managers (CSM), or Account Executives (AE) (or others as defined by the laboratory) for the export lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts (e.g., certain USACE projects) may require notification prior to placing such work.

8.2 Qualifying and Monitoring Subcontracators

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

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task. Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an email from the client in the project folder.
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica. A listing of all approved subcontracting laboratories is available on the TestAmerica intranet site.

Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract laboratory. Verify necessary accreditation, where applicable, (e.g., on the subcontractor's TNI, A2LA accreditation or State Certification).

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

All TestAmerica laboratories are pre-qualified for worksharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an email is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential subcontract 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 acknowledgement that the samples can be sent to that facility (an email is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site and notify the finance group for JD Edwards.

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

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

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.

- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Laboratory Directors, QA Managers and Sales Personnel.

8.3 Oversight and Reporting

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

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

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

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

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

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

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

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

8.4 Contingency Planning

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

SECTION 9. PURCHASING SERVICES AND SUPPLIES

9.1 Overview

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

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

9.2 Glassware

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

9.3 Reagents, Standards & Supplies

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

9.3.1 Purchasing

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

9.3.2 Receiving

It is the responsibility of the Shipping and Receiving Department to receive the shipment. It is the responsibility of the analyst who ordered the materials to document the date materials are 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. 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

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

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

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

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).

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. Typically, the minimum total pressure should be 500psig or the tank should be replaced. To prevent a tank from going to dryness, close observation of the tank gauge must take place as pressure decreases towards 500psig, or the tank should 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 1µmho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and Technical Manager 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 may be verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

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

Records of manufacturer's certification and traceability statements are maintained electronically.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and Purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and it is added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate for the specific intended application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs) if a new method, and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained electronically.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Technical Manager.

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the 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 spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc. As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors.

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a JD Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Manager are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations, and products.

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

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

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

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following SA-QA-05: *Preventive and Corrective Action.*

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to SOP-SA-QA-05.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

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

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. 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 Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client requests that a special procedure be applied to a sample that is not standard laboratory practice. Based on a technical evaluation, the laboratory may accept or reject the request based on technical or ethical merit. Such a request would need to be approved by laboratory management and documented in the project files. Deviations to standard operating procedures must be noted in the final report.

11.2 Responsibilities and Authorities

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CW-L-S-002), outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to a member of Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, Operations Manager, QA

Manager, and the Technical Manager. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & Client Advocac,y and the laboratory's Quality Director within 24 hours of discovery.

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

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

11.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CW-L-S-002) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECOs and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

11.4 Prevention of NonConforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

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

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required, and will be concluded with a discussion of the

steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be provided by the laboratory to the appropriate member of Corporate QA, which serves as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc.). Clients will not generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, or determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (e.g., Laboratory Director, Technical Manager, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval may be given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using NonConformance Memos (NCM) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 General

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

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings.
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

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

12.3.1 Cause Analysis

- Upon discovery of a event requiring action, the event must be defined and documented. A CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technical Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

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

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager, Operations Manager, and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each CAR is entered into a database for tracking purposes.
- The QA Manager reviews monthly NCRs and CARs for trends. Highlights are included in the QA Monthly Report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCM.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, SOP SA-QA-17: *Evaluation of Batch QC Data* and the analytical SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA Monthly Report.

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

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

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

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

Figure 12-1.
Corrective Action Report

Section 1 **Summary of Problem / Finding**
Finding #: Summary: Date Due to Agency:
Section 2 **Initial Investigation Summary**
Investigation Question #1: • Is this issue chronic (i.e., were multiple instances cited, or is the potential for similar issues present), or acute (i.e., an isolated, anomalous, or non-routine occurrence)? Response:
Investigation Question #2: • Are other departments likely to be impacted? Response:
Investigation Question #3: • Can the root cause be readily established/addressed and action items identified without further inquiry, or is further action needed to perform a formal RCA Investigation and/or develop the Corrective Action Plan? Note: If the root cause can be readily established/addressed and action items identified without further inquiry, then Section 3 does not need to be completed provided additional details are included in response to Investigation Question #4, below. Response:
Investigation Question #4: • Are there any additional comments worth noting? If so, please include. Response:
Section 3 **Root Cause Analysis Summary**
RCA Investigation Lead: RCA Investigation Team Members, if applicable:

RCA Question #1:

- Why was this finding cited?

Options:

1. Procedure/policy does not exist, is not adequate, or is not accurate.
2. Procedure/policy is in place, adequate, and accurate; however, employee did not comply.
3. Other

Response:

RCA Question #2:

- What are some underlying causes for the conclusion drawn in RCA Question #1 (i.e., what are some Quality System weaknesses indicated by this issue that also need to be addressed)?

Note: There may be more than one underlying cause/weakness, and each underlying cause/weakness may in turn have other underlying causes/weaknesses.

Examples:

1. Insufficient or incomplete method validation procedures.
2. Trend analysis was not performed or is insufficient.
3. Insufficient or incorrect detail in SOPs; SOPs out of date; SOPs do not match current practice, etc.
4. Missing or inadequate mechanism to capture information (e.g., form, spreadsheet, Data Types, etc.).
5. Missing or inadequate training.
6. Insufficient employee oversight / supervision.
7. Ineffective primary data review process.
8. Ineffective self-monitoring process (e.g., notebook review, secondary data review, internal audits, etc.).
9. Personnel problem, insufficient resources, lack of attention to detail, etc.
10. Insufficient reagent traceability or control procedures.
11. Poor communication channels.
12. Improper or inadequate equipment maintenance procedures.
13. Ineffective Document Control mechanisms
14. Ineffective sample scheduling mechanisms, workflow, backlogs, etc.
15. Other

Response:

RCA Question #3:

- Is a Data Recall, an SOP revision, or additional training needed?

Response:

RCA Question #4:

- Are there any additional comments worth noting? If so, please include.

Response:

Section 4
Corrective Action Assignments

<<Based on the Initial Investigation and/or Root Cause Analysis Summary outlined above, what action items are needed to: 1) correct the original finding, and 2) minimize its recurrence? >>

Action Item #1:

Assigned Party:
Due Date:
Status:

Actions Taken:

Supporting Documentation Attached:

Section 5
Audit Response Documentation

Laboratory Response sent to agency on: XXXXX, attached here.

Section 6
Subsequent Information / Documentation Requests from Agency

Summary:

Assigned to:
Due Date:

Documentation attached here:

Section 7
Additional Close-Out / Follow-Up and Comments

A)
This finding pertains to an isolated and/or anomalous event. The corrective action taken is sufficient to address this issue. No further action or follow-up is needed at this time to close out this item.
Initial / Date:

B)
An additional routine follow-up assessment is required to evaluate the effectiveness of the corrective action taken.
Follow-up Assigned To:
Due Date:
Documentation Needed:
Items used to assess effectiveness/sustainability of corrective action:
<<Include AD batch numbers, attach example logbook pages, etc., as applicable.>>

Choose One:
a) Corrective action has been implemented and is effective.
b) Similar problems have been noted. The corrective action has not been effective. Additional action is required.
Initial / Date:

Table 12-1. General Corrective Action Procedures

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Instrument Blank *(Analyst)*	- Criteria in analytical SOP	- Prepare and analyze another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst)*	- Criteria in analytical SOP	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Initial Calibration Verification (Second Source ICV) *(Analyst)*	- Criteria within analytical SOP	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Verification (CCV) *(Analyst)*	- Criteria within analytical SOP	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst)*	- Criteria in LIMS MLGs	- If matrix interferences are present, evaluate the LCS. - If the LCS is within acceptable limits the batch is acceptable.
Laboratory Control Sample (LCS) *(Analyst)*	- Criteria in LIMS MLGs and SOP SA-QA-17	- Reanalyze LCS. - Batch must be re-prepared and/or re-analyzed.
Surrogates *(Analyst)*	- Criteria in LIMS MLGs	- Individual sample must be repeated, unless obvious matrix interference is noted.
Method Blank *(Analyst)*	<1/2RL	- Reanalyze blank. - Determine source of contamination. - Re-prepare/re-analyze batch.

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems, and corrective actions. Additionally, customer service and client satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the monthly QA Metrics Report, evaluation of internal or external audits, results and evaluation of proficiency testing (PT) performance, data analysis and review processing operations, client complaints, staff observation, etc.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance, and disposal of quality and technical records. A record index is listed in Table 14-1. Technical records are maintained by the laboratory departments in the Data Archival folder on the Public_QAdrive and are 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).

Table 14-1. Records Index[1]

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

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance Log, Instrument Run Log, Preparation Logs (standard and samples), Standard and Reagent Receipt Logs, Balance Calibrations, Temperature Logs, etc.
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Special Record Retention Requirements

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

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

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information. Electronic records are maintained in the Data Archival Folder on the Public_QA drive, or in another applicable drive (such as Q-drive or I-drive). Refer to SOP SA-QA-01: *Document Control Program* for specific information on the archival, storage, and back-up of records.

14.1.4 The recordkeeping system allows for historical reconstruction of all laboratory activities that produced the analytical data as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The chain of custody would indicate the name of the sampler.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set, etc. as per SOP SA-QA-01: *Document Control Program*. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument. Where an analysis is performed without an instrument, LIMS sheets, bound logbooks, bench sheets, or spreadsheets are used to record and file data. Standard and reagent information is recorded in the LIMS for each method.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 Technical and Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records, and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

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

- laboratory sample ID code;
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically 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.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates, and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the LIMS. Records are considered archived when noted as such in the records management system.

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

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

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS

15.1 Internal Audits

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

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits Comprised of: - QA Technical Audits, and - SOP Method Compliance	Joint Responsibility: a) QA Manager or designee, b) Technical Manager or designee (Refer to SOP No. CA-Q-S-004, Internal Auditing)	QA Technical Audits: 100% of methods biennially SOP Method Compliance: 100% of methods biennially (non-DOD SOPs) 100% of methods annually (DOD SOPs)
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness and sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

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

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every year. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities (new IDOC), reviews of the analyst work products will be performed.

15.1.4 Special Audits

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

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, Soil, UST.

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

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

15.2 External Audits

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

for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the laboratory's corrective action plan will be forwarded to Corporate Quality.

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

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

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

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

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

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

SECTION 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Quality Director, and the General Manager. 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 Senior Management Team and General Managers.

16.2 Annual Management Review

The senior laboratory management team (Laboratory Director, Operations Manager, QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives, and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel can be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-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 should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.

- Adequacy of policies and procedures.
- Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/Recall SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's COO, VP of Client & Technical Services, General Managers and Quality Directors receive a monthly report 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 laboratories.

SECTION 17. PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures, and records management.

Laboratory management is responsible for formulating goals for laboratory staff with respect to education, training, and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform, or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page. (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	Or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Directors/Department Managers – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Director – **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

Specialty	Education	Experience
Technical Director - Microbiology	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics (New Hires)	1 week of hire	All
Ethics (Comprehensive)	90 days of hire	All
Data Integrity	90 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics (Comprehensive Refresher)	Annually	All
Initial Demonstration of Capability (IDOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood, and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques, or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status and records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analyst's knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicating to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the SOP SA-QA-06: *Training Procedures*.

17.4 Data Integrity and Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive ethics training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CW-L-P-004) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.
Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 55,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, 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.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

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

18.3 Work Areas

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

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas available to ensure unencumbered work. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building keys and alarm codes are distributed to employees as necessary.

Employees wear photographic identification name cards while on the premises.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage, and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOP)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints, as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002 or the laboratory's SOP SA-QA-01: *Document Control.*
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*

- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability is performed whenever there is a change in instrument type (e.g., new instrumentation), method, or personnel (e.g., analyst hasn't performed the test within the last 12 months).

The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the

information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve, and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the laboratory informs the client of its procedure for working with unusual compounds.

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Refer to SOP SA-QA-06: *Training Procedures* for information on performing Initial Demonstrations of Capability (IDOC).

A certification statement (refer to Figure 19-1) can be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

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

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

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

19.6.1.5 Determination of Range

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

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

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

19.6.1.8 Continued Demonstration of Method Performance

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

19.7 Method Detection Limits (MDL) / Limits of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP No. SA-QA-07: *Determination and Verification of Detection and Reporting Limits (RLs, MDLs, and IDLs)* for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of instrument blanks and calculating 3 x the absolute value of the standard deviation.

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

19.9 Verification of Detection and Reporting Limits

Once the MDL is determined, it must be verified on each instrument used for the given method. TestAmerica defines the DoD QSM Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDLV standard is not successful, then the laboratory will redevelop their MDL or perform and pass two consecutive MDLVs at a higher concentration and set the LOD at the higher concentration. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to the laboratory SOP SA-QA-08 for further details.

The laboratory quantitation limit is equivalent to the DoD Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects. For DoD projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specified in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. T hese records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, and chromatography retention time windows.

19.12 Estimation of Uncertainty of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could

possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty" (i.e., the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2).

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5mg/L.

Refer to SOP SA-QA-17: *Evaluation of Batch QC Data* for more information on this topic.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., EPA 524.2, EPA 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client-specific, contractual Terms and Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the

reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the laboratory was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to non-homogenous samples, Encores/Terracores, and sodium bisulfate preserved samples.

19.14 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.15 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the TestAmerica LIMS System (TALS) which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.15.5.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails, and controlled access.

19.15.5.2 Ensure Information Availability: Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.15.5.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.15.6 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to approving the data in LIMS.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices* and SOP SA-QA-08: *Evaluation of Chromatographic Data.*

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.15.6.1 All raw data is retained in the laboratory benchsheets, computer file (if appropriate), and/or runlog. All criteria pertinent to the method are recorded. The documentation is recorded at the time observations or calculations are made and each person involved is readily identified.

19.15.6.2 In general, concentration results are reported in milligrams per liter (mg/L) or micrograms per liter (µg/L) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/L, results can be reported in percent, i.e., 10,000 mg/L = 1%. Units are defined in each laboratory SOP.

19.15.6.3 In general, results are reported to 2 significant figures on the final report.

19.15.6.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS, 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.

19.15.6.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically. Electronic data from instruments are saved electronically in a daily folder on the system (Target or instrument computer). For instruments that print out calibrations and concentrations, the data are retained with the data file. The data file is stored in the Archival Folder on the Public_QA. Periodically, these files are transferred to the server and, eventually, to a tape file.

19.15.7 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.)

19.15.7.1 Corrections are made following the procedures outlined in Section 12.

19.15.7.2 Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.

19.15.7.3 Unused portions of pages must be "Z"'d out, signed and dated.

19.15.7.4 Worksheets are created with the approval of the Technical Director/QA Manager at the facility. The QA Department controls all worksheets following the procedures in Section 6.

19.15.8 Review / Verification Procedures

Data review procedures are outlined in the analytical SOPs and SOP SA-QA-02: *Data Generation and Review* and ensure that data reported are free from calculation and transcription errors and that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing manual integrations to ensure the authenticity of the data (SOP SA-QA-08). The general review concepts are discussed below; more specific information can be found in the SOPs.

19.15.8.1 The data review process at TestAmerica Savannah starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information into the LIMS. The Project Management Assistant reviews the transaction of the chain-of-custody forms and inputs the required analyses. The Project Managers perform final review of the chain-of-custody forms and entered information.

19.15.8.2 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. The analysts transfer the data into the LIMS. To ensure data compliance, another analyst/supervisor performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blanks, initial and continuing calibrations, laboratory control samples, sample data, qualifiers, manual integrations, and spike information are evaluated. Issues that deem further review include the following:

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

19.15.8.3 Unacceptable analytical results may require reanalysis of the samples. Problems may be brought to the attention of the Laboratory Director, Project Manager, Operations Manager, Quality Assurance Director/Manager, Technical Manager, or Supervisor for further investigation, if needed. Corrective action is initiated whenever necessary.

19.15.8.4 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, data qualifiers are appropriate, and project-specific requirements are met. The following are some examples of chemical relationships that can be reviewed (if data is available):

- Total Results are $\geq$ Dissolved results (e.g. metals)
- Total Solids (TS) $\geq$ Total Dissolved Solids (TDS) or Total Suspended Solids (TSS)
- TKN $\geq$ Ammonia
- Total Phosphorus $\geq$ Orthophosphate
- COD $\geq$ TOC
- Total Cyanide $\geq$ Amenable Cyanide
- TDS $\geq$ individual anions

19.15.8.5 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 and sends to the client.

19.15.8.6 A visual summary of the flow of samples and information through the laboratory, as well as data review and validation, is presented in Figure 19-2.

19.15.9 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP No. SA-QA-08, entitled *Evaluation of Chromatographic Data*.

19.15.9.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.15.9.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

19.15.9.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.15.9.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Demonstration of Capability Documentation

TRAINING DOCUMENTATION FORM
DEMONSTRATION OF CAPABILITY

Laboratory Name: TestAmerica Savannah
Address: 5102 LaRoche Avenue
Savannah, GA 31404

Date Completed: _____

Analyst Name: _____

Prep Analyst Name (s): _____

Analytical Test Method: _____

Prep Method: _____

Matrix: ☐ Soil ☐ Aqueous ☐ Other

Analytical SOP Document Control Number: _____

Prep SOP Document Control Number: _____

Analyte, Class of Analytes, or Measured Parameters: _____

If PT Study is used as DOC, list the PT Number: _____

We, the undersigned, CERTIFY that:

1. The analysts identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program and/or other state and federal programs have completed the Demonstration of Capability.
2. The test method(s) was performed by the analyst(s) identified on this certification.
3. A copy of test method(s) and laboratory-specific SOPs are available for all personnel on-site.
4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility. The associated information is organized and available for review.

Technical Director's Name	Signature	Date

Quality Assurance Officer's Name	Signature	Date

FQA049:08.13.07:6

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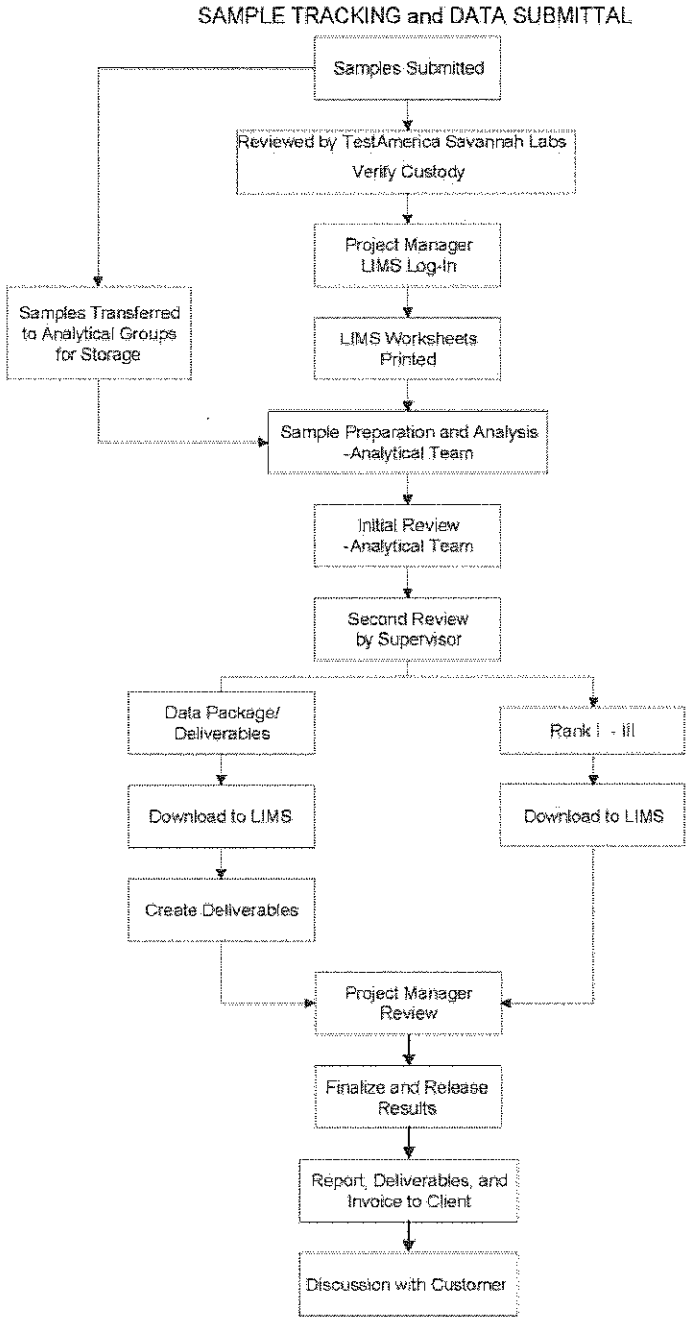
Figure 19-2. Work Flow



SECTION 20. EQUIPMENT AND CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures are also outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control (e.g. CCV run on *'date'* was acceptable, or

instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

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 laboratory operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage, or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult the analytical SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer at temperatures bracketing the range of use. IR thermometers, digital probes, and thermocouples are calibrated quarterly. IR Thermometers should be calibrated over the full range of use, including ambient, iced (4 degrees) and frozen (0 to -5 degrees), per the Drinking Water Manual.

The mercury NIST thermometer is recalibrated every three years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented electronically. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in equipment-specific logbooks or LIMS sample batches. More information on this subject can be found in SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use).*

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day – including weekends and holidays (i.e., 7 days a week).

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0°C and ≤ 6 °C.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and procedure-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A glassware and glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

Glass micro-syringes are considered the same as Class A glassware provided they are purchased with a manufacturer's certificate attesting to their accuracy. Micro-syringes are routinely purchased from Hamilton Company. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

Any device not regularly verified can not be used for any quantitative measurements.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration).

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed, if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify

the number of calibration standards, a minimum of 3 calibration points (an exception includes ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or a vendor-certified different lot if a second source is not available). For unique situations, such as EPA 1653 analyses, where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing standards are not required, only daily verifications are needed, unless specified by the reference method. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements. Refer to the specific SOPs for requirements. Most inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (e.g. GC/MS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed and documented, the laboratory shall demonstrate acceptable instrument/method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a) when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b) when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs.) Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spectrometer, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally do not need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Instrumentation List

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah Instrument List

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
ICP	Thermo Jarrell Ash (ICP D)	61E Trace	507990	1999	New
ICP	Varian (ICP E)	730-ES	IP0712M054	2008	New
ICP	Varian (ICP F)	730-ES	1P0803M118	2012	New
ICP/MS	Agilent (ICP/MS A)	Agilent 7500C G3155A	JP 10300403	2002	New
ICP/MS	Agilent (ICP/MS B)	Agilent 7500CE G3272A	JP 14101289	2005	New
ICP/MS	Agilent (ICP/MS C)	Agilent 7700x G3281A	JP10390615	2011	New
CVAA	Leeman (1)	HYDRA AA	2089	2003	New
CVAA	Leeman (2)	HYDRA AA II	00024	2011	New
GC/MS Semivolatiles	Hewlett-Packard (MS D)	5973/6890	US82311451	1999	New
GC/MS Semivolatiles	Hewlett-Packard (MS E)	5973/6890	US82311455	1999	New
GC/MS Semivolatiles	Hewlett-Packard (MS F)	5973/6890	US44647039	2004	New
GC/MS Semivolatiles	Hewlett-Packard (MS G)	5973/6890	US82311571	1999	New
GC/MS Semivolatiles	Hewlett-Packard (MS K)	5973/6890	CN10524062	2005	New
GC/MS Semivolatiles	Hewlett-Packard MS (N)	5973/6890	US72010580	1998	New
GC/MS Semivolatiles	Hewlett-Packard (MS R)	5973/6890N	21842170	2002	New
GC/MS Semivolatiles	Hewlett-Packard (MS T)	5973/6890	US33246115	2003	New
GC/MS Semivolatiles	Agilent (MS W)	5975/6890N	US10608004	2006	New
GC/MS Semivolatiles	Hewlett-Packard (MS X)	5975/6890N	CN10608061	2006	New
GC/MS Semivolatiles	Agilent (MS Y)	5975/7980A	US80838915	2008	New
GC/MS Volatiles	Hewlett-Packard (MS A)	5973/6890	US82311453	2000	New

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GC/MS Volatiles	Hewlett-Packard (MS B)	5973/6890	US82311452	2000	New
GC/MS Volatiles	Hewlett-Packard (MS C)	5975/7890	CN10917056	2012	New
GC/MS Volatiles	Hewlett-Packard (MS L)	5972/5890 II	3306A00159	1994	New
GC/MS Volatiles	Hewlett-Packard (MS M)	5972/5890 II	3251A00054	1992	New
GC/MS Volatiles	Hewlett-Packard (MS O)	5973/6890	US7200579	1993	New
GC/MS Volatiles	Hewlett-Packard (MS P)	5973/6890	US0039011	2000	New
GC/MS Volatiles	Hewlett-Packard (MS S)	5973/6890	US21843181	2002	New
GC/MS Volatiles	Agilent (MS U)	5973/6890	US52441057	2005	New
Ion Chromatograph	Dionex (IC F)	DX-500	02020190	2002	New
Ion Chromatograph	Dionex (IC G)	ICS-2000	05101132	2005	New
Ion Chromatograph	Dionex (IC H)	ICS-2000	06080799	2006	New
Ion Chromatograph	Dionex (IC J)	ICS-2000	9080225	2010	New
Ion Chromatograph	Dionex (IC K)	ICS-2000	0807011	2012	Used
GC Semivolatiles	Hewlett-Packard (SG I)	5890 II Plus (ECD)	3336A54128	2012	New
GC Semivolatiles	Hewlett-Packard (SG J)	6890 (ECD)	US00033184	2000	New
GC Semivolatiles	Hewlett-Packard (SG K)	6890 (ECD)	US10223085	2002	New
GC Semivolatiles	Hewlett-Packard (SG L)	5890 II Plus (ECD)	3033A31398	2000	Used
GC Semivolatiles	Hewlett-Packard (SG M)	5890 II Plus (ECD)	3336A51190	1993	New
GC Semivolatiles	Agilent (SG O)	6890N (NPD/FPD)	US10543005	2005	New
GC Semivolatiles	Agilent (SG Q)	6890N (FID)	CN10521056	2005	New
GC Semivolatiles	Hewlett-Packard (SG S)	6890 Plus (ECD)	US00024188	2000	New
GC Semivolatiles	Hewlett-Packard (SG X)	6890N (ECD)	CN10406086	2003	New

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GC Semivolatiles	Agilent (SG Y)	6890N (ECD)	CN10528081	2005	New
GC Semivolatiles	Agilent (SG Z)	6890N (ECD)	CN10814004	2008	New
GC Volatiles	Agilent (VG G)	6890 (FID)	14921	2007	New
GC Volatiles	Agilent (VG U)	6890 (FID)	US10439011	2005	New
GC Volatiles	Agilent (VG V)	6890 (FID)	CN10619098	2006	New
GC Volatiles	Agilent (VG W)	6890 (FID)	CN10603131	2006	New
Liquid Chromatography	Hewlett-Packard (LC J)	1100	JP63205060	2002	New
Liquid Chromatography	Hewlett-Packard (LC K)	1100	JP73016069	2002	New
Liquid Chromatography	Hewlett-Packard (LC N)	1100	JP73019052	2008	Used
General Chemistry	GENESYS	10UV	2G2E1410011	2002	New
General Chemistry	Hach (TURB1)	2100 AN	950400000487	1995	New
General Chemistry	Lachat (1)	QuickChem 8000	A83000-1070	1997	New
General Chemistry	Lachat (2)	QC 8500 Series 2	100200001169	2010	New
General Chemistry	Lachat (3)	QuickChem 8000	A8300-1086	2012	Used
General Chemistry	Milton Roy Spectronic (SPC1)	301	3802235017	1991	New
General Chemistry	Milton Roy Spectronic (SPC3)	301	20839	2009	Used
General Chemistry	Milton Roy Spectronic (SPC4)	200	1549/0412	2012	New
General Chemistry	Shimadzu	TOC-V CPN	H51404335036 CS	2006	New
General Chemistry	OI Solids	OI Solids	D110705896	2000	New
General Chemistry	Mitsubishi	TOX-10E	75C20047	1998	New
General Chemistry	Euroglass	ETS-1200	2001.068	2000	Used
General Chemistry	Mitsubishi	AOX-200	E7B20051	2011	New
General Chemistry	Mitsubishi	TOX-100	A7M42015	2005	New
General Chemistry	BOD AssayPlus	Version 3.0	270F6XB334	2006	New
General Chemistry	PCTitrate	Version 3.0	270G6XB370	2006	New
General Chemistry	Konelab (1)	Konelab20	M4218134	2000	New
General Chemistry	Konelab (2)	Konelab20	M3118114	2001	New

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SECTION 21. MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, deionized (DI) water systems, automatic pipettes, and other volumetric measuring devices. (Refer to Section 20.3.) With the exception of Class A Glassware and glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A glassware and glass microliter syringes should be routinely inspected for chips, acid etching, or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia-Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory. Refer to Section 21 for calibration of weights and thermometers.

A calibration laboratory's policy for achieving measurement traceability is defined and includes the subsequent elements of uncertainty. The calibration report or certificate contains 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. All calibration reports are filed in the QA Department.

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

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by A2LA or NVLAP with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as EPA 1653 analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be, at a minimum, the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained electronically. 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.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay

purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- 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)
- 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. T hese records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- LIMS Standard ID
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained electronically.

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container
- Recommended Storage Conditions

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and 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 specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

TestAmerica Savannah provides some sampling services. Sampling procedures are described in SOP SA-FD-05: *Field Sampling Procedures*.

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote, or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need

consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots and subsampling are located SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples.*

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time, and location of sampling
- Sample collecto'rs name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of

the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (e.g., Fed-Ex, UPS), the COC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by the laboratory when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

Additional information on the sample receipt process is given in SOP SA-CU-01: *Sample Receipt Procedures.*

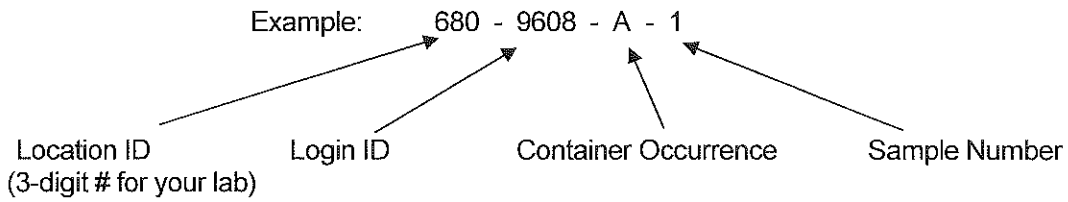
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on the Sample Receipt Checklist in LIMS and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at any time. This system includes identification for all samples, subsamples, and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Savannah is the laboratory (Location ID 680). The Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 680 - 9608 - A - 1 - **A** ←——— **Secondary Container Occurrence**

Example: 680-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);
- the Project Manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and route them to the appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

23.4 Sample Storage

In order to avoid deterioration, contamination, or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers, or protected locations suitable for the sample matrix. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, storage blanks are maintained in the volatile sample refrigerators and analyzed every week.

Analysts retrieve the sample container allocated to their analysis from the designated storage location, prepare or analyze the sample, and return the remaining sample to the storage location from which it originally came. All samples are scanned into and out of the storage locations using the LIMS sample custody program. Empty containers are scanned into the LIMS sample custody program as empty and are properly disposed of. All samples are kept for at least 30 days after the report is sent out, which meets or exceeds most sample holding times. After this time, the samples are properly disposed of in accordance with the Environmental Health and Safety Manual.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples and Foreign Soils

Upon receipt, foreign soil samples are marked with a fluorescent green "FOREIGN SOIL" label prior to distributing to the analytical departments. Once the sample is received by the department, it is stored in a "FOREIGN SOIL ONLY" box segregated from other samples. Non-hazardous foreign soil samples are sent out for incineration by a USDA-approved waste

disposal facility. RCRA hazardous foreign soil samples are heat treated at the laboratory. After heat treatment, normal disposal procedures are followed. Refer to SOP SA-QA-14: *Handling, Storage, and Disposal of Restricted Foreign and Domestic Soil Samples* and the Environmental Health and Safety Manual for additional information on disposal of hazardous samples. If not classified as hazardous, foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they did not inadvertently omit a key part of regulatory compliance testing.

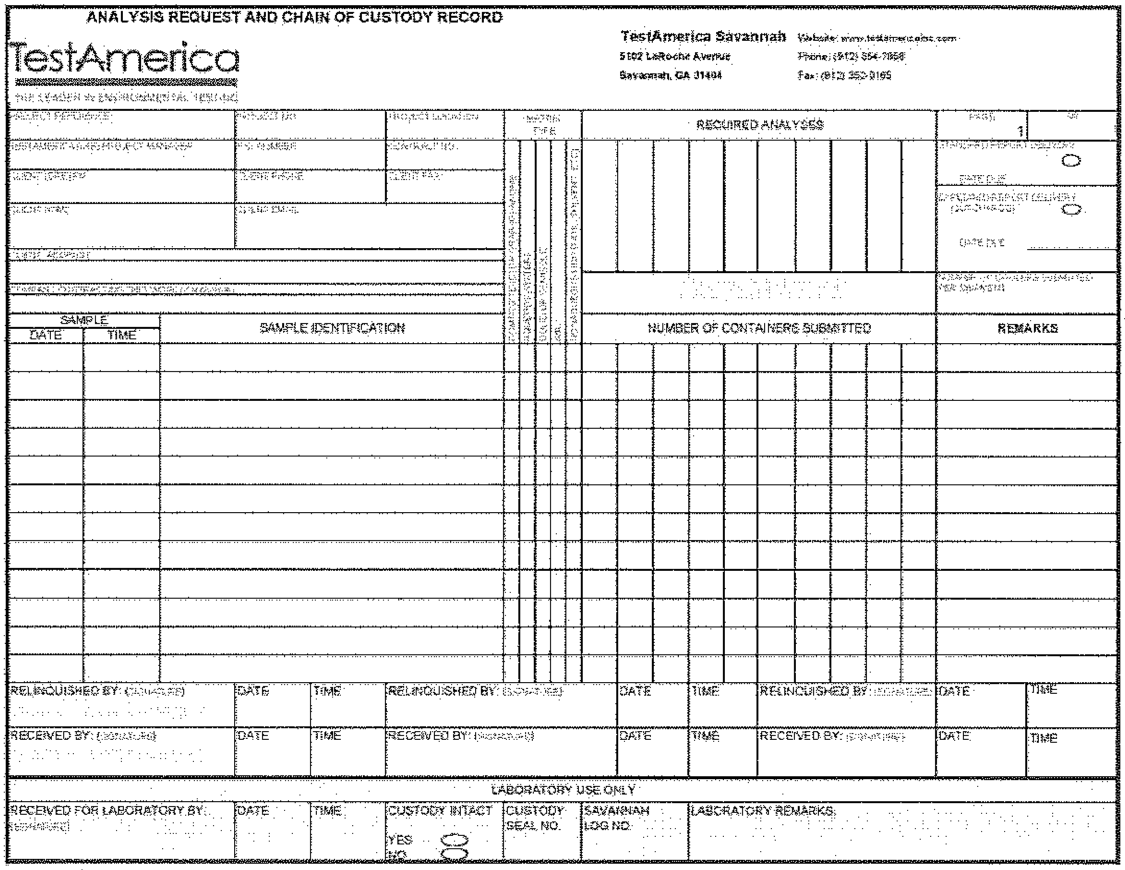
23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures outlined in the Savannah Addendum to the Environmental Health and Safety Manual. All procedures in the laboratory Environmental Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than three months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or

deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1. Chain of Custody (COC)



ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Phone: (912) 354-7858
Fax: (912) 352-0165

REQUIRED ANALYSES	PAGE 1	OF	
SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	NUMBER OF CONTAINERS SUBMITTED	REMARKS

RELINQUISHED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
RECEIVED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	CUSTODY INTACT YES NO	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS:

FCU352:01.02.08:2

Figure 23-2. Sample Acceptance Policy

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Sample Acceptance Policy

All samples will be evaluated against the criteria listed below. Samples which do not meet the criteria listed below will be qualified using the LIMS NCM Program and/or Sample Receipt Checklist.

1) Samples must arrive in good condition with a Chain-of-Custody filled out completely.

2) Samples must be properly labeled.

3) Samples must be in proper containers with adequate volume for the analysis.

4) Samples must be preserved according to the requirements of the requested analytical test method. Most analytical methods require chilling samples to 4°C. These criteria are met if the samples are chilled to below 6°C and above freezing. For methods with other temperature criteria (e.g. some bacteriological methods require ≤ 8°C), the samples must arrive within ± 2°C of the required temperature or within the method specified range.

   Note: Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5) Samples must be submitted with proper chemical preservation (pH) as required by the analytical test method.

6) Samples must be dechlorinated as required by the analytical test method.

7) Samples must be prepared and analyzed with the holding times defined in the analytical test method.

8) Samples submitted for Volatiles analyses must be submitted without headspace.

FCU058:10.15.08:0

Figure 23-3. Login Sample Receipt Checklist

Login Sample Receipt Check List

Client: TestAmerica Laboratories, Inc. Job Number:

SDG Number:

Login Number: **List Source:**

Creator:

List Number:

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background		
The cooler's custody seal, if present, is intact.		
The cooler or samples do not appear to have been compromised or tampered with.		
Samples were received on ice.		
Cooler Temperature is acceptable.		
Cooler Temperature is recorded.		
COC is present.		
COC is filled out in ink and legible.		
COC is filled out with all pertinent information.		
There are no discrepancies between the sample IDs on the containers and the COC.		
Samples are received within Holding Time.		
Sample containers have legible labels.		
Containers are not broken or leaking.		
Sample collection date/times are provided.		
Appropriate sample containers are used.		
Sample bottles are completely filled.		
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs		
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.		
If necessary, staff have been informed of any short hold time or quick TAT needs		
Multiphasic samples are not present.		
Samples do not require splitting or compositing.		
Is the Field Sampler's name present on COC?		
Sample Preservation Verified		

TestAmerica Savannah

SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying, and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	Used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	Prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	Blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 24-1. Example – Negative Controls

Control Type	Details
Trip Blank [1]	Required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	Sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	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.
Holding Blanks	Referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon method performance (e.g., Laboratory Control Sample), which entails both the preparation and measurement steps; and matrix effects (e.g., Matrix Spike or Sample Duplicate), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology, and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous

volatiles), or when all samples and standards undergo the same preparation and analysis process (such as phosphorus), a calibration verification standard is reported as the LCS.

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	Essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).

Table 24-3. Sample Matrix Control

Control Type	Details	
	Typical Frequency [1]	Added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSDs are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or surrogate spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary (recommended on an annual basis) unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (CCV) unless the analytical method specifies a tighter limit.

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- For routine analytes that are not classified as poor performers, the lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable).

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart may be visually inspected and, using professional judgment, they may be left unchanged if there is no effect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

The QA Department generates a Method Limit Group (MLG) in the LIMS that contains tables that summarize the precision and accuracy acceptability limits for analyses performed at TestAmerica Savannah. The MLG includes an effective date and is updated each time new limits are generated and entered. Unless otherwise noted, limits within these tables are laboratory generated. The LIMS maintains an archive of all limits used within the laboratory.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

- If there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed.
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (TNI).

Marginal exceedances should be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken.

Though marginal exceedances may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

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

25.2.1 A report title (e.g. Analytical Report) with a "Result" column header.

25.2.2 Each report cover page includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. Job number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Reporting limits

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Laboratory Director.

25.2.19 When TNI accreditation is required, the laboratory shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.20 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.21 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.22 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.23 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report, or preliminary report). A complete report must be sent once all of the work has been completed.

25.2.24 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.25 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory's accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

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

25.3 Reporting Level or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including QC results.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. All faxed reports are followed by hardcopy. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. TestAmerica Savannah offers a variety of EDD formats including Environmental Resources Program Information Management System (ERPIMS), Automated Data Review (ADR), Locus Focus (EIM), EQUIS ESBasic, Environmental Quality Information Systems (EQUIS), Staged Electronic Data Deliverable (SEDD), EPA Region V EDD (EDMAN), and Terrabase.

EDD specifications are submitted to the IT department by the Project Manager for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

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

25.4 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore,

information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

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

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to 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 sender immediately.

25.7 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained in the LIMS, as is the original report. The revised report is stored in the project files under the sample number followed by "Rev#" where # is the number of the report revision.

When the report is re-issued, the revision number is placed on the cover/signature page of the report or at the top of the narrative page. A brief explanation of reason for the re-issue and a reference back to the last final report generated may be included.

25.9 Policies on Client Requests for Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

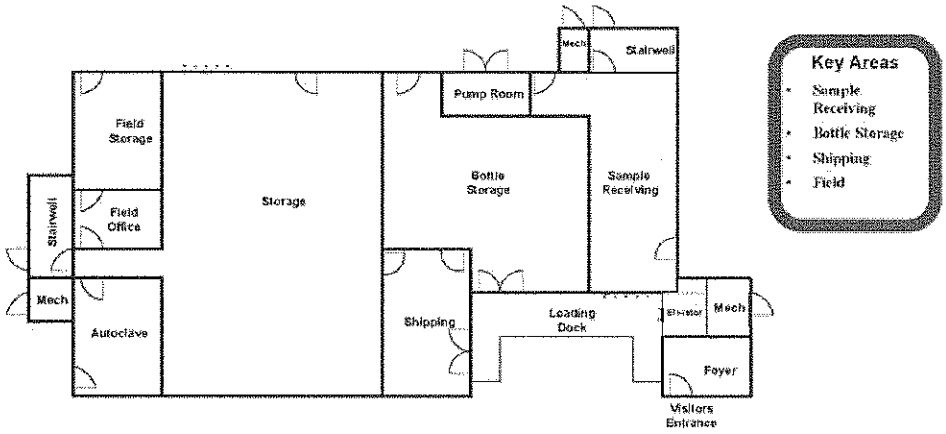
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan

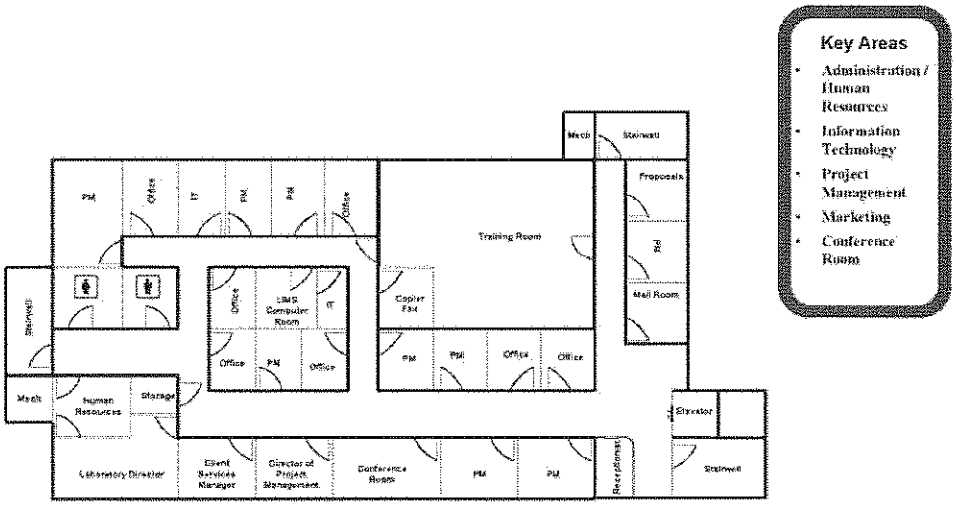
Floor Plan of Savannah



BUILDING 2 FIRST FLOOR
8, 400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

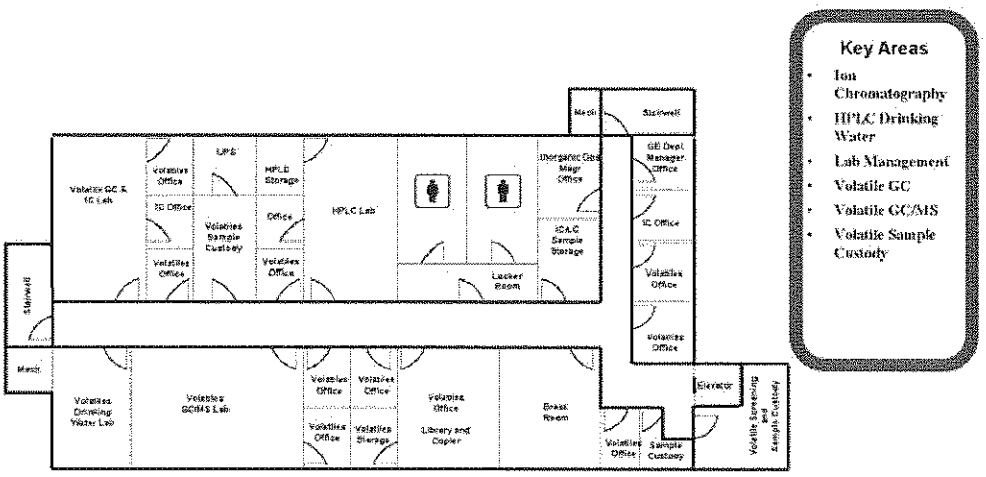
Floor Plan of Savannah



BUILDING 2 SECOND FLOOR
6,400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

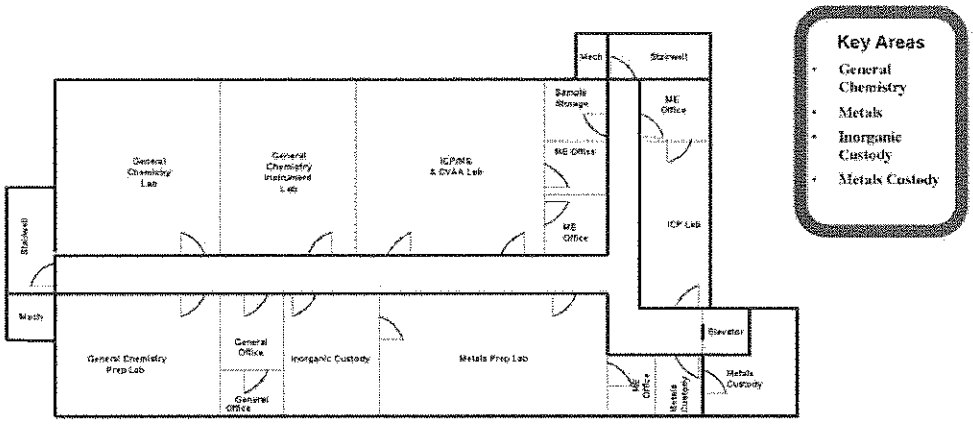
Floor Plan of Savannah



BUILDING 2 THIRD FLOOR
8,400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

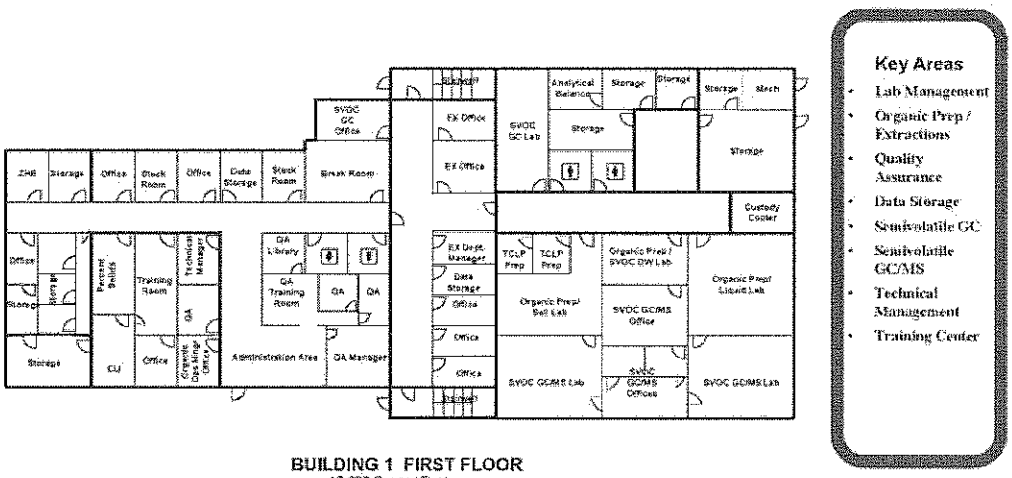
Floor Plan of Savannah



BUILDING 2 FOURTH FLOOR
8,400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

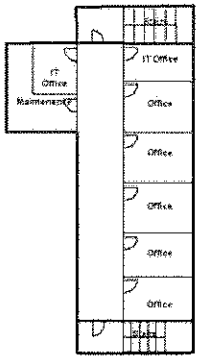
Floor Plan of TestAmerica Savannah



BUILDING 1 FIRST FLOOR
16,600 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Floor Plan of Savannah



Key Areas

- IT (Corporate)
- Maintenance

BUILDING 1 SECOND FLOOR
2,200 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Appendix 2. Glossary/Acronyms (EL-V1M2 Sec. 3.1)

Glossary:

Acceptance Criteria:
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation:
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (TNI)

Accrediting Authority:
The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (TNI)

Accuracy:
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Aliquot:
A representative portion of the sample, standard, or reagent.

Analyst:
The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (TNI)

Analyte:
The element, molecule, or compound that is being measured in a given procedure. Also referred to as a parameter.

Analytical Method:
Defines the sample preparation and instrumentation procedures that must be performed to determine the quantity of analyte in a sample.

Analytical Sequence:
The order in which calibration standards, verification standards, QC items, and samples are analyzed.

Analytical Spike:
Addition of a known concentration of analyte to an aliquot of sample after the preparation steps have been performed.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anion:
A negatively charged ion.

Anomaly:
Anomalous situations that are out of the ordinary but are not necessarily a method deviation and are not definitive enough to require a CAR are documented in the Non-Conformance Module. The use of the grand mean exception would require initiation of an Anomaly NCM.

Aromatic:
Relating to the six-carbon-ring configuration of benzene and its derivatives.

Assessment:
The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Assessment Team:
The group of people authorized to perform the on-site inspection and proficiency testing data evaluation required to establish whether an applicant meets the criteria for NELAP accreditation. (TNI)

Assessor:
One who performs on-site assessments of accrediting authorities and laboratories' capability and capacity for meeting NELAC requirements by examining the records and other physical evidence for each one of the tests for which accreditation has been requested. (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Background Correction:
A technique to compensate for variable background contribution to the instrument signal and the determination of trace metals.

Batch:
Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias:
The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank:
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Blind Sample:
A sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibration:
To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (TNI)

Calibration Check Compounds (CCC):
Term used in conjunction with SW-846, Method 8260 and 8270 to refer to the compounds in which the percent RSD is evaluated against method-prescribed criteria to decide the validity of a calibration.

Calibration Curve:
The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Method:
A defined technical procedure for performing a calibration. (TNI)

Calibration Standard:
A substance or reference material used to calibrate an instrument.

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. (TNI)

Cation:
A positively charged ion.

Chemical Analysis:
Any of a variety of laboratory methods used to evaluate the concentrations of compounds and elements present in an environmental sample.

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.

Client Complaint:
A complaint is a situation where dissatisfaction is expressed with the service provided by the laboratory.

Composite Sample:
Portions of material collected from more than one spatial location or at different times that are blended and submitted for chemical analyses. Composite samples can provide data representative of a large area with relatively few samples. However, the resulting data are less accurate with regard to the concentrations of contaminants detected in a specific location, because they represent average values.

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.

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (TNI)

Concentration:
The mass of analyte per unit mass or volume of sample. Common units of concentration for environmental analyses are microgram per liter or kilogram (ug/L or ug/kg) and milligrams per liter or kilogram (mg/L or mg/kg).

Confidence interval:
For normally distributed (random) data, the intervals where 68%, 95%, and 99% of the data fall. 68% of the data should fall within 1 standard deviation of the mean, 95% of the data should fall within 2 standard deviations of the mean, and 99% of the data should fall within 3 standard deviations of the mean.

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
(TNI)

Conformance:
An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Continuing Calibration Verification (CCV) Standard:
A mid-concentration analytical standard run periodically to verify the calibration of the analytical instrument. Also known as continuing calibration check (CCC).

Contract Laboratory Program (CLP):
A nationwide laboratory network established by the USEPA, structured to provide legally defensible analytical results to support USEPA enforcement actions or other requirements of the use community. The CLP incorporates a level of quality assurance appropriately designed for the intended usage of the data.

Control Limits:
Accuracy or precision ranges that determine whether the experimentally determined results are in control. If the results are within the acceptance ranges, the results are said to be in control; if the results are outside the limits, they are said to be out-of–control.

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)

Corrective Action Report (CAR):
The CAR form is used in situations where a recurring problem or breakdown in systems is observed and warrants a more thorough investigation than a single-event NCR. CARs may be initiated from: a specific nonconformance situation (NCM), an observed trend or frequency of events that warrant corrective action, an audit finding, etc.

Correlation Coefficient:
A number (r), which indicates the degree of dependence between two variables (concentration and response). The more dependent the variables are, the closer the value is to one. This value is used to evaluate the straightness of a line, (the linearity of the instrument).

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (TNI)

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)

Data Validation:
An evaluation of laboratory data quality based on a review of the data deliverables. This process involves procedures verifying instrument calibration, calibration verification, and other method-specific performance criterion.

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability (DOC):
Procedure to establish the ability to generate acceptable accuracy and precision. This is done initially upon starting a new method and then continues each year the method is performed.

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. (TNI)

Direct Aqueous Injection (DAI):
A technique in which an aliquot of the aqueous sample or aqueous leachate is injected directly into the gas chromatograph with no prior sample preparation.

Disposal:
Final placement or destruction of wastes. Disposal may be accomplished through the use of landfills, treatment processes, etc.

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)

E. coli:
Bacteria giving a positive total coliform response and possessing the enzyme B-glucuronidase, which cleaves the fluorogenic substrate MUG, resulting in the release of a fluorescent product when viewed under long-wavelength UV light.

Environmental Detection Limit (EDL):
The smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (TNI Radioanalysis Subcommittee)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Extractable Organics:
Semivolatiles (base/neutral and acid extractable compounds) and pesticide/polychlorinated biphenyl compounds that can be partitioned into an organic solvent from the sample matrix and are amenable to gas chromatography (GC).

Fecal Coliforms:
A subset of total coliforms that grow and ferment lactose at an elevated incubation temperature (44.5°C) and are also referred to as thermotolerant coliforms. Fecal coliforms produce colonies that appear in various shades of blue, domes and glistening, ranging in size from pinpoints to several millimeters. This group consists of mostly E. Coli (EC) but also includes some other enterics. Fecal coliforms are a more specific indicator organism for contamination. This type of bacteria is associated with the fecal material of warm-blooded animals.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA): The enabling legislation under 7 U.S.C. 135 et seq., as amended, that empowers the EPA to register insecticides, fungicides, and rodenticides. (TNI)

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 Control Samples:
General term assigned to field-generated replicates (duplicates/splits/spikes), blanks, background/upgradient samples, etc.

Field Duplicate Sample:
Independent sample collected at approximately the same time and place, using the same methods as another sample. The duplicate and original sample are containerized, handled, and analyzed in an identical manner.

Field of Testing:
TNI'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). (TNI)

Filtrate:
A filtered liquid.

Filtration:
The physical removal of solid particles from a liquid wastestream by passing the liquid across a filter medium, which serves as a barrier to the solid material.

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. (TNI)

Gas Chromatography/Mass Spectroscopy (GC/MS):
Two distinct analytical techniques used to separate and identify organic compounds: the GC is used for the separating portion and the MS is used as the detection portion of an analysis. Both techniques are typically performed by a single instrument.

Good Laboratory Practices (GLP):
Formal regulations for performing basic laboratory operations outlined in 40 CFR Part 160 and 40 CFR Part 729.

Heavy Metals:
In reference to environmental sampling, typically identified as the following trace inorganics: cadmium, lead, mercury, silver, etc. (all metals of health concern). Heavy metals can cause biological damage if consumed at low concentrations and tend to accumulate in the food chain.

Heterotrophic Bacteria:
A large group of bacteria that obtain energy by oxidizing organic matter. Coliform bacteria are a subset of this group.

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)

Homogeneous:
The quality of uniform composition.

Initial Calibration Verification (ICV):
A mid-concentration analytical standard run immediately after the calibration to verify the calibration of the analytical instrument. Also known as initial calibration check (ICC).

Inorganic Chemicals:
Chemical substances of mineral origin, not of basically carbon structure.

Inquiry:
A question or request for information about the service provided by the laboratory.

Inspection:
An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. (ANSI/ASQC E4-1994)

Instrument Blank:
A blank matrix that is the same as the processed sample matrix (i.e. extract, digestate, condensate) and introduced onto the instrument for analysis.

Instrument Detection Limit (IDL):
The minimum amount of a substance that can be measured on a specific instrument, with a specified degree of confidence that the amount is greater than zero. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. An IDL value, by definition, has an uncertainty of ±100%. The IDL thus represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Instrument Performance Check Solution (IPC):
A solution of one or more method analytes, surrogates, or other test substances used to evaluate the performance of the instrument system with respect to a defined set of criteria.

Intermediate or Secondary Stock Standard:
A solution made from two or more stock standards. A secondary standard may also be a certified solution purchased from a vendor as a mixture of several target analytes. Also known as a source reagent in LIMS if purchased and an intermediate reagent if prepared in the lab.

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. (TNI)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument 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.

Job number:
A sequential number that is assigned to each client's samples upon receipt into the laboratory. This log number provides the primary means of associating the samples to the client.

Laboratory:
A defined facility performing environmental analyses in a controlled and scientific manner. (TNI)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):
A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), there is no LCS. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Note: NELAC standards allow a matrix spike to be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. (TNI)

Laboratory Duplicate:
Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (TNI)

Laboratory Fortified Blank (LFB):
An aliquot of reagent water to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements at the required method detection limit. The percent recovery (accuracy) result for the LFB must fall within the limits listed in the LIMS. Also referred to as a laboratory control standard (LCS).

Laboratory Fortified Sample Matrix (LFM):
An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations. The percent recovery (accuracy) result for the LFM must fall within the limits listed in the LIMS. Also referred to as a matrix spike (MS).

Laboratory Fortified Sample Matrix Duplicate (LFMD):
A replicate laboratory fortified sample matrix.

Laboratory Performance Check Solution (LPC):
A solution of selected method analytes used to evaluate the performance of the instrumental system with respect to a defined set of method criteria.

Laboratory Quality Manual (LQM):
A document stating the quality policy, quality system and quality practices of the laboratory. The LQM may include by reference other documentation relating to the laboratory's quality system. Also referred to as the Quality Assurance Manual (QAM) or Quality Assurance Plan (QAP).

Laboratory Reagent Blank (LRB):
An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus. Also referred to as a method blank (MB).

Leachate:
The liquid portion of a sample that passes through a 0.6µm filter in the initial evaluation of the percent solids, or the liquid that passes through a 0.6µm filter after the sample has been subjected to the TCLP. The liquid produced by subjecting the sample to the SPLP method.

Least Squares Regression (1^{st} Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD):
An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Liquid phase:
The portion of the sample that passes through the 0.6-0.8□m filter when subjected to a pressure of 50psi during the TCLP or SPLP process.

Manager (however named):
The individual designed as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (TNI)

Mass Spectrometry (MS):
A detection instrument that differentiates compounds by their differences in mass, or mass fragments. The basic components of the MS are the ion source and lenses, the mass filter (quadrapoles), and the electron multiplier. The ion source and lenses create the ions and propel them on a consistent path to the quadrapoles. The quadrapoles filter the ions that are produced in the source, allowing them to continue to the electron multiplier, where the ions are collected and the signal sent to the data system.

Mass Spectra:
A graphical representation of the abundance of the mass ions produced when a compound is detected by mass spectrometry. The mass spectrum is essentially a fingerprint of the compound and along with the retention time of the compound provides excellent qualitative information about the presence of the compound.

Matrix:
The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (NELAC)

Matrix Duplicate (MD):
Duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate; Laboratory Duplicate.

Matrix Spike (spiked sample or fortified sample):
Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix spikes shall be performed at a frequency of one in 20 samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as, total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Matrix spike duplicates or laboratory duplicates shall be analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory shall document their procedure to select the use of an appropriate type of duplicate. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the duplicate. (QAMS)

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (TNI)

Method Detection Limit:
The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)
The MDL is defined as:

$$MDL = SD \otimes t(0.99)$$

SD = standard deviation of the replicates
t(0.99) = Student's t-Value at the 99% confidence level for number of replicates

Most Probable Number (MPN):
An estimate of the mean density of coliforms in a sample based on certain probability formulas.

National Environmental Laboratory Accreditation Conference (NELAC):
A voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (TNI)

National Environmental Laboratory Accreditation Program (NELAP):
The overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (TNI)

Neat standard:
A pure compound, element, or salt that contains the target analyte. The purity, usually expressed as a percent, of the neat standard must be known. Also known as a source reagent in LIMS.

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (TNI)

NELAC Standards:
The plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference. (TNI)

Non-conformance:
Any occurrence that prevents the lab from delivering data that is compliant with the control criteria published (or incorporated by reference) in an applicable QA plan. The Non-conformance Module is used to document nonconformance conditions and to specify the necessary action(s) taken to correct the specific problem.

Organic:
Referring to or derived from living organisms; any compound containing carbon.

Parts Per Billion (ppb):
One part of analyte per billion parts of sample. For aqueous samples, a ppb is equivalent to ug/L; for soils, ug/kg.

Parts Per Million (ppm):
One part of analyte per million parts of sample. For aqueous samples, a ppm is equivalent to mg/L; for soils, mg/kg.

Peak Gaussian Factor (PGF):
A means to measure peak symmetry and monitoring retention time drift over time. Critically evaluate peak in the instrument performance check sample, and calculate the PGF as follows,

$$PGF = \frac{1.83 \otimes W(1/2)}{W(1/10)}$$

where:
W(1/2) is the peak width at half height
W(1/10) is the peak width at tenth height

Percent Recovery:
Percent recovery is used to assess accuracy and is calculated:

$$\%REC = \frac{C\,\text{exp}\,erimental}{Cknown} \otimes 100$$

where:
$C_{experimental}$ = experimentally determined concentration
C_{known} = known or theoretical concentration

Percent Solids:
The proportion of solid in a soil sample determined by drying an aliquot of the sample.

Performance Audit:
The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (TNI)

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. (TNI)

pH:
A numerical designation of relative acidity or basicity (Alkalinity). A pH of 7 indicates neutrality; lower values indicate increasing acidity; high values indicate increasing alkalinity.

Precision:
The agreement between two or more experimentally determined results. Precision is routinely expressed as the relative percent difference between two results. Precision is not routinely used as a measurement to determine if the analysis is in control but may be required for certain programs and agencies.

Positive Control:
Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (TNI)

Post-Digestion Spike:
Addition of a known concentration of analyte to an aliquot of sample after the preparation steps have been performed.

Preservation:
Refrigeration and or reagents added at the time of sample collection to maintain the chemical, physical and/or biological integrity of the sample. Methods used to retard degradation of chemical analytes within samples by inhibiting decomposition by biological action, chemical reactions, and reducing sorption effects. Methods include limiting headspace, chemical, acid, or base addition, protection from light, cooling, etc.

Precision:
The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation:
Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (TNI)

Preventive Action:
The pro-active process of noting and correcting a potential problem before it happens due to a weakness in a system, method, or procedure.

Procedural Standard Calibration:
A calibration method where aqueous calibration standards are prepared and processed (e.g., purged, extracted, and/or derivatized) in exactly the same manner as a sample. All steps in the process from addition of sampling preservatives through instrumental analyses are included in the calibration. Using procedural standard calibration compensates for any inefficiency in the processing procedure.

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program:
The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the 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. (TNI)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC (ANSI/ASQC-E-41994)

Quantitation Limit (QL):
The lowest point at which a substance can be quantitatively measured with a specified degree of confidence using a specific method. The QL can be based on the MDL, and is generally calculated as 3-5 times the MDL, however, there are analytical techniques and methods where this relationship is not applicable. Also referred to as Practical Quantitation Level (PQL) or Reporting Limit (RL).

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. (TNI)

Range:
The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data:
Any original information from a measurement activity or study recorded in laboratory notebooks, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic/optical media, including dictated observations, and recorded data from automated instruments. Reports

specifying inclusion of "raw data" do not need all of the above included, but sufficient information to create the reported data.

Reagent:
A material that is used in a process or analysis but is not directly related to the measured analyte concentration.

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. (TNI)

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)

Regulatory Threshold Limit:
The concentration of analyte in the TCLP leachate at which the sample is deemed hazardous.

Relative Percent Difference:
The relative percent difference is calculated between the concentrations of two spikes or sample duplicates:

$$\%RPD = \left| \frac{(C1 - C2)}{\frac{C1 + C2}{2}} \right| \otimes 100$$

Where:
C_1 = concentration of the sample or spike
C_2 = concentration of the sample duplicate or spike duplicate

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. (TNI)

Reporting Limit (RL):
Defines the lowest concentration that can be reported with reasonable certainty that the result falls within the laboratories' accuracy and precision limits. Also referred to as the practical quantitation limit or PQL, the RL is usually defined as the lowest point in the calibration curve or the sample equivalent concentration of the lowest point in the calibration curve.

Representativeness:
A qualitative measure of the extent to which a sample(s) acquired from a medium describes the chemical characteristics of that medium.

Requirement:
Denotes a mandatory specification; often designated by the term "shall". (TNI)

Resolution:
Also known as separation, or percent resolution. The separation between peaks on a chromatogram, calculated by dividing the depth of the valley between the peaks by the peak height of the smallest peak being resolved, and multiplied by 100.

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. (TNI)

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. (TNI)

Sample:
A portion of material collected for chemical analyses. Note that a sample is identified by a unique sample number and that the term and the number may apply to multiple sample containers, if a single sample is submitted for a variety of chemical analyses.

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)

Sampling and Analysis Plan (SAP):
A formal document describing the detailed sampling and analysis procedures for a specific project.

Second Order Polynomial Curve (Quadratic): The 2^{nd} order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2^{nd} order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.990.

Secondary or Intermediate Stock Standard:
A solution made from two or more stock standards. A secondary standard may also be a certified solution purchased from a vendor as a mixture of several target analytes. Also known as a source reagent in LIMS if purchased and an intermediate reagent if prepared in the lab.

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)

Semivolatile Organics:
Compounds that are amenable to analysis by extraction of the sample with an organic solvent. The term semivolatile organic is used synonymously with base/neutral/acid (BNA) compounds.

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Solvent:
The organic liquid used to extract the compounds of interest out of the sample matrix. The solvent is also used to dissolve (put into solution) standards. In general, the solvent used to prepare the standards is also used to extract the samples. A good rule of thumb is that "like dissolves like", that is, a solvent must be similar in chemical structure to the compound that is being extracted or being dissolved. For most organic extractions, the solvent should also not be miscible (dissolves in all proportions) with water.

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, a representative number (at a minimum 10%) of the listed components may be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period. (TNI)

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of TNI 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)

Stock standard:
A solution made from one or more neat standards. The stock standard will usually have a high concentration, usually higher than 1000mg/L (1000ug/mL). This standard can also be purchased from a certified vendor. Also known as a source reagent in LIMS.

Storage Blank:
A blank matrix stored with field samples of a similar matrix.

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. (TNI)

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Suspended Metals:
The concentration of metals determined in the portion of a sample that is retained on a 0.45-μm filter. (The concentration of suspended metals may also be calculated from the difference between the total metals sample results minus the dissolved metals sample results.)

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)

System Performance Check Compounds (SPCCs):
Term used in conjunction with SW-846, Method 8260 and 8270, to refer to the compounds in which the response factor (RF) is evaluated against method-prescribed criteria to decide the validity of a calibration.

Target Analyte List (TAL):
Refers to the Contract Lab Program (CLP) list of inorganic analytes that includes metals and cyanide. May also refer to any general list of inorganic target analytes.

Target Compound List (TCL):
Refers to the Contract Lab Program (CLP) list of organic compounds that includes volatiles (GC/MS), semivolatiles (GC/MS), and pesticides and PCBs (GC/EC). May also refer to any general list of organic target compounds.

Technical Director:
Individuals(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (TNI)

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. (TNI)

Total Coliforms:
Gram-negative, facultative anaerobic rod-shaped enteric bacteria that ferment lactose to produce colonies with a metallic sheen (yellow to green) when viewed under a fluorescent lamp or acid and gas within 48 hours incubated at 35°C. All bacteria possessing the enzyme B-D-galactosidase, which cleaves the chromogenic substrate ONPG, resulting in release of a chromogen that produces a color change in the sample. They are used as an indicator of contamination in samples although some total coliform bacteria are found naturally in environmental samples. This type of bacteria is commonly found in the intestines of humans.

Total Metals:
Concentration of metals determined in an unfiltered water sample which is preserved (acidified) in the field, transported to the laboratory, and then follows a rigorous digestion.

Total Recoverable Metals:
Concentration of metals in an unfiltered water sample which is preserved (acidified) in the field and transported to the lab, which then performs the digestion with hot dilute mineral acid. This preparation method is typically utilized for drinking water samples and TCLP extracts.

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. (TNI)

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)

Trip Blank:
Samples prepared by adding clean, analyte-free water to sample containers for analysis for volatile organics. Preservatives are added to the blank, and the containers are sealed prior to the sampling trip. Trip blanks are transported with empty sample containers to the site of work and remain sealed until analyzed with collected environmental samples. Trip blanks permit evaluation of contamination generated from sample containers or occurring during the shipping and laboratory storage process.

Tune:
To adjust the parameters of the mass spectrometer in order to meet the mass calibration criteria.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

United States Environmental Protection Agency (EPA):
The Federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation:
The process of substantiating specified performance criteria. (EPA-QAD)

Verification:
Confirmation by examination and provision of evidence that specified requirements have been met. (TNI)

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Volatile Organic Compound (VOC):
An organic compound that is amenable to purge and trap analysis. In general, VOC have low boiling pints (<200°C), high vapor pressures (tend to evaporate easily as low temperatures), and have low molecular weight (generally less than 300amu).

Work Cell:
A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented. (NELAC)

Working Standard:
The standard that is analyzed on the instrument or using the analytical procedure. Also known as an intermediate reagent in LIMS.

Acronyms:

ACRONYM	DEFINTION
A2LA	American Association for Laboratory Accreditation
AA	Atomic Absorption
AFCEE	Air Force Center for Environmental Excellence
AL	Action Level
ASTM	American Society for Testing and Materials
BFB	Bromofluorobenzene
bgs	Below Ground Surface
BNA	Base, Neutral, Acids (Semivolatile Organics)
BOD	Biochemical Oxygen Demand
BS	Blank Spike
BSD	Blank Spike Duplicate
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
BTU	British Thermal Unit
CA	Corrective Action
CAA	Clean Air Act
CAR	Corrective Action Report
CBOD	Carbonaceous Biochemical Oxygen Demand
CCB	Continuing Calibration Blank
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CDC	Continuing Demonstration of Capability
CDOC	Continuing Demonstration of Capability
CDQO	Chemical Data Quality Objective
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act

ACRONYM	DEFINTION
MRF	Method Request Form
MRL	Method Reporting Limit
MS	Mass Spectrometer
MS	Matrix Spike
MS/MS	Tandem Mass Spectrometry
MSA	Method of Standard Additions
MSD	Matrix Spike Duplicate
MSDS	Material Safety Data Sheet
MW	Monitoring Well
NBS	National Bureau of Standards
NCASI	National Counsel for Air and Stream Improvement, Inc.
NCM	Non-Conformance Module
NCR	Non-Conformance Report
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
nm	Nanometer
NPD	Nitrogen – Phosphorus Detector
NPDES	National Pollutant Discharge Elimination System
NPW	Non-Potable Water
ORO	Oil Range Organics
OSHA	Occupational Safety and Health Administration
OSTR	Outstanding SOP Training Report

ACRONYM	DEFINTION
CF	Calibration Factor
CFR	Code of Federal Regulations
CLLE	Continuous Liquid-Liquid Extraction
CLP	Contract Laboratory Program
COA	Certificate of Analysis
COC	Chain of Custody
COD	Chemical Oxygen Demand
CRDL	Contract Required Detection Limit
CRF	Change Request Form
CRQL	Contract Required Quantitation Limit
CSM	Corporate Safety Manual
CU	Custody
CVAA	Cold Vapor Atomic Absorption
CWA	Clean Water Act
DAI	Direct Aqueous Injection
DFTPP	Decafluorotriphenylphosphate
DM	Department Manager
DO	Dissolved Oxygen
DOC	Demonstration of Capability
DOD	Department of Defense
DOD QSM	Department of Defense Quality Systems Manual
DOE	Department of Energy
DOT	Department of Transportation
DQO	Data Quality Objective
DRO	Diesel Range Organics
DU	Duplicate
DUP	Duplicate
DW	Drinking Water
ECD	Electron Capture Detector
EDD	Electronic Data Deliverable
EDQM	Environmental Data Quality Management
EHS	Environmental Health and Safety
EHSM	Environmental Health and Safety Manual

ACRONYM	DEFINTION
PAH	Polynuclear Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCB	Polychlorinated Biphenyl
PDA	Photodiode Array
PDS	Post Digestion Spike
PE	Performance Evaluation
PGF	Peak Gaussian Factor
PID	Photoionization Detector
PM	Project Manager
PNA	Polynuclear Aromatic Hydrocarbon
PP	Project Plan
ppb	Parts Per Billion
PPE	Personnel Protective Equipment
PPL	Priority Pollutant List
ppm	Parts Per Million
ppq	Part Per Quadrillion
ppt	Parts Per Trillion
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goals
PT	Proficiency Test
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
PW	Potable Water
PWS	Public Water System
QA	Quality Assurance
QAM	Quality Assurance Manager
QAM	Quality Assurance Manual
QAMP	Quality Assurance Management Plan
QAN	Quality Assurance Navigator
QAP	Quality Assurance Plan
QAPjP	Quality Assurance Project Specific Plan
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist

ACRONYM	DEFINTION
ELCD	Electrolytic Conductivity Detector
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
eV	Electron Volt
FID	Flame Ionization Detector
FPD	Flame Photometric Detector
GALP	Good Automated Laboratory Practices
GC	Gas Chromatograph or Gas Chromatography
GC/MS	Gas Chromatograph/Mass Spectrometer
GE	General
GFAA	Graphite Furnace Atomic Absorption
GLP	Good Laboratory Practices
GPC	Gel Permeation Column (Gel Permeation Chromatography)
GRO	Gasoline Range Organics
HAA	Haloacetic Acids
HAPS	Hazardous Air Pollutants
HAZMAT	Hazardous Materials
HDPE	High Density Polyethylene
HECD	Electrolytic Conductivity Detector
HPLC	High Performance Liquid Chromatography
HRGC/HRMS	High Resolution Gas Chromatography/Hugh Resolution Mass Spectrometry
HT	Holding Time
HTRW	Hazardous, Toxic, and Radioactive Waste
HTV	Holding Time Violation
IC	Ion Chromatography
IC/EC	Ion Chromatography/Electric Conductivity
IC/MS	Ion Chromatography/Mass Spectrometer

ACRONYM	DEFINTION
QC	Quality Control
QCS	Quality Control Sample
QCSR	Quality Assurance Summary Report
QL	Quantitation Limit
QMP	Quality Management Plan
QSM	Quality Systems Manual
RCRA	Resource Conservation Recovery Act
RF	Response Factor
RI	Remedial Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RT	Retention Time
RTW	Retention Time Window
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SD	Standard Deviation
SD	Sample Dilution
SD	Sample Duplicate
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SG	Semi Volatile Gas Chromatography
SIM	Selected Ion Monitoring
SM	Semi Volatile Mass Chromatography
SOC	Synthetic Organic Compound

ACRONYM	DEFINTION
ICAP	Inductively Coupled Argon Plasma Emission Spectroscopy
ICB	Initial Calibration Blank
ICCS	Interference Calibration Check Sample
ICOC	Internal Chain of Custody
ICP	Inductively Coupled Plasma
ICP/MS	ICP/Mass Spectrometer
ICS	Interference Check Sample
ICV	Initial Calibration Verification
IDC	Initial Demonstration of Capability
IDL	Instrument Detection Limit
IDOC	Initial Demonstration of Capability
IH	Industrial Hygiene
IPC	Instrument Performance Check Standard
IR	Infrared Radiation
IS	Internal Standard
ISO	International Standards Organization
ISTD	Internal Standard
LC	Liquid Chromatography
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LFB	Laboratory Fortified Blank
LFM	Laboratory Fortified Matrix
LFMD	Laboratory Fortified Matrix Duplicate
LIMS	Laboratory Information Management System
LM	Laboratory Manager
LOD	Limit of Detection
LOQ	Limit of Quantitation
LPC	Laboratory Performance Check
LQM	Laboratory Quality Manual
LRB	Laboratory Reagent Blank
LUFT	Leaking Underground Fuel Tank
LUST	Leaking Underground Storage Tank

ACRONYM	DEFINTION
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compound
SPE	Solid Phase Extraction
SPLP	Synthetic Precipitation Leaching Procedure
SR	Shipping and Receiving
SRM	Standard Reference Material
SS	Suspended Solids
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVOC	Semi Volatile Organic Compound
SW-846	Solid Waste Analytical Protocols
TAL	Target Analyte List
TAT	Turn-Around-Time
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Total Dissolved Solids
TEPH	Total Extractable Petroleum Hydrocarbons
THM	Trihalomethanes
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TM	Technical Manager
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TS	Total Solids
TSD	Thermionic Specific Detector
TSS	Total Suspended Solids
TVPH	Total Volatile Petroleum Hydrocarbons
TVS	Total Volatile Solids
UCL	Upper Confidence Level

ACRONYM	DEFINTION
MB	Method Blank
MB	Microbiology
MBAS	Methylene Blue Active Substances
MCL	Maximum Contaminant Level
MCT	Maximum Conductivity Threshold
MD	Matrix Duplicate
MDL	Method Detection Limit
ME	Metals
µg/L	Microgram per Liter
mg/L	Milligram per Liter
MLG	Method Limit Group
µm	Micrometer
MPN	Most Probable Number

ACRONYM	DEFINTION
UCMR	Unregulated Contaminant Monitoring Rule
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Service
UST	Underground Storage Tank
UV	Ultraviolet
VG	Volatile Gas Chromatography
VM	Volatile Mass Chromatography
VOA	Volatile Organic Analysis / Volatile Organic Analyte
VOC	Volatile Organic Compound
ZHE	Zero Headspace Extraction

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Savannah performs work from clients located throughout the United States, as well as in some foreign countries. Most states and/or federal agencies maintain a laboratory accreditation program that requires a laboratory to obtain certification with their agency. To obtain certification, a laboratory must maintain an effective quality system that meets the requirements of the agency. Common components of the quality system requirements include maintaining up-to-date standard operating procedures (SOPs) and a Quality Assurance Manual (QAM); participating in a Proficiency Testing (PT) program; performing method detection limit (MDL) studies, initial and continuing demonstrations of capability studies (IDOCs/CDOCs), and internal assessments; and completing an annual renewal application. In addition to the requirements needed for certification, many agencies have specific analytical and/or reporting requirements that laboratories must follow.

Many agencies offer certification via reciprocity. Reciprocity is the acknowledgement of another state and/or agency's certification program. The most common types of reciprocity are homestate reciprocity and TNI (NELAC) reciprocity.

Lab Management, Project Management, Sales & Marketing, and the QA Manager may initiate requests for certification or accreditation. The QA staff completes the administrative tasks associated with the application and maintains the related documents in accordance with SOP SA-QA-01: *Document Control Program.*

Laboratory management has the responsibility and authority to ensure that laboratory operations are in compliance with program and regulatory requirements of the jurisdiction for which laboratory certification/accreditation is sought and maintained.

To perform compliance work in a particular state, the laboratory must maintain certification for the reported analytes. Most accrediting authorities will certify laboratories on a matrix/method/analyte level. For example:

Soil / EPA 8260B / benzene
Water / EPA 624 / toluene

Generally, laboratories must apply and submit supporting documentation (SOPs, MDLs, IDOCs, PTs, etc.) for each individual matrix/method/analyte combination.

1.0 Obtaining Certification

1.1 Certification Application Process

Lab Management, Project Management, Sales & Marketing, and the QA Manager may initiate requests for certification or accreditation. The application is obtained, reviewed, and completed by the QA Manager or designee. Sections of the application may be

distributed as appropriate to various staff members to assist in completion.

The certifying agency's regulations should be carefully reviewed at the time of application to ensure any non-routine requirements are communicated to the laboratory.

The QA Manager consults with Lab Management, Project Management, and the Sales & Marketing Staff to determine if additional methods should be added to the current laboratory certification in order to support existing and future work as the laboratory's capabilities change.

1.2 Reciprocity

Reciprocity is a means of acknowledging another agency's certification via mutual agreements between certifying agencies. Many certifying agencies offer some type of reciprocal certification. The most common types of reciprocity are based on either TNI (NELAC) certification or homestate certification.

Homestate reciprocity refers to another state's certifying agency allowing a laboratory to perform work in that state, provided that the laboratory maintains accreditation within the state in which it resides.

TNI refers to The NELAP Institute which governs the NELAP Standard document outlining Quality System and laboratory functions and requirements. NELAP refers to the National Environmental Laboratory Accreditation Program. Many states will acknowledge a laboratory's TNI accreditation from another state.

Note: Reciprocal agreements between states do not afford a "blanket" certification. To obtain reciprocal certification, a laboratory must still apply for accreditation, submit all required application materials, and receive notification of certification – usually in the form of a certificate - from the reciprocal agency.

1.3 Records Maintenance

A copy of the original application, certificate, and related materials are maintained in accordance with SA-QA-01: *Document Control Program.* Copies of current certifications are kept in the Certifications folder on the public G-drive, which is accessible to all laboratory staff. In addition, copies of current laboratory certifications from Savannah and other TestAmerica facilities are maintained in the Proposal Library on the TestAmerica Oasis website and in the TotalAccess marketing tool. These documents may be required to support subcontracting and marketing activities.

1.4 Maintaining Certification

Most states require continued evidence of an effective Quality System in order for a laboratory to maintain certification. In addition to annual renewal applications, laboratories are often required to complete bi-annual PT studies with acceptable results obtained for each certifiable matrix/method/analyte combination. Annual MDL and continued demonstrations of analyst capability are also routinely required, in addition to on-site assessments.

1.5 Certification Tools and Records

There are several tools in place to aid laboratory staff in determining what certifications the laboratory maintains and understanding any state-specific analytical and/or reporting requirements.

1.5.1 Total Access

Total Access is a tool that can aid in determining which certifications the laboratory maintains. This tool does not track to the analyte level, but can still be useful in the pre-project planning process.

1.5.2 State and Project Requirement Summaries

Some states and/or projects have specific analytical and/or reporting requirements. A summary of these requirements is kept in the State and Project Requirement Summary on the G-drive. These requirements must be reviewed by project management and laboratory staff prior to initiating work. The Project Manager must clearly note in the LIMS Worksheet Notes and/or Project Plan if the Project Requirement Summary (PRS) is to be followed.

1.6 Information Resources

1.6.1 Agency Information

The QA staff maintains a controlled access database that lists current contact information for the agency that oversees laboratory certification as well as the regulatory programs that are offered for certification by the agency. This information may be provided as a resource to Lab Management, Project Management, Corporate QA, and the Sales & Marketing staff.

1.6.2 Certification Matrix

The QA Department ensures that the certification matrix maintained on Total Access is current. The QA Department ensures that the Certification Summary in the Proposal Library on the TestAmerica Oasis website is kept current.

1.6.3 Certification / Accreditation Maintenance Requirements

Laboratory Management is responsible for ensuring that laboratory operations are in compliance with the regulatory and certification program requirements for the jurisdiction in which certification is maintained.

The QA Department is responsible for maintaining up to date applications and program information including program specific regulations and requirements.

Project Management is responsible for verifying certification of analytes and methods requested by the client prior to accepting work and should be familiar with the state-

specific requirements of that state.

1.7 Certifications Listing

At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

Authority	Certification Number or Laboratory ID Number
A2LA (DoD ELAP)	0399-01
A2LA (ISO/IEC 17025)	399.01
Alabama	41450
Arkansas	88-0692
California	3217CA
Colorado	N/A
Connecticut	PH-0161
Florida	E87052
Georgia	803
Georgia EPD	N/A
Guam	09-005r
Hawaii	N/A
Illinois	200022
Indiana	N/A
Iowa	353
Kentucky	90084
Kentucky UST	18
Louisiana	30690
Louisiana	LA100015
Maine	GA00006
Maryland	250
Massachusetts	M-GA006
Michigan	9925
Mississippi	N/A
Montana	CERT0081

Authority	Certification Number or Laboratory ID Number
Nebraska	TestAmerica-Savannah
New Jersey	GA769
New Mexico	N/A
New York	10842
North Carolina DENR	269
North Carolina PHL	13701
Oklahoma	9984
Pennsylvania	68-00474
Puerto Rico	GA00006
South Carolina	98001
Tennessee	TN02961
Texas	T104704185-08-TX
USDA	SAV 3-04
Virginia	302
Washington	C1794
West Virginia DEP	94
West Virginia DHHR (DW)	9950C
Wisconsin	999819810
Wyoming	8TMS-Q

The certificates and parameter lists for each organization (which may differ) may be found on the corporate web site, the laboratory's public server, and in the QA offices.

ATTACHMENT B

Contract Required Detection Limits

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
Ag	7440-22-4	0.97	1.6	10	ug/L
Al	7429-90-5	100	100	200	ug/L
As	7440-38-2	10	10	20	ug/L
B	7440-42-8	40	40	100	ug/L
Ba	7440-39-3	2.0	2.0	10	ug/L
Be	7440-41-7	0.10	0.10	4.0	ug/L
Ca	7440-70-2	97	97	500	ug/L
Cd	7440-43-9	2.0	2.0	5.0	ug/L
Co	7440-48-4	1.0	2.0	10	ug/L
Cr	7440-47-3	2.0	2.0	10	ug/L
Cu	7440-50-8	5.0	5.0	20	ug/L
Fe	7439-89-6	24	40	50	ug/L
K	7440-09-7	40	40	1000	ug/L
Mg	7439-95-4	20	20	500	ug/L
Mn	7439-96-5	3.0	3.0	10	ug/L
Mo	7439-98-7	2.8	4.0	10	ug/L
Na	7440-23-5	280	410	1000	ug/L
Ni	7440-02-0	4.0	4.0	40	ug/L
Pb	7439-92-1	3.4	4.0	10	ug/L
Sb	7440-36-0	5.2	8.0	20	ug/L
Se	7782-49-2	6.4	8.0	20	ug/L
Sn	7440-31-5	5.4	8.0	50	ug/L
Sr	7440-24-6	1.6	1.6	10	ug/L
Ti	7440-32-6	1.0	1.0	10	ug/L
Tl	7440-28-0	8.7	10	25	ug/L
V	7440-62-2	3.0	3.0	10	ug/L
Zn	7440-66-6	6.3	10	20	ug/L
Hg	7439-97-6	0.091	0.10	0.20	ug/L

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
Ag	7440-22-4	0.096	0.16	1.0	mg/Kg
Al	7429-90-5	10	10	20	mg/Kg
As	7440-38-2	0.59	0.80	2.0	mg/Kg
B	7440-42-8	5.4	5.4	10	mg/Kg
Ba	7440-39-3	0.30	0.30	1.0	mg/Kg
Be	7440-41-7	0.020	0.020	0.40	mg/Kg
Ca	7440-70-2	20	20	50	mg/Kg
Cd	7440-43-9	0.10	0.20	0.50	mg/Kg
Co	7440-48-4	0.12	0.20	1.0	mg/Kg
Cr	7440-47-3	0.50	0.50	1.0	mg/Kg
Cu	7440-50-8	1.1	2.5	2.5	mg/Kg
Fe	7439-89-6	7.0	10	20	mg/Kg
K	7440-09-7	8.0	8.0	100	mg/Kg
Mg	7439-95-4	2.4	2.4	50	mg/Kg
Mn	7439-96-5	0.30	0.30	1.0	mg/Kg
Mo	7439-98-7	0.30	0.40	1.0	mg/Kg
Na	7440-23-5	82	82	200	mg/Kg
Ni	7440-02-0	0.31	0.41	4.0	mg/Kg
Pb	7439-92-1	0.53	0.53	1.0	mg/Kg
Sb	7440-36-0	0.53	0.80	2.0	mg/Kg
Se	7782-49-2	1.0	1.0	2.5	mg/Kg
Sn	7440-31-5	4.2	4.2	10	mg/Kg
Sr	7440-24-6	0.16	0.16	1.0	mg/Kg
Ti	7440-32-6	0.20	0.20	1.0	mg/Kg
Tl	7440-28-0	0.99	2.0	2.5	mg/Kg
V	7440-62-2	0.24	0.24	1.0	mg/Kg
Zn	7440-66-6	1.2	1.5	2.0	mg/Kg
Hg	7439-97-6	0.0082	0.0088	0.020	mg/Kg

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
C10-C28	STL00143	0.050	0.050	0.10	mg/L
C28-C40	STL00293	0.20	0.20	0.50	mg/L
#2 Diesel Fuel	68334-30-5	0.050	0.050	0.10	mg/L
Motor Oil	STL00299	0.20	0.20	0.50	mg/L
C20-C36	STL00426	0.20	0.20	0.50	mg/L
C10-C20	STL00115	0.050	0.10	0.10	mg/L
C6-C10	8006-61-9	0.011	0.025	0.050	mg/L

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
Acetone	67-64-1	5.0	5.0	25	ug/L
Acetonitrile	75-05-8	10	10	40	ug/L
Acrolein	107-02-8	7.4	7.4	20	ug/L
Acrylonitrile	107-13-1	7.2	7.2	20	ug/L
Benzene	71-43-2	0.25	0.25	1.0	ug/L
Bromobenzene	108-86-1	0.16	0.25	1.0	ug/L
Chlorobromomethane	74-97-5	0.14	0.25	1.0	ug/L
Dichlorobromomethane	75-27-4	0.25	0.25	1.0	ug/L
Bromoform	75-25-2	0.50	0.50	1.0	ug/L
Bromomethane	74-83-9	0.80	0.80	1.0	ug/L
2-Butanone (MEK)	78-93-3	1.0	1.0	10	ug/L
n-Butylbenzene	104-51-8	0.10	0.25	1.0	ug/L
sec-Butylbenzene	135-98-8	0.16	0.25	1.0	ug/L
tert-Butylbenzene	98-06-6	0.12	0.25	1.0	ug/L
Carbon disulfide	75-15-0	0.60	0.60	2.0	ug/L
Carbon tetrachloride	56-23-5	0.50	0.50	1.0	ug/L
Chlorobenzene	108-90-7	0.25	0.25	1.0	ug/L
2-Chloro-1,3-butadiene	126-99-8	0.30	0.30	1.0	ug/L
Chloroethane	75-00-3	1.0	1.0	1.0	ug/L
2-Chloroethyl vinyl ether	110-75-8	0.26	0.50	10	ug/L
Chloroform	67-66-3	0.14	0.25	1.0	ug/L
Chloromethane	74-87-3	0.33	0.33	1.0	ug/L
3-Chloro-1-propene	107-05-1	0.20	0.50	1.0	ug/L
2-Chlorotoluene	95-49-8	0.17	0.25	1.0	ug/L
4-Chlorotoluene	106-43-4	0.27	0.27	1.0	ug/L
Chlorodibromomethane	124-48-1	0.10	0.25	1.0	ug/L
1,2-Dibromo-3-Chloropropane	96-12-8	0.44	1.0	1.0	ug/L
Ethylene Dibromide	106-93-4	0.25	0.25	1.0	ug/L
Dibromomethane	74-95-3	0.20	0.25	1.0	ug/L
1,2-Dichlorobenzene	95-50-1	0.21	0.25	1.0	ug/L
1,3-Dichlorobenzene	541-73-1	0.25	0.25	1.0	ug/L
1,4-Dichlorobenzene	106-46-7	0.28	0.28	1.0	ug/L
trans-1,4-Dichloro-2-butene	110-57-6	0.50	1.0	2.0	ug/L
Dichlorodifluoromethane	75-71-8	0.25	0.25	1.0	ug/L
1,1-Dichloroethane	75-34-3	0.25	0.25	1.0	ug/L
1,2-Dichloroethane	107-06-2	0.10	0.25	1.0	ug/L
cis-1,2-Dichloroethene	156-59-2	0.15	0.25	1.0	ug/L
trans-1,2-Dichloroethene	156-60-5	0.20	0.25	1.0	ug/L
1,2-Dichloroethene, Total	540-59-0	0.29	0.50	2.0	ug/L
1,1-Dichloroethene	75-35-4	0.11	0.25	1.0	ug/L
1,2-Dichloropropane	78-87-5	0.13	0.25	1.0	ug/L
1,3-Dichloropropane	142-28-9	0.13	0.25	1.0	ug/L
2,2-Dichloropropane	594-20-7	0.12	0.25	1.0	ug/L
1,1-Dichloropropene	563-58-6	0.25	0.25	1.0	ug/L
cis-1,3-Dichloropropene	10061-01-5	0.11	0.25	1.0	ug/L
trans-1,3-Dichloropropene	10061-02-6	0.21	0.25	1.0	ug/L
Ethylbenzene	100-41-4	0.11	0.25	1.0	ug/L
Ethyl methacrylate	97-63-2	0.25	0.25	1.0	ug/L
Hexachlorobutadiene	87-68-3	0.40	0.50	1.0	ug/L
2-Hexanone	591-78-6	1.0	1.0	10	ug/L
Iodomethane	74-88-4	1.0	1.0	5.0	ug/L
Isobutyl alcohol	78-83-1	11	20	40	ug/L
Isopropylbenzene	98-82-8	0.10	0.25	1.0	ug/L
4-Isopropyltoluene	99-87-6	0.13	0.25	1.0	ug/L

Methacrylonitrile	126-98-7	3.3	5.0	20	ug/L
Methylene Chloride	75-09-2	1.0	1.0	5.0	ug/L
Methyl methacrylate	80-62-6	0.48	0.50	1.0	ug/L
4-Methyl-2-pentanone (MIBK)	108-10-1	1.0	1.0	10	ug/L
Methyl tert-butyl ether	1634-04-4	0.20	0.50	10	ug/L
Naphthalene	91-20-3	1.0	1.0	5.0	ug/L
Pentachloroethane	76-01-7	1.2	1.2	5.0	ug/L
Propionitrile	107-12-0	4.6	5.0	20	ug/L
N-Propylbenzene	103-65-1	0.15	0.25	1.0	ug/L
Styrene	100-42-5	0.11	0.25	1.0	ug/L
1,1,1,2-Tetrachloroethane	630-20-6	0.33	0.33	1.0	ug/L
1,1,2,2-Tetrachloroethane	79-34-5	0.18	0.25	1.0	ug/L
Tetrachloroethene	127-18-4	0.15	0.25	1.0	ug/L
Toluene	108-88-3	0.33	0.33	1.0	ug/L
1,2,3-Trichlorobenzene	87-61-6	0.35	0.35	1.0	ug/L
1,2,4-Trichlorobenzene	120-82-1	0.25	0.25	1.0	ug/L
1,1,1-Trichloroethane	71-55-6	0.50	0.50	1.0	ug/L
1,1,2-Trichloroethane	79-00-5	0.13	0.25	1.0	ug/L
Trichloroethene	79-01-6	0.13	0.25	1.0	ug/L
Trichlorofluoromethane	75-69-4	0.25	0.25	1.0	ug/L
1,2,3-Trichloropropane	96-18-4	0.41	0.50	1.0	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.50	0.50	1.0	ug/L
1,2,4-Trimethylbenzene	95-63-6	0.33	0.33	1.0	ug/L
1,3,5-Trimethylbenzene	108-67-8	0.33	0.33	1.0	ug/L
Vinyl acetate	108-05-4	0.28	0.50	2.0	ug/L
Vinyl chloride	75-01-4	0.18	0.50	1.0	ug/L
o-Xylene	95-47-6	0.25	0.25	1.0	ug/L
m-Xylene & p-Xylene	179601-23-1	0.20	0.50	2.0	ug/L
Xylenes, Total	1330-20-7	0.20	0.75	2.0	ug/L
Cyclohexane	110-82-7	0.25	0.25	1.0	ug/L
1-Chlorohexane	544-10-5	0.27	0.27	1.0	ug/L
Cyclohexanone	108-94-1	10	10	50	ug/L
Methyl acetate	79-20-9	0.19	0.25	1.0	ug/L
Methylcyclohexane	108-87-2	0.10	0.25	1.0	ug/L
Tetrahydrofuran	109-99-9	0.48	0.48	10	ug/L
Isopropyl ether	108-20-3	0.24	0.25	10	ug/L
Hexane	110-54-3	0.49	0.49	5.0	ug/L
Furan	110-00-9	0.41	0.41	10	ug/L
Ethyl ether	60-29-7	1.0	1.0	10	ug/L
n-Heptane	142-82-5	0.42	0.50	1.0	ug/L
1,3-Dichloropropene, Total	542-75-6	0.11	0.50	2.0	ug/L
Butadiene	106-99-0	0.11	0.25	1.0	ug/L
Methyl acrylate	96-33-3	5.0	5.0	5.0	ug/L
Ethyl acrylate	140-88-5	1.0	1.0	1.0	ug/L
n-Butyl acetate	123-86-4	5.0	5.0	5.0	ug/L
Ethylene oxide	75-21-8	200	200	200	ug/L
Propene oxide	75-56-9	200	200	200	ug/L
2-Methyl-2-propanol	75-65-0	2.6	2.6	5.0	ug/L
Methyl styrene	25013-15-4	1.0	1.0	1.0	ug/L
a-Methylstyrene TIC	98-83-9	1.0	1.0	1.0	ug/L
Ethanol	64-17-5	63	100	100	ug/L
1,4-Dioxane	123-91-1	50	50	50	ug/L

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
Acetone	67-64-1	11	11	50	ug/Kg
Acetonitrile	75-05-8	41	41	200	ug/Kg
Acrolein	107-02-8	24	24	100	ug/Kg
Acrylonitrile	107-13-1	34	34	100	ug/Kg
Benzene	71-43-2	0.73	1.0	5.0	ug/Kg
Bromobenzene	108-86-1	1.7	1.7	5.0	ug/Kg
Chlorobromomethane	74-97-5	3.3	3.3	5.0	ug/Kg
Dichlorobromomethane	75-27-4	0.97	1.0	5.0	ug/Kg
Bromoform	75-25-2	1.5	1.5	5.0	ug/Kg
Bromomethane	74-83-9	1.5	1.5	5.0	ug/Kg
2-Butanone (MEK)	78-93-3	2.4	2.4	25	ug/Kg
n-Butylbenzene	104-51-8	2.4	2.4	5.0	ug/Kg
sec-Butylbenzene	135-98-8	2.1	2.1	5.0	ug/Kg
tert-Butylbenzene	98-06-6	1.8	1.8	5.0	ug/Kg
Carbon disulfide	75-15-0	1.1	1.1	5.0	ug/Kg
Carbon tetrachloride	56-23-5	0.83	1.0	5.0	ug/Kg
Chlorobenzene	108-90-7	0.96	1.0	5.0	ug/Kg
2-Chloro-1,3-butadiene	126-99-8	2.1	2.1	5.0	ug/Kg
Chloroethane	75-00-3	2.7	2.7	5.0	ug/Kg
Chloroform	67-66-3	1.1	1.1	5.0	ug/Kg
Chloromethane	74-87-3	1.0	2.0	5.0	ug/Kg
3-Chloro-1-propene	107-05-1	2.2	2.2	5.0	ug/Kg
2-Chlorotoluene	95-49-8	2.0	2.0	5.0	ug/Kg
4-Chlorotoluene	106-43-4	1.7	1.7	5.0	ug/Kg
Chlorodibromomethane	124-48-1	1.7	1.7	5.0	ug/Kg
1,2-Dibromo-3-Chloropropane	96-12-8	4.4	4.4	10	ug/Kg
Ethylene Dibromide	106-93-4	1.5	1.5	5.0	ug/Kg
Dibromomethane	74-95-3	1.7	1.7	5.0	ug/Kg
1,2-Dichlorobenzene	95-50-1	1.3	1.3	5.0	ug/Kg
1,3-Dichlorobenzene	541-73-1	1.6	1.6	5.0	ug/Kg
1,4-Dichlorobenzene	106-46-7	0.74	1.0	5.0	ug/Kg
trans-1,4-Dichloro-2-butene	110-57-6	2.9	2.9	10	ug/Kg
Dichlorodifluoromethane	75-71-8	0.94	1.0	5.0	ug/Kg
1,1-Dichloroethane	75-34-3	1.1	1.1	5.0	ug/Kg
1,2-Dichloroethane	107-06-2	1.1	1.1	5.0	ug/Kg
cis-1,2-Dichloroethene	156-59-2	1.4	1.4	5.0	ug/Kg
trans-1,2-Dichloroethene	156-60-5	0.63	1.0	5.0	ug/Kg
1,2-Dichloroethene, Total	540-59-0	0.63	1.0	10	ug/Kg
1,1-Dichloroethene	75-35-4	1.5	1.5	5.0	ug/Kg
1,2-Dichloropropane	78-87-5	0.86	1.0	5.0	ug/Kg
1,3-Dichloropropane	142-28-9	1.8	1.8	5.0	ug/Kg
2,2-Dichloropropane	594-20-7	1.1	1.1	5.0	ug/Kg
1,1-Dichloropropene	563-58-6	0.95	1.0	5.0	ug/Kg
cis-1,3-Dichloropropene	10061-01-5	0.83	1.0	5.0	ug/Kg
trans-1,3-Dichloropropene	10061-02-6	0.87	1.0	5.0	ug/Kg
Ethylbenzene	100-41-4	1.3	1.3	5.0	ug/Kg
Ethyl methacrylate	97-63-2	3.4	3.4	5.0	ug/Kg
Hexachlorobutadiene	87-68-3	3.1	3.1	5.0	ug/Kg
2-Hexanone	591-78-6	3.3	3.3	25	ug/Kg
Iodomethane	74-88-4	1.8	1.8	5.0	ug/Kg
Isobutyl alcohol	78-83-1	52	52	200	ug/Kg
Isopropylbenzene	98-82-8	1.9	1.9	5.0	ug/Kg
4-Isopropyltoluene	99-87-6	2.2	2.2	5.0	ug/Kg
Methacrylonitrile	126-98-7	23	23	100	ug/Kg

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Methylene Chloride	75-09-2	0.98	1.0	5.0	ug/Kg
Methyl methacrylate	80-62-6	4.5	4.5	10	ug/Kg
4-Methyl-2-pentanone (MIBK)	108-10-1	4.2	4.2	25	ug/Kg
Methyl tert-butyl ether	1634-04-4	1.0	2.0	10	ug/Kg
Naphthalene	91-20-3	1.2	1.2	5.0	ug/Kg
Pentachloroethane	76-01-7	6.3	6.3	25	ug/Kg
Propionitrile	107-12-0	26	26	100	ug/Kg
N-Propylbenzene	103-65-1	2.7	2.7	5.0	ug/Kg
Styrene	100-42-5	0.93	1.0	5.0	ug/Kg
1,1,1,2-Tetrachloroethane	630-20-6	2.4	2.4	5.0	ug/Kg
1,1,2,2-Tetrachloroethane	79-34-5	1.6	1.6	5.0	ug/Kg
Tetrachloroethene	127-18-4	1.9	1.9	5.0	ug/Kg
Toluene	108-88-3	0.84	1.0	5.0	ug/Kg
1,2,3-Trichlorobenzene	87-61-6	1.6	1.6	5.0	ug/Kg
1,2,4-Trichlorobenzene	120-82-1	0.89	1.0	5.0	ug/Kg
1,1,1-Trichloroethane	71-55-6	0.59	1.0	5.0	ug/Kg
1,1,2-Trichloroethane	79-00-5	1.3	1.3	5.0	ug/Kg
Trichloroethene	79-01-6	1.3	1.3	5.0	ug/Kg
Trichlorofluoromethane	75-69-4	1.2	1.2	5.0	ug/Kg
1,2,3-Trichloropropane	96-18-4	2.4	2.4	5.0	ug/Kg
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1.3	1.3	5.0	ug/Kg
1,2,4-Trimethylbenzene	95-63-6	1.4	1.4	5.0	ug/Kg
1,3,5-Trimethylbenzene	108-67-8	1.7	1.7	5.0	ug/Kg
Vinyl acetate	108-05-4	2.5	2.5	10	ug/Kg
Vinyl chloride	75-01-4	1.5	1.5	5.0	ug/Kg
o-Xylene	95-47-6	1.1	1.1	5.0	ug/Kg
m-Xylene & p-Xylene	179601-23-1	2.6	2.6	10	ug/Kg
Xylenes, Total	1330-20-7	1.1	1.1	10	ug/Kg
Cyclohexane	110-82-7	1.3	1.3	10	ug/Kg
1-Chlorohexane	544-10-5	2.1	2.1	5.0	ug/Kg
Cyclohexanone	108-94-1	50	50	50	ug/Kg
Methyl acetate	79-20-9	5.0	5.0	10	ug/Kg
Methylcyclohexane	108-87-2	0.86	1.0	10	ug/Kg
Tetrahydrofuran	109-99-9	1.5	1.5	5.0	ug/Kg
Isopropyl ether	108-20-3	1.5	1.5	10	ug/Kg
Hexane	110-54-3	1.8	1.8	5.0	ug/Kg
Furan	110-00-9	1.5	1.5	5.0	ug/Kg
Ethyl ether	60-29-7	1.4	1.4	10	ug/Kg
n-Heptane	142-82-5	1.9	1.9	5.0	ug/Kg
1,3-Dichloropropene, Total	542-75-6	0.83	1.0	10	ug/Kg
Butadiene	106-99-0	0.73	1.0	5.0	ug/Kg
Methyl acrylate	96-33-3	5.0	5.0	5.0	ug/Kg
Ethyl acrylate	140-88-5	5.0	5.0	5.0	ug/Kg
n-Butyl acetate	123-86-4	1.0	1.0	1.0	ug/Kg
Ethylene oxide	75-21-8	100	100	100	ug/Kg
Propene oxide	75-56-9	100	100	100	ug/Kg
2-Methyl-2-propanol	75-65-0	3.0	3.0	10	ug/Kg
Methyl styrene	25013-15-4	5.0	5.0	5.0	ug/Kg
a-Methylstyrene TIC	98-83-9	5.0	5.0	5.0	ug/Kg
Ethanol	64-17-5	100	100	100	ug/Kg
1,4-Dioxane	123-91-1	50	50	50	ug/Kg

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
Acetone	67-64-1	0.50	0.50	0.50	mg/L
Acetonitrile	75-05-8	0.80	0.80	0.80	mg/L
Acrolein	107-02-8	0.40	0.40	0.40	mg/L
Acrylonitrile	107-13-1	0.40	0.40	0.40	mg/L
Benzene	71-43-2	0.020	0.020	0.020	mg/L
Bromobenzene	108-86-1	0.020	0.020	0.020	mg/L
Chlorobromomethane	74-97-5	0.020	0.020	0.020	mg/L
Dichlorobromomethane	75-27-4	0.020	0.020	0.020	mg/L
Bromoform	75-25-2	0.020	0.020	0.020	mg/L
Bromomethane	74-83-9	0.020	0.020	0.020	mg/L
2-Butanone (MEK)	78-93-3	0.20	0.20	0.20	mg/L
n-Butylbenzene	104-51-8	0.020	0.020	0.020	mg/L
sec-Butylbenzene	135-98-8	0.020	0.020	0.020	mg/L
tert-Butylbenzene	98-06-6	0.020	0.020	0.020	mg/L
Carbon disulfide	75-15-0	0.040	0.040	0.040	mg/L
Carbon tetrachloride	56-23-5	0.020	0.020	0.020	mg/L
Chlorobenzene	108-90-7	0.020	0.020	0.020	mg/L
2-Chloro-1,3-butadiene	126-99-8	0.020	0.020	0.020	mg/L
Chloroethane	75-00-3	0.020	0.020	0.020	mg/L
Chloroform	67-66-3	0.020	0.020	0.020	mg/L
Chloromethane	74-87-3	0.020	0.020	0.020	mg/L
3-Chloro-1-propene	107-05-1	0.020	0.020	0.020	mg/L
2-Chlorotoluene	95-49-8	0.020	0.020	0.020	mg/L
4-Chlorotoluene	106-43-4	0.020	0.020	0.020	mg/L
Chlorodibromomethane	124-48-1	0.020	0.020	0.020	mg/L
1,2-Dibromo-3-Chloropropane	96-12-8	0.020	0.020	0.020	mg/L
Ethylene Dibromide	106-93-4	0.020	0.020	0.020	mg/L
Dibromomethane	74-95-3	0.020	0.020	0.020	mg/L
1,2-Dichlorobenzene	95-50-1	0.020	0.020	0.020	mg/L
1,3-Dichlorobenzene	541-73-1	0.020	0.020	0.020	mg/L
1,4-Dichlorobenzene	106-46-7	0.020	0.020	0.020	mg/L
trans-1,4-Dichloro-2-butene	110-57-6	0.040	0.040	0.040	mg/L
Dichlorodifluoromethane	75-71-8	0.020	0.020	0.020	mg/L
1,1-Dichloroethane	75-34-3	0.020	0.020	0.020	mg/L
1,2-Dichloroethane	107-06-2	0.020	0.020	0.020	mg/L
cis-1,2-Dichloroethene	156-59-2	0.020	0.020	0.020	mg/L
trans-1,2-Dichloroethene	156-60-5	0.020	0.020	0.020	mg/L
1,2-Dichloroethene, Total	540-59-0	0.040	0.040	0.040	mg/L
1,1-Dichloroethene	75-35-4	0.020	0.020	0.020	mg/L
1,2-Dichloropropane	78-87-5	0.020	0.020	0.020	mg/L
1,3-Dichloropropane	142-28-9	0.020	0.020	0.020	mg/L
2,2-Dichloropropane	594-20-7	0.020	0.020	0.020	mg/L
1,1-Dichloropropene	563-58-6	0.020	0.020	0.020	mg/L
cis-1,3-Dichloropropene	10061-01-5	0.020	0.020	0.020	mg/L
trans-1,3-Dichloropropene	10061-02-6	0.020	0.020	0.020	mg/L
Ethylbenzene	100-41-4	0.020	0.020	0.020	mg/L
Ethyl methacrylate	97-63-2	0.020	0.020	0.020	mg/L
Hexachlorobutadiene	87-68-3	0.020	0.020	0.020	mg/L
2-Hexanone	591-78-6	0.20	0.20	0.20	mg/L
Iodomethane	74-88-4	0.10	0.10	0.10	mg/L
Isobutyl alcohol	78-83-1	0.80	0.80	0.80	mg/L
Isopropylbenzene	98-82-8	0.020	0.020	0.020	mg/L
4-Isopropyltoluene	99-87-6	0.020	0.020	0.020	mg/L
Methacrylonitrile	126-98-7	0.40	0.40	0.40	mg/L

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Methylene Chloride	75-09-2	0.10	0.10	0.10	mg/L
Methyl methacrylate	80-62-6	0.020	0.020	0.020	mg/L
4-Methyl-2-pentanone (MIBK)	108-10-1	0.20	0.20	0.20	mg/L
Methyl tert-butyl ether	1634-04-4	0.20	0.20	0.20	mg/L
Naphthalene	91-20-3	0.10	0.10	0.10	mg/L
Pentachloroethane	76-01-7	0.10	0.10	0.10	mg/L
Propionitrile	107-12-0	0.40	0.40	0.40	mg/L
N-Propylbenzene	103-65-1	0.020	0.020	0.020	mg/L
Styrene	100-42-5	0.020	0.020	0.020	mg/L
1,1,1,2-Tetrachloroethane	630-20-6	0.020	0.020	0.020	mg/L
1,1,2,2-Tetrachloroethane	79-34-5	0.020	0.020	0.020	mg/L
Tetrachloroethene	127-18-4	0.020	0.020	0.020	mg/L
Toluene	108-88-3	0.020	0.020	0.020	mg/L
1,2,3-Trichlorobenzene	87-61-6	0.020	0.020	0.020	mg/L
1,2,4-Trichlorobenzene	120-82-1	0.020	0.020	0.020	mg/L
1,1,1-Trichloroethane	71-55-6	0.020	0.020	0.020	mg/L
1,1,2-Trichloroethane	79-00-5	0.020	0.020	0.020	mg/L
Trichloroethene	79-01-6	0.020	0.020	0.020	mg/L
Trichlorofluoromethane	75-69-4	0.020	0.020	0.020	mg/L
1,2,3-Trichloropropane	96-18-4	0.020	0.020	0.020	mg/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.020	0.020	0.020	mg/L
1,2,4-Trimethylbenzene	95-63-6	0.020	0.020	0.020	mg/L
1,3,5-Trimethylbenzene	108-67-8	0.020	0.020	0.020	mg/L
Vinyl acetate	108-05-4	0.040	0.040	0.040	mg/L
Vinyl chloride	75-01-4	0.020	0.020	0.020	mg/L
o-Xylene	95-47-6	0.020	0.020	0.020	mg/L
m-Xylene & p-Xylene	179601-23-1	0.040	0.040	0.040	mg/L
Xylenes, Total	1330-20-7	0.040	0.040	0.040	mg/L
Cyclohexane	110-82-7	0.020	0.020	0.020	mg/L
1-Chlorohexane	544-10-5	0.020	0.020	0.020	mg/L
Cyclohexanone	108-94-1	1.0	1.0	1.0	mg/L
Methyl acetate	79-20-9	0.020	0.020	0.020	mg/L
Methylcyclohexane	108-87-2	0.020	0.020	0.020	mg/L
Tetrahydrofuran	109-99-9	0.20	0.20	0.20	mg/L
Isopropyl ether	108-20-3	0.20	0.20	0.20	mg/L
Hexane	110-54-3	0.10	0.10	0.10	mg/L
Furan	110-00-9	0.20	0.20	0.20	mg/L
Ethyl ether	60-29-7	0.20	0.20	0.20	mg/L
n-Heptane	142-82-5	0.020	0.020	0.020	mg/L
1,3-Dichloropropene, Total	542-75-6	0.040	0.040	0.040	mg/L
Butadiene	106-99-0	0.020	0.020	0.020	mg/L
Methyl acrylate	96-33-3	0.10	0.10	0.10	mg/L
Ethyl acrylate	140-88-5	0.020	0.020	0.020	mg/L
n-Butyl acetate	123-86-4	0.10	0.10	0.10	mg/L
Ethylene oxide	75-21-8	4.0	4.0	4.0	mg/L
Propene oxide	75-56-9	4.0	4.0	4.0	mg/L
2-Methyl-2-propanol	75-65-0	0.10	0.10	0.10	mg/L
Methyl styrene	25013-15-4	0.020	0.020	0.020	mg/L
a-Methylstyrene TIC	98-83-9	0.020	0.020	0.020	mg/L

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
2-Acetylaminofluorene	53-96-3	0.050	0.050	0.050	mg/L
2-Chloronaphthalene	91-58-7	0.050	0.050	0.050	mg/L
2-Chlorophenol	95-57-8	0.050	0.050	0.050	mg/L
1,2-Dichlorobenzene	95-50-1	0.050	0.050	0.050	mg/L
1,3-Dichlorobenzene	541-73-1	0.050	0.050	0.050	mg/L
1,4-Dichlorobenzene	106-46-7	0.050	0.050	0.050	mg/L
3,3'-Dichlorobenzidine	91-94-1	0.10	0.10	0.10	mg/L
2,4-Dichlorophenol	120-83-2	0.050	0.050	0.050	mg/L
4-Aminobiphenyl	92-67-1	0.050	0.050	0.050	mg/L
2,6-Dichlorophenol	87-65-0	0.050	0.050	0.050	mg/L
4-Bromophenyl phenyl ether	101-55-3	0.050	0.050	0.050	mg/L
4-Chloro-3-methylphenol	59-50-7	0.050	0.050	0.050	mg/L
4-Chloroaniline	106-47-8	0.10	0.10	0.10	mg/L
4-Chlorophenyl phenyl ether	7005-72-3	0.050	0.050	0.050	mg/L
3,3'-Dimethylbenzidine	119-93-7	0.10	0.10	0.10	mg/L
7,12-Dimethylbenz(a)anthracene	57-97-6	0.050	0.050	0.050	mg/L
2,4-Dimethylphenol	105-67-9	0.050	0.050	0.050	mg/L
Acenaphthene	83-32-9	0.050	0.050	0.050	mg/L
Acenaphthylene	208-96-8	0.050	0.050	0.050	mg/L
4,6-Dinitro-2-methylphenol	534-52-1	0.25	0.050	0.050	mg/L
Acetophenone	98-86-2	0.050	0.25	0.25	mg/L
alpha,alpha-Dimethyl phenethylamine	122-09-8	10	10	10	mg/L
2,4-Dinitrophenol	51-28-5	0.25	0.25	0.25	mg/L
Aniline	62-53-3	0.10	0.050	0.050	mg/L
2,4-Dinitrotoluene	121-14-2	0.050	0.10	0.10	mg/L
Anthracene	120-12-7	0.050	0.050	0.050	mg/L
Aramite, Total	140-57-8	0.050	0.050	0.050	mg/L
Benzo[a]anthracene	56-55-3	0.050	0.050	0.050	mg/L
Benzo[a]pyrene	50-32-8	0.050	0.050	0.050	mg/L
Benzo[b]fluoranthene	205-99-2	0.050	0.050	0.050	mg/L
1,4-Dioxane	123-91-1	0.050	0.050	0.050	mg/L
Benzo[g,h,i]perylene	191-24-2	0.050	0.050	0.050	mg/L
Benzo[k]fluoranthene	207-08-9	0.050	0.050	0.050	mg/L
Benzyl alcohol	100-51-6	0.050	0.050	0.050	mg/L
Bis(2-chloroethoxy)methane	111-91-1	0.050	0.050	0.050	mg/L
Bis(2-chloroethyl)ether	111-44-4	0.050	0.050	0.050	mg/L
Bis(2-ethylhexyl) phthalate	117-81-7	0.050	0.050	0.050	mg/L
Chrysene	218-01-9	0.050	0.050	0.050	mg/L
Diallate	2303-16-4	0.050	0.050	0.050	mg/L
Dibenz(a,h)anthracene	53-70-3	0.050	0.050	0.050	mg/L
Dibenzofuran	132-64-9	0.050	0.050	0.050	mg/L
Di-n-butyl phthalate	84-74-2	0.050	0.050	0.050	mg/L
Diethyl phthalate	84-66-2	0.050	0.050	0.050	mg/L
p-Dimethylamino azobenzene	60-11-7	0.050	0.050	0.050	mg/L
Dimethyl phthalate	131-11-3	0.050	0.050	0.050	mg/L
Dinoseb	88-85-7	0.050	0.050	0.050	mg/L
Di-n-octyl phthalate	117-84-0	0.050	0.050	0.050	mg/L
Ethyl methanesulfonate	62-50-0	0.050	0.050	0.050	mg/L
Fluoranthene	206-44-0	0.050	0.050	0.050	mg/L
3-Methylcholanthrene	56-49-5	0.050	0.050	0.050	mg/L
Fluorene	86-73-7	0.050	0.050	0.050	mg/L
Hexachlorobenzene	118-74-1	0.050	0.050	0.050	mg/L
Hexachlorobutadiene	87-68-3	0.050	0.050	0.050	mg/L
2-Methylnaphthalene	91-57-6	0.050	0.050	0.050	mg/L

Hexachlorocyclopentadiene	77-47-4	0.050	0.050	0.050	mg/L
Hexachloroethane	67-72-1	0.050	0.050	0.050	mg/L
2-Methylphenol	95-48-7	0.050	25	0.050	mg/L
Hexachlorophene	70-30-4	25	0.050	25	mg/L
Hexachloropropene	1888-71-7	0.050	0.050	0.050	mg/L
Indeno[1,2,3-cd]pyrene	193-39-5	0.050	0.050	0.050	mg/L
Isophorone	78-59-1	0.050	0.050	0.050	mg/L
3 & 4 Methylphenol	15831-10-4	0.050	0.050	0.050	mg/L
Isosafrole	120-58-1	0.050	0.050	0.050	mg/L
Methapyrilene	91-80-5	10	10	10	mg/L
1,4-Naphthoquinone	130-15-4	0.050	0.050	0.050	mg/L
Methyl methanesulfonate	66-27-3	0.050	0.050	0.050	mg/L
1-Naphthylamine	134-32-7	0.050	0.050	0.050	mg/L
2-Naphthylamine	91-59-8	0.050	0.050	0.050	mg/L
Naphthalene	91-20-3	0.050	0.050	0.050	mg/L
2-Nitroaniline	88-74-4	0.25	0.25	0.25	mg/L
3-Nitroaniline	99-09-2	0.25	0.25	0.25	mg/L
4-Nitroaniline	100-01-6	0.25	0.25	0.25	mg/L
Nitrobenzene	98-95-3	0.050	0.050	0.050	mg/L
2-Nitrophenol	88-75-5	0.050	0.050	0.050	mg/L
N-Nitrosodiphenylamine	86-30-6	0.050	0.050	0.050	mg/L
4-Nitroquinoline-1-oxide	56-57-5	0.10	0.10	0.10	mg/L
N-Nitrosodi-n-butylamine	924-16-3	0.050	0.050	0.050	mg/L
N-Nitrosodiethylamine	55-18-5	0.050	0.050	0.050	mg/L
N-Nitrosodimethylamine	62-75-9	0.050	0.050	0.050	mg/L
N-Nitrosodi-n-propylamine	621-64-7	0.050	0.050	0.050	mg/L
N-Nitrosomethylethylamine	10595-95-6	0.050	0.050	0.050	mg/L
N-Nitrosomorpholine	59-89-2	0.050	0.050	0.050	mg/L
N-Nitrosopiperidine	100-75-4	0.050	0.050	0.050	mg/L
N-Nitrosopyrrolidine	930-55-2	0.050	0.050	0.050	mg/L
N-Nitro-o-toluidine	99-55-8	0.050	0.050	0.050	mg/L
Pentachlorobenzene	608-93-5	0.050	0.050	0.050	mg/L
Pentachloronitrobenzene	82-68-8	0.050	0.050	0.050	mg/L
Pentachlorophenol	87-86-5	0.25	0.25	0.25	mg/L
Phenacetin	62-44-2	0.050	0.050	0.050	mg/L
Phenanthrene	85-01-8	0.050	0.050	0.050	mg/L
Phenol	108-95-2	0.050	0.050	0.050	mg/L
p-Phenylene diamine	106-50-3	10	0.050	0.050	mg/L
Disulfoton	298-04-4	0.050	10	10	mg/L
Ethyl Parathion	56-38-2	0.050	0.050	0.050	mg/L
Methyl parathion	298-00-0	0.050	0.050	0.050	mg/L
2-Picoline	109-06-8	0.050	0.050	0.050	mg/L
Pronamide	23950-58-5	0.050	0.050	0.050	mg/L
Phorate	298-02-2	0.050	0.050	0.050	mg/L
Famphur	52-85-7	0.050	0.050	0.050	mg/L
Pyrene	129-00-0	0.050	0.050	0.050	mg/L
Pyridine	110-86-1	0.25	0.25	0.25	mg/L
Dimethoate	60-51-5	0.050	0.050	0.050	mg/L
Butyl benzyl phthalate	85-68-7	0.050	0.050	0.050	mg/L
Safrole, Total	94-59-7	0.050	0.050	0.050	mg/L
Sulfotepp	3689-24-5	0.050	0.050	0.050	mg/L
1,2,4,5-Tetrachlorobenzene	95-94-3	0.050	0.050	0.050	mg/L
2,3,4,6-Tetrachlorophenol	58-90-2	0.050	0.050	0.050	mg/L
Thionazin	297-97-2	0.050	0.050	0.050	mg/L
2-Toluidine	95-53-4	0.050	0.050	0.050	mg/L

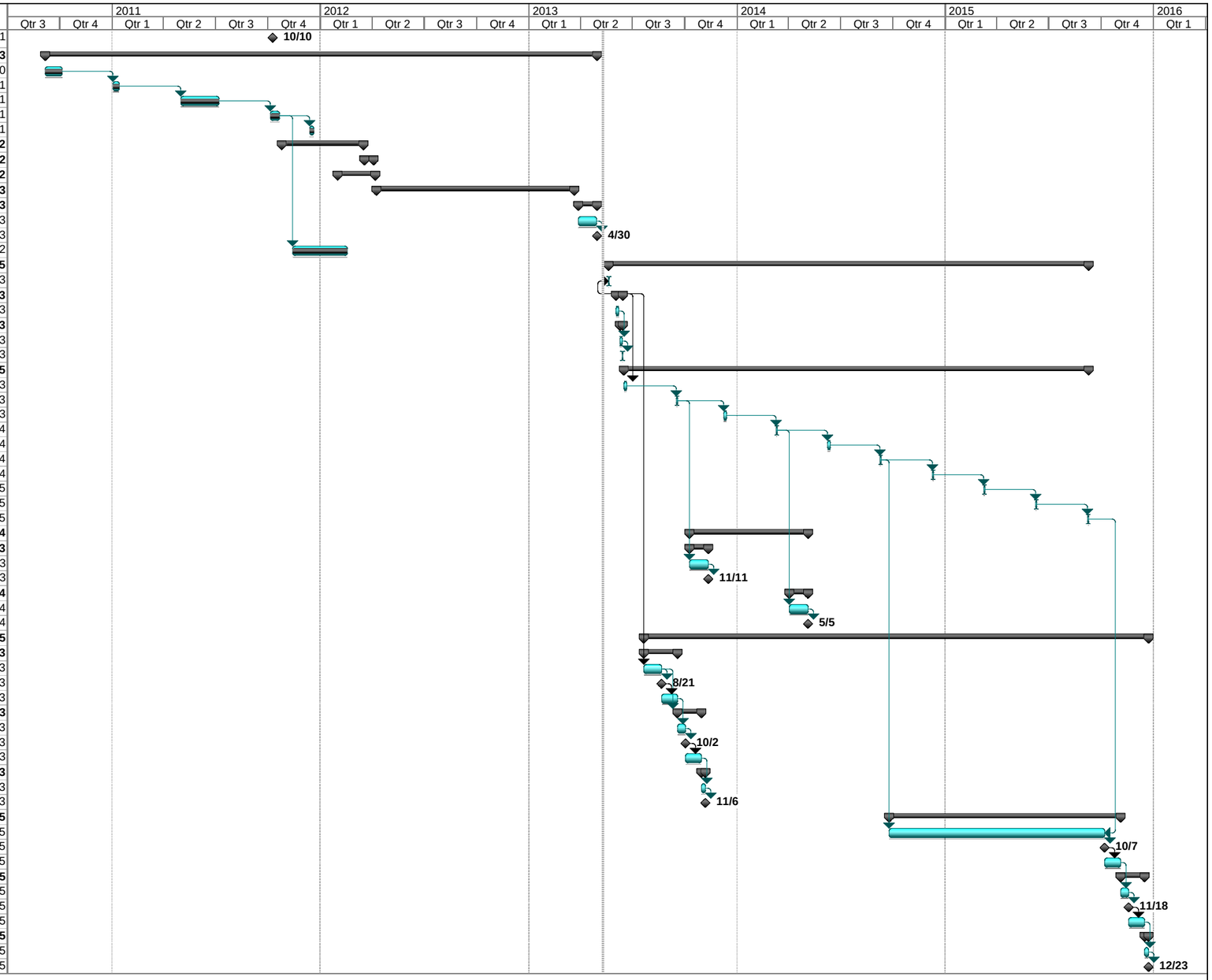
1,2,4-Trichlorobenzene	120-82-1	0.050	0.050	0.050	mg/L
2,4,5-Trichlorophenol	95-95-4	0.050	0.050	0.050	mg/L
2,4,6-Trichlorophenol	88-06-2	0.050	0.050	0.050	mg/L
Benzidine	92-87-5	0.40	0.050	0.40	mg/L
o,o',o''-Triethylphosphorothioate	126-68-1	0.050	0.40	0.050	mg/L
Benzoic acid	65-85-0	0.25	0.25	0.25	mg/L
1,3,5-Trinitrobenzene	99-35-4	0.050	0.050	0.050	mg/L
Methyl Phenols,Total	1319-77-3	0.10	0.050	0.10	mg/L
Carbazole	86-74-8	0.050	0.10	0.050	mg/L
2,6-Dinitrotoluene	606-20-2	0.050	0.050	0.050	mg/L
Atrazine	1912-24-9	0.050	0.050	0.050	mg/L
Benzaldehyde	100-52-7	0.050	0.050	0.050	mg/L
1,1'-Biphenyl	92-52-4	0.050	0.050	0.050	mg/L
Caprolactam	105-60-2	0.050	0.050	0.050	mg/L
Phenyl ether	101-84-8	0.050	0.050	0.050	mg/L
1,2,3,5-Tetrachlorobenzene	634-90-2	0.050	0.050	0.050	mg/L
1,2,3-Trichlorobenzene	87-61-6	0.050	0.050	0.050	mg/L
1,3,5-Trichlorobenzene	108-70-3	0.050	0.050	0.050	mg/L
1,3-Dinitrobenzene	99-65-0	0.050	0.050	0.050	mg/L
2,3,5,6-Tetrachlorophenol	935-95-5	0.050	0.050	0.050	mg/L
4-Chlorophenol	106-48-9	0.050	0.050	0.050	mg/L
2,3,6-Trichlorophenol	933-75-5	0.050	0.050	0.050	mg/L
2,6-Dimethylphenol	576-26-1	0.050	0.050	0.050	mg/L
2,5-Dimethylphenol	95-87-4	0.050	0.050	0.050	mg/L
2,3-Dimethylphenol	526-75-0	0.050	0.050	0.050	mg/L
3,4-Dimethylphenol	95-65-8	0.050	0.050	0.050	mg/L
2,5-Dinitrophenol	329-71-5	0.050	0.050	0.050	mg/L
3-Nitrophenol	554-84-7	0.050	0.050	0.050	mg/L
Methyl Benzoate	93-58-3	0.050	0.050	0.050	mg/L
Monomethyl Terephthalate	1679-64-7	0.050	0.050	0.050	mg/L
Toluic acid	99-94-5	0.050	0.050	0.050	mg/L
Quinoline	91-22-5	0.050	0.050	0.050	mg/L
2,4 & 2,5-Dimethylphenol	STL00327	0.10	0.10	0.10	mg/L
alpha-Pinene	80-56-8	0.050	0.050	0.050	mg/L
2,2'-oxybis[1-chloropropane]	108-60-1	0.050	0.050	0.050	mg/L
Di(2-ethylhexyl)adipate	103-23-1	0.050	0.050	0.050	mg/L
Dimethyl terephthalate	120-61-6	0.050	0.050	0.050	mg/L
3-Nitrochlorobenzene	121-73-3	0.050	0.050	0.050	mg/L
2-Nitrobiphenyl	86-00-0	0.050	0.050	0.050	mg/L
3-Nitrobiphenyl	2113-58-8	0.050	0.050	0.050	mg/L
3,4-Dichloronitrobenzene	99-54-7	0.050	0.050	0.050	mg/L
4-Nitrobiphenyl	92-93-3	0.050	0.050	0.050	mg/L
2-chloronitrobenzene / 4-chloronitrobenzene	STL00671	0.10	0.10	0.10	mg/L

Contract Required Quantitation Limits (CRQL) of VOCs, Metals, TPHC, TCLP-VOCs, TCLP-SVOCs, and Chloride

Analytes	CAS #	MDL	LOD	LOQ	Units
Chloride	16887-00-6	1	1	5.0	mg/L

Appendix C.
Anticipated Project Schedule

ID	Task Name	Duration	Start	Finish
1	**PRAP Approval**	0 days	Mon 10/10/11	Mon 10/10/11
2	**Task 1 - Project Planning**	**692 days**	**Mon 9/6/10**	**Tue 4/30/13**
3	Task 1B - Draft Health and Safety Plan	22 days	Mon 9/6/10	Tue 10/5/10
4	Task 1B - Final Health and Safety Plan	9 days	Mon 1/3/11	Thu 1/13/11
5	Task 1B - Prepare Draft Data Gap Investigation WP	49 days	Mon 5/2/11	Thu 7/7/11
6	Task 1B - Prepare Data Gap Investigation WP Amendment	12 days	Thu 10/6/11	Fri 10/21/11
7	Task 1B - Prepare Final Data Gap Investigation WP	5 days	Wed 12/14/11	Tue 12/20/11
8	**Task 1A - Prepare Draft Record of Decision**	**103 days**	**Wed 10/26/11**	**Fri 3/16/12**
14	**Task 1A - Final Record of Decision**	**12 days**	**Mon 3/19/12**	**Tue 4/3/12**
17	**Task 1B - Draft Remedial Action WP**	**48 days**	**Wed 2/1/12**	**Fri 4/6/12**
21	**Task 1B - Draft-Final Remedial Action WP**	**249 days**	**Mon 4/9/12**	**Thu 3/21/13**
33	**Task 1B - Final Remedial Action WP**	**23 days**	**Fri 3/29/13**	**Tue 4/30/13**
34	Prepare Final Remedial Action WP	22 days	Fri 3/29/13	Mon 4/29/13
35	Submit Final Remedial Action Workplan	0 days	Tue 4/30/13	Tue 4/30/13
36	**Task 2 - Data Gap Investigation with Results Memo**	70 days	Mon 11/14/11	Fri 2/17/12
37	**Task 3 - Implement Remedial Actions**	**602 days**	**Tue 5/21/13**	**Wed 9/9/15**
38	Site Kick-off Meeting for RA Activities	1 day	Tue 5/21/13	Tue 5/21/13
39	**Task 3A - Implement RA Sites 3 & 6 Soil**	**10 days**	**Mon 6/3/13**	**Fri 6/14/13**
40	Site 6 Excavation	5 days	Mon 6/3/13	Fri 6/7/13
41	**Site 3**	**5 days**	**Mon 6/10/13**	**Fri 6/14/13**
42	Excavation	4 days	Mon 6/10/13	Thu 6/13/13
43	Geomembrane Installation	1 day	Fri 6/14/13	Fri 6/14/13
44	**Task 3B - Implement RA Site 6 Groundwater**	**583 days**	**Mon 6/17/13**	**Wed 9/9/15**
45	1st Injection	5 days	Mon 6/17/13	Fri 6/21/13
46	1st Round of Groundwater Sampling	2 days	Tue 9/17/13	Wed 9/18/13
47	2nd Injection	5 days	Mon 12/9/13	Fri 12/13/13
48	2nd Round of Groundwater Sampling	2 days	Tue 3/11/14	Wed 3/12/14
49	3rd Injection	5 days	Mon 6/9/14	Fri 6/13/14
50	1st Quarterly Sample	2 days	Tue 9/9/14	Wed 9/10/14
51	2nd Quarterly Sample	2 days	Wed 12/10/14	Thu 12/11/14
52	3rd Quarterly Sample	2 days	Tue 3/10/15	Wed 3/11/15
53	4th Quarterly Sample	2 days	Tue 6/9/15	Wed 6/10/15
54	5th Quarterly Sample	2 days	Tue 9/8/15	Wed 9/9/15
55	**Task 4 - Chemical Oxidation Performance Monitoring Reports (COPMR)**	**148 days**	**Thu 10/10/13**	**Mon 5/5/14**
56	**Task 4a - Round 1 COPMR**	**23 days**	**Thu 10/10/13**	**Mon 11/11/13**
57	Prepare Round 1 COPMR	23 days	Thu 10/10/13	Mon 11/11/13
58	Submit Round 1 COPMR (within 30 days of analytical data received)	0 days	Mon 11/11/13	Mon 11/11/13
59	**Task 4b - Round 2 COPMR**	**23 days**	**Thu 4/3/14**	**Mon 5/5/14**
60	Prepare Round 1 COPMR	23 days	Thu 4/3/14	Mon 5/5/14
61	Submit Round 1 COPMR (within 30 days of analytical data received)	0 days	Mon 5/5/14	Mon 5/5/14
62	**Task 5 - Remedial Action Closure Reports (RACRs)**	**633 days**	**Mon 7/22/13**	**Wed 12/23/15**
63	**Task 5A - Draft Sites 3 & 6 Soil RACR**	**43 days**	**Mon 7/22/13**	**Wed 9/18/13**
64	Prepare Draft Sites 3 & 6 Soil RACR	23 days	Mon 7/22/13	Wed 8/21/13
65	Submit Draft Sites 3 & 6 Soil RACR	0 days	Wed 8/21/13	Wed 8/21/13
66	ANG (NGB/A7OR) Review Draft Sites 3 & 6 Soil RACR	20 days	Thu 8/22/13	Wed 9/18/13
67	**Task 5A - Draft-Final Sites 3 & 6 Soil RACR**	**30 days**	**Thu 9/19/13**	**Wed 10/30/13**
68	Prepare Draft-Final Sites 3 & 6 Soil RACR	10 days	Thu 9/19/13	Wed 10/2/13
69	Submit Draft-Final Sites 3 & 6 Soil RACR	0 days	Wed 10/2/13	Wed 10/2/13
70	NYSDEC Reviews Draft-Final Sites 3 & 6 Soil RACR	20 days	Thu 10/3/13	Wed 10/30/13
71	**Task 5A - Final Sites 3 & 6 Soil RACR**	**5 days**	**Thu 10/31/13**	**Wed 11/6/13**
72	Prepare Final Sites 3 & 6 Soil RAC	5 days	Thu 10/31/13	Wed 11/6/13
73	Submit Final Sites 3 & 6 Soil RAC	0 days	Wed 11/6/13	Wed 11/6/13
74	**Task 5B - Draft Site 6 Groundwater RACR**	**290 days**	**Thu 9/25/14**	**Wed 11/4/15**
75	Prepare Draft Site 6 Groundwater RACR	270 days	Thu 9/25/14	Wed 10/7/15
76	Submit Draft Site 6 Groundwater RACR	0 days	Wed 10/7/15	Wed 10/7/15
77	ANG (NGB/A7OR) Review Site 6 Groundwater RACR	20 days	Thu 10/8/15	Wed 11/4/15
78	**Task 5B - Draft-Final Site 6 Groundwater RACR**	**30 days**	**Thu 11/5/15**	**Wed 12/16/15**
79	Prepare Draft-Final Site 6 Groundwater RACR	10 days	Thu 11/5/15	Wed 11/18/15
80	Submit Draft-Final Site 6 Groundwater RACR	0 days	Wed 11/18/15	Wed 11/18/15
81	NYSDEC Reviews Draft-Final Site 6 Groundwater RACR	20 days	Thu 11/19/15	Wed 12/16/15
82	**Task 5B - Final Site 6 Groundwater RACR**	**5 days**	**Thu 12/17/15**	**Wed 12/23/15**
83	Prepare Final Site 6 Groundwater RACR	5 days	Thu 12/17/15	Wed 12/23/15
84	Submit Final Site 6 Groundwater RACR	0 days	Wed 12/23/15	Wed 12/23/15



Project: Schedule
Date: Fri 5/10/13

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Appendix D.
Health and Safety Plan

SITE SPECIFIC HEALTH AND SAFETY PLAN
FOR
NEW YORK AIR NATIONAL GUARD
SCHENECTADY AIR NATIONAL GUARD BASE, NEW YORK
SITE 3 – WASTE DRUM DUMP SITE AND SITE 6 – SPILL AREA ACTIVITIES

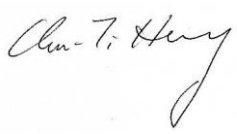
ALL PERSONNEL PARTICIPATING IN FIELD ACTIVITIES MUST BE TRAINED IN THE GENERAL AND SPECIFIC HAZARDS UNIQUE TO THIS JOB AND, IF APPLICABLE, MEET MEDICAL EXAMINATION REQUIREMENTS. ALL SITE PERSONNEL AND VISITORS SHALL FOLLOW THE GUIDELINES, RULES, AND PROCEDURES IN THIS DOCUMENT AND THE SUPPORTING PROJECT PLANS. THE PROJECT MANAGER OR SITE SAFETY OFFICER MAY IMPOSE OTHER PROCEDURES OR PROHIBITIONS, AFTER DISCUSSION WITH CORPORATE SAFETY, AND WHEN JUDGED NECESSARY FOR SAFE OPERATIONS.

THIS DOCUMENT IS PREPARED TO INFORM SITE PERSONNEL, THE BEM SYSTEMS TEAM EMPLOYEES, AND SUBCONTRACTORS OF POTENTIAL SITE HAZARDS. HOWEVER, EACH CONTRACTOR OR SUBCONTRACTOR MUST ASSUME DIRECT RESPONSIBILITY FOR THE HEALTH AND SAFETY OF ITS OWN EMPLOYEES. THIS DOCUMENT MAY NOT BE APPLICABLE TO OTHER CONTRACTORS OR SITE TASKS UNLESS APPROVED FOR SUCH USE BY CORPORATE SAFETY.

SITE SPECIFIC HEALTH AND SAFETY PLAN
FOR
SCHENECTADY AIR NATIONAL GUARD BASE, NEW YORK

Prepared by: Gary Schwartz Date: April 25, 2013

Gary Schwartz, CIH, CSP
Corporate Health & Safety Manager



Reviewed by: Date: April 25, 2013

Chun-Ti Huang
Senior Project Manager
BEM Systems, Inc.

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ANGB	Air National Guard Base
BEM	BEM Systems, Inc.
CDC	Center for Disease Control
CFR	Code of Federal Regulations
CHSM	Corporate Health and Safety Manager
CRZ	Contaminant Reduction Zone
eV	electron Volts
FID	Flame Ionization Detector
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDLH	Immediately Dangerous to Life or Health
LEL/LFL	Lower Explosive Limit/Lower Flammable Limit
mg/m3	Milligrams per Cubic Meter
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Dept. of Labor)
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
PPM	Parts Per Million
RCRA	Resource Conservation and Recovery Act
SSO	Site Safety Officer
SANGB	Schenectady Air National Guard Base
TLV	Threshold Limit Value
TO	Task Order
TWA	Time Weighted Average
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency

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1.0 INTRODUCTION

The Health & Safety Plan (HASP) presented herein has been prepared by BEM Systems, Inc. (BEM) in accordance with the regulatory requirements of 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER), 29 CFR 1926 "Construction Health and Safety", and the USACE EM 385-1-1 Safety Requirements Manual for activities scheduled at Schenectady Air National Guard Base (ANGB), New York. The HASP has been prepared for New York Air National Guard and Headquarters, Air National Guard Restoration Branch.

The HASP provides the following information, as required under 29 CFR 1910.120 and applicable standards:

- identification of tasks and potential hazards associated with each task,
- list of key personnel,
- personal protective equipment (PPE) that may be used at the site,
- employee health and safety training requirements,
- emergency contingency information,
- medical surveillance program,
- identification of confined space entry procedures,
- procedures for spill containment,
- list site control measures, as necessary, and
- decontamination procedures.

The HASP will be implemented by the Site Safety Officer (SSO) during site work. All BEM Team personnel and subcontractors who work on projects under this contract are required to comply with this HASP.

Modifications to the HASP may be proposed by the SSO, based on field conditions or changes in the technical scope of work to protection levels required in this plan. Any proposed changes must be approved by the Corporate Health and Safety Manager (CHSM).

1.1 Scope of Work

The overall scope of work for activities at the Schenectady ANGB is:

- Implement Remedial Activities
  - Sites 3 and 6 Excavation/Restoration/Installation of Geomembrane
  - Site 6 Groundwater Injection
  - Site 6 Groundwater Monitoring

Site-specific objectives are outlined below:

- Site 3 and 6: excavate and dispose off site the remaining contaminated soils
- Site 6: remediate CVOC-contaminated groundwater to achieve response complete

All fieldwork will be performed with Level D personal protection equipment (PPE). Upgrade in PPE to Level C or higher (respiratory and dermal protection) is not expected.

1.2 Project Personnel

The personnel who will be involved in environmental activities at Schenectady ANGB are listed in Table 1-1.

TABLE 1-1 PROJECT PERSONNEL

Name/Firm	Title	Work Phone	Cell Phone
BEM Systems, Inc.			
Chris Pisarri	Program Manager	407-402- 4440	407-402- 4440
Chun-Ti Huang	Project Manager	908-598-2600, ext 134	908-227-2797
Gary Schwartz, CIH, CSP	Corporate Health and Safety Manager (CHSM)	973-597-0750	973-568-7851
Malena Gordon	Environmental Scientist/SSO	908-598-2600, ext 155	609-577-4325
Travis Both	Geologist	908-598-2600, ext. 180	973-534-0382
SANGB Contact			
Lt. Col. Ronald Leadley	SANGB Environmental Manager	518-344-2341	
Subcontractor			
AECOM			
Scott Underhill	Technical Advisor	518-951-2208	518-396-7638
John Santacroce	Project Manager/SSO	518-951-2265	518-542-6333

2.0 ASSIGNMENT OF HASP RESPONSIBILITIES

The following describes the health and safety designations for BEM Team personnel and general responsibilities, which will be implemented for activities at Schenectady ANGB.

2.1 Corporate Health & Safety Manager (CHSM)

The CHSM is responsible for the review and approval of company safety protocols and procedures necessary for field operations and for the resolutions of any outstanding safety issues that arise during the site work. The CHSM shall approve any changes to this plan due to modification of procedures or newly proposed site activities.

2.2 Project Manager (PM)

The PM is responsible for assuring that the HASP is prepared, reviewed, and approved prior to the start of field activities and for assigning qualified site safety officers (SSOs) and project team members. The PM along with the CHSM and SSO are responsible for enforcing the requirements and provisions of the HASP with all field team members.

2.3 Site Safety Officer (SSO)

The SSO is responsible for enforcement of the HASP in the field and providing the daily safety meeting. The SSO has the authority, after consulting with the CHSM; to modify the requirements of the HASP based on field conditions. Before personnel may work on-site, a current medical examination and acceptable health and safety training must be approved by the CHSM.

2.4 Site Personnel

Site personnel are responsible for reading and following the contents of this HASP. Site personnel are also responsible for maintaining a safe work environment for themselves and those they work with and reporting any unsafe behavior, practices, and conditions to the SSO.

2.5 Multiemployer Worksite

Multiemployer worksites involve personnel from various companies, likely with different corporate structures, operating procedures, and safety values and culture. It is in the best interest of BEM Team personnel to be aware of contractor and subcontractor work activities that have the potential of causing harm, injury or illness, or project disruption during site activities. If an unsafe behavior or action is observed, it is recommended that the employee inform the responsible party, employee supervisor, or site supervisor/PM of the condition. It is not necessary for BEM Team field personnel to suggest or implement corrective action for other company employees. If the condition persists, and the condition presents an unsafe work environment, contact the PM or CHSM for notification and advisement.

Subcontractors will provide BEM Team with a health and safety plan for the work to be performed and the safety procedures associated with each task. Personnel training and medical clearance/fit testing certificates along with the most recent EMR and Occupational Safety and Health Administration (OSHA) 300 log will be provided and retained in the project files.

2.6 Site Employee and Visitor Orientation

It is important for site personnel to be informed of the applicable project hazards and protective measures. The following items will be included, but not limited to, in the site orientation. The CHSM or SSO will provide this information to site personnel and document the orientation for the project files.

- Acute and chronic health effects of contaminants of concern, hazard communication program
- Physical and mechanical hazards
- Personal hygiene and decontamination procedures
- Work zones
- PPE
- Evacuation plan and assembly area
- HASP review
- Air monitoring program
- Hazard recognition, reporting, and site safety

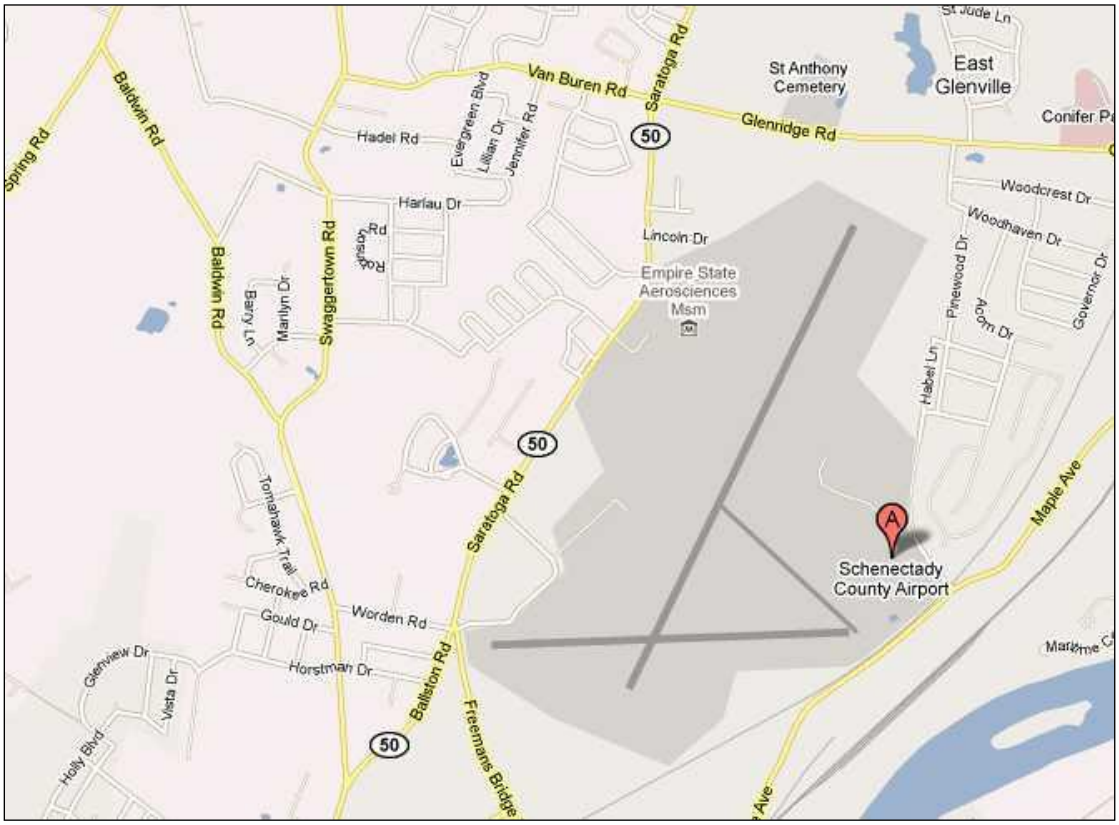
3.0 SITE DESCRIPTION/HISTORY

The Schenectady ANGB site is located at 1 Air National Guard Road. The Schenectady ANGB is located in the southeast portion of Schenectady County Airport (SCA) in Scotia, New York. The Base covers an area of roughly 106 acres. The airport is located approximately 2 miles northeast of Scotia, NY. The location of the Base is shown in Figure 3-1. The land located to the north, east, and west is residential and agricultural. South of the Base is the Mohawk River, a railway, and commercial and residential properties. Prior to the construction of the Base, the property was used for agricultural purposes.

In November of 1949, the Air National Guard authorized the formation of the 139th fighter squadron of the New York National Guard. This unit was previously located at the Scotia Naval Depot, which is approximately three miles west of the Base. By September of 1950, the permanent facilities for the unit were completed at the SCA and consisted of the present administration building, hanger, vehicle maintenance and various supply buildings.

Since then, the Schenectady ANGB has operated an array of military aircraft under numerous assignments. These have included the B-6, C-47, the C-97A and C-97G Stratocrusiers, various models of the C-130 Hercules, F-94 Starfire jets, P-47 Thunderbolt, P-51 Mustang, and the T-6. In 1991 the unit was redesignated to the 109th Airlift Wing and has since continued operations of the C-130H Aircraft.

Figure 3.1 Site Map



3.1 Previous Investigations

This section summarizes previous investigations and Remedial Actions (RA) at the Schenectady ANGB. These investigations included a Preliminary Assessment (PA), Site Investigation (SI), Remedial Investigation (RI), a Supplemental Data Collection (SDC) sampling program, a Feasibility Study (FS) for Site 6, and an Interim Removal Action (IRA).

3.1.1 Preliminary Assessment

A PA was performed at the Base by the U.S. Air Force Hazardous Material Technology Center (HMTC) in 1988. The PA included site visits, a review of existing environmental information, analysis of the Base records concerning the use and generation of hazardous materials/wastes,

and Base personnel interviews. The PA identified two AOCs: Site 1, Former Fire Training Area; and Site 2, Former Drum Storage Area.

In April of 1990, a construction crew performing routine repairs to a gravel road located adjacent to the Base sewage treatment plant unearthed four metal drums. The drums, their contents and a small amount of soil were removed and the area was restored to its original grade. Additional materials were suspected to have been buried in this location. Therefore, this area was identified as Site 3 and included in the investigations conducted at the Base.

3.1.2 Site Investigation

An SI was completed at the Base in 1996 by ABB Environmental Services. This investigation included Sites 1, 2, and 3. The SI included geophysical surveys, installation of groundwater monitoring wells, collection and analysis of surface soil and sediment samples, collection and analysis of surface water and groundwater samples, and aquifer testing. In the SI report, the delisting of Sites 1 and 2 was recommended along with further investigation of Site 3. The NYSDEC concurred with the recommendations for Sites 1 and 3, but required further investigation of Site 2.

3.1.3 Remedial Investigation

In June of 1999, an RI was completed at the Base (ANEPTEK, 2000). The RI initially included Sites 2 and 3. The RI included installation of groundwater monitoring wells, aquifer testing, and two rounds of groundwater sampling. The investigation at Site 3 also included the collection of soil and sediment samples, groundwater samples, and the excavation of 49 test pits to identify the types and extent of buried debris/wastes. All samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), herbicides, cyanide, propylene glycol, and metals.

During the RI, chlorinated compounds were detected in groundwater upgradient from Site 3. Subsequent investigations revealed a distinct chlorinated groundwater plume and this became designated as Site 6.

The investigation at Site 6 consisted of the installation of both permanent and temporary groundwater monitoring wells with two groundwater sampling events and the collection of 15 subsurface soil samples.

The results of the RI concluded, with concurrence from the NYSDEC, that Site 2 should be delisted and Sites 3 and 6 should be investigated further.

3.1.4 Time Critical Removal Action

The RI identified three AOCs (Areas A, B, and C) in Site 6. In April of 2002, a TCRA was performed. The TCRA consisted of excavating soil from each of these areas to a depth of approximately 8 feet below ground surface (bgs). Approximately 173 cubic yards of soil were removed and disposed off-site. Only two side wall confirmation samples from Area A exceeded soil cleanup objectives for tetrachloroethene (PCE); Areas B and C had no exceedences.

3.1.5 Supplemental Data Collection

A SDC sampling program for Site 6 was conducted at the Base in 2002. The SDC consisted of the installation of temporary and permanent well with groundwater sampling and the collection of subsurface soil samples. Results from the SDC indicated the presence of two areas of soil contamination (chlorinated VOCs) above state regulatory cleanup standards: both areas are in

close proximity to the areas excavated during the TCRA performed. The groundwater results indicated that a chlorinated hydrocarbon, dissolved phase groundwater plume exists at Site 6. The SDC study recommended further remedial measures be preformed for the Site 6 soils and groundwater.

3.1.6 Feasibility Study

Following the completion of the SDC sampling program, a FS was developed for Site 6. The FS recommended excavation, treatment, and off-site disposal for soils and enhanced bioremediation for the groundwater.

3.1.7 Interim Removal Action

The site-specific activities completed as part of the IRAs for Site 3 included the following:

- Excavation and off-site disposal of contaminated soils from two Test Pit (TP) areas (TP-1 and TP-7) and one Soil Sample area (SS-5) identified during the RI;
- Excavation and off-site disposal of all sediment within the drainage ditch upgradient of the weir; and
- Excavation, identification, and removal as needed of two geophysical anomalies reported in the 2004 geophysical survey.

Site-specific activities completed as part of the IRAs for Site 6 included the following:

- Excavation of all unsaturated soils above the CVOC groundwater plume, stockpiling and segregation based on photoionization (PID) screening measurements (less than 5 parts per million [ppm], between 5 and 50 ppm, and greater than 50 ppm), collection of confirmation samples from all stockpiled soils, off-site disposal of soils with residual contamination in excess of soil cleanup objectives (SCOs), and reuse as backfill all stockpiled soils below SCOs;
- Excavation, identification, and removal as needed of two geophysical anomalies reported in the 2004 geophysical survey; and,
- Installation of infrastructure necessary for field-scale treatability test of enhanced bioremediation of the chlorinated hydrocarbon groundwater plume.

As a result of the IRA, xylenes impacted soils remain in the area of Site 3, tetrachloroethene impacted soils remain in the area of Site 6, and CVOC contaminated groundwater remains in Site 6. These impacted media are the focus of the remediation associated with this HASP.

3.1.8 Data Gap Analysis

A Data Gap Investigation (DGI) was conducted on 31 October 2011 to delineate soil impacted with exceeding concentrations of xylenes at Site 3 and soil impacted with exceeding concentrations of CVOCs at Site 6 that would require future excavation. Soil borings were advanced at each site using direct push technology. Site 3 delineation results indicated that soil samples obtained from three of the fourteen boring locations were reported above the NYSDEC Recommended Soil Cleanup Objective for Unrestricted Use (RSCO Unrestricted) level of 0.26 ppm or milligrams per kilogram (mg/Kg) for xylene in soil. Site 6 delineation results indicated that soil samples obtained from two of the five boring locations were reported above the NYSDEC RSCO Unrestricted level for multiple CVOCs in soil (NYSDEC 2012).

4.0 HAZARD ASSESSMENT

BEM Team will perform environmental tasks in the areas of concern. During these activities, physical, chemical, and/or biological hazards may be encountered which are outlined in the following sections. Task-specific hazards are discussed in Section 4.4.

4.1 Physical Hazards

Physical hazards pose the greatest threat for injury at Schenectady ANGB, ranging from simple slips, trips, and falls to fatalities due to drowning. The following physical hazards have been identified as potential concerns and will be evaluated during routine audits:

- slips, trips, and falls,
- noise,
- heat/cold stress,
- hot work permits and environmental monitoring,
- accidents due to driving vehicles on uneven or unsafe surfaces,
- electrical hazards due to fallen or subsurface electrical lines,
- hazards associated with mechanical equipment, drilling
- falling objects,
- buried debris,
- areas of unknown contaminants and concentrations,
- confined space entry,
- severe weather,
- excavation/trenches,
- blood borne pathogens,
- ergonomics, safe lifting, and injury prevention
- aircraft movement area, and
- unexploded ordnance.

4.1.1 Slips, Trips, and Falls

The potential for slips, trips and falls may occur due to uneven or steep grades, ditches, slippery surfaces, poor housekeeping, or hoses and electrical cords. If possible, remove the hazard. If the hazard cannot be removed, take action to warn others of the hazard.

The SSO can use professional judgment to determine the severity of any injury incurred during a slip, trip, or fall. If a person becomes contaminated because of a slip, trip, or fall, the victim should obtain prompt medical attention. Decontamination shall be provided to the extent necessary.

4.1.2 Noise

Site activities scheduled will include the use of heavy equipment, such as excavators and wheel loaders. Unprotected workers may have exposure to noise exceeding the OSHA Action Limit (85 dBA) potentially resulting in hearing loss. BEM Team employees will be provided with hearing protection that must be worn during these activities. Annual medical monitoring

audiometric tests will be performed on employees who work in areas where the sound levels exceed 85dBA. Periodic noise sampling surveys will be conducted to determine if employees are being exposed to levels exceeding 85 dBA.

4.1.3 Heat Stress, Cold Stress and Sunburn

Heat stress and sunburn are important factors in employee health and safety. The stress of working in a hot environment can cause a variety of illnesses including heat exhaustion or heat stroke; the latter can be fatal. Personal protective equipment (i.e. EPA Level C protection) can significantly increase heat stress. Employees are expected to follow the guidelines provided in Attachment B to minimize heat stress symptoms and to wear protective hats and long-sleeved cotton shirts to protect against sunburn. Sunscreen may be worn if it does not interfere with sample analysis. To reduce or prevent heat stress, frequent rest periods and controlled beverage consumption to replace body fluids and salts may be required.

If a person feels or shows any of the heat related illnesses, the person shall take a break, get to a cool area, either an air-conditioned vehicle or building or a cool shady area and drink plenty of fluids. The SSO will be notified and monitor the personnel until the personnel's symptoms diminish. If medical attention is required, the SSO will contact local medical assistance personnel to treat and support the medical needs of the employee.

Cold Stress is also an important factor in employee health and safety. On days with low temperatures, high winds, and humidity anyone can suffer from the extreme cold. Severe cold temperatures can be life threatening. Several factors increase the harmful effects of cold: being very young or very old, wet clothing, having wounds or fractures, smoking, fatigue, emotional stress, and certain diseases and medications.

Cold weather injuries may be either local or systemic. Local cold weather injuries include chilblains (chronic injury of the skin and peripheral capillary circulation) and frostbite. Frostbite occurs in three progressive stages: frostnip, superficial frostbite, and deep frostbite. Systemic cold injuries, due to hypothermia, are those that affect the entire body system. Hypothermia is caused by exposure to cold and is aggravated by moisture, cold winds, fatigue, hunger, and inadequate clothing or shelter. The objective is to prevent the deep body temperature from falling below 96.8oF (36oC) and to prevent cold injury to body extremities. Employees should reference the cold stress section provided in Attachment B to minimize cold stress symptoms and to wear protective clothing during inclement weather.

4.1.4 Hot work permits and environmental monitoring

If welding, cutting or brazing is planned, a burn permit will be obtained from Schenectady ANGB authorizing the hot work. The permit will be posted at the work site for the duration of the shift. Welding equipment and compressed gases will be used and stored according to 29 CFR 1926 Subpart J. A fire extinguisher will be present at the welding area for use in an emergency. Combustible materials and surface growth will be removed prior to initiating a spark. The atmosphere will be tested with a compressed gas/explosive meter prior to cutting to prevent a fire or explosion due to headspace vapors present.

4.1.5 Construction Vehicles

Construction vehicles will be operating and traversing the site and adjacent residential roadways during the project. The following items will be in place during the project and must be adhered to by subcontractor personnel.

- Possess a valid and current state commercial drivers license (CDL), if applicable;
- Maintain a current Department of Transportation (DOT) medical exam and clearance, if applicable;
- Obey all posted speed limits;
- Carry current and applicable vehicle insurance;
- Placarding must be visible and appropriate for the materials being transported;
- License plates must reflect the appropriate designation and vehicle inspections must be current;
- Vehicles / construction equipment will yield to pedestrians;
- Vehicles / construction equipment must be equipped with mud flaps;
- Conduct a visual inspection for debris prior to leaving the site at the end of the work shift;
- Back up alarms must be audible and operational;
- Lights, signals and horns must work;
- Seat belt must be used while transporting materials;
- Cover load with canvas prior to moving off site;
- Stay on designated/approved roads intended for truck traffic;
- Obey all state and local traffic regulations; and
- Stay in vehicle – if driver exits vehicle (other than to cover load) they must use a hard hat, vest, safety glasses and steel toe boots.

4.1.6 Driving Vehicles

Personnel should exercise common sense and judgment when driving vehicles "off-road". Site surveillance on foot may be required to choose a clear driving path. At a minimum, employees driving company vehicles shall comply with the following:

- Required 100% seat belt use for driver and all passengers, including travel to and from the job site,
- Observing all posted speed limits,
- Yield to all pedestrians,
- Courtesy at all times,
- Use headlights when windshield wipers are on,
- Sound horn (two short beeps) just prior to backing any vehicle, and
- Abuse of vehicles or unsafe operation (management or SSO) will result in revocation of site driving privileges.

4.1.7 Electrical Hazards Due To Downed or Subsurface Electrical Lines

Fallen or subsurface power lines encountered during field activities should be reported to appropriate base personnel to determine whether or not fallen and subsurface power lines are energized. Call for a site utility markout before conducting any intrusive subsurface activities (800-282-8555).

4.1.8 Hazards Associated With Heavy Powered Industrial and Mechanical Equipment

Personnel should use the following safety measures and guidelines when working around heavy equipment and large excavations:

- A signal person should be designated by the subcontractor to assist in maintaining proper distances from overhead power lines and adjacent structures.
- Only certified and licensed subcontractor employees shall operate construction equipment.
- Maintain visual contact with the heavy equipment operator prior to approaching the cab. Never walk behind the equipment or position yourself in "blind spots" of the operator. **Heavy equipment and personnel do not mix.**
- Obey all back up or warning signals.
- Maintain a safe distance from moving bucket loaders.
- Parking brakes and chocks will be set before shutting off any vehicle.
- Buckets must be placed on the ground and locked when the equipment is not operating. This will ensure the bucket does not fall to the ground or present a hazard to people walking near it.
- No excavation will be left unattended or open without adequate barricades, caution tape, and safety signs.
- Suitable storage for all tools, materials, supplies will be provided by the contractor (or subcontractor).
- Work areas will be kept free of materials, obstructions, and substances that could cause a surface to become slick or otherwise hazardous.
- No work shall be performed below the bucket or arm of any type of heavy equipment.
- No one will be permitted to enter into any excavation greater than 5 feet deep without revision of this HASP to include safe entrance procedures and requirements for trenches.
- All excavation areas shall be secured while not attended with standard temporary railings with warning tape and complete cover when possible.

4.1.9 Falling Objects

Falling objects are a potential hazard during all activities with heavy equipment. Personnel will be required to wear hard hats during all activities with heavy equipment and any other activities where falling objects are a hazard.

4.1.10 Buried Debris

Buried debris may be found anywhere at the site. Whenever possible, exposed debris will be eliminated or clearly identified with yellow caution tape. Impalement hazards to workers will be removed as soon as possible.

If Underground Storage Tanks (USTs) or buried drums with unknown contents are encountered, work activities will immediately stop and the Project Manager, SSO, and CHSM will be notified as soon as possible before work resumes.

4.1.11 Confined Space Entry

No confined space entry situations are anticipated during the course of this project. If entry into confined spaces is required, a site specific entry program will be developed to comply with 29 CFR 1910.146.

ALL confined spaces are to be considered permit-requiring confined spaces until proven by testing and inspection to be NON-PERMIT REQUIRED confined space. Should it be necessary to enter a NON-PERMIT REQUIRED confined space, BEM Team personnel will adhere to the

requirements of 29 CFR 1910.146. The following procedures must be followed by all BEM Team employees prior to entering a NON-PERMIT REQUIRED CONFINED SPACE:

Permit-required confined space entry criteria are:

- oxygen content <19.5% or > 23.5% OR
- lower explosive limit (LEL) >10% OR
- toxicant concentrations requiring respiratory protection (i.e., greater than Permissible Exposure Limits (PELs)/ Threshold Limit Value (TLVs))

1. UTILITY SHUTDOWN: In evaluating the space, physical hazards such as electric lines, water lines, gas lines and the presence of machinery or other physical hazards are to be noted. Prior to entry, electric, gas, water and machinery are to be shut off (lock-out/tag-out procedures), as appropriate.
2. ATMOSPHERE: The atmosphere within the confined space must be monitored prior to entry for the following parameters below, in the order presented:

- OXYGEN CONTENT: The oxygen content must be between 19.5% and 23.5% on the combustible gas indicator.
- FLAMMABLE GASES AND VAPORS: The lower explosive limit (LEL) must not exceed 10% on the combustible gas indicator.
- HAZARDOUS ATMOSPHERES: The concentration of a single toxicant should not exceed the OSHA PEL or the TLV for any given 8-hour period. Total air toxicant concentrations should not exceed 5 units above background without the use of appropriate respiratory protection. Organic vapors are measured with a photoionization detector (PID) equipped with an appropriate lamp. Hazard-specific detection equipment is to be used, if toxicants are known (e.g., Draeger tubes, etc.).

The space may be classified as a non-permit required confined space and the space may be entered by BEM Team personnel if ALL of the following conditions are met:

- If no physical hazards are present AND
- lock-out/tag-out procedures have been verified by the field inspector and field supervisor (29 CFR 1910.146 and 1926.417) AND
- the oxygen content and the flammable gas and vapor concentration are within allowable limits AND
- no hazardous atmospheres exist.

3. Monitoring results and verification of lock-out/tag-out procedures are to be noted in the field notebook and initialed by BOTH the attendant and the field supervisor or field manager prior to entry into the confined space.
4. Entry into a confined space will only be allowed if the buddy system is followed. One or more persons may enter the confined space but at least one person MUST remain at the opening of the confined space and act in the role of an attendant. The attendant may not enter the confined space for any reason. In case of an emergency, the attendant will be responsible for obtaining help from the local fire department. If there are any questions regarding whether a space requires confined space entry, then the SSO or CHSM is to be consulted for clarification.

Contracted personnel who will be entering the confined space will supply their own entry equipment and health and safety plan, which will address confined space entry concerns. Contractors must treat all confined spaces as permit entry spaces and that, for the scope of this project; we will not accept the declassification of spaces or the use of alternative procedures. The Project Manager and the BEM CHSM must approve this plan.

4.1.15 Severe Weather

Operations MUST cease and personnel must seek cover during lightning. Operations must also stop during severe rain. There will be no excavation entry when it is raining. Excavations tend to collapse or cave-in with even a relatively small amount of water.

4.1.16 Excavation / Trenches

- All existing utility or other underground facilities shall be located before commencing with an excavation.
- Trees, boulders, poles, and other surface encumbrances located at the excavation/trenching site, shall be made safe and removed prior to beginning and excavation/trenching project.
- Walls and spaces of all excavations and trenches more than five feet deep into which employees may enter shall be guarded by shoring, sloping of the ground, or equivalent means. This shall be reviewed by the Safety Engineer by way of form prior to start of the excavation. Required sloping will be 1:1 unless a letter is submitted to the Safety Engineer explaining why this cannot be done.
- Daily inspections of the excavation shall be made. If there is any evidence of possible cave-ins or slides, all work in the excavation shall cease until the necessary safeguards have been taken. Particular attention shall be paid after rainstorms.
- All trenches and excavations shall be guarded on all sides with wooden or metal barricades that are linked with barricade tape. A minimum of two feet from the edges shall be maintained where possible. This is to prevent employees and/or equipment from inadvertently falling into the excavation or trench.
- All spoil piles shall be located at least three feet from the edge of the excavation to prevent it from falling back in.
- No employee shall work adjacent to any excavation until a reasonable examination of the excavation has been conducted and no conditions exist that would expose the employee to injury from moving ground.
- All work in the excavation shall at all times be supervised by a qualified person such as a trained, experienced supervisor or engineer. This individual will remain above the excavation at all times and will be responsible for identifying any unusual developments above ground, which may warn of impending earth movement. This person shall have the authority to make the appropriate changes in shoring or sloping.
- Safe means of access into the excavation/trench shall be provided. This may be a ladder, stairway or ramp securely fastened in place. Access into trenches shall require no more than 25 feet of lateral travel.
- Trenches shall only be crossed where safe crossings have been provided.
    - Walkways and bridges shall have standard guardrails (42 inches high at a minimum and able to withstand 200 pounds of force laterally at the center), and toe boards where the depth of the excavation exceeds 7.5 feet.

- Pedestrian bridges shall be of sufficient strength to prevent a vertical deflection greater than 0.5 inches when a weight of 250 pounds is applied in the center.
- Bridges intended for vehicles shall be constructed to withstand twice the load of the heaviest vehicle anticipated.

- The work area around the excavation/trench shall be kept as free as possible of necessary clutter and equipment.
- Appropriate measures shall be taken to prevent surface water from entering the trench or excavation and to provide adequate drainage of the area adjacent to the excavation/trench. If encountered, accumulation of water or fluids, which potentially endanger the health and safety of employees either directly or through affecting the excavation/trench's stability shall be controlled before further work progresses.
- All trenches, excavations, temporary wells, exploratory drilling, etc., shall be backfilled after work is completed and all associated equipment is removed.
- No employee shall be permitted to enter the excavation/trench unless they are specifically required to do so. Unauthorized persons shall not be allowed access.
- Employees shall be reminded daily, prior to start of the work shift, of the hazards associated with excavation/trenches. This will include being aware of signs of potential earth movement, which are to be brought to the immediate attention of the site supervisor. These reminders shall take place during the Tailgate Safety Meeting.
- All other applicable BEM procedures specific to the job are to be followed in addition to the above excavation/trenching work practices and conditions

4.1.17 Bloodborne Pathogens

Construction activities have the potential to expose employees to various site hazards which may result in injury and the release of blood or other potentially infectious materials (OPIM). This release of body fluids has the potential of contacting site workers if in proximity to the injured person or while performing first aid. Special considerations and precautions must be implemented to avoid personal injury and illness to bystanders, employees, responders, or first aid providers.

Human blood and body fluids can contain microorganisms - called bloodborne pathogens - that can lead to disease. Employees can be exposed to bloodborne pathogens in any number of ways: direct blood or body fluid contact through broken skin or mucous membranes (including the mouth, nose or eyes) and through needlesticks. Human immunodeficiency virus (HIV) and hepatitis B are two prevalent and deadly bloodborne diseases. Others include: syphilis; malaria; brucellosis; leptospirosis, arboviral infections, relapsing fever and Creutzfeldt-Jakob (Mad-Cow) disease.

Persons infected with HIV or Hepatitis B may not have any signs or symptoms of illness or even know they are sick. When it comes to bloodborne pathogens, the "golden rule" is to always assume that all blood and body fluids are infectious; this is termed as taking Universal Precautions. Universal Precautions requires error on the side of safety rather than exposure.

Since there is currently no cure, but rather long term treatment regiments for HIV, AIDS or Hepatitis B (HBV), Universal Precautions should always be taken. HBV can live for a week on surfaces like countertops but HIV usually dies in minutes when exposed to air. According to OSHA, potentially infectious materials include: blood; semen; vaginal secretions; cerebrospinal

fluid; synovial fluid; pleural fluid; pericardial fluid; peritoneal fluid; amniotic fluid; saliva in dental procedures; and any body fluid visibly contaminated with blood and all body fluids in situations where it is difficult or impossible to differentiate between body fluids. Also included are: any unfixed tissue or organ other than intact skin from a living or dead human; human immunodeficiency virus (HIV) - containing cell or tissue cultures; organ cultures; and HIV or HBV-containing culture medium or other solutions as well as blood, organs or other tissues from experimental animals infected with HIV or HBV.

OSHA's Bloodborne Pathogens standard for General Industry is found in 29 CFR 1910.1030.

Precautions

If an employee might contact blood and body fluids, the exposure control plan is referenced which includes:

(1) The exposure determination which identifies jobs where workers face bloodborne exposure;
(2) The procedures for evaluating the circumstances surrounding an exposure incident; and
(3) A schedule of how and when other provisions of the standard will be implemented, including methods of compliance; hepatitis B vaccination and post-exposure follow-up; training, and recordkeeping. Employees have access to the exposure control plan and the OSHA bloodborne pathogens standard.

Universal Precautions -- treating all body fluids/materials as if known to be infectious -- are mandatory. Engineering and administrative controls, such as safe needles, sharp disposal containers, hand washing and disinfection should be used if possible. Decontamination practices are identified in the exposure control plan. Disposal methods for contaminated materials, such as linens and needles, will be communicated to employees and comply with applicable medical waste regulations.

Appropriate personal protective equipment, such as gloves, face shields, splash goggles, one-way breather valves and breather bags for CPR and gowns, is available. Medical records are confidential and kept for the duration of employment plus 30 years. Training records are kept for a minimum of 3 years. Employees are trained initially upon assignment and annually thereafter. Training includes: bloodborne diseases and their transmission, exposure control plan, engineering and work practice controls, personal protective equipment, hepatitis B vaccine, response to emergencies involving blood, how to handle exposure incidents, the post-exposure evaluation and follow-up program, and signs/labels/color-coding.

Site Specific Information

1. Identify sources of bloodborne pathogens.
2. Describe exposure potential (through inhalation, splash, puncture, skin contact, etc).
3. Describe exposure controls and additional regulations or project precautions.

4.1.18 Ergonomics, Safe lifting, and Injury Prevention

Ergonomic hazards may exist during construction support and project tasks. Field personnel will work with the SSO to identify potential lifting hazards and assess means to safely maneuver materials to prevent employee strains, sprains, injuries, and resultant lost time. Manual material handling equipment may be needed to assist field staff with equipment handling. Personnel should not use back belts to substitute for safe lifting procedures. Equipment/materials manually

handled shall be performed by using the legs, keeping the material close to the body, and having a firm, secure grip on the material.

4.1.19 Aircraft Movement Area

Should any tasks at Schenectady ANGB involve the presence near or on aircraft operations areas (AOA), specific training may be required dependent upon the project/employee's proximity to the AOA. Reflective safety vests and hearing protection are required when near the AOA and when on airport property. Hand signals may need to be developed and communicated if verbal communications may be impacted by elevated sound levels. Site vehicles will require reflective/rotating beacons placed atop the roof. Vehicle lights and hazard warning flashers will also be used. Radio communication with air traffic control or airport security may be necessary prior to accessing runways or the aircraft right of way areas during project tasks.

4.1.20 Unexploded Ordnance

Although UXO is not considered to be a concern considering the current Task Order, there is no "safe" procedure for dealing with Unexploded Explosive Ordnance (UXO), merely procedures which are considered least dangerous. Maximum safety in any operation involving UXO can be achieved through adherence to applicable safety precautions, a planned approach and close supervision of personnel conducting the operation. The "cardinal rule" in planning tasks involving unexploded ordnance, ordnance residue or explosive materials is to expose the minimum number of personnel to the minimum amount of hazardous material for the minimum amount of time. The following safety concerns will be followed by the BEM Team Field Supervisor when planning operations in an area suspected of being contaminated:

a. Only Schenectady ANGB EOD personnel will be involved in UXO procedures. ANG EOD personnel will conduct operations in accordance with applicable OSHA and USACE UXO procedures included in but not limited to the following guidance documents:

- Safety Concepts and Basic Considerations for UXO Operations
- Generic Scope of Work for Ordnance Avoidance Operations

b. Non-UXO personnel may be utilized to perform UXO related procedures with the permission of and when supervised by ANG EOD personnel.

c. Personnel working near UXO must take steps to reduce the potential of generating static electricity. ANY source of ignition should not be used at the site (e.g., smoking, use non-sparking tools only). Precautions include not wearing outer or undergarments made of materials which have demonstrated the ability to generate high static such as 100% polyester, nylon, silk or wool.

d. Suspect chemical ordnance present additional hazards to personnel. Only military ANG EOD military personnel will be allowed to secure chemical ordnance. Personnel will withdraw to an offsite location to eliminate the possibility of exposure to any chemical contamination.

e. Ordnance items sometimes penetrate the earth to a depth where the force of the explosion does not break through the earth's surface. These pockets, referred to as a camouflet, contain hazardous and toxic gases. Camouflet detection and precautions must be considered if the site was used as an impact area.

f. The ANG EOD team supervisor will conduct the UXO safety briefings for site personnel.

If it is necessary to excavate the top 6 inches of surface material at the excavation area to remove metal debris so that ANG EOD personnel can perform a magnetometer survey of the area the following are general safety procedures to be implemented during excavation activities.

a. A visual surface reconnaissance and geophysical subsurface magnetometer investigation will be performed over the excavation area by Schenectady ANGB EOD personnel after the top 6 inches of surface material has been removed with a track hoe. The objective is to identify physical hazards, suspected hazards, unexploded ordnance, energetic materials, flammables, pyrotechnics, and unknown buried objects by position. Subsurface contacts will be located, marked with non-metallic identifiers, and recorded by position by ANG EOD personnel.
b. Prior to opening an excavation site, every effort shall be made to identify the presence of subsurface excavation hazards (i.e., sewer, telephone, water, fuel, electric, and pipe services). Identification of underground utilities must be coordinated with Schenectady ANGB personnel.
c. Excavation equipment may be modified to afford the operator some protection if a small munitions item should detonate. Installation of a ¾-inch Lexan shield, placed in a frame and mounted at least two inches from the surface of the operator's cab will afford limited protection from fragments or debris.

Excavation activities will be directed by the Schenectady ANGB EOD supervisor until the ANG EOD supervisor has cleared the excavation area (UXO free). The following procedures will be followed by personnel conducting excavation operations for the removal of the top 6 inches of surface material as deemed necessary based on the identification of subsurface anomalies or suspect munitions being present:

a. Determine wind direction by positioning of streamers. Excavation equipment and non-essential personnel will be remain in an upwind location of the proposed excavation point under notified by the ANG EOD personnel that entrance to the exclusion zone is safe.
b. When entrance to the exclusion zone has been deemed safe by ANG EOD personnel, the equipment operator will remove 6 inches of surface material from the excavation area under the direction of ANG EOD personnel.
c. ANG EOD personnel will observe the excavation process for any potential or suspect UXO material and will immediately halt operations if further inspection or sampling is warranted.
d. ANG EOD personnel will conduct a magnetometer survey of the excavation area after the surface material has been removed to determine whether subsurface anomalies are present and mark the position of any subsurface anomaly.
e. Prior to conducting an investigation of an anomaly, ANG EOD will establish a restricted/exclusion area for non-essential personnel while investigation activities are being conducted.
f. If additional buried ordnance is discovered, personnel will evacuate the area until excavation and removal of the ordnance by ANG EOD personnel has been completed.
g. After an area has been cleared by ANG EOD personnel as UXO free, soil excavation will continue. Excavating will not be conducted within 5 feet of a subsurface anomaly that has not been investigated by ANG EOD personnel.

Safety precautions to be implemented in the event of an UXO being discovered include, but are not limited to the following;

- Any UXO found within the confines of the work area will be positively identified by two UXO qualified technicians;
- UXO items will only be moved or handled by qualified UXO technicians;
- All personnel will wear as a minimum Level D PPE, sleeves rolled down when in heavy vegetation, leather or canvas work gloves and boots. This will minimize contact with potentially irritating and/or toxic plants. In addition to these measures, any person known to have allergic reactions to insect bites or exposure to toxic plants will be identified and will carry appropriate first aid materials at all times;
- While on the job, all personnel will move at a moderate pace and stay alert for possible trip hazards;
- Use of radio communication will be limited to areas known and confirmed to not be impacted by UXO's
- Hand digging will be performed in areas either cleared or verified to not pose a threat from UXO's
- Vibrating equipment will not be permitted in the sampling area

UXO identification and removal activities will be in compliance with OSHA, MIL-STD's and other applicable regulations including;

29 CFR 1910.109

NFPA 495

ATF P 5400.7 (dated 6/90)

Department of the Army Technical Manual TM 9-1300-206

Department of the Army Technical Manual TM 9-1300-214

Department of Defense Order DOD 6055.9-STD

Department of the Army Field Manual FM 5-250

4.2 Chemical Hazards

Personnel who have the anticipated or potential to come in to contact with soils will utilize chemical resistant gloves (neoprene or double nitrile) and Tyvek® (coated if liquids are present) clothing to prevent dermal and personal clothing contact.

Table 4-1 Site Contaminant Toxicity Assessment

Contaminant	IDLH Level	PEL, (OSHA Action Level)	Health Effects for Relevant Exposure Pathways (oral, dermal, inhalation)
Tetrachloroethylene (Perchloroethylene [PCE])	Ca [150 ppm]	TWA 100 ppm	**Exposure Routes**: inhalation, skin absorption, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen] **Target Organs**: Eyes, skin, respiratory system, liver, kidneys, central nervous

Contaminant	IDLH Level	PEL, (OSHA Action Level)	Health Effects for Relevant Exposure Pathways (oral, dermal, inhalation)
			system
Trichloroethylene (Trichloroethene [TCE])	Ca [1000 ppm]	TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)	**Exposure Routes**: inhalation, skin absorption, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen] **Target Organs**: Eyes, skin, respiratory system, liver, kidneys, central nervous system
Dichloroethylenes (1,1-DCE)	Ca [N.D.]	none	**Exposure Routes**: inhalation, skin absorption, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen] **Target Organs**: Eyes, skin, respiratory system, central nervous system, liver, kidneys
1,2-Dichloroethylene (1,2-DCE)	Ca [N.D.]	TWA 200 ppm (for 1,2)	**Exposure Routes**: inhalation, skin absorption, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, respiratory system; central nervous system depression **Target Organs**: Eyes, respiratory system, central nervous system
Vinyl Chloride	Ca [N.D.]	TWA 1 ppm C 5 ppm [15-minute]	**Exposure Routes**: inhalation, skin and/or eye contact (liquid) **Symptoms**: lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen] **Target Organs**: Liver, central nervous system, blood, respiratory system, lymphatic system
Benzene	Ca [500 ppm]	[1910.1028] TWA 1 ppm ST 5 ppm	**Exposure Routes**: inhalation, skin and/or eye contact **Symptoms**: irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen] **Target Organs**: Eyes, skin, respiratory system, blood, central nervous system, bone marrow
Toluene	500 ppm	TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)	**Exposure Routes**: inhalation, skin absorption, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, nose; lassitude (weakness, exhaustion), confusion,

Contaminant	IDLH Level	PEL, (OSHA Action Level)	Health Effects for Relevant Exposure Pathways (oral, dermal, inhalation)
			euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage **Target Organs**: Eyes, skin, respiratory system, central nervous system, liver, kidneys
Ethylbenzene	800 ppm [10%LEL]	TWA 100 ppm (435 mg/m3)	**Exposure Routes**: inhalation, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma **Target Organs**: Eyes, skin, respiratory system, central nervous system
Xylenes (m-, p-, o-)	900 ppm	TWA 100 ppm (435 mg/m3)	**Exposure Routes**: inhalation, skin absorption, ingestion, skin and/or eye contact **Symptoms**: irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis **Target Organs**: Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys
PAH	N/A	0.2 mg/m3	Respiratory irritation, dizziness, nausea, loss of consciousness. Prolonged, repeated skin contact may result in skin irritation or more serious skin disorders. **Note**: this product contains polycyclic aromatic hydrocarbons, some of which have been reported to cause skin cancer in humans under conditions of poor personal hygiene, prolonged repeated contact, and exposure to sunlight. Toxic effects are unlikely to occur if good personal hygiene is practiced.
Fuel, JP-8	N/A	400 mg/m³ (TWA)	Skin irritation (itching, burning, redness, rash); dermatitis; headache, fatigue, anorexia; dizziness, difficulty concentrating; poor coordination. INGES ACUTE: Vomiting, diarrhea, cramps; drowsiness, restlessness, irritability, loss of consciousness; death; pneumonitis (from aspiration). **Affected organs**: CNS, skin, respiratory system
Diesel Fuel	N/A	carcinogen	Acute contact may cause mild to moderate irritation and drying. Inhalation may cause respiratory tract irritation and central nervous system effects. Ingestion may cause stomach irritation, gastritis and central nervous system effects. Aspiration hazard LD50 (ORAL, RAT) > 2,000 MG/KG (not toxic to humans)
Particulates Not otherwise regulated	N.D.	15 mg/m3 total dust 5 mg/m3 respirable	**Contact**: minor dermal and eye irritation Inhalation: sneezing, congestion, mucous

Contaminant	IDLH Level	PEL, (OSHA Action Level)	Health Effects for Relevant Exposure Pathways (oral, dermal, inhalation)
		dust	membrane irritation, allergic reactions
Sodium Permanganate	N/A		Contact with contaminant can cause severe burns, irritation.

Table 4-2 Site-Specific Personal Protection Required

Activity	Level of Protection
Excavation and disposal of soils	Level D – Modified Level D/C
Groundwater injection	Level D – Modified Level D/C
Ground water sampling	Level D – Modified Level D/C

4.3 Biological Hazards

BEM Team personnel and their subcontractors should be aware of the various biological hazards that may be encountered while working at Schenectady ANGB including ticks (Lyme disease), poisonous insects (i.e., fire ants, chiggers, and disease-bearing mosquitoes), poison ivy, airborne viruses, and/or snakes. Appropriate preventative measures should be employed to minimize potential exposure to biological hazards.

Venomous insects and spiders are generally reclusive and the greatest potential for exposure arises when personnel are opening containers, structures, buildings, well casings, handling idle equipment, or construction material stockpiles.

4.3.1 Venomous Snakes

Venomous snakes will normally retreat away from people. If a snake is encountered, immediately inform the SSO or the field leader and move away from the animal. Provide the animal with the opportunity to move to another area. If the animal poses a continued hazard to personnel, the base point-of-contact will be notified and base support may be contacted to remove the animal. Venomous snakes which may be found in this area include:

- Copperhead - a moderately large, stout-bodied snake with a pattern of hourglass-shaped crossbars on its body. It is not an aggressive snake and does not bite unless disturbed or provoked. copperheads prefer rocky, forested hillsides and wetlands for habitat. The copperhead is mainly found along the lower Hudson Valley south of Kingston; it is essentially absent from the Catskills and points further west.
- Timber Rattlesnake – This venomous reptile is the only species of snake in the Delaware with a segmented rattle at the end of its tail. It has brown or black chevron-shaped markings on a yellow background, down its back. The background color may vary from a bright yellow to a dull gray. Entirely black specimens also occur. This snake rarely exceeds six feet in length. It is found mainly in the southeastern part of the state, except Long Island and New York City, with scattered populations as far north as Lake George and also along the Southern Tier in western New York.

If bitten by a snake do not apply ice, keep bite lower than the heart, do not cut the wound, do not apply a tourniquet, and do not use electric shock. If necessary, carry the victim to a medical facility or have him or her walk slowly.

First Aid: If bitten by a snake the patient should be transported immediately to a medical facility equipped and staffed to handle snakebites. The use of a snakebite kit can be utilized in an emergency. The absorption of venom should be retarded by placing the victim at rest and splinting the extremity if that was the site of the bite. If possible, a wide construction band should be placed above the bite. This should be just firm enough to allow a finger to be placed between the hand and the skin. The goal is to impede lymph flow, not venomous return. As the area begins to swell, the band should be loosened and re-applied away from the swelling.

4.3.2 Insects and Spiders

Nearly all work sites may contain ticks, venomous spiders, (black widow, brown recluse), scorpions, and venomous insects. Caution should be taken when opening the casing around monitoring wells.

BEM Team personnel should be aware of ticks and inspect themselves at the end of each workday. Remove any ticks that have attached, complete an incident report if medical attention is required, and report it to the SSO.

Black widow and brown recluse spiders, both venomous, may also be present in and around structures or vegetation. Spider bites from these species can cause swelling and intense pain and in some instances, have caused death.

Chiggers are very small red spiders. Precautionary measures include tucking pant legs into boots. Once under the skin, they are difficult to remove but can be smothered by applying a commercial ointment or clear nail polish to the affected area.

Venomous insects include wasps, bees, hornets, fire ants, and red ants.

4.3.3 Irritant Plants

Irritant plants with toxins may be found at the work site, including poison ivy, poison sumac, poison oak, Giant Hogweed, and Wild Parsnip. The sap from these plants causes severe skin irritation in many characterized by redness, blisters, swelling, and intense burning and itching.

A good practice is to wash exposed skin frequently (use “baby wipes” if no plumbed water system) to prevent an allergic reaction.

4.4 Task-Specific Hazard Assessment

Task-specific hazard assessment for the proposed scope of work is presented in Table 4-3.

TABLE 4-3 Task-Specific Hazard Assessment

Task	Hazard	Control Measure
Excavation and disposal of contaminated soil and sediments; groundwater injection through direct push locations (drilling)	Heat/Cold Stress	Follow guidelines in Attachment A or B, as applicable
	Biological Hazards	Do not threaten or touch animals. Wear protective clothing, as applicable. See Section 4.3
	Potential Exposure to Particulates/Vapors	Periodic Air Monitoring/Level D w/PPE upgrade as necessary. See Table 4-1 and Section 8 for air monitoring.
	Slips/trips/falls	Exercise precaution and good housekeeping. Remove hazard if possible.
	Flying debris	Wear safety glasses with side shields and protective face shield, steel toe boots during field work
	Noise	Wear hearing protection rated for task related noise levels
	Heavy Equipment	Awareness of proximity to equipment and overhead utilities, hand signal person designated, wear reflective traffic safety vest
	Falling objects	Hard hat, steel toe boots, safety glasses with side shields
	Biological Hazards	Do not threaten or touch animals. Wear protective clothing, as applicable. See Section 4.3
	Trenching/shoring	All sloping and benching shall be done in accordance with 29 CFR 1926.652, Appendix B. Protective systems are required on all excavations over five feet in depth or in excavations less than five feet if inspection indicates conditions that will result in a cave-in. Protection systems shall be one in accordance with 29 CFR 1926.652, Appendices C&D
	Buried utility lines	call base personnel and utility location provider for markout
	Buried debris	Identify and eliminate, if possible.
	Lifting (e.g. drums)	Use correct lifting technique and/or lifting equipment
Groundwater injection through infusion wells/Groundwater sampling	Heat Stress/Cold Stress	Follow guidelines in Attachment A or B, as applicable
	Biological Hazards	Do not threaten or touch animals. Wear protective clothing, as applicable. See Section 4.3
	Potential Exposure to Particulates/Vapors	Periodic Air Monitoring/Level D w/PPE upgrade as necessary. See Table 4-1 and Section 8 for air monitoring
	Slips/trips/falls	Exercise precaution and good housekeeping. Remove hazard if possible.

5.0 TRAINING REQUIREMENTS

5.1 OSHA Required Training

BEM Team field personnel have completed the requisite OSHA HAZWOPER training in accordance with 29 CFR 1910.120 (e). BEM Team PM's and field personnel supervisors shall have received 8 hour Supervisory training in addition to the requisite training according to 29

CFR 1910.120 (e)(4). Contractors/ subcontractors shall provide written documentation that training/experience requirements are in accordance with 29 CFR 1910.120 (e). Copies of the health and safety plan sign-off sheet are kept in the project file. Training certificates for BEM Team site personnel will be maintained at the Chatham, NJ offices.

Select field staff will maintain DOT's HM 181f training for involvement in hazardous waste labeling, sampling, drumming, and to assist the client with the appropriate disposal and classification to avoid improper disposal and resultant fines and environmental impact.

6.0 MEDICAL SURVEILLANCE PROGRAM

All BEM Team personnel and subcontractors performing fieldwork take part in a medical surveillance program that is consistent with the requirements of 29 CFR Part 1910.120 (f).

Contractor/subcontractors will maintain medical records for their own employees, but shall also provide the SSO with written documentation certifying that each employee at the site has met the requirements of the OSHA Medical Surveillance Program. This documentation will be provided before the first day of work for each employee assigned to the site.

6.1 Applicability

The medical surveillance program applies to those BEM Team personnel:

a) Who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits (PELs), above the published exposure levels for these substances without regard to the use of respirators, for 30 days or more per year as required by 29 CFR 1910.120(f)(2)(i); or
b) Who wear a respirator for 30 days or more a year or as required by 29 CFR 1910.120(f)(2)(ii) and 29 CFR 1910.134; or
c) Who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation as required by 29 CFR 1910.120 (f)(iii).

The BEM medical surveillance program includes components specified in OSHA regulations (29 CFR 1910.120 and 29 CFR 1926.65) and governmental guidance (NIOSH/OSHA/USCG/EPA, 1985). The medical surveillance program[1] provides the following components:

- Surveillance
  - Baseline medical examination,
  - Periodic medical examination and follow-up examinations, as appropriate,
  - Termination examination.
- Treatment
  - Emergency
  - Non-emergency (on a case-by-case basis)
- Recordkeeping
- Program review

[1] In New Jersey, BEM retains the services of Dr. Iris Udasin of UMDNJ-EOSHI, Piscataway, NJ as an occupational medicine consultant. The regional offices use local services.

6.2 Medical Monitoring

The medical monitoring program consists of two essential components for designated BEM employees:

- Routine medical monitoring, and
- Emergency medical care and treatment.

6.2.1 Routine Medical Monitoring

Routine medical monitoring will consist of a basic medical examination and completion of a medical questionnaire to establish the individual's general state of health, baseline physiological data, suitability for assignment, and suitability to utilize respiratory protective equipment. The basic examination is completed within 30 days of the start of employment with BEM or 30 days prior to reassignment to a field activity requiring medical monitoring. An exit examination from a previous employer may be substituted for an entrance examination, provided required tests have been completed and the examination results are less than six months old. Medical examinations will be required annually for those BEM employees meeting the applicability requirements. The annual exam may include additional tests depending on possible field exposure.

Additional exams may be performed at more frequent intervals, if:

- The examining physician determined that more frequent examinations are warranted

  OR

- An employee has
  - developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards,
  - been injured, or
  - been exposed to toxicants above the PELs or published exposure levels in an emergency situation as determined by the SSO.

The baseline and exit examination given to BEM personnel enrolled in the medical monitoring program consists of:

A. Detailed, self-administered health inventory reviewed with the patient by the examining physician,
B. Complete physical evaluation, including neurological examination,
C. Applicable Laboratory tests

Diagnostic tests will be performed by a licensed hospital or clinical laboratory that participates in a proficiency testing program(s) and maintains a rigorous quality assurance program. These laboratories will be able to provide additional tests that might be essential.

Special medical tests may also be required based on potential exposure to specific toxicants in the work environment, by the medical history or conditions of the person examined, or as required by Federal, State, or local health and safety regulations. The Medical Consultant, in coordination with the SSO, shall determine what special medical tests are appropriate and the manner in which these exams will be conducted.

6.2.2 Emergency Medical Care

This site-specific HASP addresses emergency medical care and treatment of BEM personnel, including possible exposure to toxicants and injuries due to accidents or physical problems.

The SSO is responsible to ensure that any site employee requiring medical care due to injury or illness receives emergency medical care. BEM personnel requiring emergency medical treatment will not be allowed back onsite without a written physician's release.

6.3 Responsibility

The SSO is responsible for maintaining the medical surveillance program and has the following responsibilities:

- Designate all employees who must participate in the medical monitoring program,
- Retain qualified physician(s) to conduct necessary medical examinations,
- Obtain a written statement from the examining physician indicating the employee's availability for assignment for various field activities, including but not limited to, suitability to use a respirator,
- Maintain copies of the physician's statement for all employees participating the medical surveillance program and ensure all medical retention requirements are being met by BEM,
- Ensure that all personnel medical examination are conducted within the prescribed time frame,
- Review the employee roster annually to ensure that all appropriate personnel are participating in the medical monitoring program,
- Coordinate with Human Resources on medically-related issues for record-keeping purposes,
- Assure that original medical records for BEM personnel are maintained by BEM for the time period of the duration of employment plus 30 years (29 CFR 1910.120).

6.4 Confidentiality

The information contained in the employee medical files will be available only to the Corporate Health and Safety Manager, the Human Resource Manager, the medical consultants, and examining and consulting physicians and staff. Employee medical files include:

- Original medical records,
- Physician's clearance statement,
- Disclosure agreements, and
- Requests for copies of medical records for employees.

6.5 Medical Records Information

Personnel information requested in the medical/occupational history questionnaire will provide the examining and consulting physician(s), employers and Health and Safety personal information on the general health status and establish the medical/occupational history of an individual. These forms will be completed by all designated personnel prior to their exam and will be kept as part of the medical record.

7.0 SITE CONTROL MEASURES

The purposes of the site control measures discussed in this section are to maintain order at the site and to minimize health and safety hazards to on-site personnel, visitors, and the public. Site control zones will include work zones; contaminant reductions zones, and support zones and will be maintained by the SSO or other designee.

7.1 Site Access

BEM Team personnel will abide by any security restrictions imposed by Schenectady ANGB. Site access will be limited to trained, medically cleared, essential personnel only.

7.2 Work Zones

Temporary work zones shall be established at each sampling location. The SSO shall establish an area to provide portable eyewash, first aid kit, towels, plastic garbage bags, fire extinguisher, and decontamination supplies. Access to the work zones will be controlled so that personnel entering the areas are wearing the proper personal protective equipment. Smoking, eating, drinking, and chewing tobacco will not be permitted within work zones.

7.3 Support Zone

The support zone is considered the clean area and consists of any area outside the work zone. The Command Post; appropriate sanitary facilities; safety, medical and support equipment will be located within the support zone. Potentially contaminated personnel or materials are not allowed in the support zone. The support zone will be located upwind of the work zone.

8.0 AIR MONITORING

Periodic air monitoring for particulates and organic vapors will be conducted around the work zone perimeter. The results of the air monitoring shall be recorded in the field logbook on a daily basis. This information will be recorded and a report will be generated by the SSO to employees exposed.

8.1 Action Levels

Air monitoring instrumentation will include a photoionization detector (PID) equipped with a 10.2 eV lamp and/or a flame ionization detector (FID). Air monitoring or air sampling for dusts will be evaluated as necessary. The action levels in this HASP will apply to site work for the duration of activities at the project site. The level of protection to be employed by BEM Team personnel at the work site will be based on the action levels as presented in Table 8-1.

TABLE 8-1 Action Levels

Potential Air Contaminant	Instrument [1]	Action Levels	Level of Respiratory Protection
Explosive Vapors	CGI	< 19.5% oxygen, >23.5% oxygen, or > 10% LEL	Leave Area
Explosive Vapors	CGI	> 19.5% < 23.5% oxygen, < 10% LEL	Level D
Airborne Particulates	Mini-Ram	>sustained 5 mg/m3 above background	Level C
Organic Vapors	PID-FID	Continuous sustained readings of <5 ppm above background in the breathing zone and no visible dust	Level D
	PID/FID chemical-specific Draeger tubes	Sustained (> 5 min.) readings > 5 ppm but < 50 ppm above background in the breathing zone and/or sustained dust clouds	Level C

[1] The H&S manager or Site Safety Officer must approve an equivalent unit

The generic Community Air Monitoring Plan (CAMP) will be utilized to protect on-site employees or visitors not involved in the field work during excavation activities. However, due to the reduced level of intrusion associated with the direct push soil sample activities, health and safety monitoring will be implemented to document the level of exposure encountered during the excavation, injection and groundwater monitoring activities. The CAMP is included as Appendix J.

8.2 Instrument Calibration

Instrument calibration shall be performed in the field at least once per work shift and shall be documented in the field logbook.

9.0 PERSONAL PROTECTIVE EQUIPMENT

Basic levels of protection for hazardous waste operations were selected in accordance with the provisions of 29 CFR 1910.120 (g) (3), "Personal Protective Equipment Selection". Modification to basic protective equipment ensembles may be necessary for specific operations. Personal protection may be upgraded or downgraded, as deemed appropriate by the SSO and verified by the CHSM. The site-specific personal protection program is described in Table 9-1.

TABLE 9-1 Site-Specific Personal Protection Program

Activity	Level of Protection
Excavation and disposal of soils	Level D – Modified Level D/C
Groundwater Injection	Level D – Modified Level D/C
Ground water sampling	Level D – Modified Level D/C
Sodium Permanganate Handling	Level C – Respirator only if workplace conditions warrant. Full face shield and eyewash onsite.

- Hard hat (when working around heavy equipment),
- Steel-toed work boots (for all other activities) that are chemical-resistant,

- Safety glasses, tinted or clear depending on task locations,
- Non-Latex or disposable nitrile gloves,
- Sun protection (hat and sunscreen), and
- Cold weather protection (as applicable).

Modified Level D equipment includes:

- Disposable Tyvek coveralls,
- Hard hat (when working around heavy equipment),
- Steel-toed work boots (for all other activities) that are chemical-resistant,
- Non-Latex or disposable nitrile gloves (as applicable when sampling),
- Safety glasses,
- Hearing protection (as applicable),
- Sun protection (hat and sunscreen), and
- Cold weather protection (as applicable)

Level C equipment includes:

- Disposable Tyvek coveralls,
- Hard hat (when working around heavy equipment),
- Steel-toed work boots (for all other activities) that are chemical-resistant,
- Gloves, outer chemical-resistant,
- Gloves, inner chemical-resistant,
- Hearing protection (optional), and
- Full-face or half-face, air purifying respirator (NIOSH approved) with applicable cartridges (determined by the SSO after consulting with the CHSM).

Level B equipment includes:

- Pressure-Demand SCBA Air Pack or Supplied Air system with escape bottle.
- Hooded chemical-resistant clothing,
- Gloves, outer and inner chemical-resistant,
- Boots, chemical-resistant, steel toe and shank,
- Hard hat (under suit), and
- Two-way radios (worn inside encapsulating suit).

This is the minimum level recommended for initial site entry when the contaminant and its airborne concentrations are unknown.

10.0 DECONTAMINATION PROCEDURES

10.1 Personnel Decontamination Procedures

The SSO will be responsible for supervising the proper use and decontamination of PPE and personnel.

Decontamination involves scrubbing with a soap and water solution followed by rinses with potable water. Dirt, oil, grease, and other foreign materials that are visible will be removed from surfaces. Non-disposable garments will be air-dried prior to storage. Respirators will be

sanitized daily. Rinse water used in personnel decontamination will be disposed with wastewater from equipment decontamination and drummed for laboratory analyses and proper disposal thereafter. Tyvek, gloves, etc will be disposed of with applicable hazardous waste.

10.2 Personnel Decontamination Equipment

The following supplies will be available onsite for personnel decontamination:

- plastic drop cloths
- plastic wash tubs
- long-handled brushes
- Alconox®, water, alcohol wipes, and towels to wash hands, face, and respirators.
- hand spray units

11.0 SPILL CONTAINMENT

The contractor will be responsible for planning for and assuring that any spills are contained and immediately containerized and that the affected area is cleaned. In the event that a spill occurs, the SSO shall follow the procedures specified for incident reports, Policy HS-001 and notify all applicable emergency response departments.

12.0 GENERAL SAFE WORK PRACTICES AND COMMUNICATIONS

12.1 Safety Equipment

Basic emergency and first aid equipment will be available at the support zone and/or work zone, as appropriate and include material safety data sheet (MSDS) information, hearing protection, communications equipment, first aid kit, emergency eyewash, and fire extinguishers.

12.2 Communications

Based on the close proximity of site workers, verbal communication, hand signals and the use of cell phones will be utilized between the work zones and/or support zone. Hand signals are important when working and the entire field team should become familiar with the signals before operations commence.

TABLE 12-1 Hand Signal Communication

Signal	Meaning
Hand gripping throat	Out of air; can't breath
Grip partner's wrist	Leave area immediately, no debate
Hands on top of head	Need assistance
Thumbs up	OK; I'm all right; I understand
Thumbs down	No; negative

12.3 Safety Briefings (Tailgate Safety Meetings)

Project personnel will be given tailgate safety meetings by the SSO on a daily basis to further assist site personnel in conducting their activities safely when new activities are to be conducted, changes in work practices, or if site or environmental conditions change. Briefings will also be given to facilitate conformance with prescribed safety practices when performance deficiencies

are identified during routine daily activities or as a result of safety audits. Meetings should be documented in the field book.

12.4 Safety Audits

The SSO will conduct periodic safety audits of field operations and subcontractors performance to monitor compliance with health and safety policies and procedures as set forth in this HASP. Health and safety audit findings will be documented and if necessary, corrective action taken.

13.0 EMERGENCY PREPAREDNESS

13.1 The Site Emergency Coordinator

The Site Emergency Coordinator shall be the SSO. In the event of a Fire, Medical Emergency or Hazardous Materials Emergency incident, the SSO will contact the BEM Project Manager who will then **contact Schenectady ANGB Fire Department personnel via 911 or (518) 344-2317.** The following information must and will be provided to the dispatcher;

(a) Name of Caller

(b) Location of Emergency (i.e. Building Number, Room, Construction Site),

(c) Type of Emergency, and

(d) Telephone number where caller can be reached.

Emergency Phone Numbers

Police:	911	or	(518) 384-2244
State Police:	911	or	(518) 457-6721
Fire:	911	or	(518) 344-2317 - Using cell phones (518) 344-2305 - Fire Chief (518) 344-2405 - Assistant Fire Chief

Note: If transport to the hospital is necessary, ANGB Fire Department will contact Mohawk Ambulance.

Hospital

Ellis Hospital
1101 Nott Street
Schenectady, NY 12308 (302) 674-4700

National or Regional Sources of Assistance

Schenectady ANGB Point of Contact	518-344-2341
AFCEE	210-536-5284
Corporate H&S Manager	908-598-2600
Poison Control Center	800-822-9761
EPA (RCRA Superfund Hotline)	800-424-9346
National Response Center	800-424-8802
USDOT	202-426-0656
POLICE/FIRE	911/ (518) 344-2305/344-2405
Regional OSHA Office	212-337-2378

The route-to-hospital maps are located in Attachment E. A copy of the route-to-hospital maps should be kept in the designated emergency vehicle while on-site. Additional copies will be available in the logbook or equivalent.

13.2 Implementation of Emergency Procedures

The SSO shall implement the emergency action procedures whenever conditions at the site warrant such action. The SSO will be responsible for coordinating the evacuation, emergency treatment, and emergency transport of site personnel, as necessary, and for notification of emergency response units and the appropriate management staff in accordance with Policy HS-001. In the event an evacuation is necessary, the SSO will verify all employees and visitors identified on the daily sign in and out sheet are present. The following conditions may require implementation of emergency action procedures:

- Fire or explosion on-site,
- Serious personal injury,
- Release of hazardous materials, including gases or vapors, at levels greater than the maximum use concentrations of respirators, and
- Unsafe working conditions, such as inclement weather.

The site assembly area will be predetermined by the SSO and communicated to site personnel during the initial site safety meeting.

13.3 Fire or Explosion

If a fire or explosion has taken place, emergency steps will include: evacuation of work area and venting, and notification of the fire department and other appropriate emergency response groups, if necessary.

13.4 Personal Injury

Emergency first aid will be administered on-site as appropriate. Then the individual will be transported to the nearest medical facility if required.

13.5 Overt Chemical Exposure

Typical response procedures for overt chemical exposures are described in Table 13-1 below:

TABLE 13-1 Response Procedures to Chemical Exposures

Exposure	Response Procedure
Skin Contact	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. Eyewash will be provided on-site. Eyes should be rinsed for a minimum of 15 minutes upon chemical contamination.
Inhalation	Move to fresh air and, if necessary, transport to emergency medical facility.
Ingestion	Transport to emergency medical facility.
Puncture Wound/Laceration	Transport to emergency medical facility.

13.6 Adverse Weather Conditions

In the event of adverse weather conditions, the SSO will determine if work can continue without endangering the health and safety of field workers under the following circumstances:

- Treacherous weather-related working conditions (e.g., mud, wind, flooding, hurricanes),

- Limited visibility, and/or
- Potential for electrical storms.

13.7 Accident Investigations

Accidents are usually complex. An accident may have 10 or more events that can be causes. A detailed analysis of an accident will normally reveal three cause levels: basic, indirect, and direct. At the lowest level, an accident results only when a person or object receives an amount of energy or hazardous material that cannot be absorbed safely. This energy or hazardous material is the direct cause of the accident. The direct cause is usually the result of one or more unsafe acts or unsafe conditions, or both. Unsafe acts and conditions are the indirect causes or symptoms. In turn, indirect causes are usually traceable to basic causes such as poor management policies and decisions, or to personal or environmental factors.

Most accidents are preventable by eliminating one or more causes. Accident investigations determine not only what happened, but also how and why. The information gained from these investigations can prevent recurrence of similar or perhaps more disastrous accidents. Accident investigators are interested in each event as well as in the sequence of events that led to an accident. The accident type is also important to the investigator. The recurrence of accidents of a particular type or those with common causes shows areas needing special accident prevention emphasis.

The initial investigation has three purposes:

1. Prevent further possible injury and property damage;
2. Collect facts about the accident; and
3. Collect and preserve evidence.

The SSO will be responsible for the reporting associated with an accident and for obtaining all relevant information. The SSO will be responsible for the reporting of the accident and for promptly informing the PM, CHSM, and on-site client representative (as appropriate).

The site specific accident prevention plan in Attachment J should be referenced and used to assist in the prevention of site accidents and recognition of site hazards that may contribute to a near miss. Hazardous conditions, if not identified and corrected, may lead to an injury or illness.

Steps

a. Secure the area. Do not disturb the scene unless a hazard exists.
b. Prepare the necessary sketches and photographs. Label each carefully and keep accurate records.
c. Interview each victim and witness. Also interview those who were present before the accident and those who arrived at the site shortly after the accident. Keep accurate records of each interview. Use a tape recorder if desired and if approved.

The site specific accident prevention plan in Attachment J should be referenced and used to assist in the prevention of site accidents and recognition of site hazards that may contribute to a near miss. Hazardous conditions, if not identified and corrected, may lead to an injury or illness.

13.8 Accident/Injury Reporting and Recordkeeping

The SSO shall maintain logs and reports covering health and safety aspects of the project throughout the duration of work activities. In the event of an on-site accident resulting in an exposure or injury, the SSO shall immediately complete an Incident Report and send a copy to the CHSM or PM.

13.9 Flammable Liquids

All flammable liquids such as gasoline, alcohol, paints, diesel fuel will be properly stored outside of buildings in approved per NFPA code containers to prevent fire hazards.

13.10 Fire Hydrants, Closing or Blocking Roadways

ANG Fire Department will be given a proper notification prior to using any Fire Hydrant, closing or blocking any base roadways.

14.0 APPROACHING UNKNOWN SUBSTANCES

The conditions of a drum or spill of unknown chemical substance will be treated similar to that of an Immediately Dangerous to Life and Health (IDLH) environment. This type of environment is typically defined as posing an immediate hazard to life or poses an immediate, irreversible, debilitating effect on health. The health concern is acute in nature. These are symptoms in which the onset will be rapid due to a brief, short duration exposure to extremely high or unknown concentrations of contaminant(s). Due to the nature of the unknown environment, the contaminant of concern (COC) has the potential for causing the above effects.

According to BEM's Corporate Safety Manual, no BEM Team personnel shall enter IDLH atmospheres at any time. This statement includes the conditions when both an unknown contaminant and an unknown concentration exist.

If both the contaminants and concentrations are unknown, no background information is available, and no historical site monitoring data is available, then the most prudent approach from a health and safety perspective is to cease operation and contact the Health and Safety Department.

15.0 HAZARD COMMUNICATION

BEM Team personnel shall be trained of the hazards of materials to be used during the project to comply with OSHA 1910.1200 and 1926.59. Material safety data sheets (MSDS) shall be conspicuously located on site for employee reference as necessary. In the event of an emergency, the MSDS binder will accompany the emergency response team to the medical facility. Subcontractor personnel are responsible for providing their own HazCom training, but their MSDS's will be requested by the BEM Team field personnel for the record and for use during an emergency.

16.0 HASP ACCEPTANCE

Each field team member shall complete this form after reading this HASP and completion of site-specific training before being permitted to work on-site. A signed original must be returned to the SSO/CHSM upon completion of the field activities.

I have read and understand this Health and Safety Plan prepared for the Schenectady ANGB, NY project. I will comply with the provisions contained therein.

Name Printed	Signature	Date

APPENDIX A

Heat Stress

APPENDIX A
HEAT STRESS

Weather conditions are an important consideration in planning and conducting site activities. The combination of physical activity, high ambient temperatures, high humidity, and protective gear predisposes field personnel to heat illness and represents an acute health threat. Heat also causes indirect problems such as poor judgment, lowered efficiency, and worker discomfort. The following will provide training on health stress and its health effects, signs and symptoms, predisposing factors, monitoring techniques, prevention measures, and treatment of heat-induced injuries.

Definitions:

Heat stress - a group of illnesses caused by a number of interacting factors including environmental conditions (elevated ambient temperature and humidity), clothing, work load, and the individual characteristics of the person.

Isothermic - relating to the maintenance of equality in temperature

Hyperthermia - raising of the body's core temperature due to prolonged exposure to heat.

Effects of Heat Stress

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Under normal conditions, the body produces 65-85 kcal/hr of heat. Moderate work can increase body heat by 400%. The body must lose the same amount of heat as it produces to remain isothermic. If protective clothing is worn, normal heat exchange is restricted and natural body ventilation is reduced.

Heat Illness - Clinical Syndromes

There are six separate and distinct categories of heat stress:

1. Heat Edema This common condition has symptoms such as swelling of the feet and ankles, particularly during the first 2-3 days of heat exposure. It tends to be an all or none phenomenon and is more common in females.

   FIRST AID: ELEVATE LEGS HIGHER THAN HEART DURING WORK BREAKS AND AT NIGHT.

2. Heat Rash This condition is caused by continued exposure to heat and humid air and is aggravated by tight clothing. It decreases the ability to tolerate heat as well as being a nuisance.

   FIRST AID: USE A TOPICAL STEROID SUCH AS HYDROCORTISONE. KEEP AREA DRY.

3. Heat Syncope This refers to the sudden and brief loss of consciousness (syncope) related to a prolonged upright position. There are many causes: mild dehydration, decreased vasomotor tone, and marked venous pooling. It appears to be more common in conditions of

sunlight, even in the absence of an elevated ambient temperature. Heat syncope occurs almost exclusively during tasks which require an erect posture, but without much movement, especially if isometric straining is involved (e.g., steadying a ladder or reaching up for an extended time frame).

FIRST AID: REPLACE BODY FLUIDS AND ELEVATE LEGS.

4. Heat Cramps Cramps occur with the onset of profuse sweating and inadequate fluid intake and chemical replacements (especially salts). Symptoms typical to heat cramps include muscle spasms and pain in the hands, feet and/or abdomen.

   FIRST AID: PERSISTENT OR SEVERE CRAMPS REQUIRE PROFESSIONAL MEDICAL TREATMENT.

5. Heat Exhaustion this condition is generally referred to as "heat toxemia" or "sunstroke". It occurs from increased stress on various body organs due to inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include pallor, cool moist skin, nausea, headache, dizziness, and "chills". Sweating is still present. Body temperature is elevated but less than 104oF. The person is conscious but weak and tired and complains of a flu-like feeling. Deficiency in both water and electrolytes are thought to contribute to this condition. Although hypothermic, the person's physiological mechanisms are still intact (sweating, rapid breathing, thirst) and prompt attention leads to a full recovery.

   FIRST AID: PLACE INDIVIDUAL IN COOL PLACE. DRINK FLUIDS AND MONITOR TEMPERATURE. SERIOUS CASES SHOULD BE TRANSPORTED TO THE HOSPITAL. CLOSE MONITORING IS REQUIRED ON SUBSEQUENT DAYS AS INDIVIDUALS ARE MORE SUSCEPTIBLE TO A REPEAT EPISODE.

6. Heat StrokeThis is the least common but most serious form of heat stress. It occurs when the body's normal regulatory mechanisms are overcome. Specifically, the normal responses of sweating, vasodilatation, increased respiration, and higher brain functions will diminish markedly as the core temperature approaches 105oF (oral temperature may be 103oF). The temperature will continue to rise, culminating in death, unless external remedies are applied. Heat stroke is recognized by the presence of an altered mental state, red-hot usually dry skin, nausea, and strong rapid pulse.

   FIRST AID: DO NOT DELAY TREATMENT, IRREPARABLE HARM MAY ENSUE OTHERWISE. THE INDIVIDUAL'S BODY TEMPERATURE MUST BE LOWERED RAPIDLY:

   - •MOVE VICTIM OUT OF SUN
   - •REMOVE CONSTRICTING CLOTHING
   - •WET VICTIM COMPLETELY WITH WATER, ESPECIALLY THE HEAD
   - •PLACE VICTIM IN FRONT OF FAN OR HAVE ACCESS TO NATURAL BREEZES
   - •APPLY ICE TO VICTIM'S ARMPITS, GROIN, AND THROAT
   - •MONITOR INDIVIDUAL'S BODY TEMPERATURE
   - •WHEN BODY TEMPERATURE APPROACHES 101°F, TRANSPORT VICTIM TO HOSPITAL.

Predisposing Factors

Prevention of heat stress is preferable to treatment. Several factors have been identified as increasing an individual's risk and include:

- •infection
- •sunburn
- •diarrhea
- •chronic disease
- •lack of physical fitness
- •age
- •dehydration
- •obesity
- •lack of acclimatization

  An individual's response to heat stress changes as they acclimate to warmer weather. During the first 2-3 weeks, the unacclimated individual may perspire at a rate of up to one liter/hr. This same individual, after acclimatization may perspire more abundantly (3-4 liters/hour); however, the salt concentration in the unacclimatized individual is greater than an acclimatized individual.

- alcohol and/or drug/medication use

  Alcohol directly affects the central nervous system (CNS) which then impairs temperature regulation. Additionally, the diuretic effect of alcohol leads to excess water loss and exacerbates heat-related dehydration.

1. Diuretics These are prescribed for hypertension and edematous conditions including swelling of the feet, premenstrual bloating, and dieting.
2. Anticholinergics These drugs are used for common gastrointestinal disturbances including peptic ulcers, gastritis, esophagitis (heart burn) as well as for diarrhea, some types of ear disorders, allergies/colds, and motion sickness.
3. Antidepressants These agents are the drugs used to treat depression and vascular headaches (migraines) and sometimes as a sleeping pill.
4. Tranquilizers These drugs are used to treat emotional and mental disturbances as well as use as an anti-nauseant.
5. Amphetamines These are used as diet pills and as a treatment for narcolepsy.

Monitoring

All field workers, even those not wearing protective equipment, should be monitored for heat stress.

1. Pulse Rate

Team members pulse rates should be monitored at the beginning of a rest period. The radial pulse will be counted during a 30-second period. If the heart rate exceeds 110 beats/minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 100 beats per minute at the next rest period, shorten the following work cycle by one third.

2. Body Temperature

Body temperature should also be monitored at the beginning of the rest period, before drinking.

- If the oral temperature exceeds 99.6°F, shorten the next work cycle by one third without changing the rest period.
- If the oral temperature still exceeds 99.6°F at the beginning of the next rest period, shorten the following work cycle by one third.

No one should wear semi-permeable or impermeable garments when his/her oral temperature exceeds 100.6°F.

TABLE A-1 SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATIZED WORKERS

Temperature	Normal Work Clothing	Impermeable Work Clothing
90°F or above	after each 45 minutes of work	after each 15 minutes of work
87.5°F to 90°F	after each 60 minutes of work	after each 30 minutes of work
82.5°F to 87.5°F	after each 90 minutes of work	after each 60 minutes of work
77.5°F to 82.5°F	after each 120 minutes of work	after each 90 minutes of work`
72.5°F to 77.5°F	after each 150 minutes of work	after each 120 minutes of work

Prevention

Taking the following steps can avert heat stress illnesses:

1. Adjust work schedules:
- Mandate work slowdowns, as necessary
- rotate personnel
- perform work during cooler hours of day (early morning or late afternoon)

2. Provide shelter, such as air-conditioned vehicles or shaded areas, to allow workers to rest
3. DRINK FLUIDS!!! Daily fluid intakes must equal body water lost through perspiration. The normal thirst mechanism is not sensitive enough to ensure enough water will be ingested to replace lost body fluids. When heavy sweating occurs, drink more liquids, such as Gatorade.
4. Provide cooling devices to aid natural body heat exchange.

HEAT INDEX

Air Temp.	Apparent Temperatures									
125°F	123	141								
120 °F	116	130	148							
115 °F	111	120	135	151						
110 °F	105	112	123	137	150					
105 °F	100	105	113	123	135	149				
100 °F	95	99	104	110	120	132	144			
95 °F	90	93	96	101	107	114	124	136		
90 °F	85	87	90	93	96	100	106	113	122	
85 °F	80	82	84	86	88	90	93	97	102	108
80 °F	75	77	78	79	81	82	85	86	88	91
75 °F	70	72	73	74	75	76	77	78	78	80
70 °F	65	66	67	68	69	70	70	71	72	72
%	10	20	30	40	50	60	70	80	90	100

Percent Humidity

Apparent Temperature	Heat Syndrome
130°F or higher	Heatstroke or sunstroke is imminent
105 °F - 130 °F	Sunstroke, heat cramps, and heat exhaustion likely. Heatstroke possible with prolonged exposure and physical activity.
90 °F - 105 o°F	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and physical activity.
80 o°F - 90 °F	Fatigue possible with prolonged exposure and physical activity.

APPENDIX B

Cold Stress

APPENDIX B
COLD STRESS

This section is designed to provide information on the signs and symptoms of cold stress, as well as procedures to combat cold stress.

DEFINITIONS

Frostbite - local tissue damage caused by exposure to low temperature environmental conditions. Severe occurrence may lead to deep tissue damage, gangrene, and loss of the affected part.

Frost nip - a whitened area of skin which is painful or gives a slight burning sensation.

Hypothermia - lowering of the body's core temperature due to prolonged exposure to cold.

Thermoregulatory centers - centers in the hypothalamus that regulate heat production and heat losses so that normal body temperature is maintained. These centers are influenced by nerve impulses from cutaneous (skin) receptors and by blood temperature.

Windchill - the cooling effect wind has on exposed skin.

Equivalent Chill Temperature (ECT) - an index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of lower temperature with still air (see subsequent Windchill Factor chart).

COLD INJURIES - CLINICAL SYNDROME

Two factors influence the development of a cold injury: ambient temperature and the wind velocity. Windchill is used to describe the chilling effects of moving air in combination with low temperature (see attached table). For example, an ambient temperature of 32oF with a wind of 15 mph is equivalent in chilling effect to still air at 13oF. Generally, the greatest incremental increase in windchill occurs when a wind of 5 mph increases to 10 mph. When using impermeable clothing (e.g., Saranex or Tyvek) and if the body is soaked with perspiration, the body is suddenly cooled when the PPE is removed. And, as water conducts heat 240 times faster than air, should there be a windchill when the body is perspiration-soaked, the effects of the cold are intensified.
The areas of the body most susceptible to cold injury are those with high surface area to volume ratio (fingers, toes, nose, ears). Severe injury to these extremities may occur with extreme cold temperatures. Prolonged exposure to extreme cold produces shivering, numbness, low body temperature, drowsiness, and marked muscular weakness.

There are three stages of cold injury:

1. Frost nip: Frost nip is the first sign of frost bite and is the only form of local cold injury that can be definitively treated in the field. It is characterized by a whitened area of skin which has a burning or pain sensation.
2. Frost bite: Frostbite is local tissue damage caused by exposure to low temperatures. It results when ice crystals form, either superficially or deeply, in the fluids and underlying soft tissue of the skin. The nose, cheeks, ears, fingers, and toes are most commonly affected.

The victim's skin will be cold, hard, and white. There also may be blisters. The victim may not know there is frostbite as there is no pain sensation.

With time, the victim experiences mental confusion and impairment of judgment. The victim may stagger and eyesight will fail. Eventually, the victim will become unconscious, go into shock, stop breathing, and die.

TREATMENT: THE OBJECTIVES FOR FROSTBITE FIRST AID ARE TO PROTECT THE FROZEN AREA FROM FURTHER INJURY, WARM THE AFFECTED AREA RAPIDLY, AND MAINTAIN RESPIRATION. NEVER ALLOW A THAWED AREA TO REFREEZE AS IT WILL CAUSE MORE SEVERE DAMAGE AND MAY LEAD TO AMPUTATION OF THE AFFECTED APPENDAGE.

- COVER THE FROZEN AREA AND PROVIDE EXTRA CLOTHING/BLANKETS TO VICTIM.
- BRING VICTIM INDOORS AS SOON AS POSSIBLE.
- HAVE VICTIM DRINK SOMETHING WARM.
- REWARM THE FROZEN PART QUICKLY BY IMMERSING IT IN WARM WATER (NOT HOT WATER), APPROXIMATELY 102-105OF. THIS PROCEDURE MAY TAKE UP TO 30 MINUTES AND THE VICTIM WILL FEEL MORE AND MORE PAIN AS THE TISSUES THAW.
- IF WARM WATER IS NOT AVAILABLE OR PRACTICAL TO USE, WRAP THE AFFECTED AREA GENTLY IN A SHEET/BLANKET/CLOTHING.
- ONCE THE AFFECTED AREA IS REWARMED, HAVE THE VICTIM EXERCISE IT.
- IF FINGERS OR TOES ARE INVOLVED, PLACE DRY STERILE GAUZE BETWEEN THEM TO KEEP THEM SEPARATED.
- IF TRAVEL IS NECESSARY, COVER THE AFFECTED PARTS WITH STERILE BANDAGES OR CLEAN CLOTHES AND KEEP THE INJURED AREAS ELEVATED.
- OBTAIN MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

If the victim has frost bite, DO NOT:

- RUB THE AFFECTED AREA. RUBBING MAY CAUSE GANGRENE (TISSUE DEATH).
- APPLY HEAT LAMPS, HEATING PADS, OR HOT WATER BOTTLES.
- LET THE VICTIM BRING THE AFFECTED AREA NEAR A HOT STOVE OR FIRE.
- BREAK BLISTERS.
- ALLOW THE VICTIM TO WALK IF THE FEET ARE THE AFFECTED AREAS. HOWEVER, WALKING ON A FROZEN FOOT IS BETTER THAN STAYING IN THE COLD.

ALLOW THE VICTIM TO SMOKE OR DRINK ALCOHOL.

3. Hypothermia: After prolonged exposure to the cold, the body's core temperature lowers. Hypothermia does not necessarily occur at temperature below freezing, but can occur if the person is hungry, wet, tired, and overexerted.

Hypothermia begins with severe shivering, the body's mechanism for generating heat. Victims then display abnormal behavior characterized be decreased efficiency, decreased level of communication, forgetfulness, repetitive behavior, poor motor skills, poor judgment, and lack of

concern for usual physical needs. As time goes on, victims become apathetic, listless, and sleepy; these symptoms may be followed by weakness, inability to walk, and repeated falling. Later stages consist of collapse, stupor, unconsciousness, and death, if not treated.

TREATMENT: ALL STAGES OF HYPOTHERMIA ARE TREATED BY REWARMING, EITHER PASSIVE OR ACTIVE. PASSIVE REWARMING IS ACCOMPLISHED BY CONSERVATION OF THE VICTIM'S BODY HEAT; HOWEVER, THE VICTIM MUST HAVE INTACT THERMOREGULATORY MECHANISMS FOR THIS TO BE EFFECTIVE. ACTIVE REWARMING IS WHEN HEAT IS APPLIED TO THE VICTIM BY SOME EXTERNAL SOURCE, EITHER PERIPHERALLY AND/OR THROUGH THE CORE.

- TO PREVENT FURTHER HEAT LOSS IN VICTIM, REMOVE TO WARM, DRY PLACE, OUT OF WIND, COLD, AND RAIN/SNOW.
- REMOVE WET OR DAMP CLOTHING PIECE BY PIECE AND DRY UNDERLYING SKIN.
- DRESS VICTIM IN WARM DRY CLOTHES WITH PREFERENCE TO CENTRAL BODY CORE RATHER THAN EXTREMITIES. COVER HEAD WITH HAT OR BLANKET, THEN WRAP BLANKETS AROUND ENTIRE BODY.
- ADMINISTER HOT FLUIDS ONLY IF VICTIM IS UNCONSCIOUS.
- MONITOR VICTIM'S TEMPERATURE EVERY 15 MINUTES.

TRANSFER VICTIM TO A MEDICAL FACILITY AFTER ABOVE STEPS HAVE BEEN INITIATED.

WORKER SHOULD NOT RETURN TO WORK FOR AT LEAST 48 HOURS.

Work Practices at or below 10°F Equivalent Chill Temperatures

1. The work rate should not be so high as to cause sweating that will result in wet clothing.
2. Precautions should be taken to ensure that employees become acclimated to the working conditions and required protective clothing.
3. Work should be arranged so that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.

Warm-up Breaks

If work is performed continuously in the cold at an ECT of 20oF or below, heated shelters should be provided during warm-up breaks. There are no limits to the amount of time a worker may spend in a 0oF-30oF environment. However, in temperatures below 0oF, the total allowed work time is four hours consisting of alternating one hour work periods and one hour break periods. A work-warming regimen (suggested by the ACGIH) is provided in an attached warm-up schedule.

Clothing

Adequate insulated clothing should be worn to maintain core temperatures above 97oF when work is to be performed below 40oF. If clothing becomes wet, change into dry clothes immediately. If available clothing does not give adequate protection for the prevention of hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.

Special Considerations

Employees should be excluded from work in cold weather (30oF or below) if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to air temperature below 0oF with wind speeds less than five mph should be medically certified as suitable for such exposures. At air temperatures of 36oF or less, any worker who becomes immersed in water or whose clothing becomes wet will be immediately provided a change of clothing and treated for hypothermia, as necessary.

Wind Chill Factors

	Ambient Temperature, °F										
Wind Speed (mph)	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
	Equivalent Temperature, °F										
Calm	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
5	29	20	10	1	-9	-18	-28	-37	-47	-56	-65
10	18	7	-4	-15	-26	-37	-48	-59	-70	-81	-91
15	13	-1	-13	-25	-37	-49	-61	-73	-85	-97	-109
20	7	-6	-19	-32	-44	-57	-70	-83	-96	-109	-117
25	3	-10	-24	-37	-50	-64	-77	-90	-104	-117	-121
30	1	-13	-27	-41	-54	-68	-82	-97	-109	-123	-137
35	-1	-15	-29	-43	-57	-71	-85	-99	-113	-127	-142
40	-3	-17	-31	-45	-59	-74	-87	-102	-116	-131	-145
45	-3	-18	-32	-46	-61	-75	-89	-104	-118	-132	-147
50	-4	-18	-33	-47	-62	-76	-91	-105	-120	-134	-148
LITTLE DANGER FOR PROPERLY CLOTHED PERSONS			**CONSIDERABLE DANGER**			**VERY GREAT DANGER**					
Maximum danger of false sense of security			Danger from freezing of exposed flesh within one minute			Flesh may freeze within 30 seconds					
Trenchfoot and immersion foot may occur at any point on this chart											

Work/Warm-Up Schedule for Four-Hour Shift (Reference: ACGIH TLV and BEIs)

Air Temp. – Sunny Sky	No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-15° to -19°	normal breaks	1	norm. breaks	1	75 min.	2	55 min.	3	40 min.	4
-20° to -24°	normal breaks	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease ↓	
-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease ↓		↓	
-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease ↓		↓		↓	
-40° to -44°	30 min.	5	Non-emergency work should cease ↓		↓		↓		↓	
-45° & below	Non-emergency work should cease		↓		↓		↓		↓	

NOTES:

1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For light-to-moderate work (limited physical movement): apply the schedule one step lower.

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:

- **5 mph: light flag moves**
- **10 mph: light flag fully extended**
- **15 mph: raises newspaper sheet**
- **20 mph: blowing and drifting snow**

3. TLV applies only for workers in dry clothing.

APPENDIX C

Personal Protective Equipment Program

APPENDIX C
PERSONAL PROTECTIVE EQUIPMENT PROGRAM

C-1 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) used during specific activities at Schenectady ANGB is based on air monitoring results or at the discretion of the SSO. A downgrade of PPE must be approved by the SSO.

If the SSO determines that field measurements or observations indicate that a potential exposure is greater than the protection afforded by the PPE or procedures in this HASP, work will stop and personnel will be removed until the level of exposure has been decreased or the level of protection has been increased.

The levels of PPE are categorized as Levels A, B, C, or D, based on the amount of protection required. For this project, BEM personnel will not employ Level A or Level B. If instances arise requiring the use of this level of protection, BEM personnel must evacuate the area. BEM personnel are trained in PPE up to Level C.

Level C is used when the concentration(s) and type(s) of airborne substance(s) are known and the criteria for using air-purifying respirators has been met. Level C equipment includes:

- full-face or half-face, air purifying respirators (NIOSH approved) with applicable cartridges,
- chemical-resistant clothing (overalls, chemical-splash suit, disposable chemical-resistant overalls),
- gloves, outer chemical-resistant,
- gloves, inner chemical-resistant,
- boots, chemical-resistant soles with steel toe and shank,
- boot covers, chemical-resistant, disposal,
- hard hat (optional)
- face shield (optional)
- hearing protection (optional)

Level D is used when the concentration(s) of airborne substances are below the OSHA PELs for the entire work period. Level D affords minimal protection and is used for nuisance contamination only. Level D equipment includes:

- latex gloves
- boots, chemical-resistant soles with steel toe and shank,
- safety glasses or chemical splash goggles (as necessary),
- hard hat (optional),
- escape mask (optional),
- sun protection (as applicable), and
- cold weather protection (as applicable).

Modified Level D:

- Disposable tyvek coveralls,

- Hard hat (when working around heavy equipment),
- Rubber soled-shoes (for activities in a boat) or steel-toed work boots (for all other activities),
- Latex gloves (as applicable when sampling),
- Safety glasses1,
- Hearing protection (as applicable),
- Sun protection (hat and sunscreen), and
- Cold weather protection (as applicable)

C-2 RESPIRATORY PROTECTION PROGRAM FOR FIELD SAMPLING AND OVERSIGHT ACTIVITIES AT SCHENECTADY ANGB

The following respirator program has been prepared in accordance with OSHA 29 CFR Part 1910.134 Respiratory Protection Program requirements. This program governs the selection and use of respirators on-site.

Respirators for BEM employees will be provided by BEM. The respirator protection program will be administered by, and is the responsibility of, the CHSM and/or SSO for the site. Subcontractors shall furnish their own respirators and shall be responsible for medical surveillance of their employees. The CHSM and/or SSO will be responsible for ensuring that they are in compliance with this respirator program.

The respirators will be selected according to the hazard and level of protection determined by monitoring action levels and the decision of the CHSM and/or SSO. The respirators and levels are:

Level C — Respirator

Full-face air purifying respirator with combination dust (HEPA) and organic vapor cartridge. Level C is necessary when:

- total VOC concentrations in the breathing zone, as determined by a PID/FID are greater than 5 ppm but less than 50 ppm above background and sustained for longer than five minutes, and/or
- when visible dust is evident.

Level D — No respirator required. When total VOC concentrations in the BREATHING ZONE are less than 5 ppm above background and no sustained evidence of visible dust clouds.

The respirator users will be fit tested with the size, style, and make of the respirator they will be using on-site. The fit test will be recorded and these Fit Test Records will be maintained in the field file.

Employee respirator training is provided on an annual basis and at site-specific training sessions. This training includes:

- A discussion of the nature of the respiratory hazards and the dangers if the respirator is not used properly.
- The reasons that respirators are required for protection, along with any engineering controls that may be used.

- Instructions in the selection, use, sanitary care, maintenance, proper storage and limitation of the full facepiece respirator with combination cartridge.
- Practice in proper fitting, wearing, adjusting, and checking face seal of the respirator.
- An opportunity to handle the respirator.
- Instruction on how to recognize and cope with emergency situations requiring respiratory protection.
- Explanation of the requirements for a self-contained breathing device for work in unknown concentrations and Immediately Dangerous to Life or Health (IDLH) atmospheres and for fire fighting.
- Explanation of the medical surveillance program and how it relates to respirator use.
- Explanation of the requirements for maintaining a tight seal, why beard and facial hair is prohibited, and why use of contact lenses while wearing respirators is prohibited.

Respirators will be assigned to individual workers. Each individual shall be responsible for cleaning and maintaining their assigned respirator. They will be cleaned and disinfected before being reassigned. Respirators will be cleaned after each day of work according to manufacturer's instruction. The cleaning will be done in the decontamination area. Used cartridges will be disposed of properly as contaminated material and replaced with new ones.

After cleaning, the respirators will be inspected and checked for defects such as excessive dirt, cracks or other distortions, scratches, incorrectly mounted lens, broken or worn cartridge holders on the facepiece, breaks, loss of elasticity, broken buckles, and excessively worn serration's on the head harness that may cause slippage on the head straps or harness.

Further checks include:

a) A check of the tightness of the connections
b) A check of the facepiece, valves, connecting tube, and canisters

For air purifying, the following items should also be checked:

a) Check the exhalation valve after removing its cover for:
   - Foreign material, such as detergent residue, dust particles, or human hair under the valve seat
   - Cracks, tears, or distortion in the valve material
   - Improper insertion of the valve body in the facepiece
   - Cracks, breaks, or chips in the valve body, particularly in the sealing surface
   - Missing or defective valve cover
   - Improper installation of the valve in the valve body

b) Check the air purifying elements for:
   - Incorrect cartridges, canister, or filter for contaminants of concern
   - Incorrect installation, loose connections, missing or worn gaskets, or cross threading in holder
   - Expired shelf life of cartridge or canister
   - Cracks, dents, or breaks in the cartridge or canisters case
   - Evidence of prior use of cartridge or canister, such as broken seal tape foil or other sealing material

For air supplied respirators, check the air supply for:

- Integrity and condition of air supply lines and hoses, including attachments and end fitting
- Correct operation and condition of all regulators, valves, or other airflow regulators
- For SCBAs, check that the cylinder is sufficiently charged for the intended use, preferably fully charged (mandatory on an emergency device). The emergency SCBA must have a tag for logging in monthly inspections.

Monitoring of the work area will be performed and the results will be used to select the appropriate level of protection. Refer to air monitoring section of this HASP (Section 8.0).

This program will be re-evaluated and revisions and updates added regularly.

Persons will not be assigned to tasks requiring the used of respirators unless it has been determined that they are physically able to perform the work and use the equipment.

Only those respirators jointly approved by NIOSH shall be used. All component parts (i.e., canister, replacement straps, etc.) will be of the same make.

C-3 LEVEL C PPE DONNING PROCEDURES

1. Inspect clothing and respiratory equipment before donning
2. Adjust hard hat, if worn, to fit user's head
3. Step into legs of suit, ensure proper placement of the feet within the suit; then gather the suit around the waist
4. Pull on chemical-resistant safety boots over feet of suit. Tape leg cuff over the tops of the boots.
5. Put arms through sleeves of suit. Place latex gloves on; then chemical-resistant gloves. Tape outer gloves to suit.
6. Secure fasteners
7. Place all straps of respirators in front of mask, place on face, then pull all straps over head
8. Tighten straps in pairs, bottom first, then middle, and finally the top strap.
9. Check for tightness.

APPENDIX D

Hs-001 Incident Report Policy

APPENDIX D
HS POLICY - HS001
INCIDENT REPORT

HS-001 SIGNIFICANT HEALTH & SAFETY OR ENVIRONMENTAL INCIDENT REPORTING POLICY:

Health & Safety or Environmental Incident Reporting Policy:

Health and safety or environmental incidents and/or occurrences involving BEM Systems employees or our subcontractors, must be reported to the Corporate Health & Safety Manager (CHSM). To assure timely notification of such incidents and/or occurrences, the following procedures have been developed for implementation and successful program execution.

The following types of occurrences and incidents MUST be reported:

1. Serious Occupational Injury or Illness: This includes fatalities and cases resulting in days away from work.

- Immediate verbal notification to the CHSM upon occurrence. Follow-up with fax of Incident Report Form or written summary to the CHSM within 24 hours.
- This applies to each such fatality or hospitalization of three (3) or more employees which occurs within thirty (30) days of an incident.

2. Incidents With the Potential for High Public or Client Profile:

- Immediate verbal notification of Project Manager, CHSM or Director upon occurrence. Follow-up with fax to the CHSM within 24 hours of the incident occurrence.

3. Incidents Other Than Those Listed in #1 and #2, Near-misses and Occupational Chemical Exposures: This includes, but is not limited to, exposure to chemicals by contact, inhalation or other, slips, falls, cuts, lacerations, strains, sprains, insect bites, and other types of physical, chemical, biological, or radiation exposure.

- Submission by fax of the Incident Report Form to the CHSM within 24 hours of the incident occurrence

4. Inspection by State or Federal Regulatory Agency: Including OSHA inspections and State RCRA Inspections on a project site:

- Immediate verbal notification to Project Manager and CHSM with fax notification to the CHSM within 24 hours of the incident occurrence.

5. Reportable Quantity Spills: A spill of material in excess of published EPA and/or DOT reportable quantity amounts.

- Immediate verbal notification to the Project Manager who will contact the appropriate authorities. For regulatory or response agency emergency contact numbers, refer to Section 5.12.5 in the Corporate Health & Safety Manual. Fax notification to the CHSM within 24 hours of the incident occurrence.

6. Incidents causing Damage to BEM, Public, or Private Property:

- Immediate verbal notification to the Project Manager with fax notification to the CHSM within 24 hours of the incident occurrence.

7. Health, Safety or Environmental Milestones: Examples include completing a major, long-term field effort without injury or illness.

- Written summary notification within one (1) week to the CHSM.

8. Accident and Incident Investigations:

   The Supervisor and/or Project Manager with the assistance of the CHSM will perform an accident investigation as soon as practicable following the incident occurrence.

- The information obtained during the investigation shall be summarized and forwarded to the CHSM for review and comment.
- Accident Investigations involve the following:
  1. Interview the accident victim,
  2. Interview accident witnesses,
  3. Investigation of the accident scene,
  4. Re-enactment of the accident, if recommended and necessary, and
  5. Reconstruction of the accident.
- The accident investigation summary shall be incorporated into the employee's file, the project file, the annual Corporate Safety Accident and Incident Summary file, and logged onto the OSHA 300 log, if applicable.

Notification Procedures:

Reporting procedures are as follows:

1. Once the Project Manager/CHSM has received notification of an incident/occurrence from the field, the CHSM will notify the Director.
2. Upon notification of the incident, the Director shall notify the President of the situation, as necessary.
3. The President shall, depending on the type of incident, either call or fax a copy of the completed Supervisor's Incident Report to Corporate Counsel.
4. Written Notification:

   A. Upon notification of an incident or occurrence by an employee, in addition to verbal notification of the situations described herein, the Supervisor must complete a Supervisor's Incident Report within 24 hours of the situation and submit or fax the report to the Project Manager.

      The Supervisor must complete the applicable sections describing the specific incident. (Enter NA in blanks on form which do not apply to incident). If the incident involves a BEM employee injury or illness subject to workers compensation, a copy of the Supervisor's Incident Report must also be faxed by the Supervisor or Project Manager to the BEM Corporate Human Resource Manager.

   B. The Project Manager shall fax a copy to the Director and the CHSM.

C. The Director shall forward a copy to the President who in turn shall fax it to Corporate Counsel, as necessary.

5. Fatalities or Multiple Hospitalization Incidents

Accidents/injuries which result in fatalities or the in-patient hospitalization of three or more employees as a result of a work-related incident must be verbally reported to the local OSHA field office within 8 hours of occurrence. The local OSHA field office may be contacted by calling 1-800-321-OSHA (6742).

This call MUST be made by the President, Director, Program CIH or CHSM and only after consultation with those employees and supervisors DIRECTLY involved in the incident.

6. Phone Numbers

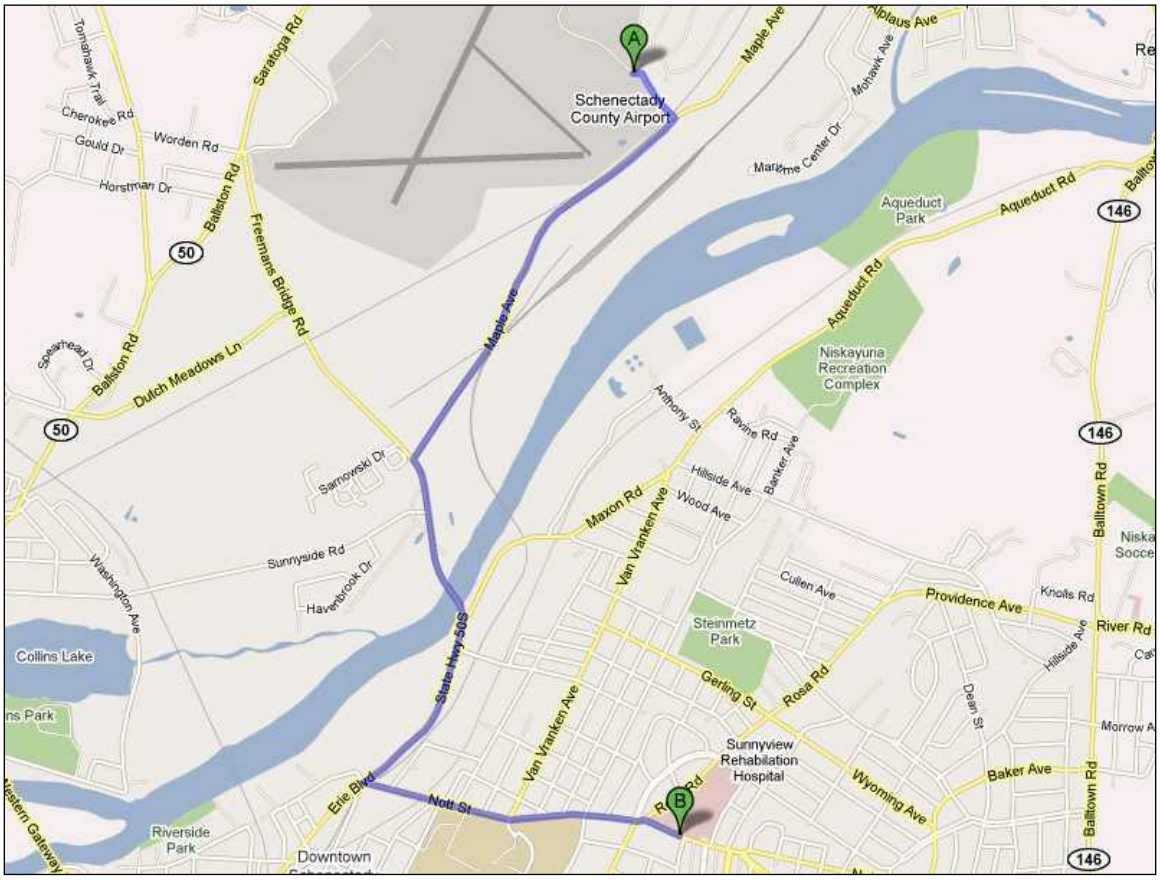
The phone numbers for the Corporate and Legal personnel to be contacted in case of emergencies are as follows:

Name	Position	Office	Home/Cellular
Mark Nardolillo	President	908-598-2600 x 111	973-697-3827
Mark Murset	Corporate Controller	908-598-2600 x 124	
Chris Pisarri	Program Manager	407-402- 4440	407-402- 4440
Dawn Bushey	Manager Business Administration	908-598-2600 x 114	973-224-5331
Gary Schwartz, CIH, CSP	CHSM	973-597-0750	973-568-7851
Corporate Fax		908-598-2622	

APPENDIX E

Route-To-Hospital Maps

APPENDIX E
ROUTE TO HOSPITAL MAP
SCHENECTADY ANGB SITE



Directions from Schenectady ANGB to Ellis Hospital 1101 Nott Street, Schenectady, 12308:

1.	Head east on Air National Guard Road toward Habel Lane	121 ft
2.	Turn right to stay on Air National Guard Road	0.2 miles
3.	Turn right at Maple Ave.	1.3 miles
4.	Turn left at Freemans Bridge Road	0.5 miles
5.	Continue onto Eire Blvd/Maxon Road Continue to follow Erie Blvd	0.6 miles
6.	Turn left at Nott Street	1.0 miles
7.	Arrive at Ellis Hospital on left	

APPENDIX F

Material Safety Data Sheets

NOVA Chemicals®

Material Safety Data Sheet

Material Name: Benzene **MSDS ID: NOVA-0011**

Section 1 - Product and Company Identification

Synonyms: Benzene, benzol
Chemical Name: Benzene
Chemical Family: Aromatic hydrocarbons
Material Use: Petrochemical industry: Solvent, raw material for petrochemicals
Chemical Formula: (C_6H_6)

NOVA Chemicals
P.O. Box 2518, Station M
Calgary, Alberta, Canada T2P 5C6

Product Information: 1-412-490-4063
MSDS Information Email:
msdsemail@novachem.com

EMERGENCY Telephone Numbers:
North America (Canada and US):
1-800-561-6682, 1-403-314-8767 (NOVA Chemicals) (24 hours)
1-800-424-9300 (CHEMTREC-USA) (24 hours)
1-613-996-6666 (Canutec-Canada) (24 hours)
Mexico and South America: +44 208 762 8322 (NCEC) (24 hours)

Section 2 - Hazards Identification

HMIS Ratings: Health: 2* **Fire:** 3 **Physical Hazard:** 0 **Personal Protection:** chemical goggles, gloves, respirator, coveralls

*Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard*

NFPA Ratings: Health: 2 **Fire:** 3 **Reactivity:** 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

Emergency Overview

DANGER! TOXIC! FLAMMABLE! CANCER HAZARD! Product is a clear liquid at room temperature with a sweet, solvent-like odor. Vapor is heavier than air and may spread long distances. Distant ignition and flashback are possible. Flammable liquid and vapor can accumulate static charge. Product will float on water and may travel to distant locations and/or spread fire. This product is considered harmful by inhalation, by skin contact, and if it is swallowed. This product is irritating to the eyes and skin. Excessive inhalation may result in heartbeat irregularities and adverse central nervous system effects including headache, sleepiness, dizziness, nausea, loss of coordination, tremors, and in extreme conditions, coma and death. Systemic absorption effects may include long-term damage to the blood-forming system, kidney and liver damage, and/or cancer (leukemia). Ingestion may also cause adverse central nervous system effects, blood disorders, kidney and/or liver damage. Small amounts, if aspirated into the lungs, may cause mild to severe pulmonary injury.

Potential Health Effects: Eye

Contact with liquid and high concentrations of this product's vapors are irritating to the eyes.

Potential Health Effects: Skin

Product may be rapidly absorbed through the skin. Prolonged and/or repeated skin contact may cause mild to severe irritation/dermatitis and chemical blistering. Prolonged contact may also cause skin sensitization and secondary skin infections.

Potential Health Effects: Ingestion

This product may be harmful if swallowed. Ingestion of this product may result in adverse central nervous system effects including headache, sleepiness, dizziness, nausea, loss of coordination, and in extreme conditions coma and/or death. Ingestion may also cause kidney and liver damage and blood disorders. Small amounts of this product, if aspirated into the lungs, may cause mild to severe pulmonary injury.

Potential Health Effects: Inhalation

This product may be harmful if inhaled. Excessive inhalation may result in heartbeat irregularities and adverse central nervous system effects including headache, sleepiness, dizziness, nausea, loss of coordination, and in extreme conditions, coma and death. Additional adverse inhalation effects may also include long-term damage to blood-forming system, kidney and liver damage, and/or cancer (leukemia). Small amounts of this product, if aspirated into the lungs, may cause mild to severe pulmonary injury.

Section 3 - Composition/Information on Ingredients

CAS #	Component	Percent by Wt.
71-43-2	Benzene	99.87-99.99
Not Available	Other hydrocarbons	0.01-0.10
Not Available	Other hydrocarbons	0.10-0.13

Additional Information

* May include cyclohexane (CAS # 110-82-7), cyclohexene (CAS # 110-83-8) and/or toluene (CAS # 108-88-3) as impurities.
The actual components and weight % concentrations vary based on operating conditions.

This product is considered hazardous under 29 CFR 1910.1200 (Hazard Communication).
This material is a controlled product under Canadian WHMIS regulations.
This material is regulated as a hazardous material / dangerous goods for transportation.

See Section 8 for applicable exposure limits. See Section 11 for applicable toxicity data.

Section 4 - First Aid Measures

First Aid: Eyes

Remove contact lenses, if it can be done safely. Immediately flush eyes with water for at least 15 minutes, while holding eyelids open. Seek medical if symptoms develop or persist.

First Aid: Skin

Remove contaminated clothing and shoes. Wash immediately with soap and water. Seek medical attention if symptoms develop or persist. Completely decontaminate clothing, shoes and other protective equipment before reuse or discard.

First Aid: Inhalation

Move affected individual to non-contaminated air. Loosen tight clothing such as a collar, tie, belt or waistband to facilitate breathing. Seek immediate medical attention if the individual is not breathing, is unconscious or if any other symptoms persist. WARNING: Contact through mouth-to-mouth resuscitation may pose a secondary risk to the rescuer. Avoid mouth-to-mouth contact by using a mouth shield or guard to perform artificial respiration.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Loosen tight clothing such as a collar, tie, belt or waistband. Seek immediate medical attention.

First Aid: Notes to Physician

For more detailed medical emergency support information call 1-800-561-6682 or 1-403-314-8767 (24 hours, NOVA Chemicals Emergency Response). Ensure thorough eye and skin decontamination. Treat unconsciousness, nausea, hypotension, seizures and cardiac arrhythmias in the conventional manner. Aspiration of this product during induced emesis can result in lung injury. If evacuation of stomach contents is considered necessary use the method least likely to cause aspiration, such as gastric lavage after protecting the airway. Observe hospitalized patients for delayed chemical pneumonia, acute tubular necrosis, encephalopathy and dysrhythmias. Monitor for urinary phenol within 72 hours of acute exposure.

Section 5 - Fire Fighting Measures

See Section 9: Physical Properties for flammability limits, flash point and auto-ignition information.

General Fire Hazards

Fire and container explosion hazards are serious when this product is exposed to heat or flame. Vapors are heavier than air and may travel along the ground to some distant source of ignition and flash back. Consider need for immediate emergency isolation and evacuation for at least 300 meters (984 feet). If tank is involved in a fire, ISOLATE for 800 meters (1/2 miles) in all directions.

Explosion Hazards

Vapors may form explosive mixture with air. Keep containers away from source of heat or fire. Containers may explode when involved in a fire. Evacuate personnel to a distance of at least 0.8 to 1.6 kilometers (1/2 mile) if a fire or rail car, tank car, or major vessel rupture is possible. This product may be a static accumulator which can form an ignitable vapor-air mixture in a storage tank.

Hazardous Combustion Products

Upon combustion, this product emits carbon monoxide, carbon dioxide, and/or low molecular weight hydrocarbons.

Extinguishing Media

Dry chemical, foam, carbon dioxide, and water spray or fog. Use water to cool fire-exposed containers and to protect personnel. Water may be an ineffective extinguishing medium. Use of an inert foam extinguishing material may also assist in short term flammable vapor suppression. Monitor water run-off for flammability, and prevent entry into ditches, sewers, drains and, waterways, or other confined or underground spaces.

Fire Fighting Equipment/Instructions

Reference 2008 Emergency Response Guidebook, Guide # 130. Position upwind. Keep unnecessary personnel away. Move containers from fire area if you can do so without risk. Fight fire from maximum distance or use unmanned holders or monitor nozzles. Immediately withdraw in case of fire and container venting or heat discoloration of a container. Fire fighters should wear full-face, self-contained breathing apparatus and thermal protective clothing. Avoid inhaling any smoke and combustion materials. Remove and clean or destroy any contaminated clothing. Cool containers with flooding quantities of water until well after the fire is out. Control runoff waters to prevent entry into ditches, sewers, drains, underground or confined spaces and waterways.

Section 6 - Accidental Release Measures

Evacuation Procedures

Isolate area. Keep unnecessary personnel away. Alert stand-by emergency and fire fighting personnel. Monitor surrounding area for build-up of flammable concentrations in air.

Small Spills

Eliminate ignition sources. Spill or leak area should be isolated immediately for 25 to 50 meters (82 to 164 feet) in all directions. Keep upwind and out of low areas. Stop discharge if safe to do so. Contain discharge by booming on water or diking on ground. Spills on water will volatilize rapidly, making containment or recovery difficult. Remove liquid material with non-sparking approved pumps, skimmers or vacuum equipment. Absorb/adsorb residual materials and clean up with non-sparking tools. Prevent entry into ditches, sewers, drains, underground or confined spaces, water intakes and waterways. Shovel material with non-sparking tools into appropriate container for disposal.

Large Spills

Consider downwind evacuation for 300 meters (984 feet). Eliminate ignition sources. Keep upwind and out of low areas. Stop discharge if safe to do so. Contain liquids by booming on water or by diking on land to prevent entry into ditches, sewers, drains or waterways. Spills on water will volatilize rapidly, making containment or recovery difficult. Recover any pooled liquid material with approved, non-sparking pumps, skimmers or vacuum equipment. An inert foam cover material may assist in short term vapor suppression. Absorb with DRY earth, sand or other non-combustible material and clean up with non-sparking tools. Soil remediation may be required.

Special Procedures

Contact local police/emergency services and appropriate emergency telephone numbers provided in Section 1. Ensure that statutory and regulatory reporting requirements in the applicable jurisdiction are met. Wear appropriate protective equipment and clothing during cleanup. Individuals without appropriate protective equipment should be excluded from area of spill until cleanup has been completed.

See Section 8 for recommended Personal Protective Equipment and see Section 13 for waste disposal considerations.

Section 7 - Handling and Storage

Handling Procedures

Keep locked up or secured. Handle in fully grounded, properly designed and approved equipment systems that are suitable for flammable liquids. Use with adequate ventilation. Do not ingest or inhale. Keep away from heat and ignition sources. No smoking or open flames permitted in storage, use, or handling areas. Dissipate static electricity during transfer by grounding and bonding containers and equipment. Bonding and grounding may be insufficient to eliminate the hazard from static-accumulating flammable liquids. For additional information on equipment bonding and grounding, refer to the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents" or National Fire Protection Association (NFPA) 77, "Recommended Practice on Static Electricity". Avoid draining or venting to atmosphere if

possible. Take special precautions when cold cutting or breaking into lines, or when cleaning and disposing of empty containers. Do not breathe product gas, fumes, vapor, or spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately. Avoid contact with skin and eyes. Keep away from incompatible materials such as oxidizing agents and acids. After handling, always wash hands thoroughly with soap and water.

Storage Procedures

Storage area should be clearly identified, well-illuminated, clear of obstruction and accessible only to trained and authorized personnel. Adequate security must be provided so that unauthorized personnel do not have access to material. Store in grounded, properly designed vessels and away from incompatible materials. Store and use away from heat, sparks, open flame, or any other ignition source. Store according to applicable regulations for flammable materials for storage tanks, containers, piping, buildings, rooms, cabinets, allowable quantities and minimum storage distances. Use non-sparking ventilation systems, approved explosion-proof equipment, and intrinsically safe electrical systems. Have appropriate extinguishing capability in storage area (e.g. portable fire extinguishers (dry chemical, foam or carbon dioxide)) and flammable gas detectors. Keep absorbents for leaks and spills readily available. Consider use of internal floating roof tanks or flame arrestors. Inspect vents during winter conditions for vapor ice build-up. Storage tanks should be above ground and diked to hold entire contents. A refrigerated room is generally recommended for warehouse storage of materials with a flash point lower than 37.8°C (100°F).

See Section 8: Exposure Controls/Personal Protection for appropriate Personal Protective Equipment. See Section 10 for information on Incompatibilities.

Section 8 - Exposure Controls / Personal Protection

Exposure Guidelines

A: General Product Information

Refer to published exposure limits - use effective control measures and PPE to maintain worker exposure to concentrations that are below these limits. Ensure that eyewash stations and safety showers are in close proximity to work locations.

B: Component Exposure Limits

ACGIH, OSHA, NIOSH, EPA, Alberta, and Ontario exposure limit lists have been checked for major components listed with CAS registry numbers. Other exposure limits may apply, check with proper authorities.

*Note: The Vacated OSHA Permissible Exposure Limits (PELs) are those provided in the 1989 update to OSHA's Air Contaminants Standard 29 CFR 1910.1000. These limits were vacated by the U.S. Court of Appeals, Eleventh Circuit but may be enforceable in some states.

Benzene (71-43-2)

ACGIH:	0.5 ppm TWA; 1.6 mg/m3 TWA; 2.5 ppm STEL; 8 mg/m3 STEL; BEI Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA (Vacated)*:	0.5 ppm Action Level; 1 ppm TWA; 5 ppm STEL (Cancer hazard, Flammable - see 29 CFR 1910.1028)
OSHA Final:	0.5 ppm Action Level; 1 ppm TWA; 5 ppm STEL (Cancer hazard, Flammable - see 29 CFR 1910.1028); 1 ppm TWA; 10 ppm TWA (applies to industry segments exempt from the benzene standard at 29 CFR 1910.1028); 5 ppm STEL (see 29 CFR 1910.1028); 25 ppm Ceiling (applies to industry segments exempt from the 1 ppm TWA and 5 ppm STEL of the benzene standard)
NIOSH:	0.1 ppm TWA; 0.32 mg/m3 TWA; 1 ppm STEL; 3.2 mg/m3 STEL 500 ppm IDLH
Alberta:	0.5 ppm TWA; 1.6 mg/m3 TWA; 2.5 ppm STEL; 8 mg/m3 STEL Substance may be readily absorbed through intact skin
Ontario:	0.5 ppm TWAEV (applies to workplaces to which the designated substance regulation does not apply); 0.5 ppm TWAEV (designated substance regulation) 2.5 ppm STEV (applies to workplaces to which the designated substance regulation does not apply); 2.5 ppm STEV (designated substances regulation)

Cyclohexane (110-82-7)

ACGIH:	100 ppm TWA; 344 mg/m3 TWA
OSHA (Vacated)*:	300 ppm TWA; 1050 mg/m3 TWA
OSHA Final:	300 ppm TWA; 1050 mg/m3 TWA
NIOSH:	300 ppm TWA; 1050 mg/m3 TWA 1300 ppm IDLH (10% LEL)
Alberta:	100 ppm TWA; 344 mg/m3 TWA
Ontario:	100 ppm TWAEV

Cyclohexene (110-83-8)

ACGIH:	300 ppm TWA; 1010 mg/m3 TWA
OSHA (Vacated)*:	300 ppm TWA; 1015 mg/m3 TWA
OSHA Final:	300 ppm TWA; 1015 mg/m3 TWA
NIOSH:	300 ppm TWA; 1015 mg/m3 TWA 2000 ppm IDLH
Alberta:	300 ppm TWA; 1010 mg/m3 TWA
Ontario:	300 ppm TWAEV; 1010 mg/m3 TWAEV

Toluene (108-88-3)

ACGIH:	20 ppm TWA; 75 mg/m3 TWA; BEI
OSHA (Vacated)*:	100 ppm TWA; 375 mg/m3 TWA; 150 ppm STEL; 560 mg/m3 STEL
OSHA Final:	200 ppm TWA; 300 ppm Ceiling
NIOSH:	100 ppm TWA; 375 mg/m3 TWA; 150 ppm STEL; 560 mg/m3 STEL 500 ppm IDLH
Alberta:	50 ppm TWA; 188 mg/m3 TWA Substance may be readily absorbed through intact skin
Ontario:	20 ppm TWAEV (also known as methylbenzene)

ENGINEERING CONTROLS

Engineering methods to reduce hazardous exposure are preferred controls. Methods include mechanical ventilation (dilution and local exhaust) process or personal enclosure, remote and automated operation, control of process conditions, leak detection and repair systems, and other process modifications. Ensure all exhaust ventilation systems are discharged to outdoors, away from air intakes and ignition sources. Supply sufficient replacement air to make up for air removed by exhaust systems. Administrative (procedure) controls and use of personal protective equipment may also be required.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Wear safety glasses; chemical goggles are recommended to prevent eye irritation or injury from splashing or vapors.

Personal Protective Equipment: Skin/Hands/Feet

Use chemically resistant gloves when handling product. Wear chemical-resistant safety footwear with good traction to prevent slipping. Work clothing that sufficiently prevents skin contact should be worn, such as coveralls and/or long sleeves and pants. If splashing or contact with liquid material is possible, consider the need for an impervious overcoat. Fire resistant (i.e., Nomex) or natural fiber clothing (i.e., cotton or wool) is recommended. Synthetic clothing can generate static electricity and is not recommended where a flammable vapor release may occur. Static Dissipative (SD) rated footwear is recommended.

Personal Protective Equipment: Respiratory

If engineering controls and ventilation are not sufficient to control exposure to below the allowable limits then an appropriate NIOSH/MSHA approved air-purifying respirator or self-contained breathing apparatus (SCBA) should be used. Supplied air breathing apparatus must be used when oxygen concentrations are low or if airborne concentrations exceed the limits of the air-purifying respirators.

Personal Protective Equipment: General

Personal protective equipment (PPE) should not be considered a long-term solution to exposure control. Employer programs to properly select, fit, maintain, and train employees to use equipment must accompany PPE. Consult a competent industrial hygiene resource, the PPE manufacturer's recommendation, and/or applicable regulations to determine hazard potential and ensure adequate protection.

Section 9 - Physical & Chemical Properties

Physical State and Appearance:	Liquid	**Color:**	Colorless
Odor:	Sweet, solvent-like	**Odor Threshold:**	1.5 to 5 ppm
pH:	Not applicable	**Vapor Pressure:**	75 mm Hg at 20°C (68°F)
Vapor Density @ 0°C (Air=1):	2.8	**Dispersion Properties:**	Is not dispersed in cold or hot water.
Boiling Point:	80°C (176°F)	**Melting Point:**	5.5°C (41.9°F)
Solubility (H2O):	Slightly soluble (0.1- 0.3%), rapidly volatilizes	**Specific Gravity (Water=1):**	0.88 at 15°C (59°F)
Ionicity (in water):	Not applicable	**Evaporation Rate (n-Butyl Acetate=1):**	Not available
Octanol/H2O Coeff.:	Kow = 2.13	**Percent Volatile:**	100%
Auto Ignition:	498°C (928°F) (benzene)	**Flash Point:**	-11°C (12°F) (benzene)
Flash Point Method:	Closed cup	**Upper Flammable Limit (UFL):**	7.8% (volume/volume) (benzene)
Lower Flammable Limit (LFL):	1.2 % (volume/volume) (benzene)	**Flammability Classification:**	Flammable

Section 10 - Stability & Reactivity Information

Chemical Stability

This product is stable under normal use conditions for shock, vibration, pressure, or temperature.

Chemical Stability: Conditions to Avoid

Keep away from heat, sparks, or open flame.

Incompatibility

Reactive with oxidizing agents, acids and halogens. May attack some forms of plastics, rubbers and coatings. Vapors may form explosive mixture with air.

Hazardous Polymerization

Not likely to occur.

Corrosivity

Not considered to be corrosive.

Hazardous Decomposition

Upon decomposition, this product emits carbon monoxide, carbon dioxide and/or low molecular weight hydrocarbons.

Section 11 - Toxicological Information

A: Acute Toxicity - General Product Information

Benzene may cause corneal injury to the eye. It is also a skin irritant that may be absorbed through the skin in harmful amounts. Inhalation of benzene can irritate the respiratory tract and may result in central nervous system (CNS) depression and possible death due to respiratory failure. Ingestion and subsequent aspiration into the lungs may cause chemical pneumonitis.

B: Component Analysis - LD50/LC50

Benzene (71-43-2)
Inhalation LC50 Rat: 13,050-14,380 ppm/4H; Oral LD50 Rat: 1800 mg/kg

Cyclohexane (110-82-7)
Inhalation LC50 Rat: 13.9 mg/L/4H; Oral LD50 Rat: >5000 mg/kg; Dermal LD50 Rabbit: >2000 mg/kg

Cyclohexene (110-83-8)
Oral LD50 Rat: 2400 µL/kg

Toluene (108-88-3)
Inhalation LC50 Rat: 12.5 mg/L/4H; Inhalation LC50 Rat: >26,700 ppm/1H; Oral LD50 Rat: 636 mg/kg; Dermal LD50 Rabbit: 8390 mg/kg; Dermal LD50 Rat: 12,124 mg/kg

C: Chronic Toxicity - General Product Information

Prolonged and/or repeated exposure can cause drying and scaling of the skin. Long-term exposure has been associated with certain types of leukemia in humans. IARC and OSHA consider benzene to be a human carcinogen. EPA has classified benzene as a Group A, known human carcinogen. Chronic exposure to benzene has been reported to cause bone marrow abnormalities and adverse blood effects including anemia. Progressive deterioration of hematopoietic function expressed as a decrease in absolute lymphocyte count is the most sensitive indicator of benzene exposure. Benzene may cause fetotoxicity and teratogenicity. Chromosomal aberrations have been noted in animal tests.

D: Chronic Toxicity – Carcinogenic Effects

ACGIH, EPA, IARC, OSHA, and NTP carcinogen lists have been checked for selected similar materials or those components with CAS registry numbers.

Benzene (71-43-2)

ACGIH: A1 - Confirmed Human Carcinogen
OSHA: 0.5 ppm Action Level; 1 ppm TWA; 5 ppm STEL (Cancer hazard, Flammable - see 29 CFR 1910.1028)
EPA: Classification: known human carcinogen for all routes of exposure
NTP: Known Human Carcinogen (Select Carcinogen)
IARC: Supplement 7 [1987], Monograph 29 [1982] (Group 1 (carcinogenic to humans))

Toluene (108-88-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
EPA: Classification: under the Guidelines for Carcinogen Risk Assessment (U.S. EPA, 2005), there is inadequate information to assess the carcinogenic potential of toluene.
IARC: Monograph 71 [1999], Monograph 47 [1989] (Group 3 (not classifiable))

E: Special Remarks on Chronic Effects

Benzene may pose a cancer hazard and may cause adverse birth and reproductive effects. Bone marrow abnormalities, leukemia, multiple myelomas, fetotoxicity, teratogenicity (ex. encephaly, angulated ribs and dilated brain ventricles) have been linked to benzene exposure.

Section 12 - Ecological Information

Ecotoxicity

A: General Product Information

Product is largely insoluble in water, and evaporates rapidly. Product has moderate absorption into soil and sediment. It is considered toxic to fish.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Benzene (71-43-2)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	12.6 mg/L	flow-through
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L	flow-through
96 Hr LC50 Lepomis macrochirus	22 mg/L	static
96 Hr LC50 Poecilia reticulata	28.6 mg/L	static
72 Hr EC50 Selenastrum capricornutum	29 mg/L	
48 Hr EC50 water flea	356 mg/L	static
48 Hr EC50 Daphnia magna	10 mg/L	

Cyclohexane (110-82-7)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	4.53 mg/L	flow-through
96 Hr LC50 Lepomis macrochirus	34.72 mg/L	
96 Hr LC50 Poecilia reticulata	48.0 mg/L	
72 Hr EC50 Scenedesmus subspicatus	>500 mg/L	
5 min EC50 Photobacterium phosphoreum	85.5 mg/L	
10 min EC50 Photobacterium phosphoreum	93 mg/L	
48 Hr EC50 water flea	400.0 mg/L	

Toluene (108-88-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	25 mg/L	1 day old
96 Hr LC50 Oncorhynchus mykiss	24.0 mg/L	flow-through
96 Hr LC50 Lepomis macrochirus	24.0 mg/L	static
96 Hr LC50 Lepomis macrochirus	13 mg/L	static
96 Hr EC50 Selenastrum capricornutum	>433 mg/L	
30 min EC50 Photobacterium phosphoreum	19.7 mg/L	
48 Hr EC50 water flea	11.3 mg/L	
48 Hr EC50 water flea	310 mg/L	
48 Hr EC50 Daphnia magna	11.3 mg/L	

Environmental Fate/Mobility

When released to soil or water, product will rapidly begin to volatilize. At 20°C (68°F) and moderate wind speeds, the evaporation rate for benzene is calculated to be over 2 g per m2 per sec. At 0°C (32°F) and moderate wind speeds, the evaporation rate is calculated to drop to below 0.1 g per m2 per sec. And at a warmer temperature of 30°C, the evaporation rate increases to over 3 g per m2 per sec. Benzene migrates in soils and in ground waters. Its airborne levels of benzene can be reduced by rain or water spray.

Persistence/Degradability

Benzene in air will photo-degrade with a calculated half-life of 13.4 days. This is accelerated in polluted atmospheres containing nitrogen or sulfur oxides. By-products include phenol, nitrophenols, nitrobenzene, formic acid and peroxyacetyl nitrate. Benzene will biodegrade in soils and ground waters (half-life 16-28 days) under aerobic conditions. Limited degradation occurs under anaerobic conditions. Sewage treatment plants have been shown to remove 44-100%.

Bioaccumulation/Accumulation

Benzene has a reported Kow = 2.13. Metabolites may partially bioaccumulate in fatty fish tissues liver and brain.

Ecological Summary

The high volatility and water solubility of benzene suggests that readily available benzene will partition to the atmosphere from the surface of water and soil within seven days. Estimated volatization half-life of benzene for soil was 7.2 to 38.4 days (Jury, WA et al., 1984). Benzene that does not evaporate will be highly to very highly mobile in the soil and may leach down into the ground water. Benzene may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm benzene in a base-rich, para-brownish soil within 1 to 10 weeks. Half-life of volatization from a model river 1m deep, was 2.7 hours at 20°C (68°F). In the atmosphere, benzene will exist predominantly in the vapor phase. It will react with oxygen photochemically to produce hydroxyl radicals with a half-life of 13.4 days. Products of photo-oxidation include phenol, nitrophenols, nitrobenzene, formic acid and peroxyacetyl nitrate. Based on the reported and estimated BCF, benzene is not expected to bioconcentrate in aquatic organisms.

Section 13 - Disposal Considerations

U.S./Canadian Waste Number & Descriptions

A: General Product Information

This product is known to be a hazardous waste according to US RCRA and Canadian regulations. The use, mixing or processing of this product may alter this product. Contact federal, provincial/state and local authorities in order to generate or ship a waste material associated with this product to ensure materials are handled appropriately and meet all criteria for disposal of hazardous waste. DO NOT ATTEMPT TO DISPOSE OF BY UNCONTROLLED IGNITION. Since emptied containers retain product/material residue, follow safe handling/label warnings even after container is emptied.

See Section 7: Handling and Storage and Section 8: Exposure Controls/Personal Protection for additional handling information that may be applicable for safe handling and the protection of employees.

Waste generator is advised to carefully consider hazardous properties and control measures needed for other materials that may be found in the waste.

B: Component Waste Numbers

Benzene (71-43-2)
RCRA: waste number U019 (Ignitable waste, Toxic waste); 0.5 mg/L regulatory level

Cyclohexane (110-82-7)
RCRA: waste number U056 (Ignitable waste)

Toluene (108-88-3)
RCRA: waste number U220

Section 14 - Transportation Information

US DOT Information

Shipping Name: Benzene
UN/NA #: UN1114 **Hazard Class:** 3 **Packing Group:** II
Required Label(s): FLAMMABLE LIQUID
Additional Info.: NOTE: The Reportable Quantity for benzene is 10 lbs. (4.54). The Reportable quantity for toluene is 1000 lbs. (454kg).
2008 Emergency Response Guidebook: Guide No. 130.

Canadian TDG Information

Shipping Name: Benzene
UN#: UN1114 **Hazard Class:** 3 **Packing Group:** II
Required Label(s): FLAMMABLE LIQUID
Additional Info.: 2008 Emergency Response Guidebook, Guide No. 130.

International Air Transport Association (IATA) Regulations

Shipping Name: Benzene
UN#: UN1114 **Hazard Class:** 3 **Packing Group:** II
Required Label(s): FLAMMABLE LIQUID

International Maritime Dangerous Goods (IMDG) Code

Shipping Name: Benzene
UN#: UN1114 **Hazard Class:** 3 **Packing Group:** II
Required Label(s): FLAMMABLE LIQUID
Additional Info.: EmS No.: F-E, S-D

Section 15 - Regulatory Information

A: International Regulations

Component Analysis – International Inventory Status

Component	CAS #	US - TSCA	CANADA - DSL	EU - EINECS
Benzene	71-43-2	Yes	Yes	Yes

B: USA Federal & State Regulations

Ongoing occupational hygiene, medical surveillance programs, or site emission or spill reporting may be required by Federal or State regulations. Check for applicable regulations.

USA OSHA Hazard Communication Class

This product is considered hazardous under 29 CFR 1910.1200 (Hazard Communication). HCS Classes:
HCS CLASS: Flammable liquid IB having a flash point lower than 22.8°C (73°F) and having a boiling point at or above 37.8°C (100°F).
HCS CLASS: Highly Toxic
HCS CLASS: HUMAN CARCINOGEN
HCS CLASS: Irritating substance
HCS CLASS: Target organ effects

USA Right-to-Know - Federal

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Benzene (71-43-2)
SARA 313: 0.1 % de minimis concentration
CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

Cyclohexane (110-82-7)
SARA 313: 1.0 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

Toluene (108-88-3)
SARA 313: 1.0 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

USA Right-to-Know - State

The following components appear on one or more of the following state hazardous substances lists. Some components (including those present only in trace quantities, and therefore not listed in this document) may be included on the Right-To-Know lists of other U.S. states. The reader is therefore cautioned to contact his or her NOVA Chemicals' representative or NOVA Chemicals' Product Integrity group for further U.S. State Right-To-Know information.

Component	CAS	NJ	PA
Benzene	71-43-2	Yes	Yes
Cyclohexene	110-83-8	Yes	Yes
Toluene	108-88-3	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):
WARNING! This product contains a chemical known to the state of California to cause cancer.
WARNING! This product contains a chemical known to the state of California to cause reproductive/developmental effects.

C: Canadian Regulations - Federal and Provincial

WHMIS Ingredient Disclosure List (IDL)

The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List (IDL):

Component	CAS #	Minimum Concentration
Benzene	71-43-2	0.1 %
Cyclohexane	110-82-7	1 %
Cyclohexene	110-83-8	1 %
Toluene	108-88-3	1 %

WHMIS Classification

Workplace Hazardous Materials Information System (WHMIS): This product has been classified in accordance with the hazard criteria of the CPR (Canadian Controlled Products Regulations) and the MSDS contains all of the information required by the CPR.
WHMIS CLASS B2: Flammable liquid with a flash point lower than 37.8°C (100°F).
WHMIS CLASS D2A: Carcinogen (Benzene)
WHMIS CLASS D2B: Toxic

Other Regulations

Ongoing occupational hygiene, medical surveillance programs, or site emission or spill reporting may be required by Federal or Provincial regulations. Check for applicable regulations.

Section 16 - Other Information

Label Information

DANGER! TOXIC! FLAMMABLE! CANCER HAZARD! Product is a clear liquid at room temperature with a sweet, solvent-like odor. Vapor is heavier than air and may spread long distances. Distant ignition and flashback are possible. Flammable liquid and vapor can accumulate static charge. Product will float on water and may travel to distant locations and/or spread fire. This product is considered harmful by inhalation, by skin contact, and if it swallowed. This product is irritating to the eyes and skin. Excessive inhalation may result in heartbeat irregularities and adverse central nervous system effects including headache, sleepiness, dizziness, nausea, loss of coordination, tremors, and in extreme conditions, coma and death. Systemic

absorption effects may include long-term damage to the blood-forming system, kidney and liver damage, and/or cancer (leukemia). Ingestion may also cause adverse central nervous system effects, blood disorders, kidney and/or liver damage. Small amounts, if aspirated into the lungs, may cause mild to severe pulmonary injury.
FIRST AID:
SKIN: Remove contaminated clothing and shoes. Wash immediately with soap and water. Seek medical attention if symptoms develop or persist. Completely decontaminate clothing, shoes and other protective equipment before reuse or discard.
EYES: Remove contact lenses, if it can be done safely. Immediately flush eyes with water for at least 15 minutes, while holding eyelids open. Seek medical if symptoms develop or persist.
INHALATION: Move affected individual to non-contaminated air. Loosen tight clothing such as a collar, tie, belt or waistband to facilitate breathing. Seek immediate medical attention if the individual is not breathing, is unconscious or if any other symptoms persist. WARNING: Contact through mouth-to-mouth resuscitation may pose a secondary risk to the rescuer. Avoid mouth-to-mouth contact by using a mouth shield or guard to perform artificial respiration.
INGESTION: DO NOT INDUCE VOMITING. Loosen tight clothing such as a collar, tie, belt or waistband. Seek immediate medical attention.
IN CASE OF A LARGE SPILL: Consider downwind evacuation for 300 meters (984 feet). Eliminate ignition sources. Keep upwind and out of low areas. Stop discharge if safe to do so. Contain liquids by booming on water or by diking on land to prevent entry into ditches, sewers, drains or waterways. Spills on water will volatilize rapidly, making containment or recovery difficult. Recover any pooled liquid material with approved, non-sparking pumps, skimmers or vacuum equipment. An inert foam cover material may assist in short term vapor suppression. Absorb with DRY earth, sand or other non-combustible material and clean up with non-sparking tools. Soil remediation may be required.

References

Available on request.

Special Considerations

Bonding and grounding may be insufficient to eliminate the hazard from static-accumulating flammable liquids. For additional information on equipment bonding and grounding, refer to the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents" or National Fire Protection Association (NFPA) 77, "Recommended Practice on Static Electricity".

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists; BLEVE = Boiling Liquid Expanding Vapor Explosion; BOD = Biochemical Oxygen Demand; CAS = Chemical Abstracts Service; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CPR = Controlled Products Regulations; DOT = Department of Transportation; DSL = Domestic Substances List; EINECS = European Inventory of Existing Commercial Substances; EPA = Environmental Protection Agency; EU = European Union; FDA = Food and Drug Administration; IARC = International Agency for Research on Cancer; IDL = Ingredient Disclosure List; Kow = Octanol/water partition coefficient; LEL = Lower Explosive Limit; NIOSH = National Institute for Occupational Safety and Health; NJTSR = New Jersey Trade Secret Registry; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; RCRA = Resource Conservation and Recovery Act; SARA = Superfund Amendments and Reauthorization Act; TDG = Transportation of Dangerous Goods; TSCA = Toxic Substances Control Act.

MSDS Prepared by: NOVA Chemicals
MSDS Information Phone Number: 1-412-490-4063

Other Information

Notice to Reader:
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This is the end of MSDS # NOVA-0011.

MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

EMERGENCY OVERVIEW
CAUTION!
OSHA/NFPA COMBUSTIBLE LIQUID - SLIGHT TO MODERATE IRRITANT
EFFECTS CENTRAL NERVOUS SYSTEM
HARMFUL OR FATAL IF SWALLOWED

Moderate fire hazard. Avoid breathing vapors or mists. May cause dizziness and drowsiness. May cause moderate eye irritation and skin irritation (rash). Long-term, repeated exposure may cause skin cancer.
If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

NFPA 704 (Section 16)

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800) 424-9300**
COMPANY CONTACT (business hours): Corporate Safety (732) 750-6000
MSDS INTERNET WEBSITE: www.hess.com (See Environment, Health, Safety & Social Responsibility)

SYNONYMS: Ultra Low Sulfur Diesel (ULSD); Low Sulfur Diesel; Motor Vehicle Diesel Fuel; Diesel Fuel #2; Dyed Diesel Fuel; Non-Road, Locomotive and Marine Diesel Fuel; Tax-exempt Diesel Fuel

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and CHEMICAL INFORMATION ON INGREDIENTS

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Diesel Fuel (68476-34-6)	100
Naphthalene (91-20-3)	Typically < 0.01

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher. Diesel fuel may be dyed (red) for tax purposes. May contain a multifunctional additive.

3. HAZARDS IDENTIFICATION

EYES
Contact with liquid or vapor may cause mild irritation.

SKIN
May cause skin irritation with prolonged or repeated contact. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Similar products produced skin cancer and systemic toxicity in laboratory animals following repeated applications. The significance of these results to human exposures has not been determined - see Section 11 Toxicological Information.

IARC classifies whole diesel fuel exhaust particulates as probably carcinogenic to humans (Group 2A). NIOSH regards whole diesel fuel exhaust particulates as a potential cause of occupational lung cancer based on animal studies and limited evidence in humans.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash).

4. FIRST AID MEASURES

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT:	> 125 ^{o}F (> 52 ^{o}C) minimum PMCC
AUTOIGNITION POINT:	494 ^{o}F (257 ^{o}C)
OSHA/NFPA FLAMMABILITY CLASS:	2 (COMBUSTIBLE)
LOWER EXPLOSIVE LIMIT (%):	0.6
UPPER EXPLOSIVE LIMIT (%):	7.5

FIRE AND EXPLOSION HAZARDS
Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA
SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY'S SPILL CONTINGENCY OR EMERGENCY RESPONSE PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE

HANDLING PRECAUTIONS

Handle as a combustible liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Diesel fuel, and in particular low and ultra low sulfur diesel fuel, has the capability of accumulating a static electrical charge of sufficient energy to cause a fire/explosion in the presence of lower flashpoint products such as gasoline. The accumulation of such a static charge occurs as the diesel flows through pipelines, filters, nozzles and various work tasks such as tank/container filling, splash loading, tank cleaning; product sampling; tank gauging; cleaning, mixing, vacuum truck operations, switch loading, and product agitation. There is a greater potential for static charge accumulation in cold temperature, low humidity conditions.

Documents such as 29 CFR OSHA 1910.106 "Flammable and Combustible Liquids, NFPA 77 Recommended Practice on Static Electricity, API 2003 "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents and ASTM D4865 "Standard Guide for Generation and Dissipation of Static

Electricity in Petroleum Fuel Systems" address special precautions and design requirements involving loading rates, grounding, bonding, filter installation, conductivity additives and especially the hazards associated with "switch loading." ["Switch Loading" is when a higher flash point product (such as diesel) is loaded into tanks previously containing a low flash point product (such as gasoline) and the electrical charge generated during loading of the diesel results in a static ignition of the vapor from the previous cargo (gasoline).]

Note: When conductivity additives are used or are necessary the product should achieve 25 picosiemens/meter or greater at the handling temperature.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

EXPOSURE LIMITS

Components (CAS No.)	Source	Exposure Limits TWA/STEL	Note
Diesel Fuel: (68476-34-6)	OSHA	5 mg/m, as mineral oil mist	
	ACGIH	100 mg/m^3 (as totally hydrocarbon vapor) TWA	A3, skin
Naphthalene (91-20-3)	OSHA	10 ppm TWA	
	ACGIH	10 ppm TWA / 15 ppm STEL	A4, Skin

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile, neoprene, or PVC are recommended. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION
A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE
Clear, straw-yellow liquid. Dyed fuel oil will be red or reddish-colored.

ODOR
Mild, petroleum distillate odor

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	320 to 690 oF (160 to 366 ^{o}C)
VAPOR PRESSURE:	0.009 psia @ 70 ^{o}F (21 ^{o}C)
VAPOR DENSITY (air = 1):	> 1.0
SPECIFIC GRAVITY (H_2O = 1):	0.83 to 0.88 @ 60 ^{o}F (16 ^{o}C)
PERCENT VOLATILES:	100 %
EVAPORATION RATE:	Slow; varies with conditions
SOLUBILITY (H_2O):	Negligible

10. STABILITY and REACTIVITY

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS
Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers; Viton ®; Fluorel ®

HAZARDOUS DECOMPOSITION PRODUCTS
Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY
Acute dermal LD50 (rabbits): > 5 ml/kg
Acute oral LD50 (rats): 9 ml/kg
Primary dermal irritation: extremely irritating (rabbits)
Draize eye irritation: non-irritating (rabbits)
Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY
Carcinogenic: OSHA: NO IARC: NO NTP: NO ACGIH: A3

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

MUTAGENICITY (genetic effects)
This material has been positive in a mutagenicity study.

12. ECOLOGICAL INFORMATION

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Diesel Fuel	Placard (International Only):
HAZARD CLASS and PACKING GROUP:	3, PG III	
DOT IDENTIFICATION NUMBER:	NA 1993 (Domestic) UN 1202 (International)	
DOT SHIPPING LABEL:	None	

Use Combustible Placard if shipping in bulk domestically

15. REGULATORY INFORMATION

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the state and/or local level. Consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the *de minimis* levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

CALIFORNIA PROPOSITON 65 LIST OF CHEMICALS

This product contains the following chemicals that are included on the Proposition 65 "List of Chemicals" required by the California Safe Drinking Water and Toxic Enforcement Act of 1986:

INGREDIENT NAME (CAS NUMBER)	Date Listed
Diesel Engine Exhaust (no CAS Number listed)	10/01/1990

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 3 (Combustible Liquid) and Class D, Division 2, Subdivision B (Toxic by other means)

16. OTHER INFORMATION

NFPA® HAZARD RATING HEALTH: 0
FIRE: 2
REACTIVITY: 0

Refer to NFPA 704 "Identification of the Fire Hazards of Materials" for further information

HMIS® HAZARD RATING HEALTH: 1 * * Chronic
FIRE: 2
PHYSICAL: 0

SUPERSEDES MSDS DATED: 02/28/2001

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212) 642-4900
API	American Petroleum Institute (202) 682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

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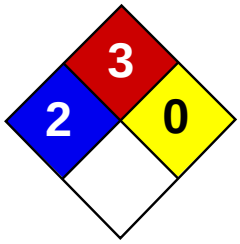

Material Safety Data Sheet
Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C8H10

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD50): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer). CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:
CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001) CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001) CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States] TWA: 435 STEL: 545 from OSHA (PEL) [United States] TWA: 435 STEL: 545 (mg/m3) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States] TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)] TWA: 100 STEL: 125 (ppm) [Belgium] TWA: 100 STEL: 125 (ppm) [Finland] TWA: 50 (ppm) [Norway] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in diethyl ether. Very slightly soluble in cold water or practically insoluble in water. Soluble in all proportions in Ethyl alcohol. Soluble in Carbon tetrachloride, Benzene. Insoluble in Ammonia. Slightly soluble in Chloroform. Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:
Lethal Dose/Conc 50% Kill: LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg Lowest Published Lethal Dose/Conc: LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Can cause mild skin irritation. It can be absorbed through intact skin. Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm , it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS) Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include

headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and conciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987). Ingestion: Do not drink, pipet or siphon by mouth. May cause gastroinestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through)]. 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Ethylbenzene Illinois toxic substances disclosure to employee act: Ethylbenzene Illinois chemical safety act: Ethylbenzene New York release reporting list: Ethylbenzene Rhode Island RTK hazardous substances: Ethylbenzene Pennsylvania RTK: Ethylbenzene Minnesota: Ethylbenzene Massachusetts RTK: Ethylbenzene Massachusetts spill list: Ethylbenzene New Jersey: Ethylbenzene New Jersey spill list: Ethylbenzene Louisiana spill reporting: Ethylbenzene California Director's List of Hazardous Substances: Ethylbenzene TSCA 8(b) inventory: Ethylbenzene TSCA 4(a) proposed test rules: Ethylbenzene TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97 SARA 313 toxic chemical notification and release reporting: Ethylbenzene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Manufacturer's Material Safety Data Sheet. -Fire Protection Guide to Hazardous Materials, 13th ed., National Fire Protection Association (NFPA) -Registry of Toxic Effects of Chemical Substances (RTECS) -Chemical Hazard Response Information System (CHRIS) -Hazardous Substance Data Bank (HSDB) -New Jersey Hazardous Substance Fact Sheet -Ariel Global View -Reprotext System

Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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MATERIAL SAFETY DATA SHEET

SECTION 1 ◆ PRODUCT AND COMPANY IDENTIFICATION

Explorer Pipeline Company 6846 South Canton P.O. Box 2650 Tulsa, Oklahoma 74101	**FOR EMERGENCY SOURCE INFORMATION CONTACT:** ➢ (918) 493 - 5100 ➢ CHEMTREC: (800) 424-9300 (24 hour contact) ➢ CANUTEC: (613) 996-6666 ➢ SETIQ: 91-800-00214

TRADE NAMES/SYNONYMS: Jet Fuel Grade JP-8	**CHEMICAL FAMILY:** Petroleum, Hydrocarbons, Diethylene Glycol Monomethyl Ether	**EPL Code:** 50

This material safety data sheet represents the composite characteristics and properties of fungible petroleum hydrocarbons and other related substances transported by explorer pipeline company. The information presented was compiled from one or more product shipper sources and is intended to provide health and safety guidance for these fungible products. Individual shipper and manufacturer MSDSs are available at Explorer Pipeline Company's, Tulsa, Oklahoma, offices.

SECTION 2 ✷ HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Combustible Liquid!!

- Clear, water-white liquid with faint petroleum hydrocarbon odor;
- Harmful or fatal if swallowed, inhaled or absorbed through skin.
- May cause CNS depression.
- Can produce skin irritation upon prolonged or repeated contact.
- Keep away from heat, sparks and open flame;
- Wash thoroughly after handling;
- Contains petroleum distillates! If swallowed, do not induce vomiting since aspiration into the lungs will cause chemical pneumonia;
- Avoid breathing vapors or mist;
- Use only with adequate ventilation; and
- Obtain prompt medical attention. Keep Out of Reach of Children!

SECTION 3 ▼ COMPOSITION/INFORMATION OF INGREDIENTS

INGREDIENT	CAS NUMBER	PERCENTAGE (%)
Distillates (petroleum), hydrotreated light	84742-47-8	100%
Antioxidant, anti-static, corrosion inhibitor and metal deactivator	As approved	Added at less than 100 ppm
Ethanol, 2- (2-methoxyethoxy)-	111-77-3	0.10-0.15 % by volume normally added as an anti-icing agent as required by military specification.

ACUTE

SUMMARY OF ACUTE HAZARDS: Minute amounts aspirated into the lung during ingestion or vomiting may cause mild to severe pulmonary injury and possibly death.

GETTING IT IN YOUR EYE...

- High vapor concentrations are irritating to the eyes.

GETTING IT ON YOUR SKIN...

- Repeated tests on laboratory mice have shown that liquid concentrations could lead to produce skin tumors and/or skin cancer.

- Prolonged or repeated skin contact with this product tends to remove skin oils, possibly leading to irritation and dermatitis. Repeated liquid contact with skin will dry and defat the skin, leading to irritation.

SWALLOWING IT...

- May be harmful or fatal if swallowed. Minute amounts of aspirated into the lungs during ingestion or vomiting may cause mild to severe pulmonary injury and possibly death.

BREATHING IT...

- Inhalation of components of exhaust from burning, such as carbon monoxide, may cause death at high concentrations. Exposure to the exhaust of this fuel should be minimized. Exposure to the respiratory tract may cause headaches, dizziness, anesthesia, drowsiness, unconsciousness, and other central nervous system effects.

CHRONIC

- See signs and symptoms above.

CANCER, REPRODUCTIVE AND GENETIC EFFECTS

- See signs and symptoms above.

See Toxicological Information (Section 11) For More Information

SECTION 4 ✣ FIRST AID MEASURES

EYES: If splashed into the eyes, flush with clear water for 15 minutes or until irritation subsides. If irritation persists, call a physician.

SKIN: In case of skin contact, remove any contaminated clothing and wash skin with soap and water. Launder or dry-clean clothing before reuse. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial treatment within the first few hours may significantly reduce the ultimate extent of injury.

INGESTION: If ingested, DO NOT induce vomiting; call a physician immediately.

INHALATION: If overcome by vapor, remove from exposure and call a physician immediately. If breathing is irregular or has stopped, start resuscitation, administer oxygen, if available.

NOTE TO PHYSICIAN: TREAT SYMPTOMATICALLY AND SUPPORTIVELY

SECTION 5 ⌘ FIRE FIGHTING MEASURES

This liquid is volatile and gives off invisible vapors. Either the liquid or vapor may settle in low areas or travel some distance along the ground or surface to ignition sources where they may ignite or explode.

FLASH POINT:(Method Used) 100 °F	**FLAMMABLE LIMITS:**	LEL: 0.9% UEL: 7.0%

AUTOIGNITION TEMPERATURE: 410 °F

EXTINGUISHING MEDIA: Foam, water spray (fog), dry chemical, carbon dioxide and vaporizing liquid type extinguishing agents may all be suitable for extinguishing fires involving this type of product, depending on size or potential size of fire and circumstances related to the situation. Plan fire protection and response strategy through consultation with local fire protection authorities or appropriate specialists.

HAZARDOUS REACTIONS/DECOMPOSITION: Fumes, smoke, carbon monoxide, sulfur oxides, aldehydes and other decomposition products, in the case of incomplete combustion. Incomplete combustion generates highly poisonous carbon monoxide, and possibly other toxic gases.

SPECIAL INSTRUCTIONS: Use water spray, dry chemical, foam or carbon dioxide to extinguish the fire. Use water to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to provide protection for men attempting to stop a leak. Water spray may be used to flush spills away from exposures. Minimize breathing of gases, vapor, fumes, or decomposition products. Use supplied-air breathing equipment for enclosed or confined spaces or as otherwise needed.

SECTION 6 ❖ ACCIDENTAL RELEASE MEASURES

- Shut off and eliminate all ignition sources.
- Keep people away.
- Recover free product.
- Add sand, earth or other suitable absorbent to spill area.
- Minimize breathing vapors.
- Minimize skin contact.
- Ventilate confined spaces.
- Open all windows and doors.
- Keep product out of sewers and watercourses by diking or impounding.
- Advise authorities if product has entered or may enter sewers, watercourses, or extensive land areas.
- Assure conformity with applicable governmental regulations.
- Continue to observe precautions for volatile, combustible vapors from absorbed material.

SECTION 7 ✂ HANDLING AND STORAGE

- Prior to working with this product workers should be trained on its proper handling and storage.
- Storage: Protect against physical damage.
- Separate from oxidizing materials.
- Store in a cool, well ventilated area of non-combustible construction away from possible sources of ignition.

SECTION 8 ⌖ EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: Keep containers closed when not in use. Do not store near heat, sparks, flame, or strong oxidant. In order to prevent fire or explosion hazards, use appropriate equipment.

OTHER HYGIENIC AND WORK PRACTICES: Minimize breathing vapor, mist, or fumes. Avoid prolonged or repeated contact with skin. Remove contaminated clothing; launder or dry-clean before re-use. Remove contaminated shoes and thoroughly clean before re-use; discard if oil-soaked. Cleanse skin thoroughly after contact, before breaks and meals, and at end of work period. Product is readily removed from skin by waterless hand cleaners followed by washing thoroughly with soap and water.

PERSONAL PROTECTIVE EQUIPMENT

- **EYES:** Use splash goggles or face shield when eye contact may occur.
- **SKIN:** Use chemical-resistant gloves, apron, or other impervious clothing, if needed, to avoid contaminated regular clothing, which could result in prolonged or repeated skin contact.
- **RESPIRATORY PROTECTION:** Use supplied-air respiratory protection in confine or enclosed spaces, if needed.

SECTION 9 ϟ PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT (760 MM HG): 320°-572 °F	**PERCENT VOLATILE BY VOLUME:** 100%
SPECIFIC GRAVITY (H_2O = 1): 0.775-0.840 @ 39.2°F	**VISCOSITY UNITS, TEMP:** 8 cSt @ -20°C
FREEZING POINT: -53°F	**VAPOR DENSITY (AIR =1):** 5
VAPOR PRESSURE: <5 mm Hg @ 20°C	**SOLUBILITY IN WATER:** Negligible
APPEARANCE AND ODOR: Clear, water-white liquid. Faint petroleum hydrocarbon odor.	

SECTION 10 ⌑ STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable

CONDITIONS TO AVOID: Ignition sources, such as heat, sparks, pilot lights, static electricity, and open flames.

OTHER PHYSICAL AND CHEMICAL PROPERTIES: No Data

MATERIALS TO AVOID: Avoid contact with strong oxidant such as liquid chlorine, concentrated oxygen, sodium hypochlorite, etc.

HAZARDOUS POLYMERIZATION: Not expected to occur.

SECTION 11 ⊛ TOXICOLOGICAL INFORMATION

No Data Available

SECTION 12 ❋ ECOLOGICAL INFORMATION

No Data Available

SECTION 13 ✣ DISPOSAL CONSIDERATIONS

Avoid waste contact/breathing harmful vapors. Contaminated product/soil/water may be RCRA hazardous waste.

SECTION 14 ★ TRANSPORTATION INFORMATION

Not Meant To Be All Inclusive - Check Local, State, And Federal Laws And Regulations

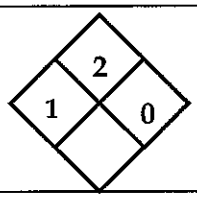
Agency	Shipping Name	Packing Group	Hazard Class	UN/NA #
U.S. DOT	Fuel, Aviation, Turbine Engine.	I, II, or III	Combustible Liquid	1863

SECTION 15 ☽ REGULATORY INFORMATION

No Data Available

SECTION 16 ✺ OTHER INFORMATION

NFPA 704 LABEL:



HMIS LABEL

1-2-0

MSDS REVISIONS: Change in Format and update of Information

MSDS CREATION DATE: July 1997 | **REVISION #1:** 01/03/06

DISCLAIMER

The information in this MSDS was obtained from sources which we believe are reliable. **HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESS OR IMPLIED, REGARDING ITS ACCURACY.** Some conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. **FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.** All product measurements such as flash point, *etc.* are considered approximate values. All data provided by Explorer Pipeline Company.

This MSDS was prepared and is to be used only for this product. If the product is used as a component in another product, such as refined petroleum hydrocarbon mixtures, this MSDS information may not be applicable.

MSDS DEVELOPER: Cass Willard

Cass Willard, CIH

DATE: 01/03/06

Material Safety Data Sheet
PAH Contaminated Soil

ACC# 17974

Section 1 - Chemical Product and Company Identification

MSDS Name: PAH Contaminated Soil
Catalog Numbers: SRS103100
Synonyms: API separator sludge
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
Not available	Soil	78-99	unlisted
120-12-7	Anthracene	0-2	204-371-1
129-00-0	Pyrene	0-2	204-927-3
132-64-9	Dibenzofuran	0-2	205-071-3
205-99-2	Benzo(b)fluoranthene	0-2	205-911-9
206-44-0	Fluoranthene	0-2	205-912-4
208-96-8	Acenaphthylene	0-2	205-917-1
218-01-9	1,2-benzphenanthrene	0-2	205-923-4
50-32-8	Benzo(a)pyrene	0-2	200-028-5
56-55-3	1,2-Benzanthracene	0-2	200-280-6
83-32-9	Acenaphthene	0-2	201-469-6
85-01-8	Phenanthrene	0-2	201-581-5
86-73-7	Fluorene	0-2	201-695-5
87-86-5	Pentachlorophenol	0-2	201-778-6
91-20-3	Naphthalene	0-2	202-049-5
91-57-6	2-methylnaphthalene	0-2	202-078-3

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: not available solid.
Warning! May cause allergic skin reaction. Causes eye and skin irritation. May cause cancer based on animal studies.
Target Organs: Eyes, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. Naphthalene can cause cataracts, optical neuritis, and cornea injuries. Ingestion of large quantities may cause severe hemolytic anemia and
Inhalation: Causes respiratory tract irritation. May cause effects similar to those described for ingestion.
Chronic: May cause cancer according to animal studies. Prolonged exposure to respirable crystalline quartz may cause delayed lung injury/fibrosis (silicosis).

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: Not published.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Avoid generating dusty conditions.

Section 7 - Handling and Storage

Handling: Avoid generating dusty conditions. Use with adequate ventilation. Avoid contact with skin and eyes. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a cool, dry place.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Soil	none listed	none listed	none listed
Anthracene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).
Pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).
Dibenzofuran	none listed	none listed	none listed
Benzo(b)fluoranthene	none listed	none listed	none listed
Fluoranthene	none listed	none listed	none listed
Acenaphthylene	none listed	none listed	none listed
1,2-benzphenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).
Benzo(a)pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).
1,2-Benzanthracene	none listed	none listed	none listed
Acenaphthene	none listed	none listed	none listed
Phenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).
Fluorene	none listed	none listed	none listed
Pentachlorophenol	0.5 mg/m3 TWA; Skin - potential significant contribution to overall exposure by the cutaneous r oute	0.5 mg/m3 TWA 2.5 mg/m3 IDLH	0.5 mg/m3 TWA
	10 ppm TWA; 15 ppm		

Naphthalene	STEL; Skin - potential significant contribution to overall exposure by the cutaneous r oute	10 ppm TWA; 50 mg/m3 TWA 250 ppm IDLH	10 ppm TWA; 50 mg/m3 TWA
2-methylnaphthalene	0.5 ppm TWA; Skin - potential significant contribution to overall exposure by the cutaneous r oute	none listed	none listed

OSHA Vacated PELs: Soil: No OSHA Vacated PELs are listed for this chemical. Anthracene: No OSHA Vacated PELs are listed for this chemical. Pyrene: No OSHA Vacated PELs are listed for this chemical. Dibenzofuran: No OSHA Vacated PELs are listed for this chemical. Benzo(b)fluoranthene: No OSHA Vacated PELs are listed for this chemical. Fluoranthene: No OSHA Vacated PELs are listed for this chemical. Acenaphthylene: No OSHA Vacated PELs are listed for this chemical. 1,2-benzphenanthrene: No OSHA Vacated PELs are listed for this chemical. Benzo(a)pyrene: No OSHA Vacated PELs are listed for this chemical. 1,2-Benzanthracene: No OSHA Vacated PELs are listed for this chemical. Acenaphthene: No OSHA Vacated PELs are listed for this chemical. Phenanthrene: No OSHA Vacated PELs are listed for this chemical. Fluorene: No OSHA Vacated PELs are listed for this chemical. Pentachlorophenol: 0.5 mg/m3 TWA Naphthalene: 10 ppm TWA; 50 mg/m3 TWA 2-methylnaphthalene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: not available
Odor: none reported
pH: Not available.
Vapor Pressure: Not applicable.
Vapor Density: Not available.
Evaporation Rate: Not applicable.
Viscosity: Not applicable.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Insoluble in water.
Specific Gravity/Density: Not available.
Molecular Formula: Mixture
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.

Conditions to Avoid: High temperatures.
Incompatibilities with Other Materials: None reported.
Hazardous Decomposition Products: No data available.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 120-12-7: CA9350000
CAS# 129-00-0: UR2450000; UR2450100
CAS# 132-64-9: HP4430000
CAS# 205-99-2: CU1400000
CAS# 206-44-0: LL4025000
CAS# 208-96-8: AB1254000; AB1254200
CAS# 218-01-9: GC0700000
CAS# 50-32-8: DJ3675000
CAS# 56-55-3: CV9275000
CAS# 83-32-9: AB1000000
CAS# 85-01-8: SF7175000
CAS# 86-73-7: LL5670000
CAS# 87-86-5: SM6300000; SM6314000; SM6321000
CAS# 91-20-3: QJ0525000
CAS# 91-57-6: QJ9635000
LD50/LC50:
CAS# 120-12-7:
Oral, mouse: LD50 = 4900 mg/kg;
.

CAS# 129-00-0:
Draize test, rabbit, skin: 500 mg/24H Mild;
Inhalation, rat: LC50 = 170 mg/m3;
Inhalation, rat: LC50 = 170 mg/m3;
Oral, mouse: LD50 = 800 mg/kg;
Oral, rat: LD50 = 2700 mg/kg;
.

CAS# 132-64-9:
.

CAS# 205-99-2:
.

CAS# 206-44-0:
Oral, rat: LD50 = 2 gm/kg;
Skin, rabbit: LD50 = 3180 mg/kg;
.

CAS# 208-96-8:
Oral, mouse: LD50 = 1760 mg/kg;
.

CAS# 218-01-9:
.

CAS# 50-32-8:
.

CAS# 56-55-3:
.

CAS# 83-32-9:
.

CAS# 85-01-8:
Oral, mouse: LD50 = 700 mg/kg;
Oral, rat: LD50 = 1.8 gm/kg;
.

CAS# 86-73-7:
.

CAS# 87-86-5:
Draize test, rabbit, eye: 100 uL/24H Mild;
Inhalation, mouse: LC50 = 225 mg/m3;
Inhalation, mouse: LC50 = 225 mg/m3;
Inhalation, rat: LC50 = 355 mg/m3;
Inhalation, rat: LC50 = 200 mg/m3;
Inhalation, rat: LC50 = 335 mg/m3;
Oral, mouse: LD50 = 36 mg/kg;
Oral, mouse: LD50 = 117 mg/kg;
Oral, mouse: LD50 = 30 mg/kg;
Oral, rabbit: LD50 = 200 mg/kg;
Oral, rat: LD50 = 27 mg/kg;
Oral, rat: LD50 = 27 mg/kg;
Oral, rat: LD50 = 50 mg/kg;
Skin, rat: LD50 = 96
CAS# 91-20-3:
Draize test, rabbit, eye: 100 mg Mild;
Inhalation, rat: LC50 = >340 mg/m3/1H;
Oral, mouse: LD50 = 316 mg/kg;
Oral, rat: LD50 = 490 mg/kg;
Skin, rabbit: LD50 = >20 gm/kg;
Skin, rat: LD50 = >2500 mg/kg;
.

CAS# 91-57-6:
Oral, rat: LD50 = 1630 mg/kg;
.

Carcinogenicity:
CAS# 120-12-7:

- **ACGIH:** A1 - Confirmed Human Carcinogen (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

CAS# 129-00-0:

- **ACGIH:** A1 - Confirmed Human Carcinogen (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

CAS# 132-64-9: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 205-99-2:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 7/1/87
- **NTP:** Suspect carcinogen
- **IARC:** Group 2B carcinogen

CAS# 206-44-0: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 208-96-8: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 218-01-9:

- **ACGIH:** A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
- **California:** carcinogen, initial date 1/1/90
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

CAS# 50-32-8:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 7/1/87
- **NTP:** Suspect carcinogen
- **IARC:** Group 1 carcinogen

CAS# 56-55-3:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 7/1/87
- **NTP:** Suspect carcinogen
- **IARC:** Group 2B carcinogen

CAS# 83-32-9: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 85-01-8:

- **ACGIH:** A1 - Confirmed Human Carcinogen (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

CAS# 86-73-7: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 87-86-5:

- **ACGIH:** A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
- **California:** carcinogen, initial date 1/1/90
- **NTP:** Not listed.
- **IARC:** Group 2B carcinogen

CAS# 91-20-3:

- **ACGIH:** Not listed.
- **California:** carcinogen, initial date 4/19/02
- **NTP:** Suspect carcinogen
- **IARC:** Group 2B carcinogen

CAS# 91-57-6: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information available.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Mutagenicity: No information available.
Neurotoxicity: No information available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 206-44-0: waste number U120.
CAS# 218-01-9: waste number U050.
CAS# 50-32-8: waste number U022.
CAS# 56-55-3: waste number U018.
CAS# 91-20-3: waste

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA

Soil is not listed on the TSCA inventory. It is for research and development use only.
CAS# 120-12-7 is listed on the TSCA inventory.
CAS# 129-00-0 is listed on the TSCA inventory.
CAS# 132-64-9 is listed on the TSCA inventory.
CAS# 205-99-2 is not listed on the TSCA inventory. It is for research and development use only.
CAS# 206-44-0 is listed on the TSCA inventory.
CAS# 208-96-8 is listed on the TSCA inventory.
CAS# 218-01-9 is listed on the TSCA inventory.
CAS# 50-32-8 is listed on the TSCA inventory.
CAS# 56-55-3 is listed on the TSCA inventory.
CAS# 83-32-9 is listed on the TSCA inventory.
CAS# 85-01-8 is listed on the TSCA inventory.
CAS# 86-73-7 is listed on the TSCA inventory.
CAS# 87-86-5 is listed on the TSCA inventory.
CAS# 91-20-3 is listed on the TSCA inventory.
CAS# 91-57-6 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 129-00-0: Effective 6/1/87, Sunset 6/1/97 CAS# 91-20-3: Effective 6/1/87, Sunset 6/1/97

Chemical Test Rules

CAS# 91-20-3: 40 CFR 799.5115

Section 12b

CAS# 91-20-3: Section 4, 0.1 % de minimus concentration

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 120-12-7: 5000 lb final RQ; 2270 kg final RQ CAS# 129-00-0: 5000 lb final RQ; 2270 kg final RQ CAS# 132-64-9: 100 lb final RQ; 45.4 kg final RQ CAS# 205-99-2: 1 lb final RQ; 0.454 kg final RQ CAS# 206-44-0: 100 lb final RQ; 45.4 kg final RQ CAS# 208-96-8: 5000 lb final RQ; 2270 kg final RQ CAS# 218-01-9: 100 lb final RQ; 45.4 kg final RQ CAS# 50-32-8: 1 lb final RQ; 0.454 kg final RQ CAS# 56-55-3: 10 lb final RQ; 4.54 kg final RQ CAS# 83-32-9: 100 lb final RQ; 45.4 kg final RQ CAS# 85-01-8: 5000 lb final RQ; 2270 kg final RQ
CAS# 86-73-7: 5000 lb final RQ; 2270 kg final RQ CAS# 87-86-5: 10 lb final RQ; 4.54 kg final RQ CAS# 91-20-3: 100 lb final RQ; 45.4 kg final RQ

SARA Section 302 Extremely Hazardous Substances

CAS# 129-00-0: 1000 lb lower threshold TPQ; 10000 lb upper threshold T PQ

SARA Codes

CAS # 120-12-7: immediate.
CAS # 129-00-0: immediate, delayed.
CAS # 206-44-0: immediate.
CAS # 50-32-8: immediate, delayed.
CAS # 56-55-3: delayed.
CAS # 83-32-9: immediate.
CAS # 85-01-8: immediate.
CAS # 91-20-3: immediate, delayed, fire.
CAS # 91-57-6: immediate.

Section 313

This material contains Anthracene (CAS# 120-12-7, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
This material contains Dibenzofuran (CAS# 132-64-9, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
This material contains Benzo(b)fluoranthene (CAS# 205-99-2, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR
This material contains Fluoranthene (CAS# 206-44-0, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

This material contains 1,2-benzphenanthrene (CAS# 218-01-9, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

This material contains Benzo(a)pyrene (CAS# 50-32-8, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

This material contains 1,2-Benzanthracene (CAS# 56-55-3, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

This material contains Phenanthrene (CAS# 85-01-8, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

This material contains Pentachlorophenol (CAS# 87-86-5, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

This material contains Naphthalene (CAS# 91-20-3, 0-2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

CAS# 132-64-9 is listed as a hazardous air pollutant (HAP).

CAS# 87-86-5 is listed as a hazardous air pollutant (HAP).

CAS# 91-20-3 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 87-86-5 is listed as a Hazardous Substance under the CWA. CAS# 91-20-3 is listed as a Hazardous Substance under the CWA. CAS# 120-12-7 is listed as a Priority Pollutant under the Clean Water Act. CAS# 129-00-0 is listed as a Priority Pollutant under the Clean Water Act. CAS# 205-99-2 is listed as a Priority Pollutant under the Clean Water Act. CAS# 206-44-0 is listed as a Priority Pollutant under the Clean Water Act. CAS# 208-96-8 is listed as a Priority Pollutant under the Clean Water Act. CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act. CAS# 50-32-8 is listed as a Priority Pollutant under the Clean Water Act. CAS# 56-55-3 is listed as a Priority Pollutant under the Clean Water Act. CAS# 83-32-9 is listed as a Priority Pollutant under the Clean Water Act. CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act. CAS# 86-73-7 is listed as a Priority Pollutant under the Clean Water Act. CAS# 87-86-5 is listed as a Priority Pollutant under the Clean Water Act. CAS# 91-20-3 is listed as a Priority Pollutant under the Clean Water Act. CAS# 206-44-0 is listed as a Toxic Pollutant under the Clean Water Act. CAS# 83-32-9 is listed as a Toxic Pollutant under the Clean Water Act. CAS# 87-86-5 is listed as a Toxic Pollutant under the Clean Water Act. CAS# 91-20-3 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 120-12-7 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

CAS# 129-00-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

CAS# 132-64-9 can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.

CAS# 205-99-2 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

CAS# 206-44-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.
CAS# 208-96-8 can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.
CAS# 218-01-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 50-32-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 56-55-3 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 83-32-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.
CAS# 85-01-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.
CAS# 86-73-7 can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.
CAS# 87-86-5 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 91-20-3 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 91-57-6 is not present on state lists from CA, PA, MN, MA, FL, or NJ.

California Prop 65

WARNING: This product contains Benzo(b)fluoranthene, a chemical known to the state of California to cause cancer. WARNING: This product contains 1,2-benzphenanthrene, a chemical known to the state of California to cause cancer. WARNING: This product contains Benzo(a)pyrene, a chemical known to the state of California to cause cancer. WARNING: This product contains 1,2-Benzanthracene, a chemical known to the state of California to cause cancer. WARNING: This product contains Pentachlorophenol, a chemical known to the state of California to cause cancer. WARNING: This product contains Naphthalene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 205-99-2: 0.096 æg/day NSRL (oral) CAS# 218-01-9: 0.35 æg/day NSRL (oral) CAS# 50-32-8: 0.06 æg/day NSRL CAS# 56-55-3: 0.033 æg/day NSRL (oral) CAS# 87-86-5: 40 æg/day NSRL CAS# 91-20-3: 5.8 æg/day NSRL

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

Not available.

Risk Phrases:

Safety Phrases:

WGK (Water Danger/Protection)

CAS# 120-12-7: 2
CAS# 129-00-0: No information available.
CAS# 132-64-9: No information available.
CAS# 205-99-2: No information available.
CAS# 206-44-0: No information available.
CAS# 208-96-8: No information available.
CAS# 218-01-9: No information available.
CAS# 50-32-8: No information available.
CAS# 56-55-3: No information available.
CAS# 83-32-9: No information available.
CAS# 85-01-8: No information available.

CAS# 86-73-7: No information available.
CAS# 87-86-5: 3
CAS# 91-20-3: 2
CAS# 91-57-6: No information available.

Canada - DSL/NDSL

CAS# 120-12-7 is listed on Canada's DSL List.
CAS# 129-00-0 is listed on Canada's DSL List.
CAS# 132-64-9 is listed on Canada's DSL List.
CAS# 218-01-9 is listed on Canada's DSL List.
CAS# 50-32-8 is listed on Canada's DSL List.
CAS# 83-32-9 is listed on Canada's DSL List.
CAS# 85-01-8 is listed on Canada's DSL List.
CAS# 86-73-7 is listed on Canada's DSL List.
CAS# 87-86-5 is listed on Canada's DSL List.
CAS# 91-20-3 is listed on Canada's DSL List.
CAS# 91-57-6 is listed on Canada's DSL List.
CAS# 206-44-0 is listed on Canada's NDSL List.
CAS# 208-96-8 is listed on Canada's NDSL List.
CAS# 56-55-3 is listed on Canada's NDSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

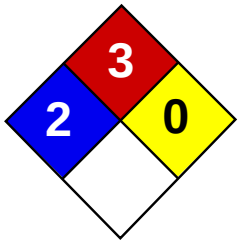
Canadian Ingredient Disclosure List

CAS# 120-12-7 is listed on the Canadian Ingredient Disclosure List.
CAS# 129-00-0 is listed on the Canadian Ingredient Disclosure List.
CAS# 205-99-2 is listed on the Canadian Ingredient Disclosure List.
CAS# 206-44-0 is listed on the Canadian Ingredient Disclosure List.
CAS# 208-96-8 is not listed on the Canadian Ingredient Disclosure List.
CAS# 218-01-9 is listed on the Canadian Ingredient Disclosure List.
CAS# 50-32-8 is listed on the Canadian Ingredient Disclosure List.
CAS# 56-55-3 is listed on the Canadian Ingredient Disclosure List.
CAS# 83-32-9 is listed on the Canadian Ingredient Disclosure List.
CAS# 85-01-8 is listed on the Canadian Ingredient Disclosure List.
CAS# 86-73-7 is not listed on the Canadian Ingredient Disclosure List.
CAS# 87-86-5 is not listed on the Canadian Ingredient Disclosure List.
CAS# 91-20-3 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #5 Date: 11/20/2008

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.



Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C6-H5-CH3 or C7-H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N2O4; AgClO4; BrF3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

toxic substances disclosure to employee act: Toluene Illinois chemical safety act: Toluene New York release reporting list: Toluene Rhode Island RTK hazardous substances: Toluene Pennsylvania RTK: Toluene Florida: Toluene Minnesota: Toluene Michigan critical material: Toluene Massachusetts RTK: Toluene Massachusetts spill list: Toluene New Jersey: Toluene New Jersey spill list: Toluene Louisiana spill reporting: Toluene California Director's List of Hazardous Substances.: Toluene TSCA 8(b) inventory: Toluene TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92 SARA 313 toxic chemical notification and release reporting: Toluene CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S29- Do not empty into drains. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:30 PM

Last Updated: 11/06/2008 12:00 PM

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SAFETY DATA SHEET

VINYL CHLORIDE (MONOMER)

MSDS No.: M9192 **Rev. Date:** 2009-Oct-07 **Rev. Num.:** 02

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Company Identification:	Occidental Chemical Corporation 5005 LBJ Freeway P.O. Box 809050 Dallas, Tx 75380-9050
24 Hour Emergency Telephone Number:	1-800-733-3665 or 1-972-404-3228 (U.S.); 32.3.575.55.55 (Europe); 1800-033-111 (Australia)
To Request an MSDS:	MSDS@oxy.com or 1-972-404-3245
Customer Service:	1-800-752-5151 or 1-972-404-3700
Synonyms:	VCM, Monochloroethylene, Chloroethene, Ethylene, chloro-, Vinyl chloride monomer
Product Use:	PVC Manufacturing

2. HAZARDS IDENTIFICATION

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EMERGENCY OVERVIEW:

Color: Colorless
Physical State: Compressed, liquefied gas
Odor: Sweet
Signal Word: DANGER

MAJOR HEALTH HAZARDS: LIQUID MAY CAUSE FROSTBITE TO EYES AND SKIN. MAY CAUSE CENTRAL NERVOUS SYSTEM EFFECTS. CONTAINS VINYL CHLORIDE, A KNOWN HUMAN CANCER AGENT. CAUSES DAMAGE TO LIVER AND PERIPHERAL NERVOUS SYSTEM THROUGH PROLONGED OR REPEATED EXPOSURE. CAUSES DAMAGE TO LUNGS THROUGH PROLONGED OR REPEATED EXPOSURE BY INHALATION. SUSPECTED OF CAUSING GENETIC DEFECTS. REPRODUCTIVE HAZARD.
PHYSICAL HAZARDS: Extremely flammable gas under pressure.
PRECAUTIONARY STATEMENTS: Keep away from heat, sparks and flame. Wash thoroughly after handling. Avoid contact with eyes, skin and clothing. Do not breathe vapors or spray mist. Do not eat, drink or smoke in areas where this material is used. Use only outdoors or in a well-ventilated area. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Store in well-ventilated place. Keep container tightly closed.

****

POTENTIAL HEALTH EFFECTS:

Inhalation: Several minutes of exposure to high, but attainable concentrations (over 1000 ppm) may cause central nervous system depression with effects such as dizziness, drowsiness, disorientation, tingling, numbness or burning sensation of the hands and feet, impaired vision, nausea, headache, difficulty breathing, cardiac arrhythmias, unconsciousness, or even death.

Skin contact: May cause irritation. Rapid evaporation of the material may cause frostbite.

Eye contact: May cause irritation. Rapid evaporation of the material may cause frostbite.

Ingestion: Not a likely route of exposure.

Chronic Effects: Causes damage to the liver, musculoskeletal system, and peripheral nervous system through prolonged or repeated exposure.

Interaction with Other Chemicals Which Enhance Toxicity: Alcohol may enhance toxic effects

Medical Conditions Aggravated by Exposure: Hepatitis B infection

See Section 11: TOXICOLOGICAL INFORMATION

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	Percentage	CAS Number
Vinyl chloride	99 - 100	75-01-4

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. If respiration or pulse has stopped, have a trained person administer basic life support (Cardio-Pulmonary Resuscitation and/or Automatic External Defibrillator) and CALL FOR EMERGENCY SERVICES IMMEDIATELY.

SKIN CONTACT: If frostbite or freezing occur, immediately flush with plenty of lukewarm water (100-105 F, 38-41 C). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT: Immediately flush eyes with a directed stream of water for at least 15 minutes, forcibly holding eyelids apart to ensure complete irrigation of all eye and lid tissues. Washing eyes within several seconds is essential to achieve maximum effectiveness. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION: Not a likely route of exposure.

Notes to Physician: Cardiac stimulants such as epinephrine should not be given to persons overexposed to chlorinated hydrocarbons.

5. FIRE-FIGHTING MEASURES

Fire Hazard: Severe fire hazard. Vapor/air mixtures are explosive. Vapors or gases may ignite at distant sources and flash back. Containers may rupture or explode if exposed to heat.

Extinguishing Media: Stop flow of gas before extinguishing fire. Use carbon dioxide, regular dry chemical, foam or water. Use water spray to keep containers cool.

Fire Fighting: Move container from fire area if it can be done without risk. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this can't be done, then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. Wear NIOSH approved positive-pressure self-contained breathing apparatus operated in pressure demand mode.

Sensitivity to Mechanical Impact: Not sensitive.

Sensitivity to Static Discharge: Electrostatic charges may build up during handling and may form ignitable vapor-air mixtures in storage containers. Ground equipment in accordance with industry standards and best practices such as NFPA 77 [Recommended Practices on Static Electricity (2007)] and American Petroleum Institute (API) RP Recommended Practice 2003 [Protection Against Ignitions Arising our of Static, Lightning, and Stray Currents (2008)].

Lower Flammability Level (air): 3.6 %
Upper Flammability Level (air): 33.0 %
Flash point: -108 F (-78 C)
Autoignition Temperature: 882 F (472 C)

Hazardous Combustion Products: Oxides of carbon, Hydrogen chloride, Phosgene

6. ACCIDENTAL RELEASE MEASURES

Occupational Release:
Remove sources of ignition. Ventilate closed spaces before entering. Stop leak if possible without personal risk. Vapors or gases may ignite at distant ignition sources and flash back. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Keep out of water supplies and sewers. Wear appropriate personal protective equipment recommended in Section 8 of the SDS. Releases should be reported, if required, to appropriate agencies.

7. HANDLING AND STORAGE

Storage Conditions: Store and handle in accordance with all current regulations and standards. Keep container tightly closed and properly labeled. Store in a cool, dry area. Store in a well-ventilated area. Do not enter confined spaces unless adequately ventilated. Avoid heat, flames, sparks and other sources of ignition. May be subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Keep separated from incompatible substances (see Section 10 of SDS).

7. HANDLING AND STORAGE

Handling Procedures: Avoid breathing vapor or mist. Avoid contact with skin, eyes and clothing. Keep away from heat, sparks and flame. Ground any equipment used in handling. Use non-sparking tools and equipment. All energized electrical equipment must be designed in accordance with the electrical classification of the area.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Regulatory Exposure limit(s):

Component	CAS Number	OSHA Final PEL TWA	OSHA Final PEL STEL	OSHA Final PEL Ceiling
Vinyl chloride	75-01-4	1 ppm	5 ppm	-----

OEL: Occupational Exposure Level; OSHA: United States Occupational Safety and Health Administration; PEL: Permissible Exposure Limit; TWA: Time Weighted Average; STEL: Short Term Exposure Limit

Non-Regulatory Exposure Limit(s):

- The Non-Regulatory United States Occupational Safety and Health Administration (OSHA) limits shown in the table are the Vacated 1989 PEL's (vacated by 58 FR 35338, June 30, 1993).

- The American Conference of Governmental Industrial Hygienists (ACGIH) is a voluntary organization of professional industrial hygiene personnel in government or educational institutions in the United States. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

Component	CAS Number	ACGIH TWA	ACGIH STEL	ACGIH Ceiling	OSHA TWA (Vacated)	OSHA STEL (Vacated)	OSHA Ceiling (Vacated)
Vinyl chloride	75-01-4	1 ppm	-----	-----	-----	-----	-----

ENGINEERING CONTROLS: Use closed systems when possible. Provide local exhaust ventilation where vapor may be generated. Ensure compliance with applicable exposure limits.

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: Wear safety glasses with side-shields. If eye contact is likely, wear chemical resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

Skin and Body Protection: Wear appropriate chemical resistant clothing.

Hand Protection: Wear appropriate chemical resistant gloves

Protective Material Types: Butyl rubber, Nitrile, Silver Shield®, Viton®

Respiratory Protection: Refer to 29 CFR 1910.1017 for selection of respirators for vinyl chloride. A respiratory protection program that meets 29 CFR 1910.134 must be followed whenever workplace conditions warrant use of a respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Compressed, liquefied gas

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Colorless
Odor:	Sweet
Odor Threshold:	Not reliable to prevent excessive exposure
Molecular Weight:	62.5
Molecular Formula:	C2ClH3
Flash point:	-108 F (-78 C)
Lower Flammability Level (air):	3.6 %
Upper Flammability Level (air):	33.0 %
Boiling Point/Range:	7 F (-14 C)
Freezing Point/Range:	No data available
Vapor Pressure:	2660 mmHg @ 25 C
Vapor Density (air=1):	2.15
Specific Gravity (water=1):	0.91 @ 25/25 C
Water Solubility:	2.7 g/L
pH:	Not applicable
Volatility:	100%
VOC Content(%):	100%
Evaporation Rate (ether=1):	>15
Partition Coefficient (n-octanol/water):	Log Kow = 1.36

10. STABILITY AND REACTIVITY

Reactivity/ Stability: Stable at normal temperatures and pressures.

Conditions to Avoid: Avoid air and sunlight. Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

Incompatibilities/ Materials to Avoid: Oxidizing agents, Oxides of nitrogen, Metals, Aluminum, Aluminum alloys, Copper, Metal alkyl complexes and alkali metals such as sodium, potassium and their alloys

Hazardous Decomposition Products: Oxides of carbon, Chlorine, Hydrogen chloride, Phosgene

Hazardous Polymerization: Polymerization can occur. Avoid elevated temperatures, oxidizing agents, oxides of nitrogen, oxygen, peroxides, other polymerization catalysts/initiators, air and sunlight.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA:

Component	LD50 Oral	LC50 Inhalation	LD50 Dermal
Vinyl chloride	500 mg/kg (Rat)	-----	-----

CHRONIC TOXICITY: Occupational overexposure has produced a specific cancer (angiosarcoma of the liver) and is associated with hepatocellular cancer. Occupational exposure has also resulted in changes in bones and skin, especially in the extremities such as the fingers (acroosteolysis). Additionally, repeated exposure may result in dose-related sensory disorders, peripheral nervous system effects, blood system damage, lymphatic system changes, liver malfunction, and pulmonary insufficiency.

CARCINOGENICITY: This material is classified as follows:

Component	NTP:	IARC (GROUP 1):	IARC (GROUP 2):	OSHA:
Vinyl chloride	Known Carcinogen	Group 1	Not listed	Listed

MUTAGENIC DATA: Mutagenic in bacteria studies. Genetic studies in animals were negative in some cases and positive in others.

REPRODUCTIVE TOXICITY: Reproductive effects and testes damage occurred in rats exposed to vinyl chloride. These endpoints, however, were generally noted at concentrations greater than those necessary to cause liver damage.

12. ECOLOGICAL INFORMATION

Aquatic Toxicity:
This material is believed to be practically non-toxic to fish on an acute basis (LC50>100 mg/L)

FATE AND TRANSPORT:

BIODEGRADATION: Vinyl chloride may degrade under anaerobic conditions.

PERSISTENCE: Tropospheric half-life is estimated to be 23 hours. If released to air, this material will remain in the gas phase. If released to soil, volatilization will occur, but material that does not volatilize may be highly mobile. If released to water, evaporation will occur.

BIOCONCENTRATION: Bioconcentration potential is low (BCF <100 or log Kow <3).

13. DISPOSAL CONSIDERATIONS

Reuse or reprocess, if possible. Dispose in accordance with all applicable regulations. May be subject to disposal regulations: U.S. EPA 40 CFR 261. Hazardous Waste Number(s): D001, U043.

14. TRANSPORT INFORMATION

U.S.DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
HAZARD CLASS/ DIVISION: 2.1
LABELING REQUIREMENTS: 2.1
DOT RQ (lbs): RQ 1 Lbs. (Vinyl chloride)

14. TRANSPORT INFORMATION

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS OR DIVISION: 2.1

15. REGULATORY INFORMATION

U.S. REGULATIONS

OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200) (US)

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): If a release is reportable under CERCLA section 103, notify the state emergency response commission and local emergency planning committee. In addition, notify the National Response Center at (800) 424-8802 or (202) 426-2675.

Component	CERCLA Reportable Quantities:
Vinyl chloride	1 lb (final RQ)

EPCRA EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated

EPCRA SECTIONS 311/312 HAZARD CATEGORIES (40 CFR 370.21):
Fire Hazard, Reactive Hazard, Sudden Release of Pressure, Acute Health Hazard, Chronic Health Hazard

EPCRA SECTION 313 (40 CFR 372.65): The following chemicals are listed in 40 CFR 372.65 and may be subject to Community Right-to Know Reporting requirements

Component	Status:
Vinyl chloride	Listed

OSHA SPECIFICALLY REGULATED SUBSTANCES: OSHA 29 CFR 1910.1017 (Vinyl chloride); The U.S. Department of Labor, Occupational Safety and Health Administration specifically regulates manufacturing, handling and processing of vinyl chloride. Such regulations have been published at 29 CFR 1910.1017.

OSHA PROCESS SAFETY (PSM) (29 CFR 1910.119): The PSM standard may apply to processes which involve a flammable liquid or gas in a quantity of 10,000 pounds (4535.9 kg) or more.

NATIONAL INVENTORY STATUS

U.S. INVENTORY STATUS: Toxic Substance Control Act (TSCA): All components are listed or exempt

TSCA 12(b): This product is not subject to export notification

Canadian Chemical Inventory: All components are listed

STATE REGULATIONS

Component	Vinyl chloride
California Proposition 65 Cancer WARNING:	Listed
Massachusetts Right to Know Hazardous Substance List	Listed

	New Jersey Right to Know Hazardous Substance List	Listed	
	New Jersey Special Health Hazards Substance List	Listed	a
	New Jersey - Environmental Hazardous Substance List	Listed	
	Pennsylvania Right to Know Hazardous Substance List	Listed	
	Pennsylvania Right to Know Special Hazardous Substances	Listed	
	Pennsylvania Right to Know Environmental Hazard List	Listed	
	Rhode Island Right to Know Hazardous Substance List	Listed	

CANADIAN REGULATIONS
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

WHMIS Classification: A, B1, D2A, D2B, F

16. OTHER INFORMATION

Prepared by: OxyChem Corporate HESS - Health Risk Management

HMIS: (SCALE 0-4) (Rated using National Paint & Coatings Association HMIS: Rating Instructions, 2nd Edition)
Health: 2* **Flammability:** 4 **Reactivity:** 2
NFPA 704 - Hazard Identification Ratings (SCALE 0-4)
Health: 2 **Flammability:** 4 **Reactivity:** 2

IMPORTANT:
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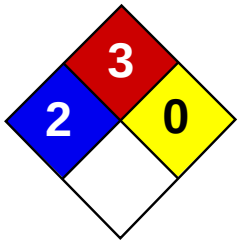
OSHA Standard 29 CFR 1910.1200 requires that information be provided to employees regarding the hazards of chemicals by means of a hazard communication program including labeling, material safety data sheets, training and access to written records. We request that you, and it is your legal duty to, make all information in this Material Safety Data Sheet available to your employees.



Material Safety Data Sheet
m-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: m-Xylene

Catalog Codes: SLX1066

CAS#: 108-38-3

RTECS: ZE2275000

TSCA: TSCA 8(b) inventory: m-Xylene

CI#: Not applicable.

Synonym: m-Methyltoluene

Chemical Name: 1,3-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{m-}Xylene	108-38-3	100

Toxicological Data on Ingredients: m-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to blood, kidneys, the nervous system, liver. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 139.3°C (282.7°F)

Melting Point: -47.87°C (-54.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 6 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 5000 mg/kg [Rat.]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier. 0900 Detected in maternal milk in human. Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: m-Xylene Massachusetts RTK: m-Xylene TSCA 8(b) inventory: m-Xylene SARA 313 toxic chemical notification and release reporting: m-Xylene CERCLA: Hazardous substances.: m-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable. R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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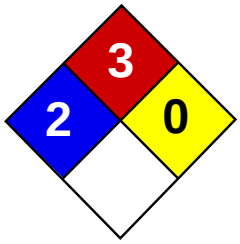

Material Safety Data Sheet
o-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: o-Xylene

Catalog Codes: SLX1012

CAS#: 95-47-6

RTECS: ZE2450000

TSCA: TSCA 8(b) inventory: o-Xylene

CI#: Not applicable.

Synonym: 1,2-Dimethylbenzene

Chemical Name: o-Xylene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{o-}Xylene	95-47-6	100

Toxicological Data on Ingredients: o-Xylene LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/male [POSSIBLE]. The substance may be toxic to kidneys, liver, upper respiratory tract, skin, eyes, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 463°C (865.4°F)

Flash Points: CLOSED CUP: 17°C (62.6°F).

Flammable Limits: LOWER: 0.9% UPPER: 6.7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards:
Vapors are heavier than air and may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapors may form explosive mixtures with air. Containers may explode when heated. Runoff to sewer may create fire or explosion hazard

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] STEL: 150 (ppm) from NIOSH STEL: 655 (mg/m3) from NIOSHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Mobile, nonpolar liquid.)

Odor: Aromatic. Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 144.4°C (291.9°F)

Melting Point: -25°C (-13°F)

Critical Temperature: 359°C (678.2°F)

Specific Gravity: 0.88 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.05 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties:
Dispersed in diethyl ether. Is not dispersed in cold water, hot water. See solubility in diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, flames, incompatible materials.

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Photochemically reactive. Incompatible with strong oxidizers(e.g. chlorine, bromine, fluorine), and strong acids (e.g. nitric acid, acetic acid).

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Lowest Published Lethal Dose - Inhalation (LCL): 6125 ppm 12 hours [Rat]; 6125 ppm 12 hours [Human] Lowest Published Lethal Dose - Oral: 5000 mg/kg [Rat]

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Classified Reproductive system/ toxin/male [POSSIBLE]. May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eyes, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (male) and birth defects based on animal data. 0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier. 0900 Detected in maternal milk in human. Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Efffects Skin: May cause skin irritation. May be absorbed through skin i harmful amounts. Eyes: Causes severe eye irritation. Inhalation: Causes respiratory tract and mucous membranes irritation. May affect sense organs, behavior (Central Nervous system) which may result in dizziness, general weakness, central nervous system depression, confusion, ataxia, disorientation, lethargy, drowsiness, headaches. May also affect respiration, cardiovascular system, liver, blood, and digestive system (nausea, vomiting) Ingestion: Harmful if swallowed. Causes digestive tract irritation with nausea, vomiting

and diarrhea. May also affect metabolism, liver, and urinary system, and central nervous system (excitement followed by headache, dizziness, drowsiness and nausea). Chronic Potential Health Effects: Skin: Prolonged or repeated contact may cause defatting of skin and dermatitis. Eyes: Prolonged or repeated exposure may cause conjunctivitis or permanent eye damage. Inhalation: Chronic inhalation may cause effects similar to those of acute inhalation.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylene UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: o-Xylene Illinois chemical safety act: o-Xylene New York release reporting list: o-Xylene Pennsylvania RTK: o-Xylene Florida: o-Xylene Massachusetts RTK: o-Xylene Massachusetts spill list: o-Xylene New Jersey: o-Xylene New Jersey spill list: o-Xylene Louisiana spill reporting: o-Xylene California Director's List of Hazardous Substances: o-Xylene TSCA 8(b) inventory: o-Xylene TSCA 8(d) H and S data reporting: o-Xylene: Effective: 10/4/82; Sunset: 10/4/92 SARA 313 toxic chemical notification and release reporting: o-Xylene CERCLA: Hazardous substances.: o-Xylene: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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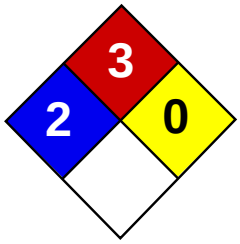

Material Safety Data Sheet
p-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: p-Xylene

Catalog Codes: SLX1120

CAS#: 106-42-3

RTECS: ZE2625000

TSCA: TSCA 8(b) inventory: p-Xylene

CI#: Not applicable.

Synonym: p-Methyltoluene

Chemical Name: 1,4-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{p-}Xylene	106-42-3	100

Toxicological Data on Ingredients: p-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 12400 mg/kg [Rabbit.]. VAPOR (LC50): Acute: 4550 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to blood, kidneys, the nervous system, liver. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 138°C (280.4°F)

Melting Point: 12°C (53.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 9 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 5000 mg/kg [Rat.]. Acute dermal toxicity (LD50): 12400 mg/kg [Rabbit.]. Acute toxicity of the vapor (LC50): 4550 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier. 0900 Detected in maternal milk in human. Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: p-Xylene Florida: p-Xylene Massachusetts RTK: p-Xylene New Jersey: p-Xylene TSCA 8(b) inventory: p-Xylene SARA 313 toxic chemical notification and release reporting: p-Xylene CERCLA: Hazardous substances.: p-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable. R38- Irritating to skin. R41- Risk of serious damage to eyes. R48/20- Harmful: danger of serious damage to health by prolonged exposure through inhalation.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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MSDS: Sodium Permanganate (40%)

DATE ISSUED: 12/04

SECTION 1 - CHEMICAL PRODUCT IDENTIFICATION

PRODUCT NAME: *Sodium Permanganate Solution
DESCRIPTION: *40% minimum as NaMnO4

SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

CHEMICAL NAME	%	TLV	CAS No.
* Sodium Permanganate * * *	40-42	.2mg Mn per cubic meter of air	*10101-50-5

SECTION 3 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: *

EFFECTS OF OVEREXPOSURE - ACUTE

EYES: *Sodium Permanganate is damaging to eye tissue on contact. It may cause burns that result in damage to the eye.

SKIN: *Momentary contact of solution at room temp may be irritating to the skin,leaving brown stains.

INGESTION: *If swallowed,may cause burns to mucous membranes of the mouth,throat,esophagus, and stomach

INHALATION: *May cause irritation to the respiratory tract

EFFECTS OF OVEREXPOSURE - CHRONIC *

PRIMARY ROUTE OF ENTRY: *

SECTION 4 - FIRST AID MEASURES

EYES: *Flush immediately with large amounts of water for at least 15 minutes. Seek medical attention immediately.

SKIN: *Wash contaminated area with water. Seek medical attention if irritation persists.

INGESTION: *If person is conscious, give large amounts of water or milk. Seek medical attention.

INHALATION: *Remove person from contaminated area to fresh air. Seek medical attention.

*PHYSICIANS NOTE: *Decomposition products are alkaline.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASHPOINT: *None
FLAMMABILITY: *Nonflammable
AUTOFLAMMABILITY: *None EXPLOSIVE LIMITS: LOWER: n/a UPPER:n/a
EXPLOSION HAZARD: *Explosive in contact with sulfuric acid or peroxides,or readily oxidizable substances
EXTINGUISHING MEDIA: Use large amounts of water. Dike to contain.

SPECIAL EXPOSURE HAZARDS IN FIRE: Keep containers cool by spraying with water if exposed to fire.
SPECIAL PROTECTIVE EQUIPMENT FOR A FIRE: Self-contained breathing apparatus should be worn.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

ENVIRONMENTAL PRECAUTIONS: *Contain spill by collecting the liquid in a pit or holding behind a dam. Dilute to approx 6% solution with water and then reduce with sodium thiosulfate,a bisulfite or ferrous salt solution.
METHODS FOR CLEANUP: *Flush with abundant water into the sewer, if permitted by federal,state, and local authorities. If not,collect and treat as above.

SECTION 7 - HANDLING AND STORAGE

HANDLING: *Wash hands thoroughly with soap and water after handling.
STORAGE: *Store in a cool, well-ventilated area. Segregate from acids,peroxides, Formaldehyde,and all combustible,organic or easily oxidized materials.

SECTION 8 - EXPOSURE CONTROL / PERSONAL PROTECTION

ENGINEERING CONTROLS: General ventilation is recommended. Eyewash and safety shower stations must be located in the immediate area.
EXPOSURE GUIDELINES: not established

PERSONAL PROTECTION EQUIPMENT:

RESPIRATORY: NIOSH-approved self-contained breathing apparatus for exposure to levels above limits.
HAND: Rubber gloves and boots.
EYE: Chemical goggles which are splash and dust proof or face shield.
SKIN: If clothing is contaminated. wash skin and launder clothing.

NOTE: BEFORE EATING, DRINKING OR SMOKING, WASH FACE AND HANDS THOROUGHLY WITH SOAP AND WATER.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE, COLOR AND ODOR: *Purple Solution
PH as is: *5-7
BOILING POINT: *105 degrees C
FLASH POINT: *
VAPOR PRESSURE: *760 mm Hg @ 105 degrees C
SPECIFIC GRAVITY: *1.36-1.39
SOLUBILITY IN WATER: *Miscible in all proportions
VISCOSITY: *

SECTION 10 - STABILITY AND REACTIVITY

HAZARDOUS POLYMERIZATION: *material is not known to polymerize
CHEMICAL STABILITY: *Stable under normal conditions
CONDITIONS TO AVOID: *contact with incompatible materials or heat(275* F)
MATERIALS TO AVOID: *Acids,peroxides,formaldehyde,antifreeze,hydraulic fluids,and all combustible organic or readily oxidizable materials
HAZARDOUS DECOMPOSITION PRODUCTS: *may form corrosive fumes in a fire

SECTION 11 - TOXICOLOGICAL INFORMATION

ACUTE TOXICITY: irritating to body tissue with which it comes into contact
IRRITANCY: *
SENSITIZATION: *
SUB-ACUTE, SUB-CHRONIC AND PROLONGED TOXICITY:No known cases of chronic poisoning due to permanganates have been reported.
EMPIRICAL DATA ON EFFECTS ON HUMANS: has not been classified as a carcinogen by OSHA,NTP,IARC

SECTION 12 - ECOLOGICAL INFORMATION

PERSISTENCE IN THE ENVIRONMENT:Permanganate has a low estimated lifetime in the environment
BIOLOGICAL OXYGEN DEMAND:In non-reducing and non-acidic environments MnO2 is insoluble
CHEMICAL OXYGEN DEMAND:
AQUATIC TOXICITY: No data
Daphnia magna
Fathead minnow
OTHER INFORMATION: * Discharge of this product must be in accordance with all federal, state, local or other applicable laws and regulations.

SECTION 13 - DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: *Is considered a D001 hazardous (ignitable) waste.For disposal, see section 6

SECTION 14 - TRANSPORTATION INFORMATION

DOT SHIPPING NAME: Permanganates,inorganic,aqueous solution,n.o.s.
UN Number: UN3214
DOT HAZARD CLASS: Oxidizer 5.1
PACKING GROUP: II

SECTION 15 - REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA): All components of this product are listed in the Toxic Substances Control Act inventory.
COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA): Not Listed
SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA Title III) - Section 311 Hazard Categories:302/303 not listed 311/312 hazard Catagories: Fire,acute and chronic

toxicity Section 313 contains 20% manganese compounds as part of the chemical structure and is subject to the reporting requirements section313 of title III

Acute Health:	Yes
Chronic Health:	No
Fire:	No
Sudden Release of Pressure:	No
Reactive:	No

SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA Title III) - Section 311:
Components of this product subject to reporting: none

SECTION 16 - OTHER INFORMATION

HMIS RATINGS
HEALTH: 1 FLAMMABILITY: 0 REACTIVITY: 0 SPECIAL HAZARD: Oxidizer

The information and recommendations contained in this Material Safety Data Sheet have been compiled from sources believed to be reliable and to represent the best opinion on the subject as of the date on this sheet. However, no warranty, guarantee or representation, expressed or implied, is made by F2 Industries LLC., as to the correctness or sufficiency of this information or to the results to be obtained from the use thereof.

APPENDIX G

Site-Specific Safety Programs

APPENDIX G
SITE-SPECIFIC SAFETY PROGRAMS

SITE SPECIFIC HAZARD COMMUNICATION PROGRAM

1.0 GENERAL:

1.1 It is the intent of BEM Systems, Inc to ensure that all employees and contractors are informed of the hazards, precautions and actions required to maintain their safety and well being.

1.2 The purpose of the Hazard Communication Program is to ensure that BEM's operations at _____ site are in compliance with the OSHA Hazard Communication Standard, 29 CFR 1910.1200 and 29 CFR 1926.59.

1.3 Project number _____, dates of project _____, name of SHSO _____, name of PM _____, Contact numbers _____.

2.0 DEFINITIONS:

2.1 CFR – Code of Federal Regulations

2.2 HCS – Hazard Communications Standard

2.3 HMI – Hazardous Material Inventory

2.4 MSDS – Material Safety Data Sheets

2.5 OSHA – Occupational Safety and Health Administration

3.0 APPLICABILITY:

3.1 The OSHA Hazard Communication Standard, 29 CFR 1910.1200 requires that employers evaluate the potential hazards of chemicals utilized in the work place and communicate information concerning hazards and appropriate corrective measures to employees. The standard requires each facility or site to: develop a site specific written hazard communication plan, develop a Hazardous Material Inventory (HMI), maintain an accompanying Material Safety Data sheet (MSDS) file, ensure all containers have adequate labeling that describes chemical contents and associated hazards, and provide employees training that meets the requirements of the standard.

3.2 BEM stores and uses hazardous materials as part of operation and maintenance activities at _____. The HMI only lists the hazardous materials stored and used at the _____ site.

3.3 Responsibilities:

3.3.1 The Site Health and Safety Officer is the HCS program coordinator, acting as the representative of the Project Manager, who has overall responsibility for the implementation of this program.

3.3.2 The Corporate Health and Safety Manager (CHSM) provides technical assistance to the Project Manager and Site Health and Safety Officer. The CHSM is responsible for evaluating the implementation of the Hazard Communication Program and notifying the Project Manager of deficiencies.

3.3.3 BEM Systems maintains an MSDS library in the Health and Safety File on every hazardous chemical used at the project. The MSDS must be a fully completed OSHA form 174 or equivalent.

SUMMARY OF HAZARD COMMUNICATION RESPONSIBILITIES

Positions	Responsibilities
Corporate Health and Safety Manager	• Provide assistance with Haz Comm Program • Maintain MSDS library • Evaluate overall implementation of the program • Approve hazardous materials prior to site use
Project Manager	• Implementation of Haz Comm Program • Assign tasks to ensure compliance • Ensure all employees are trained and contractors informed of hazards • Archive Hazard Material Inventory as part of final project file
Site Health and Safety Officer	• Contact CHSM or other BEM Sr. Health and Safety Specialist for approval on any hazardous materials prior to purchase • Inform Project Manager of planned acquisitions of hazardous materials • Maintain and update written HMI and MSDS files • Notify CHSM or other BEM Health and Safety Specialist if there is difficulty obtaining an MSDS • Notify Project Manager if the facility does not have the personal protective equipment (PPE) recommended by the manufacturer of a hazardous chemical

4.0 PROCEDURES:

4.1 Hazardous Materials Inventory

4.1.1 BEM maintains a current HMI of hazardous products and chemicals used or otherwise under control of BEM at the _____ facility. See Appendix "A" for current HMI.

4.1.2 The HMI is updated upon receipt of any new product containing hazardous chemicals by the Site Health and Safety Officer (SHSO). The SHSO shall review all MSDS's to determine necessary precautions to be implemented and PPE utilized.

4.1.3 The HMI is maintained at the _____ main office, as well as, the _____ office.

4.1.4 The HMI is forwarded to the CHSM annually, when changed or updated, and upon demobilization from the project. The HMI will be made available to concerned parties upon request.

4.1.5 The Project Manager or SHSO contacts the CHSM or other BEM Sr. Health and Safety Specialist before the acquisition of any new highly hazardous chemical

products. This includes any hazard rating of 3 or 4 on the 0-4 scale for flammability, reactivity, and health.

4.1.6 The SHSO receives verbal approval for a new chemical product from the Sr. Health and Safety Specialist, who may request a copy of the MSDS.

4.2 Material Safety Data Sheets (MSDS)

4.2.1 The SHSO maintains an MSDS library on every substance on the hazardous list in the Health and Safety file. The MSDS must be a fully completed OSHA form 174 or equivalent.

4.2.2 New materials will not be used until an MSDS is acquired or exempted by a BEM Sr. Health and Safety Specialist. Materials that are purchased in a store as consumer goods and used in a manner consistent with that of a home user are exempt. Typical examples are floor and window cleaning compounds.

4.2.3 A BEM Engineer or Scientist will review each MSDS for accuracy and completeness and will consult with the manufacturer if additional information is necessary.

4.2.4 The SHSO will ensure that an MSDS is available for each hazardous material used. Copies of the MSDS and hazardous chemical inventory are provided to employee representatives and are also available to any of our employees upon request. When an MSDS is not available from the manufacturer the container will have a label, which meets the requirements of, Labels and Other Forms of Warning. Alternately, MSDS's not available from the manufacturer can be obtained through the internet at various sites, such as, hazards.com, msdsonline.com, or msds.pdc.cornell.edu/msdssearch.asp.

4.2.5 The SHSO is responsible for acquiring, updating, and archiving MSDS's for the _____ Site.

4.2.6 Site personnel will inform the SHSO of planned chemical product purchases. The SHSO is responsible for acquiring the MSDS from the manufacturer. The SHSO will review the MSDS and/or package label to ensure that the site has the manufacturers' recommended protective equipment. The SHSO will alert the Project Manager if the site does not have all of the recommended protective equipment for a particular hazardous material.

4.2.7 MSDS will meet the requirements of the HCS. It must be fully completed and reviewed prior to receipt of the first shipment of any potentially hazardous chemical. Whenever practical, a less hazardous substance will be substituted.

4.2.8 MSDS for hazardous chemicals no longer used at the facility will be archived and maintained by BEM Systems, Inc for the duration of the project.

4.3 Labels and Other Forms of Warnings

4.3.1 The SHSO is responsible for ensuring that all hazardous chemicals used by BEM or BEM subcontractors at the site are properly labeled and referencing the corresponding MSDS to verify all label information.

4.3.2 Labels must include the following minimum information:

- Chemical Name and Hazard Warning
- Name of the Chemical manufacturer, importer, distributor or other responsible party.

4.3.3 Daily use / shift containers or small containers used by the employee drawing the material do not require labeling. Unused portions must be returned to a properly labeled container at the end of the shift.

4.4 Subcontractor Employees

4.4.1 The Site Superintendent or SHSO informs outside contractor personnel of chemical hazards that may be encountered in the course of their work.

4.4.2 The SHSO monitors any hazardous chemicals brought into the site under their jurisdiction by an outside contractor.

4.5 Non-Routine Tasks

4.5.1 The SHSO, Superintendent, or Project Manager will consult with the BEM Sr. Safety and Health Specialist when planning non-routine tasks with hazardous materials.

4.5.2 Before work is started a meeting between the SHSO and the affected personnel will be held to discuss the hazards and appropriate personal protective equipment.

5.0 TRAINING

5.1 All site personnel who work with or are potentially exposed to hazardous chemicals receive initial training on the Hazardous Communication Standard and the safe use of hazardous chemicals. Additional training is provided to employees whenever new chemicals are acquired.

5.2 As required by 29 CFR 1910.1200 and 1926.59, site personnel are instructed on the HCS, the hazardous characteristics of chemicals at the facility, methods to control chemical hazards, labeling requirements, and reading a MSDS.

5.3 Each BEM site employee receives annual refresher Hazard Communication Training about the regulation, MSDS management, HMI maintenance, and labeling requirements.

5.4 BEM training includes the following elements:

- Summary of the OSHA HCS and BEM corporate site templates
- Hazardous chemical properties
- Physical and health hazards associated with chemical exposures
- Procedures for personal protection
- Chemical spill and leak procedures
- MSDS – Content, comprehension and location
- General categories of project site chemicals and their hazards

6.0 RECORD KEEPING

6.1 The SHSO is responsible for implementing the Site Hazard Communication Program and maintaining all of the applicable records on-site.

6.2 The records are maintained in the _____ located on the subject property

6.3 The records include, but are not limited to, the following:

- MSDS for all hazardous materials on site.
- Hazardous Material Inventory
- Documentation of hazard communication training conducted on-site.

6.4 MSDS for hazardous chemicals and products will be archived by BEM for the duration of the project.

SITE SPECIFIC HEARING CONSERVATION PROGRAM

1.0 GENERAL

1.1 Purpose

The purpose of the BEM Systems, Inc. site specific Hearing Conservation Program is to protect the safety and health of employees by protecting them from those occupational noises which could cause development of Noise Induced Hearing Loss (NIHL). The program is designed to comply with the Occupational Safety and Health Administration (OSHA) standard on Hearing Conservation, 29 CFR 1910.95 and all other specific standards that have hearing conservation requirements.

The site specific Hearing Conservation Program is to ensure compliance with the applicable OSHA standard for BEM's operations located at _____.

The project number is _____, the project dates are anticipated to be from _____, the Site Health and Safety Officer is designated as _____, and the Project Manager is _____. The individual to contact in the event of an emergency is _____ at _____.

1.2 Primary Objective

The primary objective of BEM Systems, Inc. Hearing Conservation Program is to prevent employee exposure to occupational noise that may either exceed established occupational exposure limits or have the potential for developing Noise Induced Hearing Loss (NIHL). This will be accomplished as far as feasible by accepted engineering measures prior to providing PPE.

1.3 Scope

This site specific program applies to all BEM personnel, and by personnel of contracted employees working at _____, where noise exposure can not be eliminated, controlled, or reduced to acceptable limits by engineering or administrative controls.

1.4 Responsibilities

1.4.1 Site Health and Safety Officer. The SHSO has day-to-day responsibility for the implementation of the Hearing Loss Conservation Program. He / She shall ensure potentially harmful noise exposures and sources are evaluated, appropriate corrective and protective actions are taken, audiometric testing and training are provided as needed and records are kept as required.

1.4.2 Project Manager. Project Managers are responsible for complying with and enforcing the provisions of the Hearing Loss Prevention Program. They will assist in identifying and helping control hazards, report changes, which may require evaluation, and participate in improving the program.

1.4.3 Corporate Health and Safety Manager. The CHSM has the overall responsibility for implementing the Hearing Conservation Program. The CHSM may

implement the program and may delegate responsibilities to other qualified personnel.

1.4.4 Employees. Employees are responsible for assisting those who perform the sound surveys by sharing their knowledge about the work environment, the machinery in operation, and specific jobs. Employees also must cooperate by maintaining their normal work routines when asked to wear dosimeters so that the results will be representative of their actual exposures. They are also responsible for notifying their supervisors when changes occur in noise levels due to changes in equipment condition, location, or work practices are observed so that the need for additional evaluations of hearing protection may be determined.

1.5 Industry Standards

In addition to government regulations and standards, applicable standards and guidelines should be consulted and used where doing so enhances safety. The following organizations may also be referenced:

- Occupational Safety and Health Administration 29 CFR 1910;
- Occupational Safety and Health Administration 29 CFR 1926;
- American National Standards Institute (ANSI);
- National Institute of Occupational Safety and Health (NIOSH); or
- American Conference of Governmental Industrial Hygienist (ACGIH).

2.0 TERMS AND LIMITS:

2.1 Sound

Sound is defined as pressure variations of frequencies and intensities such that the human ear can detect and which produces a sensory response in the brain. There are certain effects produced by excessive sounds that appear to be universally undesirable for all people. These effects include the following:

- Interferes with speech;
- Stress reactions; and
- Fatigue.

The decibel, abbreviated dB, is the preferred unit for measuring sound. It relates sound pressure to a reference level in such a manner that a 10-dB increase is 10 times the sound pressure. Most measurements taken for hearing conservation purposes us the “A” weighting scale, which approximates the response of the human ear. Such measurements are referred to as dBA.

2.2 Noise

Noise is simply unwanted sound that interferes with the perception of wanted sound and can be annoying as well as having the same undesirable effects as excessive sound.

2.3 Exposure Limit

2.3.1 OSHA’S Permissible Noise Exposure. The Occupational Noise Exposure standard mandated by OSHA does not allow employees to work in an

environment where noise exposures equal or exceed an 8-hour time weighted average of 90 dBA or 87 dBA when working a 12-hour work shift.

2.3.2 OSHA'S Hearing Conservation Program. This program shall be implemented when employee noise exposures equal or exceeds an 8-hour Time Weighted Average (TWA) of 85 dBA or 82 dBA for a 12-hour work shift.

2.3.3 Recommended Exposure Limit (REL). The BEM Hearing Conservation Program follows OSHA'S Hearing Conservation Program and BEM recommends setting the permissible noise exposure at a TWA of 85 dBA for a 8-hour work shift or 82 dBA for a 12-hour work shift. The noise assessment shall be determined from measurements taken on the following parameters:

- 80 dBA Threshold;
- 90 dBA Criterion Level (8-hour);
- 87 dBA Criterion Level (12-hour);
- 5 dB Exchange Rate; and
- Integrating all sounds from 80 to 130 dB's.

2.3.4 Daily Noise Dose. The daily noise exposure can alternatively, and equivalently, be expressed as a dose (D) of 50% as measured according to the parameter in 2.3.3.

2.3.5 Ceiling Limit. Exposure too impulsive or impact noise shall not exceed 140 dB peak unweighted sound pressure level.

3.0 NOISE ASSESSMENT:

3.1 Assessments shall be conducted at _____ site to determine the noise exposure levels representative of all employees whose noise exposure may equal or exceed allowable OSHA TWA. If noise exposure at _____ site exceed the allowable TWA the OSHA Hearing Conservation Standard shall be posted in a readily accessible area. An assessment shall also be performed when employees have complaints with hearing loss, speech, and other sounds are muffled for several hours or ringing in the ears after leaving a work area. To identify noise sources, evaluate hearing protection, or when an employee shows awareness change in hearing threshold. However, for workers who move around frequently or who perform different tasks with intermittent or varying noise levels a dosimeter will be used to provide an assessment of the extent of exposures. Employees are permitted and encouraged to observe and participate in monitoring activities so long as neither data nor work assignments are compromised. This participation will help ensure valid results, as workers often have the experience to identify the prevailing noise sources, indicate periods when noise exposure may differ, and recognize whether given noise levels are typical or atypical. The following is a list of areas at _____ site that have potential to cause Noise Induced Hearing Loss:

_____

_____

_____

3.2 Instrumentation

THE SHSO SHALL PERFORM THE ASSESSMENTS AND CAN USE A VARIETY OF INSTRUMENTS TO CONDUCT THE SURVEY, BUT THE METHOD SHALL CONFORM TO THE AMERICAN NATIONAL STANDARD MEASUREMENT OF OCCUPATIONAL NOISE EXPOSURE, ANSI S12.19 – 1997. CALIBRATE ALL NOISE-MEASURING INSTRUMENTS ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS BEFORE AND AFTER EACH DAY OF USE AND WHENEVER THE TEMPERATURE OR RELATIVE HUMIDITY CHANGES SIGNIFICANTLY.

3.2.1 Sound Level Meter. The sound level meter is the basic measuring instrument for noise exposure. It consists of a microphone, a frequency selective amplifier, and an indicator. At a minimum, it measures sound level in dB Sound Pressure Level (SPL).
A Sound Level Meter may be used for several purposes, included but not limited to:

- Spot-checking noise dosimeter performance;
- Determining an employee's noise dose whenever a noise dosimeter is unavailable or inappropriate;
- Identifying and evaluating individual noise sources for abatement purposes;
- Aiding in the determination of the feasibility of engineering controls for individual noise source for abatement purposes;
- Develop a contour map of an area; and
- Evaluating the adequacy of hearing protection.

When taking measurements set the Sound Level Meter to take readings with the following parameters: Slow Response, "A" Weighting, and Upper Level.

3.2.2 Noise Dosimeter. The noise dosimeter is used when measuring the employee's noise exposure if the noise levels are varying or intermittent, when they contain impulsive components, or hen the employee moves around frequently during the work shift. The microphone must be placed in the hearing zone, normally on the collar of the employee's shirt of jacket. When using the Noise Dosimeter set to the following parameters:

- 5-dB Exchange Rate;
- Slow Response;
- Sound Measurement Range from at least 80 – 130 dB;
- Criterion Level of 90 dB for 8-hour work shift;
- Criterion Level of 87 dB for 12-hour work shift; and
- Threshold Level of 80 dB.

Record all data using the "Noise Exposure Assessment Form"

4.0 HEARING PROTECTION:

4.1 BEM employees at _____ site will be required to wear hearing protection when engaged in work that exposes them to noise that equals or

exceeds the allowable limit. This requirement does not imply that employees should not wear hearing protection unless they equal or exceed the allowable exposure limit. For example, it would be desirable for an employee at _____ site who is going in and out of a noise or habitually exposed to loud noise to wear hearing protection while in the noisy area even though the TWA was less than the REL.

4.2 Location of Hearing Protection

_____ site shall keep hearing protection readily available and accessible to all employees. Hearing Protection shall be found in _____.

5.0 HAZARD COMMUNICATION:

5.1 Caution Signs

A caution sign shall be clearly visible at the entrance or the boundary of areas at _____ site where noise exposures routinely exceed 82 or 85 decibels. All caution signs shall be in English and, where applicable, in the predominant language of workers who do not read English. The Caution sign shall textually or graphically contain the following information:

5.2 Notification to Workers

BEM employees at _____ site who are exposed above the REL shall be informed about the potential consequences of noise exposure and the methods of preventing noise induced hearing loss. Notification to employees will be within 21 days of the noise measurement and both the employee and Health and Safety Professional shall sign the Noise Exposure Assessment form.

6.0 TRAINING:

Employees who are working in identified noise areas shall attend an initial training session when they first enter the program and annually thereafter. Hearing Loss Prevention presentations should be updated at least annually or more frequently if there is a significant turnover in employees, equipment, or process change. In addition, training sessions may focus specifically on hearing loss prevention, but will also cover hearing health topics and be used in regularly scheduled general tailgate meetings at _____ site.

The content of the training program may be separated into two categories:

A. Management

- Effect of noise on hearing and productivity;
- Requirements for an effective Hearing Conservation Program;
- Compliance and regulations;
- Reduction of fears;
- •Estimated Heating Loss Prevention costs;
- Estimated compensation costs; and
- Expected and achieved benefits of the Hearing Conservation Program.

B. Employees

- Effects of noise and initial motivation to avoid them;
- Hearing protection;
- Audiometric Evaluations;
- BEM's Hearing Conservation Policy;
- Questions and Answers; and
- Final motivation.

SITE SPECIFIC LOCKOUT/TAGOUT PROGRAM

1.0 GENERAL:

1.1 It is the intent of BEM Systems, Inc. to ensure that all employees and contractors are aware of workplace hazards, precautions and actions required to maintain their safety and well being.

1.2 The purpose of the Lockout/Tagout Program is to ensure that BEM's operations at _____ site is in compliance with the OSHA Control of Hazardous Energy (lockout/tagout) Standard, 29 CFR 1910.147 and 29 CFR 1926.417.

1.3 Project number _____, dates of project _____, name of SHSO _____, name of PM _____, contact numbers for person to notify in case of emergency _____.

2.0 DEFINITIONS

2.1 CFR – Code of Federal Regulations

2.2 LOTO – Lockout / Tagout

2.3 OSHA – Occupational Safety and Health Administration

2.4 HASP – Health and Safety Plan

3.0 APPLICABILITY

3.1 The OSHA control of hazardous energy (lockout/tagout) Standard, 29 CFR 1910.147 requires that employers establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start-up or release of stored energy in order to prevent employee injury.

3.2 BEM employees are properly trained in the proper LOTO procedures. The site-specific HASP for _____ location addresses to contact _____ in case of a LOTO situation.

3.3 Responsibilities:

3.3.1. The Site Health and Safety Officer is the LOTO program coordinator, acting as the representative of the Project Manager, who has overall responsibility for the implementation of this program.

3.3.2. The Corporate Health and Safety Manager (CHSM) provide technical assistance to the Project Manager and Site Health and Safety Officer (SHSO). The CHSM is responsible for evaluating the implementation of the LOTO Program and notifying the Project Manager of deficiencies.

3.3.3. BEM _____ office will supply any necessary training required for LOTO procedures during work performed at _____.

Summary Of Lockout/Tagout Responsibilities

Positions	Responsibilities
Corporate Health and Safety Manager	• Provides assistance with LOTO Program • Evaluate overall implementation of the program
Project Manager	• Approves/disapproves exceptions of the LOTO policy • Maintains awareness of all aspects of the LOTO policy • Ensures that all employees under their supervision understand the requirements for compliance with this policy and are made aware of the LOTO procedure and are issued appropriate locks/tags
Site Health and Safety Officer	• Provides necessary employee training for LOTO procedures • Conducts periodic inspections of work sites to ensure compliance with LOTO procedures • Provides guidance regarding the applicability of the LOTO policy • Provides exceptions to the LOTO policy to the CHSM for consideration and review

4.0 GENERAL PROCEDURES

4.1 LOCKOUT/TAGOUT

4.1.1. IMPLEMENTATION OF LOTO SHALL BE PERFORMED ONLY BY AUTHORIZED AND TRAINED EMPLOYEES.

4.1.2. THE SHSO WILL PERFORM A SURVEY TO LOCATE AND IDENTIFY ALL ISOLATING DEVICES AND DETERMINE WHICH DEVICES APPLY TO THE EQUIPMENT TO BE LOCKED OUT.

4.1.3. THE LOCKOUT PROCEDURES SHALL INCLUDE THE FOLLOWING INFORMATION; NAME OF EQUIPMENT AND MANUFACTURER, TYPES AND MAGNITUDE OF ENERGY AND HAZARDS, NAMES/JOB TITLES OF EMPLOYEES AUTHORIZED TO PERFORM LOCKOUT, NAMES OF AFFECTED EMPLOYEES AND HOW TO NOTIFY EACH, TYPE AND LOCATION OF ENERGY ISOLATING MEANS, AND METHOD OF ISOLATION SELECTED.

4.1.4. BEFORE ANY EMPLOYEE PERFORMS ANY MAINTENANCE OR REPAIR OF A MACHINE OR EQUIPMENT WHERE UNEXPECTED START UP OR RELEASE OF STORED ENERGY COULD OCCUR AND CAUSE INJURY, THE MACHINE OR EQUIPMENT SHALL BE ISOLATED, AND RENDERED INOPERATIVE.

4.1.5. IF AN ENERGY-ISOLATING DEVICE IS CAPABLE OF BEING LOCKED OUT, THEN THIS POLICY REQUIRES THAT A LOCKOUT AND TAGOUT BE UTILIZED. IF AN ENERGY-ISOLATING DEVICE IS NOT CAPABLE OF BEING LOCKED OUT, THE POTENTIAL FOR CONTACT TO, OR THE ACTIVATION OF, THE ENERGIZED SOURCE BE THOROUGHLY EVALUATED. IF DEEMED THAT PERSONAL CONTACT OR EQUIPMENT CYCLING IS NOT LIKELY, THEN A TAGOUT MAY BE USED.

4.1.6. WHENEVER MAJOR REPLACEMENT, REPAIR, RENOVATION OR MODIFICATION OF MACHINES OR EQUIPMENT IS PERFORMED, AND

WHENEVER NEW MACHINES OR EQUIPMENT ARE INSTALLED, ENERGY ISOLATING DEVICES FOR SUCH MACHINES OR EQUIPMENT SHALL BE DESIGNED TO ACCEPT A LOCKOUT DEVICE.

4.1.7. EMERGENCY REMOVAL OF PADLOCKS SHALL BE ACCOMPLISHED BY CONTACTING THE COMPETENT PERSON, SHSO, OR PROJECT MANAGER TO DETERMINE THE STATUS OF THE LOCKOUT AND WHETHER OR NOT IT IS SAFE TO ENERGIZE THE SUBJECT EQUIPMENT.

4.1.8. RESTORING MACHINES OR EQUIPMENT TO NORMAL OPERATIONS SHALL INCLUDE CHECKING AROUND THE AFFECTED AREA TO ENSURE THAT NO INDIVIDUALS OR MATERIALS ARE PRESENT. ENSURE THAT ALL TOOLS HAVE BEEN REMOVED, GUARDS HAVE BEEN REPLACED, EMPLOYEES ARE CLEAR, AND LOCKOUT DEVICES HAVE BEEN REMOVED. RE-ENGAGE THE ENERGY ISOLATING DEVICE TO RESTORE ENERGY TO THE EQUIPMENT.

4.2 ENERGY CONTROL PROCEDURE

4.2.1. THE _____ OFFICE SHALL DEVELOP, DOCUMENT AND UTILIZE THESE PROCEDURES TO CONTROL POTENTIALLY HAZARDOUS ENERGY WHEN EMPLOYEES ARE ENGAGED IN THE ACTIVITIES COVERED BY THIS POLICY.

4.2.2 THE PROCEDURES SHALL CLEARLY AND SPECIFICALLY OUTLINE SCOPE, PURPOSE, AUTHORIZATION, RULES, AND TECHNIQUES TO BE UTILIZED FOR THE CONTROL OF HAZARDOUS ENERGY, AND THE MEANS TO ENFORCE COMPLIANCE INCLUDING:

A) A SPECIFIC STATEMENT OF THE INTENDED USE OF THE PROCEDURE,

B) SPECIFIC PROCEDURAL STEPS FOR SHUTTING DOWN, ISOLATING, BLOCKING, AND SECURING MACHINES OR EQUIPMENT TO CONTROL HAZARDOUS ENERGY,

C) SPECIFIC PROCEDURAL STEPS FOR THE PLACEMENT, REMOVAL, AND TRANSFER OF LOCKOUT DEVICES OR TAGOUT DEVICES AND THE RESPONSIBILITY FOR THEM, AND

D) SPECIFIC REQUIREMENTS FOR TESTING A MACHINE OR EQUIPMENT TO DETERMINE AND VERIFY THE EFFECTIVENESS OF THE LOCKOUT DEVICES, TAGOUT DEVICES, AND OTHER ENERGY CONTROL MEASURES.

4.3 PROTECTIVE MATERIALS AND HARDWARE

1. LOTO DEVICES SHALL BE PROVIDED BY _____ AND SHALL BE THE ONLY AUTHORIZED DEVICE USED FOR LOTO OF ENERGY DEVICES AND SHALL NOT BE USED FOR OTHER PURPOSES. EACH EMPLOYEE WILL BE ISSUED ONE KEY FOR EACH LOCK. IF THE

EMPLOYEE LOSES THE KEY TO THE ASSIGNED LOCK, THE LOCK WILL BE REMOVED FROM SERVICE AND ANOTHER KEY/LOCK SET ISSUED.

2. TAGOUT DEVICES, INCLUDING THEIR MEANS OF ATTACHMENT, SHALL BE SUBSTANTIAL ENOUGH TO PREVENT INADVERTENT OR ACCIDENTAL REMOVAL. ATTACHMENT MEANS SHALL BE A ONE-PIECE, NYLON CABLE TIE WHICH SHALL BE NON-REUSABLE, SELF LOCKING AND NON-RELEASABLE WITH A MINIMUM UNLOCKING STRENGTH OF NO LESS THAN 50 POUNDS.

4.4 PERIODIC INSPECTIONS

4.4.1. THE SHSO WILL CONDUCT A PERIODIC INSPECTION OF THE ENERGY CONTROL PROCEDURE TO ENSURE THAT THE PROCEDURES AND THE REQUIREMENTS OF THIS POLICY ARE BEING FOLLOWED.

4.4.2. WHERE LOCKOUT IS USED FOR ENERGY CONTROL, THE PERIODIC INSPECTION SHALL INCLUDE A REVIEW, BETWEEN THE INSPECTOR AND EACH AUTHORIZED EMPLOYEE, OF THAT EMPLOYEE'S RESPONSIBILITIES UNDER THE ENERGY CONTROL PROCEDURES BEING INSPECTED.

4.4.3. THE SHSO SHALL FORWARD A COPY OF THE PERIODIC INSPECTION VERIFICATION SUMMARY TO THE CHSM. THE CERTIFICATION SHALL IDENTIFY THE MACHINE OR EQUIPMENT ON WHICH THE ENERGY CONTROL PROCEDURE WAS BEING UTILIZED, THE DATE OF THE INSPECTION, THE EMPLOYEES INCLUDED IN THE INSPECTION AND THE PERSON PERFORMING THE INSPECTION.

4.4.4. COPIES OF THE INSPECTION REPORT SHALL BE SENT TO THE CHSM AND KEPT ON FILE AT _____ .

4.5 TRAINING AND COMMUNICATION

4.5.1. TRAINING SHALL BE PROVIDED BY PERSONS COMPETENT IN THE ASPECTS OF LOTO TO ENSURE THAT THE PURPOSE AND FUNCTION OF THE ENERGY CONTROL PROGRAM IS UNDERSTOOD BY EMPLOYEES AND THAT THE KNOWLEDGE AND SKILLS REQUIRED FOR THE SAFE APPLICATION, USAGE, AND REMOVAL OF ENERGY CONTROLS ARE PROVIDED. THE TRAINING WILL INCLUDE THE FOLLOWING:

A) BEM WILL TRAIN EACH AUTHORIZED EMPLOYEE IN THE RECOGNITION OF HAZARDOUS ENERGY SOURCES, THE TYPE AND MAGNITUDE OF THE ENERGY AVAILABLE IN THE WORKPLACE, METHODS AND MEANS NECESSARY FOR ENERGY ISOLATION AND CONTROL, AND THE DATE AND LOCATION OF THE TRAINING.

B) THE COMPETENT PERSON SHALL INSTRUCT EACH AFFECTED EMPLOYEE IN THE PURPOSE AND USE OF THE ENERGY CONTROL PROCEDURE.

C) THE COMPETENT PERSON SHALL INSTRUCT ALL OTHER EMPLOYEES WHOSE WORK OPERATIONS ARE OR MAY BE IN AN AREA WHERE ENERGY CONTROL PROCEDURES MAY BE UTILIZED, ABOUT THE PROCEDURE, AND ABOUT THE PROHIBITION RELATING TO ATTEMPTS TO RESTART OR REENERGIZE MACHINES OR EQUIPMENT WHICH ARE LOCKED OUT OR TAGGED OUT.

D) THE EMPLOYEE WILL SIGN THE LOG FORM DOCUMENTING THEIR ATTENDANCE AND DATE.

4.5.2. THE COMPETENT PERSON WILL TRAIN EMPLOYEES IN THE LIMITATIONS OF TAGS WHEN TAGS ARE USED IN LIEU OF LOCKOUT DEVICES.

4.5.3. RETRAINING WILL BE PROVIDED FOR ALL AUTHORIZED AND AFFECTED EMPLOYEES WHENEVER THERE IS A CHANGE IN THEIR JOB ASSIGNMENTS, A CHANGE IN MACHINERY, EQUIPMENT OR PROCESSES THAT PRESENT A NEW HAZARD, OR WHEN THERE IS A CHANGE IN THE ENERGY CONTROL PROCEDURES. ADDITIONAL RETRAINING SHALL ALSO BE CONDUCTED WHENEVER A PERIODIC INSPECTION REVEALS, OR WHENEVER THERE IS A REASON TO BELIEVE, THAT THERE ARE DEVIATIONS FROM OR INADEQUACIES IN THE EMPLOYEE'S KNOWLEDGE OR USE OF THE ENERGY CONTROL PROCEDURES.

4.5.4. THE CHSM OR HIS DESIGNEE WILL CERTIFY THAT EMPLOYEE TRAINING HAS BEEN ACCOMPLISHED AND IS BEING KEPT UP TO DATE. THE CERTIFICATION SHALL CONTAIN EACH EMPLOYEE'S NAME AND DATES OF TRAINING.

MACHINE SPECIFIC LOCKOUT/ TAGOUT PROCEDURE AND ENERGY CONTROL FORM

DATE: _____ COMPLETED BY: _____

MACHINES OR EQUIPMENT UTILIZING THIS PROCEDURE AND LOCATION:

_____

PROCEDURE FOR CONTROLLING HAZARDOUS ENERGY:

DETERMINE THE SOURCE OF HAZARDOUS ENERGY FOR THE MACHINE OR EQUIPMENT THAT WILL BE SERVICED.

_____ ELECTRICAL _____ ENGINE _____ SPRING
OTHER: _____

_____ COUNTER WEIGHT _____ FLYWHEEL _____ HYDRAULIC
_____

_____ PNEUMATIC _____ CHEMICAL _____ THERMAL

NOTIFY AFFECTED EMPLOYEES THAT A SPECIFIC MACHINE WILL BE SHUT DOWN AND LOCKED OUT.

1. SHUT DOWN MACHINE USING THE FOLLOWING PROCEDURES.
2. ISOLATE ALL ENERGY SOURCES LISTED ABOVE. INDICATE SPECIFIC, DETAILED PROCEDURES FOR EACH (USE ADDITIONAL PAGES AS NECESSARY):
3. APPLY LOCKS TO ALL ISOLATION DEVICES LISTED ABOVE.
4. HAVE AUTHORIZED EMPLOYEE(S) BEEN ISSUED LOCKS, TAGS, AND HASPS?
5. IF TAG IS USED IN LIEU OF A LOCK WHEN INCAPABLE OF BEING LOCKED OUT, INDICATE ADDITIONAL SAFETY PRECAUTIONS BELOW:
6. VERIFY THAT THE MACHINE IS LOCKED OUT BY TESTING THE OPERATING CONTROLS. RETURN ALL CONTROLS TO THE NEUTRAL OR OFF POSITION AFTER TESTING.
7. PROCEDURE FOR REMOVING LOCKS/TAGS
   - A. PHYSICALLY WALK AROUND THE EQUIPMENT, CHECK TO BE SURE THAT ALL SAFETY COVERS, GUARDS, AND PANELS HAVE BEEN REPLACED AND ALL EMPLOYEES ARE SAFELY POSITIONED.
   - B. ENSURE THAT ALL TOOLS, RAGS, AND WORK MATERIALS ARE REMOVED FROM THE IMMEDIATE VICINITY.
   - C. NOTIFY PM AND ALL OTHER AFFECTED EMPLOYEES, AS NECESSARY, THAT LOCKS/TAGS ARE GOING TO BE REMOVED AND THAT THE EQUIPMENT IS READY FOR OPERATION.
   - D. REMOVE ALL SAFETY PADLOCKS/DEVICES, BLOCKS, AND OTHER ENERGY RESTRAINTS.

E. RESTORE ALL ENERGY TO THE EQUIPMENT BY ACTIVATING THE 'ON' SWITCH.

F. OPERATE THE EQUIPMENT TO ENSURE PROPER OPERATION.

APPENDIX H

Excavation and Trenching Safety Inspection Log

Excavation Checklist

Project: _____ Weather: _____ Date: _____

Measurements of Trench: Depth: _____ Length: _____ Width: _____
Soil Type: ___ See attached "Soils Analysis Checklist"
Type of Protective System Used: _____

General Inspection of the Job site

Yes	No	N/A	
___	___	___	Excavations, adjacent areas, and Protective Systems inspected by the Competent Person daily, prior to the start of work.
___	___	___	Competent Person has the authority to remove workers from the excavation immediately.
___	___	___	Surface encumbrances supported or removed.
___	___	___	Employees protected from loose rock or soil that could possibly pose a hazard by falling or rolling into the excavation.
___	___	___	Hard hats worn by all employees.
___	___	___	Spoils, materials, and equipment set back a minimum of 2' from the edge of the excavation.
___	___	___	Barriers provided at all remote excavations, well, pits, shafts, etc.
			Walkways and bridges, over excavations 4' or more in depth, must be equipped with guardrails.
___	___	___	Warning vests, or other highly visible garments, provided and worn by all employees exposed to public vehicular traffic.
___	___	___	Employees required to stand away from vehicles being loaded or unloaded.
___	___	___	Employees prohibited from working or walking under suspended loads.
___	___	___	Employees prohibited from working on the faces of sloped or benched excavations above other employees.
___	___	___	Warning system established and utilized when mobile equipment is operating near the edge of an excavation.

Utilities

___ ___ ___ Utility companies contacted and/or utilities located.

___ ___ ___ Exact location of utilities marked when approaching the utilities.

___ ___ ___ Underground installations protected, supported, or removed when the excavation is open.

Means of Access and Egress

___ ___ ___ Lateral travel distance to a means of egress does not exceed 25', for excavations 4' or more in depth.

___ ___ ___ Ladders, when used, must extend 3' above the edge of the trench and be secured.

___ ___ ___ Structural ramps used by employees must be designed by a Competent Person.

___ ___ ___ Structural ramps used for equipment must be designed by a Registered Professional Engineer (RPE).

___ ___ ___ Ramps must be constructed of materials of uniform thickness, securely cleated together on the bottom, and have a non-slip surface.

___ ___ ___ Employees protected from cave-ins while entering, working in, or exiting excavation.

Wet Conditions

___ ___ ___ Precautions taken to protect employees from accumulation of water.

___ ___ ___ Water removal equipment monitored by a Competent Person.

___ ___ ___ Surface water controlled or diverted.
___ ___ ___ Inspection made after each rainstorm.

Hazardous Atmosphere

___ ___ ___ Atmosphere tested when there is a reasonable possibility of oxygen deficiency, or build up of other hazardous gases, that may expose an employee to a hazard.

___ ___ ___ Oxygen content is between 19.5% and 21%.

___ ___ ___ Ventilation provided to prevent flammable gas from building up to 20% of the lower explosive limit of the gas.

___ ___ ___ Testing conducted to ensure that atmosphere remains safe.

___ ___ ___ Emergency Response Equipment readily available where a hazardous atmosphere could or does exist.

___ ___ ___ Employees trained on the use of Personal Protective and Emergency Response Equipment.

___ ___ ___ Safety harness and lifeline must be individually attended when an employee entering a deep confined excavation or bell bottom pier.

Protective Support Systems

___ ___ ___ Materials and/or equipment selected on soil analysis, expected loads, and trench parameters.

___ ___ ___ Materials and equipment inspected and in good condition.

___ ___ ___ Materials and equipment not in good condition must be removed from service and not returned until repaired, inspected, and approved by a Registered Professional engineer.

___ ___ ___ Protective systems installed without exposing employees to hazards of cave-ins, collapses, or from being struck by materials of equipment.

___ ___ ___ Install from the top, down, and from the bottom up. Members of Protective Support System must be securely fastened.

___ ___ ___ Adjacent structures must be securely supported.

___ ___ ___ Excavations below the footing of base must be approved by a Registered Professional Engineer.

___ ___ ___ The backfill process must progress with the removal of the support system.

___ ___ ___ Material excavated to a level no greater than 2' from the bottom of the Protective Support System, and only if system is designed to support the calculated loads.

___ ___ ___ Shield system placed to prevent lateral movement.

___ ___ ___ Employee prohibited from remaining in a Trench Box

when being moved vertically.

_____ _____

Signature of Competent Person Date

Soils Analysis Checklist

This checklist must be completed when an analysis is performed to determine the soil(s) type present in the excavation. A separate analysis must be performed for each change in soil conditions, such as layers in the excavation wall, if the trench extends long distances, etc.

Project:_____ Weather:_____

Measurements of Trench: Depth:_____ Length:_____
Width:_____

Sample: Location Taken From:_____ Time:_____
Date:_____

Visual Test

Particle Type: Fine Grained (cohesive) ___ Course Grained (sand or gravel) ___

Water Conditions: Wet ___ Dry ___ Submerged ___ Surface Water Present ___

Previously Disturbed Soils? Yes___ No___

Underground Utilities Protected? Yes___ No___

Layered Soils? Yes___ No___

Layered Soil Dipping Into Excavation? Yes___ No___

Excavation Exposed to Vibration? Yes___ No___

Surface Encumbrances Present? Yes___ No___
If yes, what type? _____

Evidence of Cracking or Spalling Observed? Yes___ No___

Potentially Hazardous Atmosphere Exist? Yes___ No___
If yes, identify condition & source: _____
(If yes, follow the company Confined Space Procedures)

Manual Test

Plasticity: Cohesive ___ Non-cohesive ___

Dry Strength: Granular (crumbles easily) ___ Cohesive (broken w/difficulty) ___

Note: The following unconfined compressive strength tests should be performed on undisturbed soils.

Thumb Test: used to estimate unconfined compressive strength of a cohesive soil.

Test Performed Yes___ No___

___Type "A" Soil: indented by thumb with very great difficulty.

___Type "B" Soil: indented by thumb with some difficulty.

___Type "C" Soil: easily penetrated, or if soil is submerged, seeping, or subject to water, runoff, etc.

Pentrometer or Shearvane: used to estimate unconfined compressive strength of saturated soils.

Test Performed Yes___ No___

___Type "A" Soil: unconfined compressive strength of 1.5 tsf or greater.

___Type "B" Soil: unconfined compressive strength between 0.5 & 1.5 tsf.

___Type "C" Soil: unconfined compressive strength of 0.5 tsf or less or if soil is submerged, seeping or subject to water, runoff, etc.

Wet Shake Test: used to determine the percentage of granular and cohesive materials in a soil sample. Compare results to a soil textural classification chart.

___% granular ___% cohesive ___% silt

___Type "A" Soil: clay, silty clay, sandy clay, clay loam, and in some cases silty clay loan, and sandy clay loam.

___Type "B" Soil: angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and in some cases silty clay loam, and sandy clay loam.

___Type "C" Soil: granular soil including gravel sand and loamy sand.

Note: Type A Soil - no soil is a Type A if the soil is fissured, subject to vibration, previously disturbed, layered dipping into the excavation on a slope of 4H:1V.

Soil Classification System

___Type "A" Soil ___Type "B" Soil ___Type "C" Soil

For selection of the appropriate protective system, use the flow chart in Appendix F of the Standard.

___Sloping or Benching (Appendix B) Specify Angle _____

___Timber Shoring (Appendix C)

___Aluminum Hydraulic Shoring (Appendix D)

_____ _____

Signature of Competent Person Date

Daily Trenching Log

Project:_____ Weather:_____

Was One Call System Contacted (prior to initial excavation? Yes___ No___

Protective System(s): ___Trench Shield (Box) ___Wood Shoring ___Sloping ___other

Measurements of Trench: Depth_____ Length_____ Width_____

Purpose of Trench: Drainage___ Sewer___ Gas___ Water___ Other___: _____

Was a Visual Soil Test Made? Yes___ No___ If yes, what type? _____

Was a Manual Soil Test Made? Yes___ No___ If yes, what type? _____

Type of Soil? _____ Strength of Soil _____

Surface Encumbrances Present? Yes___ No___ If yes, what type? _____

Water Conditions: Wet___ Dry___ Submerged___ Surface Water ___

Potentially Hazardous Atmospheres Exist? Yes___ No___
(If yes, follow the company Confined Space Procedures)

Is Trenching or Excavation Exposed to Vehicular Traffic (exhaust)? Yes___ No___
(If yes, follow the company Confined Space Procedures)

Are Employees Exposed to Public Vehicular Traffic? Yes___ No___
(If yes, warning vests are required)

Are Other Utilities Protected? Yes___ No___
(Water, gas, sewer, or other structures)

Are Sewer or Natural Gas Lines Exposed? Yes___ No___
(If yes, follow the company Confined Space Procedures)

Are ladders within 25' of all workers? Yes___ No___

Do ladders extend 3' above the top edge of the excavation? Yes___ No___

Is excavated material stored a minimum of 2' from the edge of the excavation? Yes___ No___

Did Employees Receive Training in Trenching and Excavation? Yes___ No___

Date and Time of Last Periodic Inspection: _____

Comments and/or Notes:

_____	_____
Signature of Competent Person	Date

APPENDIX I

Site-Specific Accident Prevention Plan

SITE-SPECIFIC ACCIDENT PREVENTION PLAN
FOR
SCHENECTADY AIR NATIONAL GUARD BASE

New York

Prepared for:

HEADQUARTERS, AIR NATIONAL GUARD
3500 FETCHET AVENUE
ANDREWS AFB, MD 20762

Prepared by:

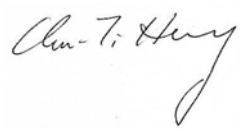
BEM SYSTEMS, INC.

100 Passaic Avenue
Chatham, NJ 07928

July 2012

SITE-SPECIFIC ACCIDENT PREVENTION PLAN
FOR

SCHENECTADY AIR NATIONAL GUARD BASE
New York



Reviewed by: _____ Date: 4/30/2011

Chun-Ti Huang, P.E.
Project Manager
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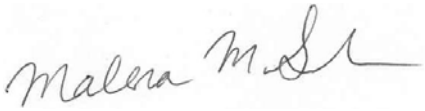

Reviewed and
Implemented by: _____ Date: 4/30/2011

Malena Gordon
Field Leader / Site Safety Officer
BEM Systems, Inc.
908-598-2600 x155

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Background Information

BEM Systems, Inc. (BEM) has prepared this Accident Prevention Plan for the SITE 3 – Drum Disposal Area and Site 6 – Suspected Spill Area activities to be conducted at the Schenectady ANGB, NY.

BEM maintains and enforces a proactive safety compliance program for its employees and subcontractors. BEM's corporate safety statistics including our EMR rates and OSHA recordable incident rates are summarized for the period of 2002 to 2011.

Year	Experience Modification Rate	OSHA Recordable Case Rate
2011	0.74	3.21
2010	0.915	0.00
2009	0.899	0.00
2008	1.133	0.00
2007	0.880	0.00
2006	0.840	2.07
2005	0.830	2.00
2004	0.810	0.00
2003	0.810	1.99
2002	0.835	0.99

The scope of work (SOW) for the Schenectady ANGB site has been identified as the following activities. Additional tasks added to the SOW will be incorporated into the accident prevention plan and an associated job hazard analysis conducted for each as necessary.

Scope of Work

The scope of work covered under this accident prevention plan includes activities related to the following and is further detailed below:

- To perform Interim Removal Actions (IRAs) at Sites 3 and 6 consisting of removal and off-site disposal of contaminated soil and buried waste;
- To develop a focused feasibility study (FFS) consisting of further groundwater contamination delineation, enhanced bioremediation pilot study, human health and ecological risk assessment, and remedial alternatives evaluation for any residual contamination at Sites 3 and 6.

Accident Prevention

The following procedures and guidelines will be used to protect the safety of personnel during the completion of the tasks identified in the SOW. BEM uses a proactive approach during the assessment and implementation of safety protocols and procedures. The project team will work together to identify the potential hazards associated with the individual work tasks and address the protective measures prior to initiation. These measures will include engineering, administrative, and PPE controls to the extent practical and feasible for the job tasks considered. Personnel will be properly trained and informed of the site conditions and task hazards through each phase of the project. Changes in tasks or identification of new hazard will be communicated to site personnel and controlled before personnel have the potential to be exposed to or impacted by the condition.

Statement of Safety and Health Policy

BEM maintains a comprehensive corporate safety and health program that is the foundation of our training, compliance, and client service activities. The corporate safety program is used by employees and supports the intention of the site specific health and safety plan (HASP). The corporate safety program and regulatory compliance programs are managed and enforced by BEM for all industrial, construction, and hazardous waste remediation and consulting projects.

The following statement from BEM's President and CEO confirms our commitment to employee safety, protection of the environment, and overall corporate responsibility.

It is the desire, obligation and commitment of BEM Systems, Inc. (BEM) to provide a safe working environment for all employees. This Corporate Health and Safety Program Manual has been developed in accordance with the requirements of the Occupational Health and Safety Administration (OSHA) pursuant to hazardous waste operations, construction activities, Hazard Communications regulations, USDOT regulations for environmental sample shipment, applicable industry standards, guidelines, and best practices. This manual was prepared to assist those employees participating in projects covered under the above regulations in fostering and maintaining safe work practices.

In order for the program to succeed, each employee shall implement safety and accident prevention measures and provide leadership in health and safety aspects. The authority, responsibility, and accountability for safety, as outlined in this Corporate Health and Safety Manual, shall be viewed in the same manner as our business standards regarding quality and productivity.

The BEM corporate health and safety program requires cooperation and mutual commitment between management and each employee. Management intends that the Corporate Health and Safety program will provide employees with the work place conditions, equipment, materials, and training needed to perform their job function in a safe and efficient manner.

The Health and Safety Manual shall be an integral part of BEM's day-to-day operations supported and adhered to by all levels of management and staff. Please become familiar with its contents since it will ensure that you meet your obligations and BEM achieves its commitment in matters of employee health and safety and responsible industry practices.

Responsibilities and Lines of Authorities

The responsibility for health and safety is distributed across all lines of personnel staffing.

The Corporate Health and Safety Manager (CHSM) is responsible for the review and approval of company safety protocols and procedures necessary for field operations and for the resolutions of any outstanding safety issues that arise during the site work. The CHSM will approve any changes to this plan due to modification of procedures, newly proposed site activities or site conditions.

The project manager (PM) is responsible for assuring that the HASP is prepared, reviewed, and approved prior to the start of field activities and for assigning qualified site safety and health officers (SSO) and project team members. The PM along with the CHSM is responsible for enforcing the requirements and provisions of the HASP with all field team members.

The SSO has overall responsibility for the development and implementation of this HASP. The SSO is also responsible for enforcement of the HASP in the field and providing the daily safety (toolbox) meeting. The SSO has the authority, after consulting with the CHSM to modify the requirements of the HASP based on field conditions. Before personnel may work on-site, a current medical examination and acceptable health and safety training must be submitted and approved by the SSO.

Visitors are required to report to the SSO prior to accessing the site or work zones. The SSO will document decisions regarding access to the site. If granted limited access, visitors must provide the SSO with documented compliance with the training and medical requirements of this HASP, comply with other applicable sections, and satisfy additional conditions placed on them as deemed appropriate by the SSO to ensure visitor safety. Visitors must sign in and out daily under the SSO's direction for the duration of their approved visit. Appropriately trained personnel shall escort all visitors throughout the site.

Multiemployer worksites involve personnel from various companies, likely with different corporate structures, operating procedures, and safety values and culture. It is in the best interest of BEM personnel to be aware of contractor and subcontractor work activities that have the potential of causing harm, injury or illness, or project disruption during site activities. If any unsafe behavior or action is observed, it is recommended that the employee inform the responsible party, employee supervisor, or site foreman/PM of the condition. If appropriate action is not taken to rectify the condition, BEM field personnel will suggest or implement corrective action for other company employees. If the condition persists, and the condition presents an unsafe work environment, BEM will cease operations until a corrective action has been implemented.

Site personnel are responsible for reading and following the contents of this HASP. Site personnel are also responsible for maintaining a safe work environment for themselves and those they work with and reporting any unsafe behavior, practices, and conditions to the SSO.

Subcontractors and Suppliers

Subcontractors to be used during the site tasks include drillers to advance soil borings or install monitoring wells and waste disposal contractors. Safety concerns will be addressed by the SSO with the site superintendent. These concerns will be immediately corrected or interim measures implemented that provide a comparable level of safety.

Safety supply and equipment vendors for PPE and field gear and local delivery service personnel (FedEx, UPS) will provide materials to the site in the support zone.

BEM's SSO will be onsite to track the site access of visitors, vendors, and suppliers. Site visitors will be required to sign in and sign out at the support zone access control point, as established based on site tasks and delineation. Daily tailgate safety meetings will be conducted by the SSO. The content of the safety meetings will relate to the job tasks scheduled for the day and those safety issues observed during prior day's tasks.

The safety responsibility of subcontractors ultimately relies upon the subcontractor to ensure the safety of their employees and personnel. BEM will inform the subcontractor of deviations from the HASP or activities that do not comply with applicable federal, state, local or military standards. Subcontractors are required to submit a separate HASP, training records, EMR, and OSHA logs for their company and project team.

Training

It is important for site personnel to be informed of the applicable project hazards and protective measures. The following items will be included, but not limited to, in the site orientation. The HSM or SSO will provide this information to site personnel and document the orientation for the project files.

- Acute and chronic health effects of contaminants of concern, hazard communication program
- Physical and mechanical hazards
- Personal hygiene and decontamination procedures
- Work zone location, delineation, and purpose
- PPE
- Evacuation plan and assembly area
- HASP review
- Air monitoring program
- Hazard recognition, reporting, and site safety

Personnel will be required to maintain the appropriate level of training according to their proposed site activities to comply with the applicable regulations, and provide an increased level of safety awareness during construction and remedial activities.

Personnel will be trained in HAZWOPER (refresher and supervisor level), respiratory protection, personal protective equipment, hazard communication, CPR/FA (for designated individuals), and confined space entry (as applicable). These training sessions will be provided to employees annually or as site conditions or tasks change based on the regulatory requirements.

BEM personnel are not members of an emergency response team and will coordinate with and utilize a trained, local emergency response team. These team members will be verified to have received and maintain the necessary training credentials and have experience in assessing and controlling the event, and removing materials.

Individuals selected to provide safety training to project personnel will provide their credentials to the PM and CHSM for review to ensure that they are qualified and competent in the subject matter. Personnel will be identified by the SSO/CHSM at least one month prior to being required to attend refresher or follow up training to ensure consistency, regulatory compliance, and a heightened level of safety awareness across the project staffing lines.

Safety meetings will be conducted periodically, after an accident to review the cause and corrective actions, before the initiation of new project tasks, and before new equipment or materials are planned to be used during construction or remedial activities.

Safety and Health Inspections

Detailed safety compliance audits will be performed by the CHSM or the SSO at the request of the safety manager or client representative. Announced and unannounced audits will be performed within the first phases of the project to assess compliance with the site HASP and applicable regulations. Deficiencies will be documented, employees and project management notified, and recommendations for corrective actions and an implementation schedule provided to protect the health and safety of workers, visitors, and client representatives.

The audits will be documented on internal audit forms. A summary report will be generated documenting the findings and discussed with the SSO and PM for correction and prevention. A general summary will be documented in the project field log of the audit being conducted and overall findings.

It is not likely that inspections by any external agencies will be required or necessary. They may be conducted at the request of the PM or the client.

Safety and Health Expectations, Incentive Programs and Compliance

BEM currently does not maintain or promote a safety incentives program. The firm believes that it is each employee's responsibility to conduct themselves in a manner that will not jeopardize the safety of their coworkers, subcontractors, client representatives, or themselves.

The safety goals for this and each of BEM's projects are zero accidents, incidents, or recordable cases. We provide PM's with the resources and support necessary to safely execute the SOW,

protect project personnel, and deliver a quality product to the client in a timely and cost efficient manner. Safety is incorporated into every phase of a project.

BEM prides itself on managing a proactive safety and health program. Employees receive annual training on topics that pertain directly to their work activities and the potential hazards that those activities may present.

Periodic safety compliance audits are performed by a member of the safety department to evaluate the project with regard to hazard recognition, protection, and correction. PM's and employees are educated on how to anticipate and prevent hazardous conditions, the measures necessary to protect personnel, and the most prudent actions to mitigate the hazard and prevent injury or illness. Project personnel observed performing unsafe behaviors are verbally informed of their actions and the consequences of those actions discussed with the employee and the PM/supervisor. The individuals are informed of the correct procedures at the time of the incident or near miss, and to the entire project team during the next tailgate or safety meeting.

The site specific HASP requires that PM's support the CHSM to ensure that personnel are informed of the contents of the safety plan, site safety procedures, potential hazards associated with project tasks, protective measures to be implemented during project tasks, and to inform the PM or the CHSM of any safety and health concerns, questions, or tasks to be investigated.

Accident Reporting

BEM maintains a corporate accident reporting and investigation procedure. This information is included in each HASP and communicated to project personnel. Qualified personnel are utilized to assist with the accident investigation to determine the cause and applicable corrective actions.

The supervisor's incident report form will be completed by the supervisor, with the employee's assistance, within 24 hours of the incident. Fatalities or hospitalization of three or more employees will require that the CHSM and OSHA be notified within 8 hours of the occurrence. The information documented on the incident report form will include the activities being performed at the time of the accident, injury sustained, length of employment, and other employee specific information. Near misses are to be reported to the PM and CHSM to use as a learning tool to prevent an accident from occurring from an unsafe act or condition.

Medical Support

BEM will maintain at least two CPR/FA trained project staff on site, during the project at all times according to the requirements of the ACoE EM 385-1-1 Safety and Health Requirements Manual, Section 3. These trained personnel will secure the incident area and assess the general condition of injured personnel. They will provide the necessary care that is within their level of training and skills, to initially address the injured personnel and stabilize their condition until experienced medical personnel arrive at the site.

BEM has verified the location of the local emergency medical support team as well as the onsite response team for medical emergencies, spills, fires, or other events that have the potential to impact personnel safety, create business interruptions, or damage client/contractor property. The following information is incorporated into the site specific HASP and will be posted in conspicuous locations at the project site.

Police:	911	or	(518) 384-2244
State Police:	911	or	(518) 457-6721
Fire:	911	or	(518) 374-7744

Hospital
Ellis Hospital
1101 Nott Street
SCHENECTADY, NY 12308 1-888-355-4746

Ambulance **EMT** 911

National or Regional Sources of Assistance:
AFCEE.....(210) 536-5284
CHSM.....(908) 598-2600
Poison Control Center.....(800) 282-3171
EPA (RCRA Superfund Hotline).....(800) 424-9346
National Response Center.....(800) 424-8802
USDOT .....(202) 426-0656

POLICE/FIRE.....911

Personal Protective Equipment (PPE)

PPE will be used during the project when engineering or administrative controls are not feasible or in the interim as they are being installed. The CHSM or a designated, competent person will be responsible for conducting the site specific hazard assessments pertaining to the SOW and site activities. BEM will complete and maintain written documentation for each hazard analysis conducted for the project. This information will be communicated to site personnel to assist them in safely completing their assigned tasks, preventing injuries, and direct and indirect impacts associated accidents and injuries.

The hazard assessment will be signed and certified by the individual performing the assessment. The CHSM will review the assessments for accuracy and applicability for the SOW to ensure the safety of project personnel and the use of appropriate PPE. Personnel will be initially trained, and annually thereafter, on the type, use, limitations, inspection, maintenance, replacement, and storage of PPE issued them.

Plans (Programs, Procedures) Required by the Safety Manual (as applicable)

BEM maintains both corporate and site specific health and safety programs to comply with OSHA regulations and ACoE requirements.

The following programs may be applicable to this project and have been/will be developed accordingly. They will be maintained on site and are available for review by project personnel and client representatives upon request. Additional compliance plans will be developed or existing plans modified based on changes in the SOW, site working conditions, equipment, or personnel responsibilities.

- Hazard Communication Program (04.B.01);
- Spill plans (01.E.01, 06.A.02);
- Firefighting plan (01.E.01);
- Posting of emergency telephone numbers (01.E.04);
- Respiratory protection plan;
- Health hazard control program (06.A.02);
- Confined space (06.I);
- Hazardous energy control plan (12.A.07);
- Critical lift procedures (16.C.17);
- Access and haul road plan (22.I.10);
- Site specific health and safety plan;
- Plan for prevention of alcohol and drug abuse (Defense Federal Acquisition Regulation Supplement Subpart 252);

EM 385-1-1 Compliance Plan

BEM will enforce the use of safe working procedures for project personnel and subcontractor staff throughout the course of the project. Detailed site-specific hazards and controls are provided in the activity hazard analysis for each phase of the operation.

Safety procedures and programs compliment BEM's corporate health and safety program and enable the PM, SSO, and CHSM to maintain the highest level of safety and reinforce our, and senior management's, commitment to a safe and healthy work environment. Some of these programs include, but are not limited to, safety work plans, activity specific inspection logs, hazard assessments, safe work authorization forms, air monitoring plans, and employee awareness training. These plans are covered in the site specific Health and Safety Plan and are also available by contacting BEM HQ in Chatham, NJ at 908-598-2600.

APPENDIX J

Community Air Monitoring Plan

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

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

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

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

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

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

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

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

Particulate Monitoring, Response Levels, and Actions

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

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

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

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

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Appendix E.
Permanganate Calculations for Site 6 ISCO

RemOx® S and L ISCO Reagents Estimation Spreadsheet

Input data into boxes with blue font.

	Estimates	Units		
Treatment Area Volume				
Length	220	ft		
Width	150	ft		
Area	33000	sq ft		
Thickness	2	ft		706.5
Total Volume	2444	cu yd	7333333 lb	26.58007
			3333333 kg	
Soil Characteristics/Analysis				
Porosity	30	%		
Total Plume Pore Volume	148114	gal		
Avg Contaminant Conc	1	ppm		
Mass of Contaminant	1.24	lb		
PNOD	2	g/kg	3333.333 kg	3000
Effective PNOD	25	%	333.3333 kg	
Effective PNOD Calculated	0.5			
PNOD Oxidant Demand	3630	lb	733.3333 lb	
Avg Stoichiometric Demand	2.5	lb/lb		
Contaminant Oxidant Demand	3.09	lb		
Theoretical Oxidant Demand	3633.09	lb		
Confidence Factor	1			
Calculated Oxidant Demand	3633.090175			
Injection Volumes for RemOx L				
RemOx L Injection Concentration	40.0%	%		
Calculated Specific Gravity	1.366492	g/ml		
Total Volume of Injection Fluid	715	gal		
Pore Volume Replaced	0.00	%		

Amount of RemOx L ISCO Reagent Estimated — **8,156 pounds**, **714 gallons**

RemOx® S and L ISCO Reagents Estimation Spreadsheet

Input data into boxes with blue font.

	Estimates	Units			
Treatment Area Volume					
Length	120	ft			
Width	15	ft			
Area	1800	sq ft			
Thickness	2	ft			706.5
Total Volume	133	cu yd	400000	lb	26.58007
			181818.2	kg	
Soil Characteristics/Analysis					
Porosity	25	%			
Total Plume Pore Volume	6732	gal			
Avg Contaminant Conc	1	ppm			
Mass of Contaminant	0.06	lb			
PNOD	3	g/kg	181.8182	kg	3000
Effective PNOD	25	%	18.18182	kg	
Effective PNOD Calculated	0.75				
PNOD Oxidant Demand	297	lb	40	lb	
Avg Stoichiometric Demand	2.5	lb/lb			
Contaminant Oxidant Demand	0.14	lb			
Theoretical Oxidant Demand	297.14	lb			
Confidence Factor	1.5				
Calculated Oxidant Demand	445.7106937				
Injection Volumes for RemOx L					
RemOx L Injection Concentration	40.0%	%			
Calculated Specific Gravity	1.366492	g/ml			
Total Volume of Injection Fluid	88	gal			
Pore Volume Replaced	0.01	%			

Amount of RemOx L ISCO Reagent Estimated — **1,001 pounds**, **88 gallons**

RemOx® L ISCO Reagent Dose Estimator Spreadsheet

Input data into boxes with blue font.

	Estimates	Units
INPUT SECTION:		
To determine the amount of RemOx L required to make a specific volume of a specific concentration of $NaMnO_4$		
Total Gallons of Solution:	**3580**	Gallons
Concentration of $NaMnO_4$ Solution Desired:	**10**	%
Specific Gravity:	**1.0916**	
Pounds of 100% $NaMnO_4$ Needed:	**3264.8**	Pounds
Pounds of 40% $NaMnO_4$ Needed:	**8161.9**	Pounds
Gallons of 40% $NaMnO_4$ Needed:	**714.1**	Gallons

RemOx® L ISCO Reagent Dose Estimator Spreadsheet

Input data into boxes with blue font.

	Estimates	Units
INPUT SECTION:		
To determine the amount of RemOx L required to make a specific volume of a specific concentration of $NaMnO_4$		
Total Gallons of Solution:	450	Gallons
Concentration of $NaMnO_4$ Solution Desired:	10	%
Specific Gravity:	1.0916	
Pounds of 100% $NaMnO_4$ Needed:	410.4	Pounds
Pounds of 40% $NaMnO_4$ Needed:	1025.9	Pounds
Gallons of 40% $NaMnO_4$ Needed:	89.8	Gallons