REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 West High Street, Springfield, Missouri
RCRA Permit Number MOD007129406

Submitted by:

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Certification Statement

This is to certify that this document has been prepared under the supervision of a Professional Geologist registered with the State of Missouri.

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LIST OF ACRONYMS

APTX	Auto-recording Pressure Transmitter
BTEX	Benzene, toluene, ethylbenzene, xylenes
BMW	Bedrock Monitoring Well
CAP	Corrective Action Program
City	City of Springfield
CMS	Corrective Measures Study
COCs	Chemicals of Concern
C-O-C	Chain- of- Custody
CSM	Conceptual Site Model
DNAPL	Dense, non-aqueous phase liquid
DOT	Department of Transportation
DQOs	Data Quality Objectives
DMP	Data Management Plan
EPA, U.S. EPA	United States Environmental Protection Agency
EWI	Environmental Works, Inc.
FM	Field Manager
ft bls	Feet below land surface
GWPS	Groundwater Protection Standard
HH&E	Human Health and the Environment
HWMU	Hazardous Waste Management Unit
IDW	Investigation Derived Waste
IM	Interface Meter
KMCC	Kerr-McGee Chemical Corporation
MDNR	Missouri Department of Natural Resources
MPP	Microsoft Project Plan
MW	Monitoring Well
MWCR, MWCC	Missouri Well Construction Rules / Code
NE, NW	Northeast, Northwest
OA	Ozark Aquifer
OCU	Ozark Confining Unit
OSWER	Office of Solid Waste and Emergency Response
O&M	Operations and Maintenance
PAH	Polycyclic Aromatic Hydrocarbons
PC	Pumping Center
PCC	Post Closure Care
PID	Photoionization Detector

PM	Project Manager
PMP	Project Management Plan
POC	Point of Compliance
PPE	Personal Protective Equipment
PS	Principal Scientist
PW	Piezometer Well
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource and Conservation Recovery Act
RFI	RCRA Facility Investigation
RG	Registered Geologist
RW	Recovery Well
SDS	Safety Data Sheet
SE, SW	Southeast, Southwest
SFZ	Secondary Flow Zone
SPA	Springfield Plateau Aquifer
RAO	Remedial Action Optimization
RAO WP	RAO Work Plan
SAP	Sampling and Analysis Plan
SMW	Shallow Monitoring Well
SOPs	Standard Operating Procedures
SPM	Senior Project Manager
SSHP	Site Safety and Health Plan
SV	Soil Vapor
SVOC	Semi-volatile Compound
TFZ	Tertiary Flow Zone
TOC	Top of Casing
UFW	Upper Flow Zone
UV	Ultraviolet
VI	Vapor Intrusion
VISL	Vapor Intrusion Screening Level
VOCs	Volatile Organic Compounds
VTM	Virtual Task Manager
YSI	Yellow Springs Instrument

1 INTRODUCTION

This Remedial Action Optimization Work Plan (RAO WP) for the former Tronox Facility (Facility) in Springfield, MO is being submitted by the Greenfield Environmental Multistate Trust LLC, not individually, but solely in its representative capacity as Trustee for the Multistate Environmental Response Trust (the Multistate Trust) in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA) Post Closure Care Permit #MOD007129406 (PCC Permit), issued by the Missouri Department of Natural Resources (MDNR). The Multistate Trust has implemented the corrective action program since assuming responsibility for the Springfield Facility on February 14, 2011, as a result of the Tronox LLC bankruptcy settlement approved by the U.S. Bankruptcy Court (New York).

Under the terms of the Multistate Environmental Response Trust Agreement (Settlement Agreement), the Multistate Trust's responsibilities include performing Environmental Actions approved by the Lead Agency (MDNR), and selling, transferring or facilitating the re-use of all or part of the assets. Therefore, the Multistate Trust's overarching objectives for the Facility are to:

- Perform Environmental Actions that are protective, sustainable, compliant with all applicable regulations, and will satisfy the requirements of the PCC Permit and RCRA. The Environmental Actions would result in a final decision from MDNR in the form of a "Corrective Action Complete" determination for the Facility.
- Transfer ownership and future stewardship of the Facility to a new owner(s), for a future beneficial use that is consistent with site conditions.

Monitoring and corrective action performance evaluations completed to date have determined that the existing monitoring well network no longer fully delineates the dissolved-phase plume, and the existing information is not sufficient to assess corrective action program performance. Therefore, the Multistate Trust is proposing supplemental investigations to update the understanding of site conditions, determine whether additional corrective measures are needed to protect human health and the environment (HH&E), and meet the requirements of the PCC Permit.

The purpose of the RAO WP is to clearly identify the objectives and scope of proposed investigation and optimization work, and the document has been structured to reflect the Corrective Action Framework (CAF). The CAF is used to clarify investigation goals and expectations as part of the LEAN approach MDNR is incorporating into their RCRA Corrective Action program.

The subsequent sections of the RAO WP present information organized as follows:

- Section 2: Facility Background. This section summarizes existing information relevant to the proposed work, such as the facility setting and surrounding land use, and presents a brief operating regulatory history. This section also outlines the Multistate Trust's proposed strategy for achieving a "Corrective Action Complete" determination and ultimately returning the site to a beneficial use. Existing reports and documents containing detailed background information which have been previously submitted to MDNR will be incorporated by reference as appropriate.
- Section 3: Current Conceptual Site Model. Section 3 integrates existing information on historic wood-treating operations and releases, site geology and hydrogeology, and the nature and extent of contamination, with information on potential migration pathways, exposure pathways, and receptors. This section will also identify areas where additional or updated data are needed to complete a comprehensive understanding of site conditions and potential risk.
- Section 4: Investigation Objectives and Approach. This section identifies the objectives of the investigation and the proposed approach to obtaining the information necessary to achieve the objectives. The proposed investigation actions and objectives are intended to supplement results of previous investigations as reviewed in available reports.
- Section 5: Sampling and Analytical Plan. Section 5 presents the sampling and analytical plan details, relying primarily on tables and figures to specify the location and types of samples to be collected, as well as the proposed analyses.
- Section 6: Schedule. The schedule for the RAO is outlined in graphical format, with goals and critical factors affecting the schedule identified.
- Section 7: References. Historical documents reviewed as part of the RAO WP preparation are provided here.
- Appendices: Updated Facility Plans
    - Data Management Plan
    - Health and Safety Plan
    - Waste Management Plan
    - QAPP
    - Project Management Plan

2 FACILITY BACKGROUND

This section provides a brief summary of the Facility technical and regulatory background relevant to this WP. Detailed descriptions of historic operations, as well as regulatory and environmental actions conducted at the Facility, have been provided in previous documents, including the RCRA Facility Investigation (July 1992), the Corrective Measures Study (July 1993), MDNR Site Reassessment Report (March 2006), and 2011 to 2015 Corrective Action Evaluation (CAE) Reports submitted by the Multistate Trust; a listing of these and other relevant documents is provided in Section 7.0.

2.1 Facility Setting and Surrounding Land Use

The Facility is located in Section 9, Township 29N, Range 22W at 2800 West High Street, city of Springfield (City), Greene County, Missouri. The entire Facility property has an area of 67.73 acres, with the eastern 32 acres associated with the former wood-treating operations. The Facility location, shown on a topographic base, is depicted on Figure 1.0.

The northwest portion of the City where the Facility is located is a mix of residential, commercial, light industrial, and government-owned properties. Immediately northwest, north, and northeast of the Facility are residential neighborhoods of single-family homes. The residential neighborhood to the northeast encompasses an area drainage feature designated the “Clifton Drainage”. The bordering property to the east is owned by Greene County Public Works Department and is used mainly for vehicle and materials storage. Residential areas lie further to the east and southeast. The BNSF Railroad operates a large railyard adjacent to the southwest, south, and southeast of the Facility with several active train tracks along the border. Residential property is further to the southwest.

2.2 Summary of Facility Operations, Investigation, and Remediation History

This section provides a summary of key Facility historical operations, as well as previous investigation findings and remedial actions relevant to the RAO.

2.2.1 Summary of Facility Operations and Regulatory History

Kerr-McGee Chemical Corporation (KMCC) operated a wood-treating facility from 1907 to 2004 by impregnating timber with creosote in pressure vessels. The location of former process and waste operations pertinent to the investigation are shown on Figure 2.0, and include:

- Pre-RCRA Original Cell (impoundment);

- Surface Impoundments 1, 2, and 3;
- Production Process and Retort Area;
- Wastewater Treatment Area;
- Drip Track; and
- Black-Tie Storage Area.

The pre-RCRA cell and surface impoundments occupied much of the eastern portion of the Facility. They were unlined and used as aeration and settling basins for process wastewater, which contained creosote. Freshly treated timber ties were placed in the drip track area for excess creosote to drip off them, and the "black tie" area is where final treated ties were moved from the drip track and stored.

A 1970 investigation by the U. S. Environmental Protection Agency (U.S. EPA, EPA) confirmed that creosote contamination in a spring northeast of the Facility was likely attributed to KMCC operations. In 1981, KMCC began regulated closure of the impoundments, and in 1988 KMCC signed an EPA Consent Order (No. 7-88-H-0019) requiring investigation and remedial activities to eliminate all groundwater impact originating from the facility. Following completion of a 1992 RCRA Facility Investigation (RFI) and completion of a 1993 Corrective Measures Study (CMS), KMCC implemented remedial actions. In September 2002, MDNR issued Missouri Hazardous Waste Management Facility Permit Part 1 (#MOD007129406) (MHWMF Permit, Permit) to regulate post-closure care (PCC).

2.2.2 Summary of Remedial Actions and Previous Investigations

In 1979, KMCC established a land farm on the western portion of the Facility for interim storage of sludge removed from the impoundments. In 1981, KMCC discontinued use of the tank farm, unloading pad, drip pad, and surface impoundments and closed these hazardous and solid waste management units (HWMUs, SWMUs). Closure involved removal of 12,124 tons of contaminated soil, post-excavation verification sampling, and the covering of these areas with low-permeability clay and/or concrete.

Prior to the RFI, a system of groundwater and DNAPL recovery wells were also installed along the north, east, and south Facility property borders, and at former impoundment and process areas to serve as interim measures to prevent off-site contaminant migration and to provide source abatement interior to the contaminant plume on-site. All total, between 1981 and 2005, 160 monitoring wells and seven recovery well networks were installed at the Facility; 73 monitoring wells remain active. Figures 3.0 and 4.0 depict on-site and off- site locations of the active and closed wells.

The July 1992 Final RFI Report stated the following conclusions:

- Historical operations resulted in the release of creosote-related contaminants (including tank bottoms designated RCRA K001 hazardous waste) from former impoundments and the production process areas. Releases involved creosote-related dense, non-aqueous phase liquid (DNAPL) and dissolved-phase plume (plume), which seeped into underlying sediments, and impacted groundwater on-site and in some off-site areas.
- Free product definitely related to the Facility had not been confirmed in off-site areas. Specifically, in the northeast off-site area, where one isolated occurrence of free product was observed, two other potential sources of this material exist. One was a former asphalt production plant, and the second was a petrochemical liquids transporter.
- The presence of creosote constituents in sediments in the Clifton Drainage, and in the Vich and Branch Springs (located further north in the Clifton Drainage), may relate, in part, to the Facility; but their presence could have contributions from the two other potential sources noted above.
- The potential for human contact with contaminated soil, sediment and groundwater was evaluated as limited.

The July 1993 CMS Report stated these conclusions regarding impact from the SWMUs and remedial corrective actions:

- The presence of DNAPL in the uppermost aquifer requires corrective measures for removal as the highest priority.
- SWMUs closed in 1988 were the major contributors of soil and groundwater contamination.
- SWMU closure eliminated the soil ingestion and surface water exposure pathways, and no further soil remedial action was recommended.
- No additional action was recommended for off-site impacted surface water sediment in the Clifton drainage area, with natural bioremediation of soils advocated.
- The air medium was not evaluated based on high vapor pressure of semi-volatile compounds (SVOCs) comprising creosote, their ready absorption to clay sol, and the majority of presence below 10 feet depth.
- Expansion of the recovery system required expansion with an off-site recovery well in the north Clifton Drainage (near SMW-65/RW- 21), and on-site at the eastern boundary near P-10/PW-11.
- Augment the recovery system with in-situ bioremediation when dissolved-phase and DNAPL concentrations decrease to allow feasible effectiveness.

2.2.3 Summary of Key Permit Monitoring and Remedial Action Status

The MHWMF Permit specifies and regulates PCC and corrective action requirements and goals for the Facility. Key regulated components of the Permit, and their reasons for applicability to the RAO are:

- **Groundwater Protection Standards (GWPS):** Allowable concentrations of chemicals of concern (COCs) in groundwater that are protective of human health and the environment. These COCs and their current GWPS are presented in Table 1.0, and are the delineating factors to be used for investigations in the RAO.
- **Point of Compliance (POC):** The POC surrounds the former SWMUs, and is where GWPS must be met to satisfy completion of corrective action. Corrective actions are therefore intended to meet this goal. The POC is defined by 13 monitoring wells as annotated on Figure 3.0. The GWPS has consistently been exceeded in eight of the POC wells.
- **Post-Closure Care Monitoring and Corrective Action Program (CAP) Provisions:**
    - The groundwater monitoring system must detect and delineate horizontal and vertical extent of contamination, including beyond the Facility boundary. If not delineated or defined, additional monitoring wells must be installed. Monitoring results demonstrate that plume extent is not delineated by the current monitoring well network.
    - New monitoring wells installed as part of the RAO will be monitored and sampled for the GWPS list on a quarterly basis for one year, and then will be sampled as part of the current semi-annual sampling schedule.
    - Monitoring must have ability to evaluate effectiveness of corrective actions to remove and/or contain contamination. Data from the monitoring network to date does not support full evaluation of the effectiveness of corrective measures.
    - Recovery wells are required to maintain control of contamination to prevent additional off-site plume migration, to recover free product, and further reduce levels of groundwater contamination. Monitoring results indicate that the current recovery system may not be fully controlling off-site plume migration or effectively removing creosote, and groundwater concentrations remain elevated at several wells.
    - Referenced federal regulations (40 CFR 264.101) require corrective actions as necessary to protect human health and the environment, including beyond the facility boundary. Potential risk to human health and the environment off-site has not been fully evaluated.

Special Permit Condition II.D.2 states that MDNR will determine when the horizontal and vertical extent of groundwater contamination has been adequately redefined. When this determination has been made, the wells defining such extent shall be incorporated into and designated for continued monitoring in the Facility Sampling and Analysis Plan (SAP). Within 30 days of written notification of MDNR's determination, the Multistate Trust will identify the defining monitoring wells providing that delineation and submit appropriate SAP revisions to the MDNR Hazardous Waste Program.

3 CURRENT CONCEPTUAL SITE MODEL

This section integrates existing information on hydrogeological features, contaminant source, nature, transport, and extent, and tentative receptor exposure pathways into a conceptual site model (CSM). This CSM describes what is currently understood about the Facility, and serves as the basis to identify areas where additional information is needed to maintain compliance with the PCC Permit, and evaluate current and potential future corrective measures. The purpose of the RAO is to provide the missing information to gain a better understanding of site conditions, and refine the CSM. Key site features are compiled into an isometric diagram shown on Figure 5.0, and Figure 6.0 provides a plan-view of DNAPL and dissolved-phase plume extent.

3.1 Conceptual Site Model Input Features

Key features for constructing the CSM are presented below.

<u>Hydrogeological Setting and Migration Pathways</u>

- Unconsolidated is silty clay with residual chert horizons.
- Bedrock is 10-15 ft deep, a dolomitic, cherty limestone, with zones of fractures and solution cavities (voids) possible within the upper 50 feet.
    - Primary groundwater migration pathways occur within these karst zones.
    - Regional joint/fracture trends are oriented northeast-southwest and northwest-southeast.
- The Clifton drainage is a downgradient surface drainage, and may have formed above a karst trough. It only bears water in wet seasons.
    - The karst trough is apparent at the northeast corner of the Facility.
    - Sinkholes and springs occur within the Clifton drainage.
    - The karst trough lines up with an on-site northeast-oriented “joint” feature (EPA, February 1977). This “joint” trends diagonally across the Facility.
    - Northern Clifton drainage turns 45° to the north just south of Kearney Street.
- Multiple bedrock water-bearing zones are separated by aquitard-like horizons.
    - Upper Flow Zone (UFZ) (upper Burlington Formation) has water levels 5 to 20 feet deep; groundwater flow 7 to 60 ft/year (1,000 ft/yr in karst conduits).
    - UFZ has a groundwater divide near the southern Facility border, with northeast flow north of the divide, and flow south on the south side of the divide.

- Secondary Flow Zone (SFZ) (middle to lower Burlington Formation) has water levels 45 to 50 ft deep; groundwater flow is northwest less than 0.1 ft/yr.
- Tertiary Flow Zone (TFZ)(Pierson Formation) has water levels 110 to 120 feet deep; groundwater flow southwest variable less than 1 ft/yr to 85 ft/yr.
- The UFZ, SFZ, and TFZ all occur in the upper regional Springfield Plateau Aquifer (SPA).

<u>Contaminant Source, Nature, Extent, and Transport</u>

- Source was wood-treating chemicals, primarily creosote and dissolved creosote components from impoundments, and creosote from leaks and drippage in process areas.
  - Petroleum-based carrier used for creosote, adding more volatile COCs.
- DNAPL occurs in unconsolidated and bedrock zones.
  - In UFZ, seven DNAPL areas on-site.
  - In UFZ, DNAPL at two downgradient, off-site limited areas (near Kearney Street in northern Clifton drainage, possibly encountered in residential sewer excavation in southern Clifton drainage).
  - In SFZ, DNAPL only at one central on-site location, but creosote noted in fractures between the UFZ and SFZ in central (BMW-5A) and southwest Facility (BMW-10R) drilling.
  - DNAPL migration pathways are bedding planes, vertical fractures, and karst voids.
  - DNAPL is ongoing source of groundwater impact, and possibly mobile.
- Dissolved phase plume in UFZ and SFZ
  - UFZ dissolved phase occurs mainly within fractures and voids, so plume concentrations will be heterogeneous within any given area.
  - Matrix diffusion of COCs will be a factor in concentration heterogeneity also, given that releases occurred over 25 years ago.
  - UFZ plume in UFZ extends beyond on-site DNAPL areas.
  - UFZ plume extends 1,700 feet off site to northeast along Clifton drainage. Plume trend changes direction in north drainage area.
  - UFZ plume may extend east off site.
  - UFZ plume extends south off site and may be migrating.
  - In SFZ, on-site plume is at three locations northeast (decreasing concentrations), central (DNAPL), and southwest (steady high concentrations). Locations lineup along northeast fracture trend.
  - No dissolved phase occurs in TFZ.

- COCs are benzene, toluene, ethylbenzene, xylene (BTEX), and polycyclic aromatic hydrocarbons (PAHs). Naphthalene, one of the primary constituents of creosote, has been the main indicator parameter to-date.
- Highest concentration areas of COCs encompass the SWMUs identified as the primary source areas, the former impoundment and process areas.
- Plume concentrations are not stable, decreasing in some wells but increasing in limited on-site perimeter wells and some off-site wells. This suggests the potential presence of an ongoing source or moving plume.

Monitoring and Remedial System

- UFZ monitoring wells in north Clifton drainage exhibit significant changes in potentiometric flow directions and elevation on either side of the abrupt change in direction of Clifton drainage.
- Recovery wells (RW) in the northeast, center, and east on-site pumping centers (PC) extend into the weathered bedrock zone, whereas RWs along the south Facility border appear completed primarily in the unconsolidated zone.
- Plume concentrations exceeding GWPS occur at edge of monitoring network
  - 10 off-site UFZ locations northeast and south exceed GWPS in 2015, including at the edge of monitoring network.
  - Increasing UFZ concentration trend at northeast on-site corner.
- Recovery of DNAPL has decreased, although some wells continue to have significant accumulations.
  - Increasing thickness trend at east border (12C) and northeast border (RW-2, RW-3).

Potential Receptors and Exposure Routes

- Domestic water consumption is an unlikely exposure route.
  - Municipal water supply in Springfield with no known residential wells near Facility.
  - Deep Ozark Aquifer (OA) is regional aquifer water source, and separated from SPA by Ozark Confining Unit (OCU) aquitard.
- Surface water dermal contact is unlikely.
  - No ponds, lakes, or steady surface water flows exist or are accessible
  - Downstream Woodlawn Spring recharge area is fenced off.
- On- and off-site construction worker exposure potential exists (creosote encountered in Clifton drainage residential sewer excavation); potential plume migration in utility corridors is unknown.
- Surface soil data was apparently not collected in all locations where Facility operations may have released creosote to the ground surface.

- Vapor intrusion potential has not been evaluated.
- Historical ecological surveys indicated no potential receptors.

3.2 Conceptual Site Model Features Integration

Aspects of key features of the Facility can be combined to explain the following known or suspected conclusions regarding contaminant occurrence, nature, fate and transport, and implications for remediation at the Facility:

- A northeast fracture-karst feature appears to trend diagonally across the Facility area, and likely formed a karst trough with the Clifton drainage as a surface expression. Additional fracture trends may exist at other orientations.
- The abrupt northerly change in direction of the Clifton drainage may indicate intersecting fracture trends that could alter direction and depth of subsurface migration pathways.
- Waste impoundments were built atop an apparent northeast fracture trend, and the increased permeability into bedrock contributed to downward movement of DNAPL and impacted groundwater into the upper karst bedrock.
- DNAPL moved by gravity downward and outward from multiple source areas along fractures, bedding planes, and karst features where pore entry pressures could be overcome by head pressure of the DNAPL mass.
- Impact within the UFZ weathered/karst bedrock UFZ zone occurs at progressively deeper horizons moving downgradient northeast from the Facility:
    - Facility northeast corner: creosote in karst at elevation 1265-1270.
    - Northeast residential area: creosote in karst at elevation 1256 (SMW-63).
    - North Clifton Drainage south Kearney St: creosote in karst at elevation 1220 (SMW-72).
    - North Clifton Drainage, north Kearney St: creosote in WL-MW-3 with screen elevation 1210-1220.
    - Woodlawn/Vish Springs water levels are elevation 1206-1207; this is likely hydraulic base elevation for Clifton Drainage karst system, with groundwater flow tending toward this elevation.
- The relative abundance of UFZ migration pathways resulted in DNAPL and dissolved phase plume distribution confined mainly within the UFZ; however, fractures extending to the SFZ are possible and may have provided a pathway for local, limited vertical movement of DNAPL and impacted groundwater into the SFZ, since a downward hydraulic gradient exists.
    - Creosote in fractures to 80 ft (BMW-5A) and 94 ft (BMW-10R).
    - Hydraulic connection at 138 ft deep between BMW-5 and BMW-5A.

- Over 70 years of source material seepage into a karst hydrogeological network resulted in significant downgradient movement of the dissolved-phase plume. With a groundwater divide, the plume has moved outward from source areas in two directions.
- Although source areas were remediated and closed, continued high, and some increasing, plume concentrations on-site and continued DNAPL thicknesses in wells indicates an ongoing DNAPL source could be present.
- The UFZ plume extends beyond the on-site and off-site outward limits of the monitoring network to the northeast, north, east, south, and southwest.
- UFZ plume concentrations on-site in the northeast, and off-site to the south, are increasing despite active pumping centers at those locations. Plume concentrations exceed the GWPS at the majority of the POC wells and at some off-site wells. DNAPL recovery has decreased despite continued accumulation in recovery wells. In general, the current corrective measures are not meeting the requirements of the PCC Permit.
- Potential exposure risk appears limited to construction workers for excavation in certain areas, but is not known for indoor vapor inhalation.

3.3 Conceptual Site Model Questions and Information Needs

In summary, the current CSM is not able to fully explain observations and conclusions from recent semi-annual monitoring events. Further, as noted in the annual Corrective Action Effectiveness reports, these data and observations do not demonstrate attainment of the PCC Permit requirements and goals. This RAO is designed to address the uncertainties associated with the current CSM, and develop information needed to assess potential modifications to the corrective action program and so the overall corrective action objectives for the Facility will be met.

The information and data to be developed by this RAO are detailed in Table 2.0 below:

Table 2.0 Key Information and Data Needs
Hydrogeological Setting
• The existence, vertical and horizontal extent, and influence of northeast fracture/karst zone(s) through the Facility is indicated but has not been characterized • Depth and potential of this fracture trend as a vertical migration pathway for contaminants to the SFZ has not been characterized • The extension of this fracture trend to the southwest has not been adequately investigated, and could be an unknown migration pathway • The lateral and vertical extent of other fracture and karst migration features on-site and off-site have not been adequately characterized • The connectivity of karst channels off-site throughout Clifton drainage has not been characterized

• Potential intersecting fracture trends in the northern Clifton drainage area, relationship of flow with drainage elevations, and related effects on migration pathway direction and depth require characterization to support delineation
Contamination Source, Nature, Extent, and Transport
• The presence and distribution of remaining DNAPL at source zones has not been delineated. • The size and characteristics of remaining on-site DNAPL mass is unknown, so that potential DNAPL mobility cannot be ascertained • The extent of DNAPL and dissolved phase plume in the UFZ has not been delineated in off-site areas to the north, east and south of the Facility • DNAPL extent near Kearney Street (RW-21, WL MW-3) has not been delineated, and it's connection with Facility creosote is complicated with other potential nearby sources • Presence of SFZ DNAPL in the central Facility (BMW-5) has not been evaluated for vertical migration pathways or delineated for extent • Elevated SFZ plume concentrations in the southwest Facility area needs investigation of vertical migration route and delineation.
Monitoring and Remediation System
• Significant UFZ water level changes in the northern Clifton drainage could be caused by different monitoring intervals in wells. Well monitoring intervals and their use for potentiometric evaluation should be checked • Additional UFZ monitoring wells are required for off-site plume delineation northeast in the Clifton drainage, off-site east on Greene County property, and off-site south on BNSF and southwest on residential property • Central Facility DNAPL in the SFZ and high plume concentrations in the southwest Facility require delineation and evaluation of vertical pathway • Hydraulic control at the northeast Facility (PC-1) is questionable; additional hydraulic testing may be needed for data to evaluate effectiveness • Hydraulic control at the east Facility border is unknown; additional off-site monitoring points are needed • Apparent off-site plume migration at the south Facility boundary indicates hydraulic control is insufficient; evaluation of RW construction and placement, and additional monitoring data is needed • Capability of the recovery system capacity to handle increased effluent should be evaluated since additional pumping may be needed for hydraulic control • DNAPL recovery effectiveness appears questionable; data on DNAPL recoverability is needed for evaluation
Potential Receptor Exposure
• Vapor intrusion potential exposure pathway has not been fully evaluated • Delineation of dissolved-phase plumes will is needed to assess potential construction worker exposure in excavations

4 INVESTIGATION OBJECTIVES, APPROACH, AND PHASE I ACTIVITIES

This section presents specific objectives and the intended technical approach to supply the information and data issues identified from the integrated CSM, monitoring, and PCC Permit requirement analysis. Results of previous investigations were taken into account in the development of planned actions. The first phase activities of the RAO are also described.

4.1 Overview of RAO Technical Approach

RAO work will be performed in a phased in investigation approach to meet specific RAO objectives, with work in subsequent actions modified as appropriate based on results of the previous phase of work. Collected data will be managed according to the data management plan attached to this WP.

The first phase (Phase I) of the RAO will involve a preliminary evaluation of pumping network performance, evaluation of historical data, and collection and evaluation of new data and information through less intrusive activities. The intention is to perform Phase I actions during review and finalization of the RAO WP. Phase I results will then be used to further refine the need and application of intrusive field activities to be employed in Phase II.

The Phase I pumping network evaluation will entail field testing of hydraulic control at the northeast pumping center (PC-1), and an initial capacity calculation of all seven Facility pumping centers. The condition of existing mechanical corrective measures recovery and treatment system components, and evaluation of changes in those components and their operation, will be conducted separately from this work plan's initial evaluation pumping network performance capability. The Multistate Trust will propose an expanded evaluation of existing pumping well components, effluent piping, and treatment systems to understand their effectiveness with respect to the updated CSM and HH&E risk results and review this information with MoDNR prior to starting work.

4.2 Data Quality Objectives

Table 2.0 provides information needed to answer questions or clarify issues related to the CSM. Table 3.0 provides specific objectives to address the items in Table 2.0, with a detailed investigation approach plan, as well as decision factors or criteria that will guide decision-making in the field or during follow-up actions.

The sections of Table 3.0 list specific issue statements with objectives for the following categories, organized as lettered sections in the table. These sections reflect the approximate sequence of planned RAO activities, although there will be some overlap. In the "Investigation Approach" column, the planned Phase I actions are presented in blue text.

Under each section listed below, the issue statements and investigation approaches for each statement are listed in approximate sequential order as well:

- Update Monitoring Well Elevation Data to Ensure Accurate Hydrogeological Information
- Update Characterization of Upper Flow Zone DNAPL-Groundwater Flow and Migration Pathways
- Update Delineation of Upper Flow Zone DNAPL and Dissolved-Phase Plume
- Identify and Characterize Potential Off-Site Exposure Pathways to DNAPL and Dissolved-Phase Plumes
- Update Understanding of Potential for Contaminant Vertical Migration Pathway from UFZ and SFZ
- Update Delineation of Secondary Flow Zone Dissolved-Phase Plume
- Update Identification and Characterization of On-Site Source Material
- Preliminary PC-1 Hydraulic Control and Pumping Centers Evaluation

Overall, planned progressive RAO phased technical activities include: review and potentiometric evaluation of historical hydraulic and DNAPL data to discern horizontal and vertical migration pathways; map and photograph area fracture analyses; geophysical resistivity surveys; progressively stepped out installation of groundwater monitoring wells in the UFZ and SFZ; and the collection of soil, groundwater, and vapor samples for laboratory analysis.

4.3 Phase I Activities

The following field and evaluation activities are planned for the first phase of the RAO, and address the objectives for sections A and B, and the first items for C, D, and E in Table 3.0 with the investigation approaches highlighted in blue font on the table. Consistent with the results of a conference call between the Multistate Trust and MDNR on March 29, 2016, the Phase I activities will be conducted concurrent with DNR's review of the draft RAO Work Plan. Results of these Phase I activities will establish a reliable baseline for performing follow-on Phase II activities.

4.3.1 Survey Monitoring Well Network

Monitoring wells were variably installed 15 to over 30 years ago. To ensure correct reference elevations for hydrologic monitoring, the well network will be resurveyed for elevations of land surface and top-of-casing (TOC).

4.3.2 Evaluate Historical Data for DNAPL Horizons, Horizontal/Vertical Delineation, and Migration Pathways

All historical boring logs will be reviewed noting observations of DNAPL occurrence, depth to bedrock, stratigraphic positions of solution cavities, fractures, etc. to establish a hydrogeologic-contamination distribution and migration framework baseline. Preliminary review of boring logs indicates the depths and extent of these features, as well as DNAPL occurrence, are variable for different on-site and off-site areas. DNAPL recovery records will also be reviewed to identify trends and their changes for different Facility areas. This framework will define the horizontal patterns and vertical horizons to guide new well installation locations and interpretation of observations.

4.3.3 Screen Utility Corridors for Contaminant Migration

Subsurface utility corridors within the adjacent residential area northeast of the Facility will be investigated as possible contaminant migration routes. Sewer manholes, electrical and water access vaults, and other utility access points will be screened for the off-site presence of Facility contaminants by visual observation, odors, and measurements with a photoionization detector (PID). The preliminary screening will be performed for readily accessible access points in City rights-of-way (ROWs). If results indicate the possible presence of Facility contaminants, and a sample can be collected of creosote or impacted water, a sample will be collected and analyzed for COCs listed in Table 1.0.). The off-site screening will be conducted using a “step-out” approach, starting first at locations closest to the Facility boundary and moving out, away from the Facility only if needed based on the results of the initial screening/sampling. If impact from the Facility is indicated by these activities, the Multistate Trust will develop additional Phase II investigation approaches to further characterize utilities as possible migration pathways and evaluate risk. Results could also have input to guiding Phase II soil vapor evaluations (see work plan section 5.4.3).

4.3.4 Evaluate Hydrogeologic Categories of Monitoring Wells

The monitoring horizons of the 73 active UFZ monitoring wells will be reviewed and compared to the target stratigraphic horizons of contaminant occurrence in their respective areas, in order to ensure appropriate monitoring application within the hydrogeologic framework. Results of this evaluation will be one factor in the placement of new monitoring wells and configuration of their screened intervals.

4.3.5 Area Fracture Trace – Migration Pathway Evaluation

Fracture trends likely control groundwater and contaminant migration via the secondary porosity features they generate, so discerning potential fracture trends is key to siting effective monitoring wells. The following evaluations will be used to identify potential fracture trends.

4.3.5.1 Air Photo – Topographical-Potentiometric-Karst Features Evaluation

Previous studies in southwest Missouri demonstrate that preferential joint patterns are northeast-southwest and northwest-southeast, and also reflect common trends of regional lineaments that can indicate fracture trends. Preliminary documents review indicates that lineaments are present in the Facility area (e.g., the major northeast-southwest lineament associated with the Clifton Drainage feature, and the northeast "joint" feature). Historical aerial photographs, pre-development if possible, will be viewed in stereo pairs (if available) to identify additional linear features/potential fracture traces. These will be plotted on Facility area maps. Standard 7.5-minute USGS topographical maps will also be analyzed for natural lineaments that could indicate potential fracture zones. Geological features in the Missouri Geological Survey's GeoStrat databases (http://dnr.mo.gov/geostrat/) will also be reviewed.

Depth to top of bedrock data from available well logs will be used to prepare a bedrock elevation map, which will be evaluated for linear trends of bedrock lows, thickened weathered zones, and deeper secondary porosity features that could indicate fracture influence. The known northeast and northwest regional trend tendency will be used to bias the air photograph, topographical, and bedrock trend analysis. Identified linear features will be projected into areas of interest on and surrounding the Facility. Identified trends will provide at least one delineating dimension for siting monitoring wells. Ideal locations for wells are where two linear trends intersect.

Surface drainage elevations and depths of impact occurrence in the north Clifton drainage area will be compared to elevations of impact in the northeast Facility area to evaluate flow gradients for contaminant migration between these two areas.

4.3.5.2 Geophysical Resistivity Survey

In less-developed portions of the northeast Clifton Drainage area, geophysical resistivity surveys are proposed to supplement the area fracture evaluation to help discern the possible multiple intersecting fracture trends for more effective well placements. The primary area of interest for the surveys is south of Kearney Street where wells contain DNAPL or high concentrations of COCs (RW-21, SMW-72, WL_MW-3); this area is depicted on Figure 4.0.

Figure 7.0 depicts two potential resistivity survey transects, each approximately 1,000 feet long. These are tentatively planned in physically accessible areas and oriented to detect fracture zones trending northeast, north, or northwest. Specific positioning and orientation of the resistivity transects will depend on results of the fracture evaluation, as well as property access permission and developed cultural features (e.g. electrical lines and sewer utilities). City Public Works has provided a map showing sewer lines, and the geophysical contractor has confirmed the surveys can be conducted given existing cultural features. The Multistate

Trust will provide MDNR with a map depicting proposed transects once they are finalized following the fracture evaluation. This geophysical work will be performed and interpreted by Missouri State University personnel who have successfully completed resistivity surveys at other area projects. These surveys have successfully identified depressions in top of bedrock and subsurface zones of higher conductivity, which, respectively, can indicate fracture or karst features and zones of potential water flow. These results can confirm linear features from the fracture analysis and/or provide very specific target locations for well installations.

The electrical resistivity survey will be conducted using a GF Instruments ARES automated imaging system (http://www.gfinstruments.cz/index.php?menu=gi&cont=ares_ov) with 64 electrodes. A Schlumberger array will be used, with the electrodes spaced two meters apart, or as necessary to achieve a minimum effective penetration depth of approximately 50 feet. Electrode locations in latitude and longitude will be recorded using a Trimble XT GWPS Unit. Downloaded data will be processed using Earth-Imager software. Each modeled resistivity profile will be interpreted to determine the depth to bedrock and presence of karst features and fractures. All survey data will be presented on a CD in ASCII or native file format.

4.3.6 Review Existing Analytical Data for Preliminary Risk Evaluation

Existing groundwater analytical data from northeast and east Facility wells will be evaluated for potential vapor intrusion risk using the U.S. EPA's vapor intrusion screening levels (VISL) tool. Data will be input using THQ=1 for initial screening per procedures given in the *Office of Solid Waste and Emergency Response (OSWER) Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (OSWER Publication 93200.2-154, June 2015). This will provide an initial evaluation of potential risk using on-site data at the property border. The evaluation will be updated with data from new monitoring wells to be installed in Phase II (see WP section 5.2). Results of the VISL screening will guide the necessity and placement of soil vapor wells (see WP section 5.4.3).

To evaluate potential exposure risk from surface activities at former on-site SWMUs, available reports will be researched for soil analytical data in the following areas (see Figure 2.0):

- Experimental Land Farm area (northeast Facility)
- Former Black Tie storage area (southeast Facility)
- Drip Track production area

Historical soil sample data for these areas will be evaluated against screening criteria for dermal exposure found in the November 2015 U.S. EPA Regional Screening Levels document (http://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2015). New soil data will be collected for an updated evaluation as a Phase II activity from areas where potential exposure risk is indicated from this preliminary evaluation. In addition,

Phase II soil sampling will be done for areas where no historical data is available (see WP section 5.4.3).

4.3.7 Initial Evaluation of Facility Pumping Network

This section provides plans for an initial evaluation of Facility pumping centers to address section H of Table 3.0. The Multistate Trust plans a more extensive evaluation of the mechanical components of the recovery well network and treatment system as a parallel activity during RAO work. Results from the initial evaluation described herein will be used to help focus testing and evaluation during that more comprehensive evaluation. The preliminary evaluation involves two aspects of the recovery system: (1) hydraulic control and zone of influence at northeast Facility Pumping Center 1, and (2) determining the current capacity of each of the seven pumping centers.

4.3.7.1 Hydraulic Control at Pumping Center 1

Pumping Center 1 in the northeast Facility a key pumping center for hydraulic control because it is the most hydraulically downgradient on-site location, it is located within the Clifton drainage karst trough area, and it is immediately upgradient of an off-site residential area. A groundwater seep between RW-6 and SMW-14 (see Figures 3.0 and 8.0) has been observed during periods of high recharge from significant (2-inch) rain events, suggesting that hydraulic control to maintain inward gradient may not be consistently maintained. As a preliminary step to evaluate hydraulic influence, as measured by the factors shown in Table 15.0, the following actions are proposed:

- A 2” piezometer will be installed in the unconsolidated zone at the location of the groundwater seep. The piezometer will be installed with total depth at refusal, with top of screen at 4 ft bls, and an above ground completion. Well filter pack and grout seal well construction will be in accordance with MWCR.
- Auto-recording pressure transmitters (APTX) will be installed in the piezometer, downgradient monitoring well SMW-14, and RW-6 (the closest recovery well), and programmed for 30-minute data recording interval. Water levels will also be manually gauged and recorded for these wells and adjacent SMW-15 by the on-site operator daily during normal work days as a back-up measure.
- APTX monitoring will continue until at least two rain events exceeding 1.5” of precipitation have occurred. Data will be downloaded every two weeks, and within two days after rain events, and processed to yield water elevations. Processed data will be verified against manual water levels.

Changes in head values, their inter-relationships, and variation in related hydraulic gradients during dry and wet recharge conditions will be evaluated for degree of hydraulic control using comparisons and evaluations in Table 15.0.

- Head differences RW-6 → Piezometer → SMW-14
- Hydraulic gradients RW-6 / Piezometer, RW-6 / SMW-14, Piezometer / SMW-14

Hydraulic control will be evaluated per the following matrix:

Table 4.0 Evaluation of Hydraulic Control at PC-1		
Objective: Determine strength, consistency, and potential need for increased hydraulic control in central area of Pumping Center 1		
Parameter	**Comparison Between These Points**	**Indicators for Degree of Hydraulic Control**
Head Elevations	RW-6 Piezometer SMW-14	• Strong control indicated by RW-6 head lower than both Piezometer and SMW-14 heads during dry and wet conditions more than 75% of time • Some control indicated by: o RW-6 head lower than both Piezometer and SMW-14 during dry and wet conditions more than 75% of time o RW-6 head lower than Piezometer head, but SMW-14 head same or lower than RW-6 • Weak or lack of control indicated by: o All three heads stay about same with minor variation o RW-6 head above Piezometer and SMW-14 heads more than 75% of time during dry and wet seasons
Horizontal Hydraulic Gradients	RW-6 and Piezometer RW-6 and SMW-14 Piezometer and SMW-14	• Strong control indicated by: o Gradients all toward the south more than 75% of time o Steeper gradients indicate stronger control • Some control indicated by: o Gradients toward RW-6 at least 50% of time or only during dry conditions o SMW-14 gradient toward RW-6 but Piezometer gradient away from RW-6 • Weak or lack of control indicated by: o All gradients flat with minor variation o Gradients all toward the north more than 50% of time

Temporal consistency of hydraulic control parameters will be evaluated by graphing hydrographs of the three wells and evaluating vertical head relationships over time.

Measurements from SMW-15 will provide a sense of lateral extent of control with respect to RW-6, which is located in the center of the karst trough.

An initial test to evaluate pumping capability to increase hydraulic control at PC-1 will be performed by using a variable speed electric pump to perform a short-term pumping test. A pump capable of yielding 10 to 50 gallons per minute (GPM) will be temporarily set in RW-6, and operated over several hours while recording water levels using the APTX in the same wells (RW-6, piezometer, and SMW-14). Effluent water will be placed in poly tanks and transported for input into the on-site treatment system. Resulting data will be evaluated using the same parameters stated in Table 15.0.

4.3.7.2 Calculation of Pumping Center Networks Capacity

To provide additional network-wide information for the comprehensive recovery well evaluation, the rate and volume capacity of each of the seven PC networks will be calculated based on current network pumping operation, piping infrastructure, and effluent treatment system.

These calculations will not involve field measurements or testing, rather, input data for each PC network will be collated from available reports, design documents, maps, and observations from field set-ups. These inputs include:

- Pump depths and associated piping sizes and routing at each wellhead;
- Effluent line size, lengths, and routing from each PC to the treatment building;
- Inflow line routing, manifold attachments, and piping into treatment tanks; and
- Vertical head changes related to all the above routing.

These data will be processed using standard engineering principles and textbook “look-up” values to calculate flow rates, friction losses, etc. to determine the maximum capacity of the pump and piping network, and the current flow from each PC using the existing pump operating setups. For calculations, all piping will assume to be unobstructed with full internal diameters available for fluid flow. Capacity results for individual PCs can be combined to determine the current system-wide capacity into the treatment system. The maximum capacity of the effluent lines into the treatment system can be used to back-calculate maximum pumping rates from each PC that can be achieved for the given PC component and total networks' capacity. This information can be used as input to initial design for any potential increasing in pumping for any given PC future operations.

5 SAMPLING AND ANALYTICAL PLAN

This section provides specifications for monitoring well installations and soil boring investigations to address the objectives presented under sections C through G on Table 3.0. Related sampling activities are also presented; sampling activities include field screening as defined below, and collection of groundwater samples for chemical analyses. Because well installation, field screening, and development activities will be similar for all areas, section 5.1 provides details of these common procedures. Specific standard operating procedures (SOPs), as well as sampling and analytical quality assurance/quality control (QA/QC) protocols are provided in the attached QAPP. The attached Site Safety and Health Plan (SSHP) will govern protection of personnel during RAO activities, and all investigation derived waste (IDW) will be managed per the attached Waste Management Plan.

5.1 New Monitoring Well Installation Procedures

Prior to monitoring well installation, or any intrusive RAO activity, Missouri One-Call will be contacted at least 72 hours prior to field work to mark utilities. Private utility locator services will be utilized if Missouri One Call or *reliable* Facility records do not identify locations of utilities. Subsurface activities will not be conducted within 5 feet of any marked underground utilities. If intrusive work in close proximity to an underground utility is necessary, hydro-excavation will be used to clear the utility before continuing to work in the area.

5.1.1 New Monitoring Well Installation and Development

UFZ monitoring well installations are planned to monitor the base of the unconsolidated zone and the weathered portion of the upper bedrock, and will require casing and screen completions. SFZ wells occur deeper in competent bedrock, and will be installed as cased wells with open bore bottom hole completions. Appropriate Missouri Well Construction Rules (MWCR) variances will be obtained from MDNR prior to commencing work. Wells will be drilled using air rotary methods with tri-cone roller or air hammer bits, and hollow-stem augers as appropriate; the specific procedures for installing and constructing UFZ and SFZ monitoring wells are detailed in Table 5.0 with additional information provided in the QAPP (Attachment A).

All wells will be completed with above-ground protective pedestals in non-traffic, vegetated areas, or areas of potential flooding. In traffic areas, completions will be flush-mounted in traffic-rated vaults. All new wells will be surveyed for location and elevation reference, with elevations surveyed to the nearest 0.10 foot and tied into the Missouri State Plane Coordinate System. All installed wells will be certified with MDNR.

5.1.2 Field Sampling Procedures for Monitoring Well Installation

No soil or rock sampling for chemical analysis will be performed during well drilling. However, the following data collection and field screening procedures will be conducted during each well installation, with descriptions and data recorded on boring and well completion logs:

- Structural features and water producing zones will be logged based on cuttings observations and drill rig reactions to encountered lithologies.
- Soil and rock cuttings will be collected every 2 to 5 feet and visually logged for lithology and indications of impact. Small amounts of cuttings will be bagged and labeled with the well and depth for later reference.
- Photoionization detector (PID) screening of effluent air will be performed every 2 to 5 feet.
- If impact is indicated, an ultraviolet light will be used to check cuttings for potential creosote presence.
- All data will be logged on appropriate field forms. .

5.2 Phase II UFZ Monitoring Well Installations

Issue statements and objectives under section C in Table 3.0 specify new monitoring well installations for delineation of DNAPL and plume extent in the UFZ for off-site areas in the northeast residential area, the northern Clifton drainage near Kearney Street, the eastern off-site Greene County area, and the southern BNSF off-site area. Well locations and specifications to meet the stated objectives are provided in the following tables and referenced figures. Sampling and analysis of groundwater for new wells to verify delineation and the need for additional step-out planning will be performed following new well development and a minimum 3-day equilibration period (see section 5.3).

Table 6.0 – Northeast Residential Clifton Drainage UFZ New Monitoring Wells (see Figure 8.0 - Off-site Northeast Monitoring Wells)		
Objective: Delineate the nature and extent of the dissolved-phase plume to the north-northeast of the Facility		
New Well Locations	**Well Specifications**	**Key Factors**
3 wells in City road rights-of-way or easements within 1,000 ft of Facility; six possible areas are depicted on Figure 8.0	• 2”-diameter casing and screen, spanning bedrock interface • Well depth to 25 ft • 10-17 ft expected target monitoring zone	• Well locations selected per Phase I fracture evaluation • Requires City approval • Start near Facility and progressively step out to the northeast

Table 7.0 – North Clifton Drainage at Kearney Street UFZ New Monitoring Wells (see Figure 7.0 – North Geophysical Surveys and New Monitoring Wells)		
Objective: Define downgradient horizontal extent of this zone and vertical impact pattern		
New Well Locations	**Well Specifications**	**Key Factors**
3 wells in City or MODOT road rights-of-way or easements as first priority, or on commercial property, 2 wells north and 1 south of Kearney Street	• 2”-diameter casing and screen, bedrock only • Well depth to 50 ft • 30-50 ft expected target monitoring zone	• Well locations selected per Phase I fracture evaluation & geophysical results • Requires City or commercial owner access approval • Focus efforts to avoid other sources • Use later analytical data to evaluate Facility connection

Note: Downgradient delineation is proposed at this isolated Kearney Street location following initial well installation in the Clifton Drainage residential area since this is the most northern extent of the well network and DNAPL is present. The next step will be fill-in between Clifton drainage residential and this north Clifton drainage Kearney Street location, if warranted, using the results of this drilling to help guide installations. Step out installation plans are presented in Table 8.0.

Table 8.0 – Northeast, North Clifton Drainage Fill-In UFZ New Monitoring Wells (see Figure 7.0 – North Geophysical Surveys and New Monitoring Wells) (see Figure 8.0 - Off-site Northeast Monitoring Wells)		
Objective: Characterize horizontal and vertical connectivity within Clifton Drainage migration pathway		
New Well Locations	**Well Specifications**	**Key Factors**
1 to 2 wells in City road rights-of-way or easements as first priority, or on commercial property. Fill-in wells between Figures 7.0 and 8.0 target locations. May also serve as further step-outs for northeast residential area	• 2”-diameter casing and screen, bedrock only • Well depth to 40 ft • 20-40 ft target monitoring zone	• Well locations selected per Phase I fracture evaluation & Tables 6 and 7 drilling results • Requires City or commercial owner access approval

Table 9.0 – Off-site East Greene County UFZ New Monitoring Wells (see Figure 9.0 – Off-site East New Monitoring Wells)		
Objective: Define the UFZ horizontal extent of DNAPL and dissolved-phase plume, and vertical distribution of DNAPL, to the east using a step-out investigation approach		
New Well Locations	**Well Specifications**	**Key Factors**
2 wells on Greene County property within 300 ft of Facility as initial delineation step	• 2”-diameter casing and screen, bedrock only • Well depth to 40 ft • 20-40 ft expected target monitoring zone	• Well locations selected per Phase I fracture evaluation • Requires Greene County access approval • Step-out wells further east pending initial sampling results

Table 10.0 – Off-site Southeast, South, Southwest UFZ New Monitoring Wells (see Figure 10.0 – Off-Site South New Monitoring Wells)		
Objective: Define UFZ horizontal extent of the plume in the off-site area southwest, south and southeast of Site impact. Consider both fracture direction and groundwater flow direction. Use temporary wells to check for impact and groundwater flow direction		
New Well Locations	**Well Specifications**	**Key Factors**
2 wells southwest in City ROWs as first priority 3 wells on BNSF property to south and southeast	• 1”-2”-diameter casing and screen, bedrock only • Well depth to 25 ft • 10-20 ft expected target monitoring zone • Temporary well installs	• Temporary wells located per Phase I fracture evaluation • Requires City and BNSF access approval

Initial prospective locations for the temporary wells are depicted on Figure 10.0, and are based on the following reasoning:

- **Location A:** Proposed to delineate several UFZ wells at the west end of PC-7 with GWPS exceedances, and set along a southwest direction from these wells based on a suspected northeast-southwest fracture trend through the Facility (see, third bullet group under section 3.1, first bullet under section 3.2, and third bullet under “Hydrogeological Setting” in Table 2.0), to more likely intersect any extension of impacted groundwater.
- **Location B:** Proposed to delineate GWPS exceedance southwest of SMW-64, also along a potential regional fracture trend direction (related to the same northeast-southwest fracture trend noted immediately above), and therefore more likely to encounter secondary porosity that could transmit impacted groundwater downgradient.
- **Location C:** Proposed for two purposes: (1) to delineate GWPS exceedance south of SMW-25, and (2) as a close-in downgradient monitor point for future hydraulic control testing of PC-7.

- **Location D:** Proposed to delineate GWPS exceedances southeast of SMW-30, based on possible northwest-southeast fracture trends, and also to delineate east of SMW-62.
- **Location E:** Proposed to delineate southeast of SMW-62, again based on a possible southeast fracture trend, and also to fill the gap between proposed location D and existing well SMW-60 (which will require repair due to surface damage).

Permanent well locations will be proposed to MDNR based on evaluating sampling data and groundwater flow directions derived from the temporary wells.

5.3 Sampling and Hydraulic Testing of New UFZ Monitoring Wells

Following installation, development, and time for groundwater equilibration of newly planned monitoring wells in the northeast, north, east, and south off-site areas, the monitoring wells will be sampled and collected groundwater submitted for chemical analysis, in order to determine if plume delineation is achieved in those areas. Analyses will be performed for the COC analyte list provided in Table 1.0 established for GWPS monitoring. Table 10.0 below presents a sampling plan with objectives, analytes, and laboratory methods proposed for this initial screening evaluation for delineation.

Table 11.0 Initial Off-site New UFZ Monitoring Well Delineation Sampling Plan

Objectives: (1) Sample new wells to verify delineation is achieved
(2) Obtain initial screening data for vapor intrusion screening

Location	Sampling Plan	Analytes	Method	Reasoning
Northeast Clifton drainage residential area new wells	Sample installed wells using low flow sampling technique	VOCs per Table 1.0	8021B	• Table 1.0 analytes define the required GWPS COCs to be delineated
		SVOCs/ PAHs per Table 1.0	8270C	
North Clifton drainage Kearney Street new wells	Select one new well from each area for full Appendix IX VOC analysis	VOCs (full list)	8260B	• To verify results of historical analyses that VOCs are characterized
Clifton drainage new fill-in wells				
East Greene County new wells				
South area BNSF new wells				

Decision Factor: Delineation = Concentration below GWPS

- If concentration(s) exceed any GWPS COC, evaluate factors for step-out wells

Evaluation factors to consider for the need for step-out wells include: well location and neighborhood, extent of analytical GWPS exceedance, presence/absence of significant migration pathways (e.g., fractures or voids encountered), and accessibility for placing step-out wells. If additional delineation is indicated, the Multistate Trust will plan additional step-

out monitoring wells to more completely define downgradient or lateral plume delineation. Locations will be determined from fracture evaluations or other investigation data and recommended to MDNR for approval, prior to mobilizing drillers. Monitoring wells will be planned in City ROWs as a first priority, or on private/commercial property if necessary, with appropriate approvals/permits/access agreements obtained prior to drilling.

All new monitoring wells will be sampled quarterly as required by Special Permit Condition II.E.2.c to establish concentration trends. If the results of one year of quarterly monitoring are consistent with the stability of the plume observed in existing wells, the Multistate Trust will submit a proposal to sample the new wells on the existing semi-annual schedule.

In addition to analytical sampling, off-site new wells will also be evaluated for hydraulic testing (e.g., slug testing). The decision factors supporting testing are: (1) groundwater impact by Facility contaminants, (2) secondary porosity features (e.g., fractures or voids) that indicate potentially higher hydraulic conductivity values that could influence contaminant migration, further delineation, or remedial considerations, and (3) a lack of historical hydraulic parameter data for the area of the new well. The Multistate Trust will consult with MDNR concerning new well situations where hydraulic testing may warranted prior to initiating any testing.

5.4 Identify and Characterize Potential Exposure Pathways to DNAPL and Dissolved-Phase Plumes

Potential exposure risk to contaminants, the objectives for section D in Table 3.0, will be addressed in a progressive manner to screen dermal contact and vapor intrusion.

5.4.1 Off-Site Dermal Exposure Risk Screening

Off-site dermal exposure risk is most likely from encountering impacted groundwater or creosote in excavations or utility work involving construction workers. Key data inputs for this evaluation will be depth to saturation data from well construction and measured well water levels, as well as observations and concentrations of COCs from 2015, and new groundwater data from the RAO. Decision factors for evaluating these data are:

- Saturation levels and water depth less than 10 feet (Missouri risk-based standard for construction worker exposure)
- Concentrations of COCs exceeding screening levels for dermal exposure as listed in the November 2015 U.S. EPA Regional Screening Levels document http://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2015
- Likely presence of creosote or groundwater impacted by Facility contaminants in utility corridors as indicated by observation, PID readings, odor, and sample results from WP section 4.3.3

Locations and data where these criteria are exceeded will be conveyed to MDNR, and the Multistate Trust will coordinate with MDNR regarding additional evaluation of these areas, including exposure risk evaluation.

5.4.2 On-Site Dermal Exposure Risk Evaluation

On-site exposure risk potential for residual impact at former wood-treating operations areas (Land Farm, Black Tie storage area, Drip Track) will be further evaluated pending results of the screening work performed as described in WP section 4.3.6. Areas where historical sample data indicate potential risk, and areas where no historical data exists, will be evaluated by collection of samples for analysis per the plan in Table 12.0.

Table 12.0 On-Site Surface Impact Evaluation Sampling Plan

Objective: Determine if current exposure risk exists for Facility areas with potential surface contamination

Location	Sampling Plan	Analytes	Method	Reasoning
Land Farm (if indicated) Black Tie Storage area (if indicated) Drip Track area (if indicated)	Use shovel or hand auger to collect composited samples (5 –10 aliquots each) from upper 24 inches of soil, below surface capping materials	Table 1.0 GWPS Chemicals of Concern list, with any additions indicated by WP section 4.3.6 review	8021B 8270C and per other COCs identified in section 4.3.6 review	• Soil contaminants are same wood-treating COCs established for groundwater • Surficial exposure only involves upper portion of original soil • Surface covers added as part of historical remediation cover original impacted soil

Decision Factor: Risk = exceedance of U.S. EPA dermal screening levels

- Use November 2015 U.S. EPA Regional Screening Levels document
- If concentrations indicate risk, evaluate options for future mitigation

5.4.3 Vapor Inhalation Exposure Screening

Phase II evaluation of potential vapor inhalation in the Northeast Clifton drainage residential area will be evaluated in two progressive steps:

Step 1: Concentrations of benzene, toluene, ethylbenzene, xylene (BTEX), 2-methylnaphthalene (2-MN), and naphthalene from delineation sampling of the new wells will be input to EPA's VISL tool and evaluated against the EPA June 2015 vapor intrusion criteria using the same procedure as the preliminary screening described in WP section 4.3.6. If VISL screening indicates that impacted groundwater may pose a potential indoor inhalation risk, soil vapor samples will be collected in Step 2.

Step 2: Up to three pairs of soil vapor wells will be installed near monitoring wells exhibiting

potential risk from VISL screening to enable vapor sampling for direct determination of indoor inhalation vapor risk. The vapor wells will be located in residential street ROW areas within 100 feet of residences (per the OSWER Guidance). Vapor well pairs will be installed using the Geoprobe® method per US EPA Standard Operating Procedure 2042 (see Attachment A, QAPP). One well will be installed shallow (3 feet) and one deep (8 feet) to test for both slab and basement home construction scenarios. Vapor samples will be sampled per the SOP in the QAPP, and analyzed for BTEX, 2-MN, and naphthalene. Analytical results will be compared to the USEPA Residential Screening Tables (November 2015), residential air screening levels, using TQH=0.1 due to multiple potential hazardous constituents for a conservative approach. Appropriate attenuation factors per Table 6-1 of the OSWER Publication 93200.2-154 will be applied as part of this evaluation.

If soil vapor criteria are exceeded, the Multistate Trust will convey these data with location information to MDNR, and will coordinate with MDNR for further evaluation and risk prioritization of these areas.

5.5 Update Understanding of Potential for Contaminant Vertical Migration Pathway from UFZ to SFZ

The CSM notes that DNAPL occurring in SFZ well BMW-5, significant dissolved-phase impact in SFZ well BMW-10R, and presence of a potential fracture zone crossing the Facility through the locations of these wells suggest a mechanism for vertical connectivity between the upper UFZ and middle SFZ bedrock zones. Determining and understanding this potential contaminant migration potential is important for monitoring and remediation considerations.

Objectives for evaluating contaminant vertical migration potential, as outlined in section E of Table 3.0, will be addressed in two steps. The first step is evaluation of historical geological and potentiometric data and information as part of Phase I activities (see WP section 4.3.2), focusing on the central Facility BMW-5 area and southwest BMW-10R area.

The second step will be progressive installation of two new SFZ bedrock wells near BMW-5 and BMW-10R, with visual and chemical monitoring of UFZ and SFZ zones in stages as the wells are installed. In addition to providing detailed vertical information for evaluating the vertical migration potential and vertical delineation of impact, these wells will:

- Provide depths of impacted horizons for planning appropriate SFZ monitoring intervals for new wells to avoid creating vertical migration pathways, and
- Provide SFZ horizontal delineation for these existing impacted wells.

One SFZ open bore well is proposed hydraulically downgradient northwest of BMW-5, and monitoring well is proposed northeast of BMW-10R along the approximate fracture trend, as depicted in Figure 11.0. Specific locations will be finalized by Phase I fracture evaluation

results. Wells will be installed in phases, with monitoring and sampling as depth progresses to vertically evaluate for DNAPL presence and UFZ/SFZ impacted groundwater horizons, enabled by multiple casing and open bore progressive installation. The iterative process is the same for both wells, and is outlined in Table 13.0:

Table 13.0 – Progressive Installation and Testing New SFZ Monitoring Wells (see Figure 11.0 – New Wells for Vertical and Horizontal SFZ Delineation)

Objectives: (1) Identify and characterize vertical migration pathways to SFZ to aid in effective design of further delineation and/or corrective measures for SFZ impact
(2) Identify SFZ migration zone and impacted horizon depths in SFZ for appropriate design of well monitoring intervals to avoid potential vertical cross-contamination
(3) Determine if DNAPL is present in the SFZ beyond BMW-5

Drilling Phase	Evaluation Actions	Key Factors
Case well 15 ft into bedrock and drill open bore to 80 ft	• Video well bore, log lithology, structures, & DNAPL • Collect low-flow samples at 25 ft and 60 ft; analyze for GWPS COCs • Pump to lower water level at least 20 ft; measure recharge levels with time	• Need clear water for video; record video • Note Elsey Formation if encountered • Adjust sample horizons for identified porosity features • Minimal low flow rate to avoid vertical water pull • Several COCs previously detected in SFZ justifies full GWPS list • Measure recharge until recovered
Ream out well to 10” to 80 ft, grout in 6” casing, and open bore to 180 ft	• Video well bore, log features & DNAPL • Collect low-flow samples at 90 ft, 125 ft, and 175 ft; analyze for GWPS COCs • Pump to lower water level at least 20 ft; measure recharge	

Evaluate results for UFZ-SFZ connectivity and vertical impact delineation for both DNAPL, if present, and plume concentration vertical distribution. Vertical connectivity between UFZ and SFZ is indicated by one or more of the following; more conditions strengthen the confirmation of fracture connection:

- Presence of vertical fractures, solution features, and/or other secondary porosity features from lower UFZ (60 to 80 feet) into upper SFZ (90 to 120 feet)
- Presence of DNAPL in SFZ horizons whether present or absent in upper UFZ zone
- Similar groundwater chemical footprint (analytes and concentrations) in both lower UFZ and upper and lower SFZ
- Relatively high rate of groundwater recharge in SFZ after pumping out water;

SFZ normally has very slow recharge

If vertical connectivity is indicated, the Multistate Trust will evaluate options for additional testing of existing and other new SFZ wells near the northeast fracture trend (BMW-1, BMW-2, new SFZ delineation wells proposed near BMW-10R (see WP section 5.6)) to further evaluate extent of the influence, and coordinate with MDNR for developing additional activities.

Identification of impact and migration pathway horizon depths will be used to design appropriate monitoring intervals for new SFZ monitoring wells. The results will also be used to evaluate existing SFZ well monitoring intervals. BMW-5 has a long open bore monitored interval (73 to 158 feet depth), which could encounter deep fracture extensions from the UFZ. BMW-5 is also reported to contain DNAPL. BMW-6, northwest and hydraulically downgradient of BMW-5, is screened in a deeper narrow interval (193 to 207 feet depth), which may not be adequate for monitoring downgradient impact migration from BMW-5. If this comparison identifies potential monitoring depth issues, the Multistate Trust will evaluate the need for further evaluation or modification to the SFZ well network.

If the Elsey Formation is encountered in the deep portion of these two new wells, there is potential for vertical contamination into this upper portion of the Elsey, which other Springfield investigations have found to be more permeable and hydraulically conductive than the Burlington Formation or underlying Pierson Formation. If the Elsey is present, the lower portion of the new open bores should be grouted to at least 5 feet above top of the Elsey to minimize the potential for cross-contamination.

5.6 Update Delineation of SFZ Dissolved-Phase Plume

The SFZ plume for two SFZ monitoring wells, BMW-02 and BMW-10R, is no longer fully delineated, as stated in section D of Table 3.0. BMW-02 is near the northeast Facility boundary, and its dissolved-phase concentrations are decreasing. Based on this trend, the objective for evaluating BMW-02 is continued groundwater chemical monitoring to confirm the decreasing impact and improving water quality. No additional new wells are proposed to delineate the BMW-02 area. With the relatively low and decreasing plume concentrations in BMW-02, existing monitoring wells BMW-01 and BMW-04 will serve to delineate the SFZ in the northeast area.

BMW 10R is located near the southern Facility border, and has a history of variable COC detections and GWPS exceedances. Sampling reported no detections or limited low concentration detections in 2009, 2010, 2011, 2013, and 2015; while significant GWPS exceedances of several COCs were reported in 2012 and 2014. Since the well is near the

Facility property border and within the trend of a potential fracture zone, additional horizontal delineation is proposed. In addition to the vertical delineation well proposed in WP section 5.5, two additional SFZ monitoring wells are proposed to laterally delineate SFZ impact at BMW-10R as outlined in Table 14.0 and depicted on Figure 11.0.

Table 14.0 –New SFZ Delineation Monitoring Wells at BMW-10R (see Figure 11.0 - New Wells for Vertical and Horizontal SFZ Delineation)		
Objective: (1) Define the on-site and off-site SFZ horizontal extent of the plume in area of BMW-10R (2) Determine the need for / scope of corrective measures		
New Well Locations	**Well Specifications**	**Key Factors**
1 well northwest of BMW-10R in downgradient direction 1 well southwest of BMW-10R along potential fracture trend	• 6”-diameter casing grouted to 80 ft minimum • Open borehole to up to 180 ft • Final target monitoring zone	• Well locations selected per Phase I fracture evaluation • Adjust casing depth and final depth from vertical delineation results • Requires access agreement with BNSF

Wells will be monitored for DNAPL presence. Analysis of groundwater from these new wells to verify delineation and the need for additional step-out planning will be performed following new well development and a minimum three-day equilibration period. Low flow sampling will be performed with analysis of VOCs by Method 8021B and SVOCs by Method 8270C.

Observations from drilling the new SFZ delineation monitoring wells, results from the vertical migration evaluation, and analytical data from the delineation sampling will be evaluated to determine if the SFZ is sufficiently delineated. If additional evaluation or delineation is indicated, the Multistate Trust will coordinate planning and activities with MDNR.

5.7 Update Identification and Characterization of On-Site Source Material

The ongoing recovery of DNAPL through the Facility recovery system, continued several-feet thick accumulations of DNAPL in wells, and persistent, high COC concentrations at several on-site monitoring wells indicate residual and potentially mobile DNAPL source material remains on-site. This indicates the original SWMU source zones may not have been completely delineated and remediated. The objectives of section G on Table 3.0 will address these unknown conditions of the CSM, through intrusive investigation at the following former operations source areas and known DNAPL occurrence areas:

- Closed pre-RCRA waste cell (see Figure 2.0)
- DNAPL areas around closed impoundment 2 (see Figure 2.0)
- East-central Facility boundary
- Northeast Facility inferred DNAPL area
- Southwest former process area
- South Facility border near Drip Track and RW-20

The areas targeted for investigation are depicted on Figure 12.0, and the investigation will use Geoprobe® technology for direct push borings in grid groupings, employing two analytical field methods:

- TarGOST® direct push creosote sensing
- Macrocore® direct push soil sampling

TarGOST® is a probe using fluorescence instrument sensors that identify and quantify creosote presence, and send measurement data up the drill string, where it is analyzed and plotted as a signal response vs. probe depth. Measurements are taken at a small depth scale (typically 1 inch) to provide real time, high resolution data depiction of creosote bodies. The data profile is a relative response which is pre-calibrated using a sample of on-site DNAPL. The TarGOST® output is further refined by targeting select points for collection of Geoprobe® MacroCore® sample for chemical analysis.

Approximately 45 target locations are planned, as depicted on Figure 12.0, with the purpose of finding and quantifying size and mass of creosote bodies. Table 15.0 summarizes details of the planned investigation approach.

Table 15.0 Identification and Characterization of On-Site Source Material

Objective: (1) Confirm on-site source areas are identified by previous investigations
(2) Update information on the location, volume, mobility, and leachability of source material present
(3) Identify physical site characteristics that affect ability to remove, treat, and/or contain source materials

Field Method	Sampling Plan	Analytes	Method	Key Factors
TarGOST® Direct push	1. Collect DNAPL sample to pre-calibrate TarGOST® sensor 2. Push sensor to refusal in each boring, note real time results 3. Expand boring grid in areas as needed	Creosote/ creosote constituents	TarGOST® fluorescence sensor	• DNAPL sample needed to quantify sensor output • Use real-time results to extend, fill-in, or join grids as needed to quantify • Access needed for off-site Greene County east and BNSF south

Geoprobe® Macrocore®	1. Fill in lithology borings between Tar-GOST® grid areas with soil core	Visual, PID, odor, moisture, DNAPL	Field screen UV light	• Fill in borings for delineating/connecting mass areas to support TarGOST®
	2. For each DNAPL mass area, collect 1 core sample for lithology logging	Visual, PID, odor, moisture, DNAPL	Field screen UV light	• Direct lithology samples location with TarGOST® results after most borings done
	3. Collect 3 soil samples for analysis at medium and strong creosote TarGOST® responses	VOC SVOCs	8021B 8270C	• Collect DNAPL impacted soil horizon based on TarGOST® results with lithology samples if possible
	4. Collect 1 soil samples for geotech analysis at largest DNAPL mass area	Grain size, density, specific gravity, moisture	ASTM D422 ASTM D2937 ASTM D854 ASTM D2216	• Shelby tube with undisturbed sample is required from non-impacted horizon for input to future corrective action options

TarGOST® data will be combined with chemical sampling results and observations from Geoprobe® borings to produce two-dimensional plan maps and cross-sections depicting locations and extents of detected DNAPL (creosote) bodies. TarGOST® response data will be calibrated with sample chemical results to yield estimated thicknesses and qualitative estimates of saturation levels of DNAPL in each boring. The DNAPL thicknesses and saturations for all borings in each tested area will be evaluated to estimate an overall DNAPL volume and saturation for the DNAPL body of each area. The thicknesses and saturation variability in each DNAPL body will be evaluated to qualitatively estimate the potential for mobility of DNAPL within that body.

Each DNAPL body will also be evaluated by examining the location of the DNAPL body with respect to DNAPL thickness over time in local and downstream monitoring wells, and available historical downstream recovered volume data for additional evidence of DNAPL mobility for that body. Persistent DNAPL thicknesses and/or persistent DNAPL recovery in local or downstream wells related to that DNAPL body are indicators confirming the likelihood of mobile DNAPL.

The DNAPL bodies will be prioritized for consideration of future corrective actions based on the size of the body, the potential for mobility, and the location of the body with respect to potential bedrock migration pathways (from WP sections 4.3.2 and 4.3.5, as well as new well installation observations). DNAPL body size and volume estimates, manner of occurrence, lithology, and geotechnical parameters of the unconsolidated media will be factors to include for evaluating types of future corrective actions might be applicable. These actions could include stabilization, removal, or in-situ treatment options.

6 SCHEDULE

A chart of the schedule of proposed RAO activities is provided as Figure 13.0. The chart provides planned lengths of time for each activity within the Phase I and Phase II timelines of the RAO. Phase I actions are primarily desktop actions, whereas Phase II activities are outside field work activities. Exceptions for Phase I are well surveying and any geophysical resistivity field activities performed.

As previously noted and agreed to with DNR, the Phase I activities will be done concurrently with DNR review of the RAO WP. Phase II activities will begin within one week following approval and acceptance of the RAO WP by MDNR. Phase II activities will also require completion of Phase I activities and evaluation of results, since these results may indicate changes to Phase II planned actions. Since monitoring well installation is the first activity in Phase II, startup of Phase II will be affected by the driller's schedule.

The following factors may affect the startup, duration, and completion of schedule tasks:

- Timing of MDNR approval of the RAO WP
- Availability of surveying, geophysical, and drilling contractors (advance notice of expected WP approval date will help secure driller schedule)
- Weather
- Obtaining approved access agreements from the City and private property owners for off-site RAO activities on their properties. These activities are surveying, geophysics, monitoring, drilling, and sampling

Well installation for the UFZ will be implemented in a phased, step-out manner, where initial wells will be installed close the Facility boundaries, field-evaluated, and sampled as described in Section 5.1. Follow-on wells will be progressively installed outward away from the Facility as needed for plume delineation. Most wells will be installed in City right-of-ways, and remaining wells are planned for commercial properties Figure 14.0 depicts this step-out plan for well installation, is color-coded to illustrate the step-out plan, and contains a listing of step-out criteria and the planned means of communicating these data with MDNR.

RAO implementation and performance of planned activities will be a coordinated effort between MDNR, the Multistate Trust, and Multistate Trust contractors. The attached Project Management Plan (PMP) describes the organization and companies involved, their relationship and roles, and the communication plan for the project. Per Special Permit Condition II.D.5., the Multistate Trust will contact MDNR at least five working days before any field work associated with any intrusive field work or work involving construction or modification of the groundwater monitoring system.

Consistent with RCRA Corrective Action regulations and guidance, the Multistate Trust will work with MDNR to make sure the local community is informed and appropriately involved in the remaining cleanup process. Given the proximity of the site to residential and private properties, the fact that a significant part of the RAO work involves activities within residential areas and on City and private company properties and rights-of-way, and past interest and concerns expressed by adjacent residents, a Community Involvement Plan is being prepared by the Multistate Trust and will be submitted separately.

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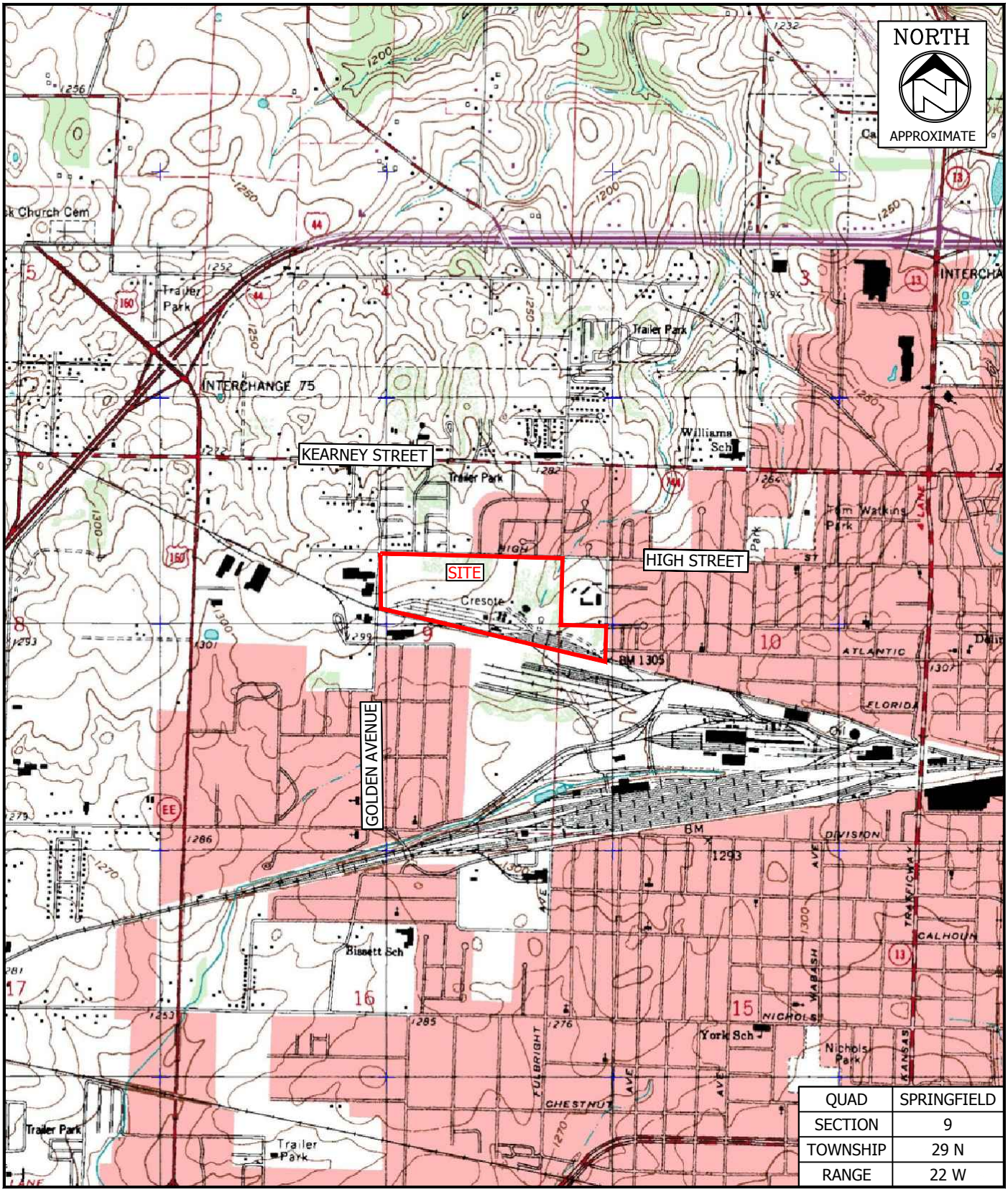
FIGURES

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri



QUAD	SPRINGFIELD
SECTION	9
TOWNSHIP	29 N
RANGE	22 W

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EWI# 150683
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Aug. 11, 2016

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PREPARED BY:
ENVIRONMENTAL WORKS

SITE LOCATION - TOPOGRAPHIC MAP

FORMER TRONOX FACILITY
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
1.0

NORTH

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Aug. 11, 2016

SCALE IN FEET
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APPROXIMATE

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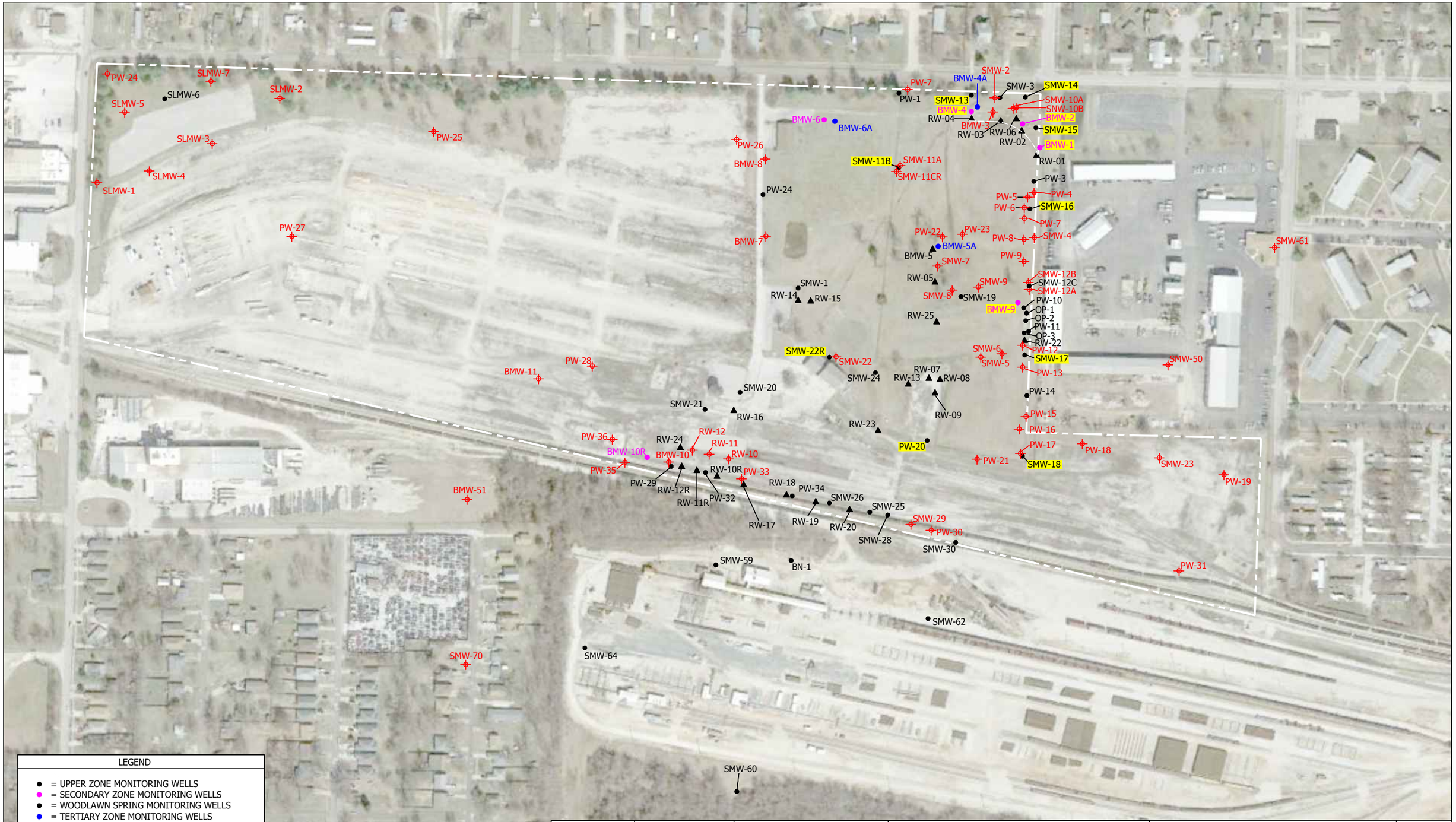
HISTORICAL OPERATIONS FEATURES

KERR-MCGEE/TRONOX
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
2.0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SLMW-5
SLMW-3
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RW-11R
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SMW-25
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PW-30
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SMW-30
SMW-59
BN-1
PW-31
SMW-62
SMW-64
SMW-70
SMW-60
LEGEND
= UPPER ZONE MONITORING WELLS
= SECONDARY ZONE MONITORING WELLS
= WOODLAWN SPRING MONITORING WELLS
= TERTIARY ZONE MONITORING WELLS
= RECOVERY WELLS
= PLUGGED AND ABANDONED WELLS
= TRENCH
= PROPERTY BOUNDARY
= POINT OF COMPLIANCE WELLS
NORTH
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Aug. 11, 2016
SCALE IN FEET
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APPROXIMATE
PREPARED FOR:
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PREPARED BY:
ENVIRONMENTAL WORKS
CURRENT WELL NETWORK - SOUTH
KERR-MCGEE/TRONOX
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI
FIGURE
3.0

NORTH

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SCALE IN FEET
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APPROXIMATE

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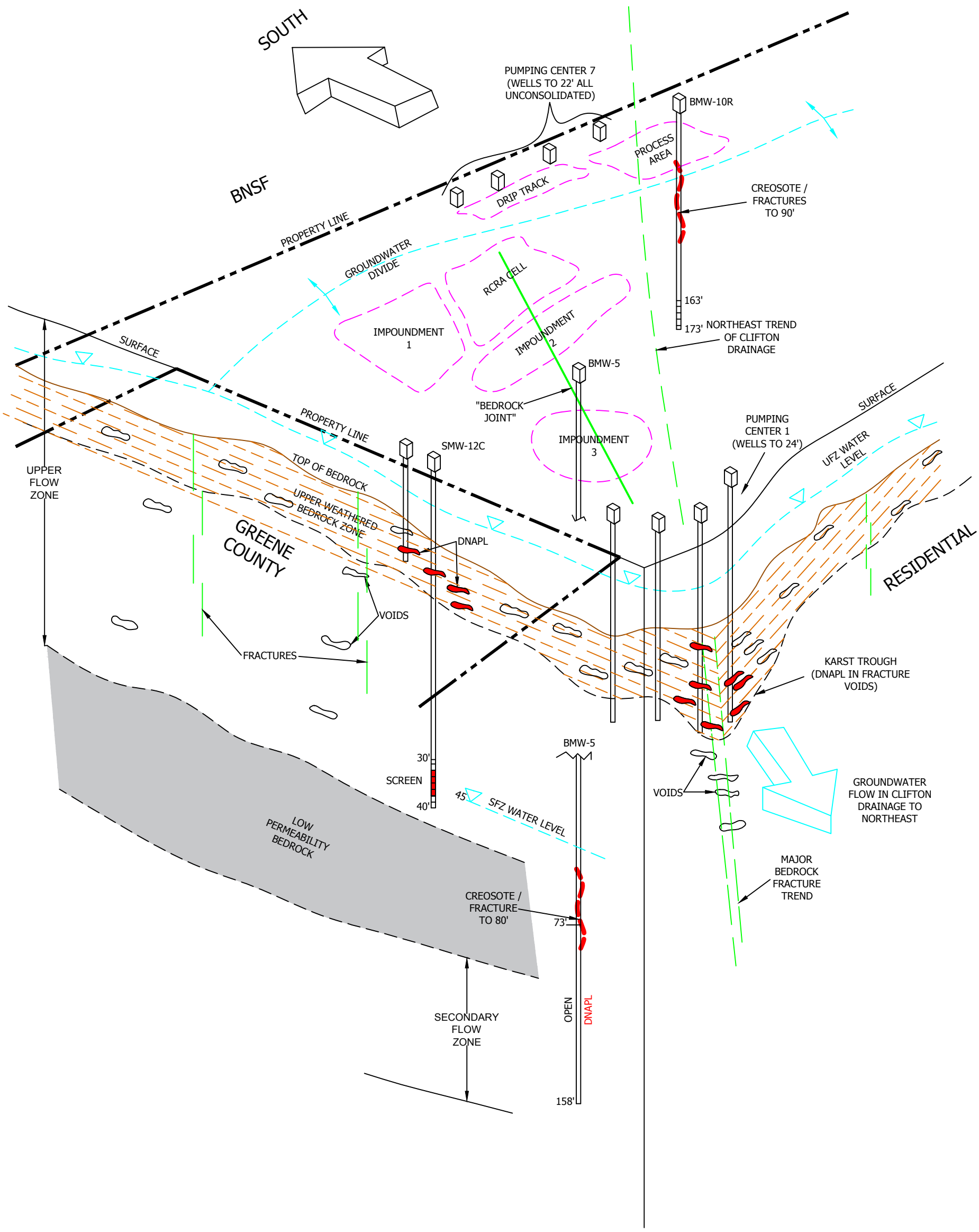
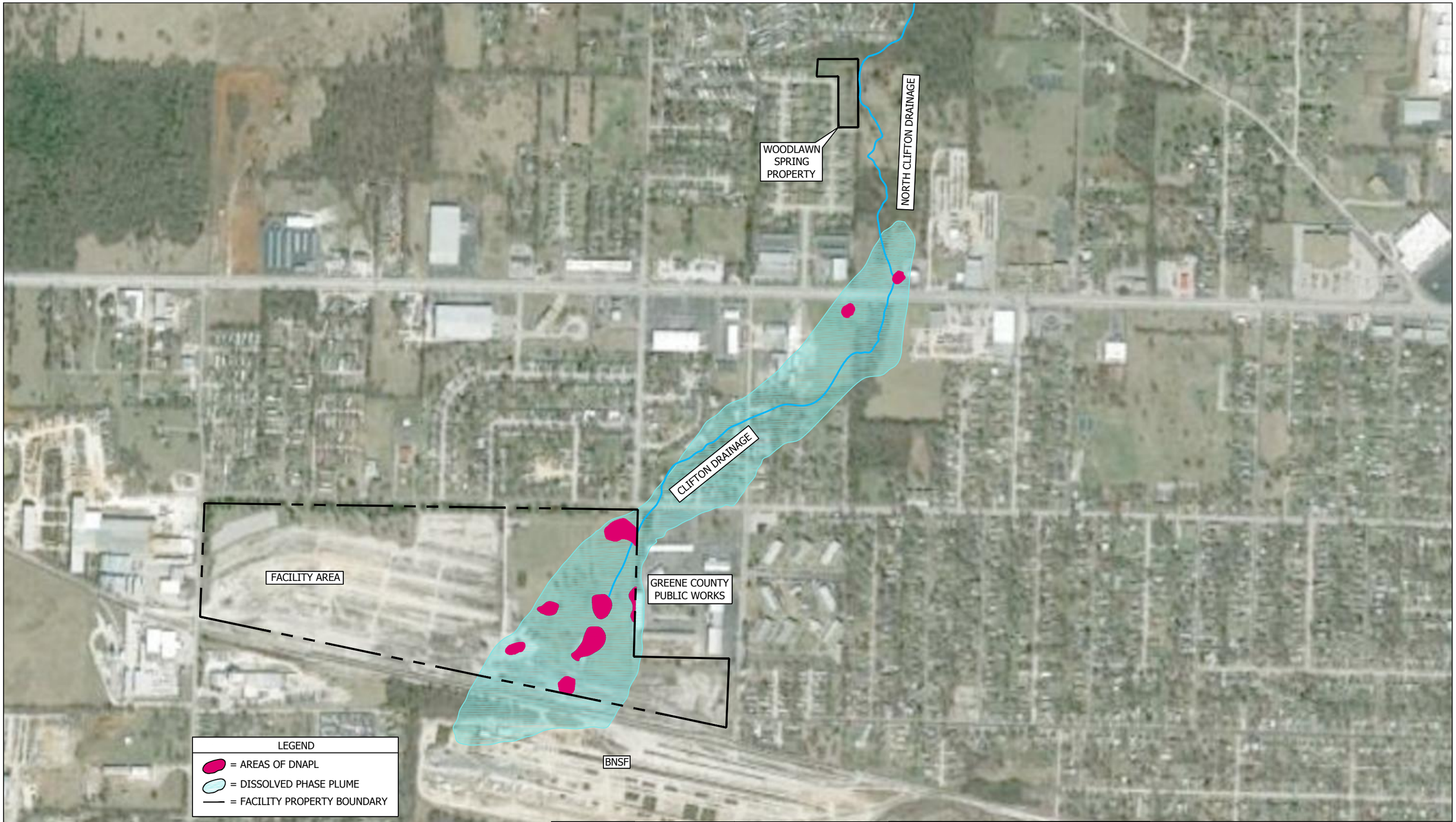
CURRENT WELL NETWORK
NORTH

KERR-MCGEE TRONOX
2800 WEST HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
4.0



NORTH	CHECKED BY: B. LANNING E.W.I. # 150683 DRAWN BY: MRB Aug. 11, 2016	NOT TO SCALE	PREPARED FOR: Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust PREPARED BY: ENVIRONMENTAL WORKS	CONCEPTUAL SITE MODEL DIAGRAM FORMER TRONOX / KERR-MCGEE WOOD TREATMENT FACILITY 2800 W. HIGH STREET SPRINGFIELD, GREENE COUNTY, MISSOURI	FIGURE 5.0



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Aug. 11, 2016

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APPROXIMATE

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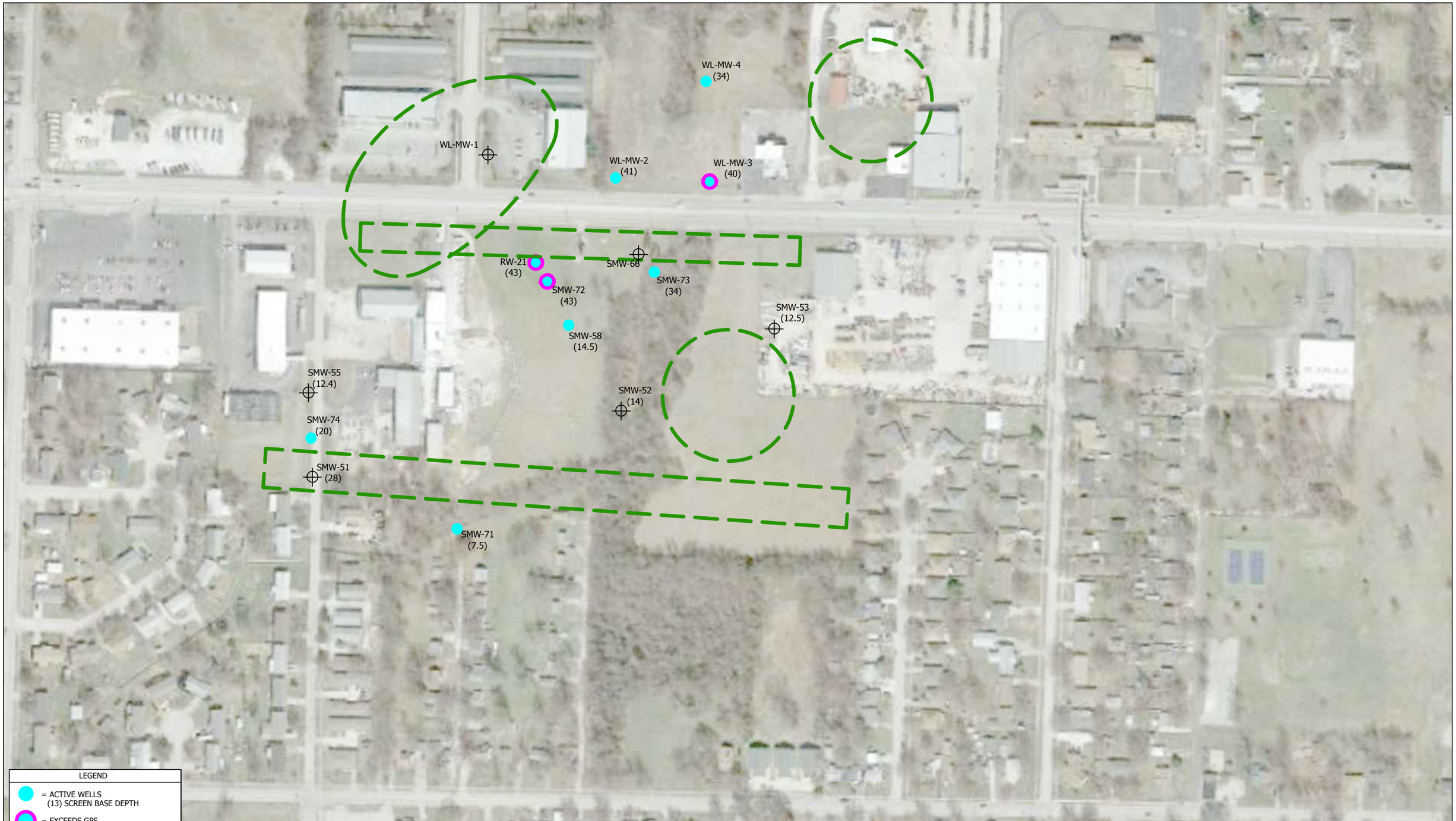
DNAPL AND DISSOLVED PHASE LOCATIONS AND EXTENT

KERR-MCGEE/TRONOX
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
6.0



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Aug. 11, 2016

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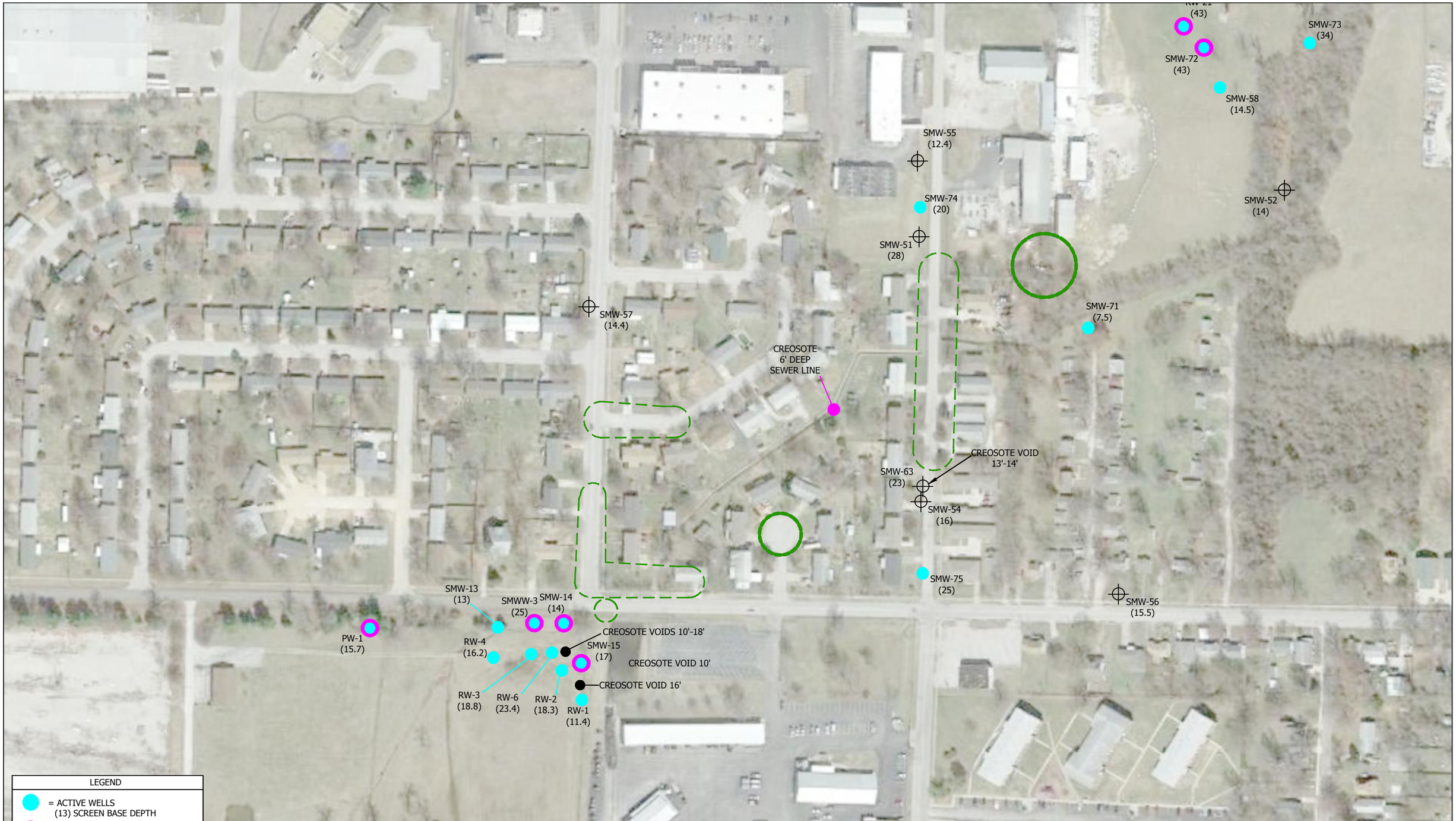
NORTH GEOPHYSICAL SURVEYS AND
NEW MONITORING WELLS

SPRINGFIELD SITE GREENFIELD MULTISTATE TRUST
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
7.0



NORTH

CHECKED BY:
B. LANNING

E.W.I. # 150683
DRAWN BY: CLM
Aug. 11, 2016

SCALE IN FEET
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APPROXIMATE

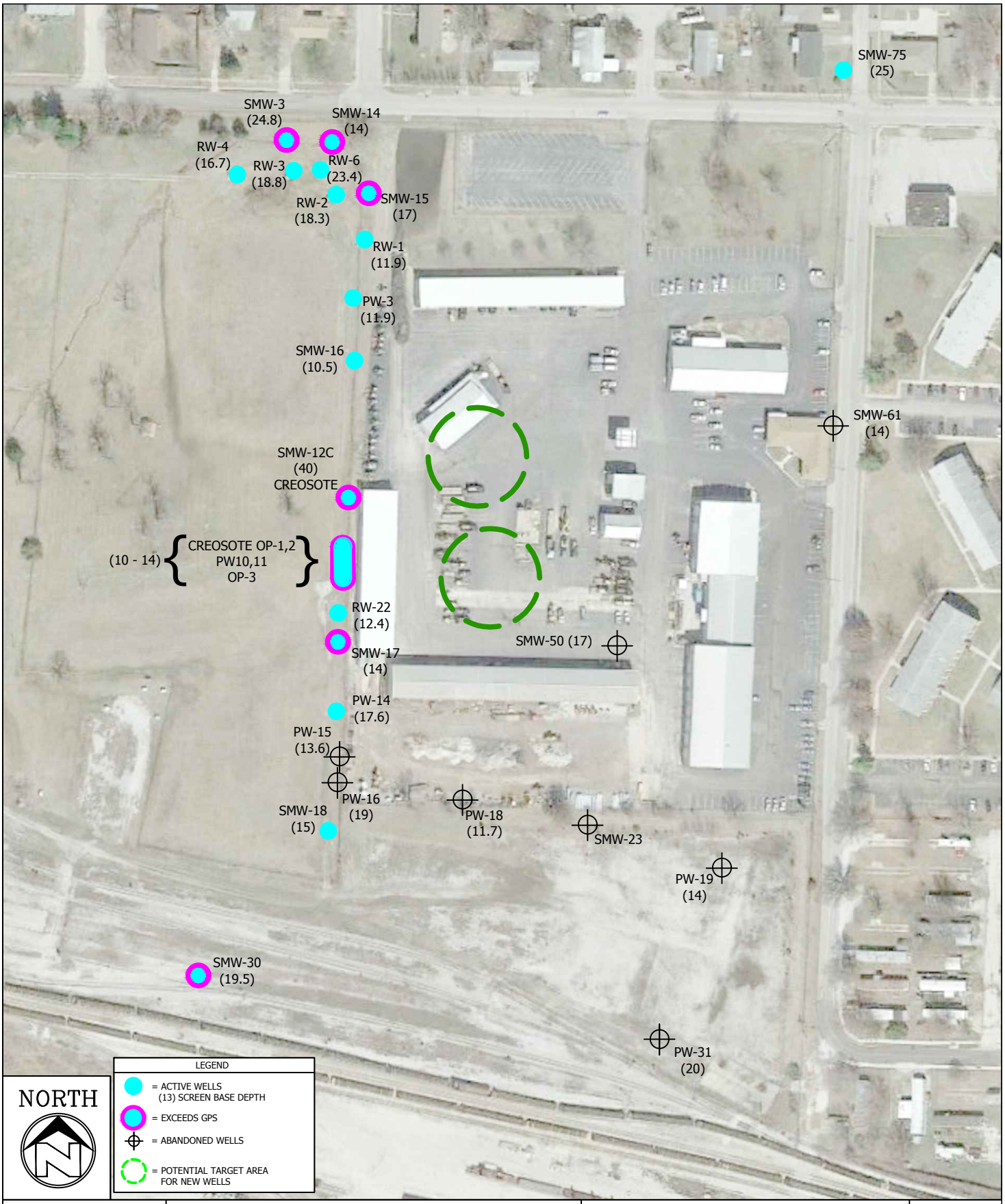
PREPARED FOR:
Greenfield Environmental Multistate Trust, LLC,
Trustee of the Multistate Environmental
Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

OFF-SITE NORTHEAST NEW MONITORING WELLS

SPRINGFIELD SITE GREENFIELD MULTISTATE TRUST
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
8.0



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EWI# 150683
DRAWN BY: CLM
Aug. 11, 2016

PREPARED FOR:

Greenfield Environmental Multistate Trust, LLC,
Trustee of the Multistate Environmental
Response Trust

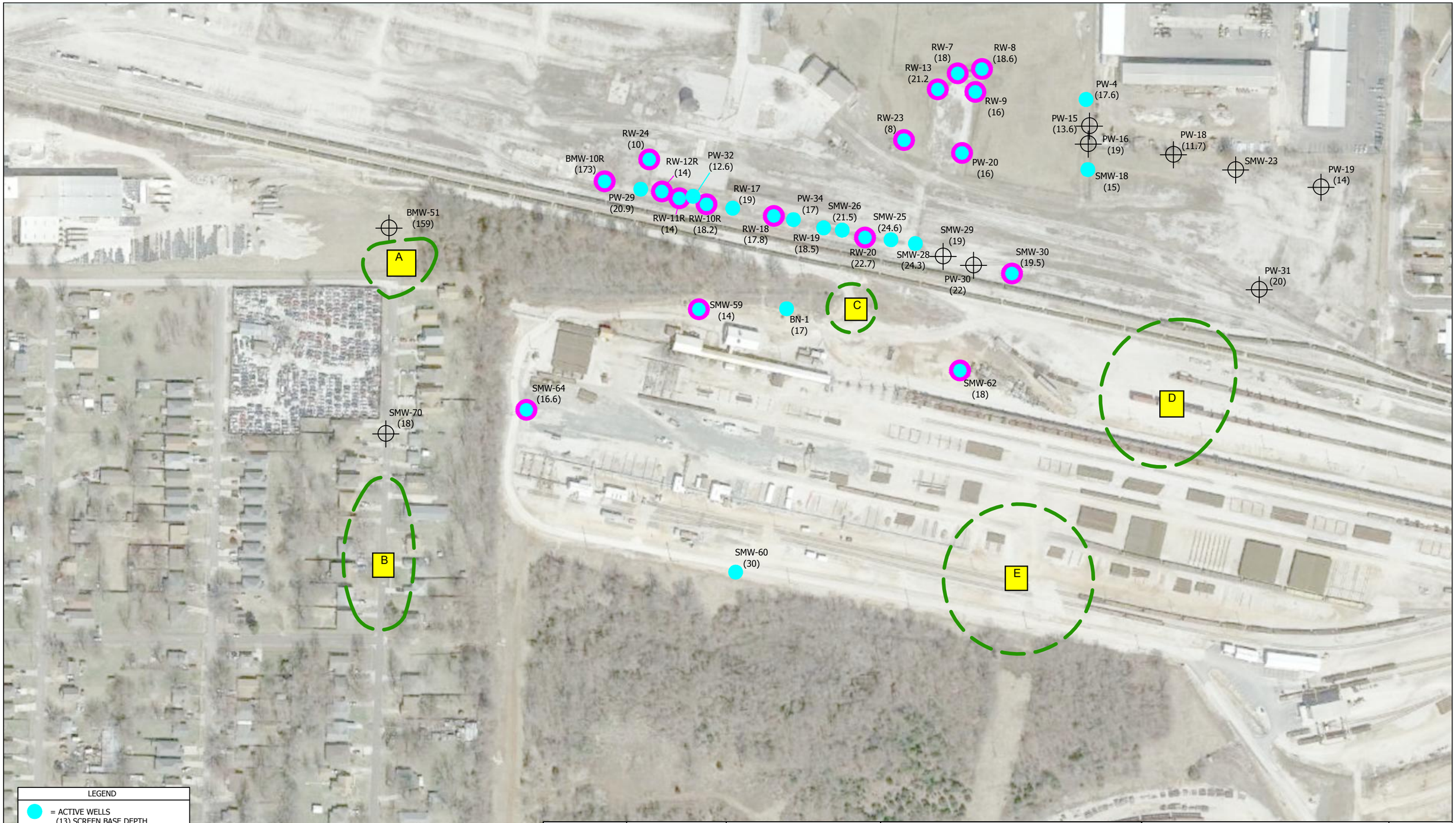
PREPARED BY:

ENVIRONMENTAL WORKS

OFF-SITE EAST NEW MONITORING WELLS

SPRINGFIELD SITE GREENFIELD MULTISTATE TRUST
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
9.0



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CHECKED BY:
B. LANNING

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Aug. 11, 2016

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APPROXIMATE

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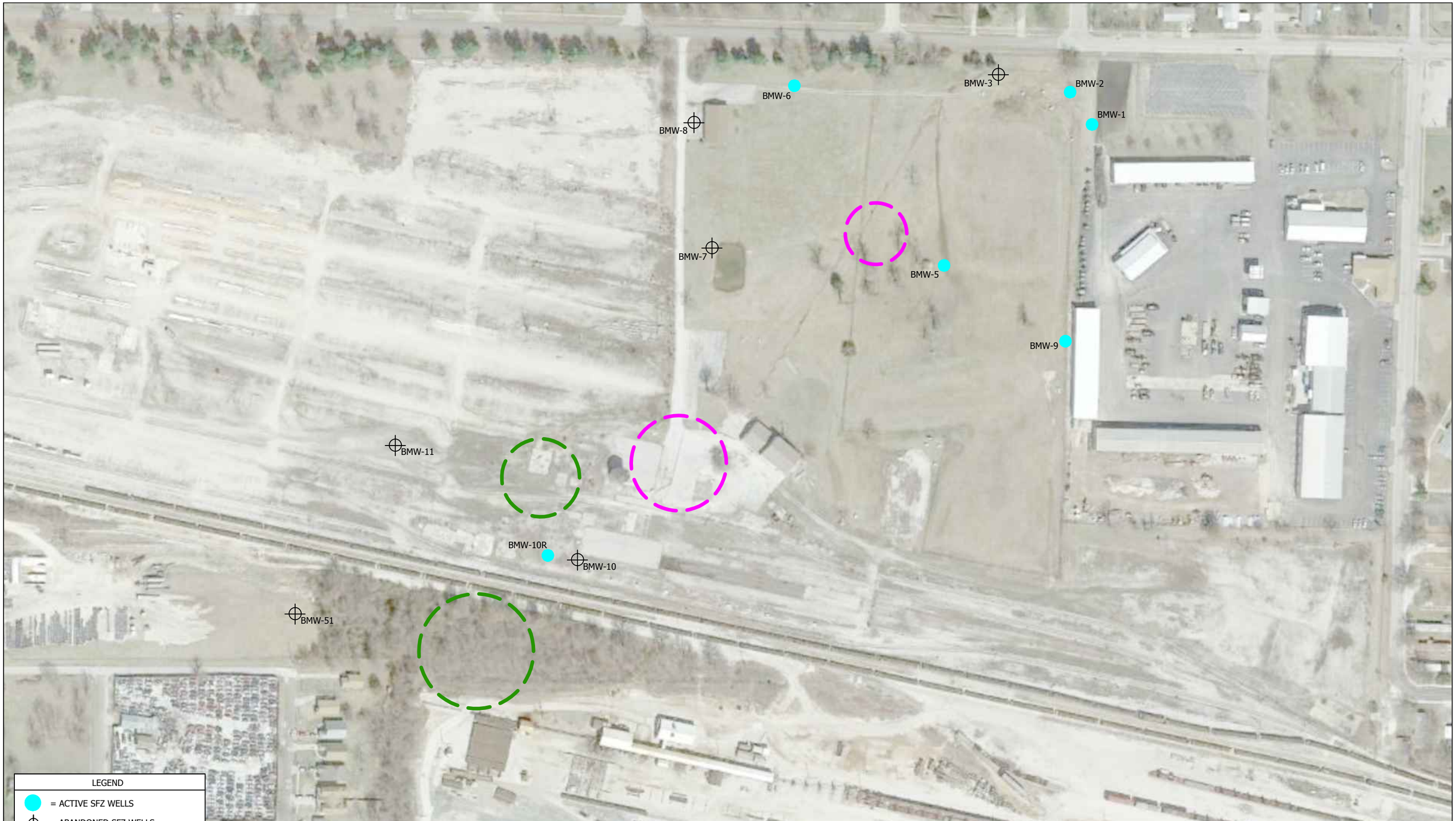
Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

OFF-SITE SOUTH NEW MONITORING WELLS

SPRINGFIELD SITE GREENFIELD MULTISTATE TRUST
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
10.0



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APPROXIMATE

PREPARED FOR:
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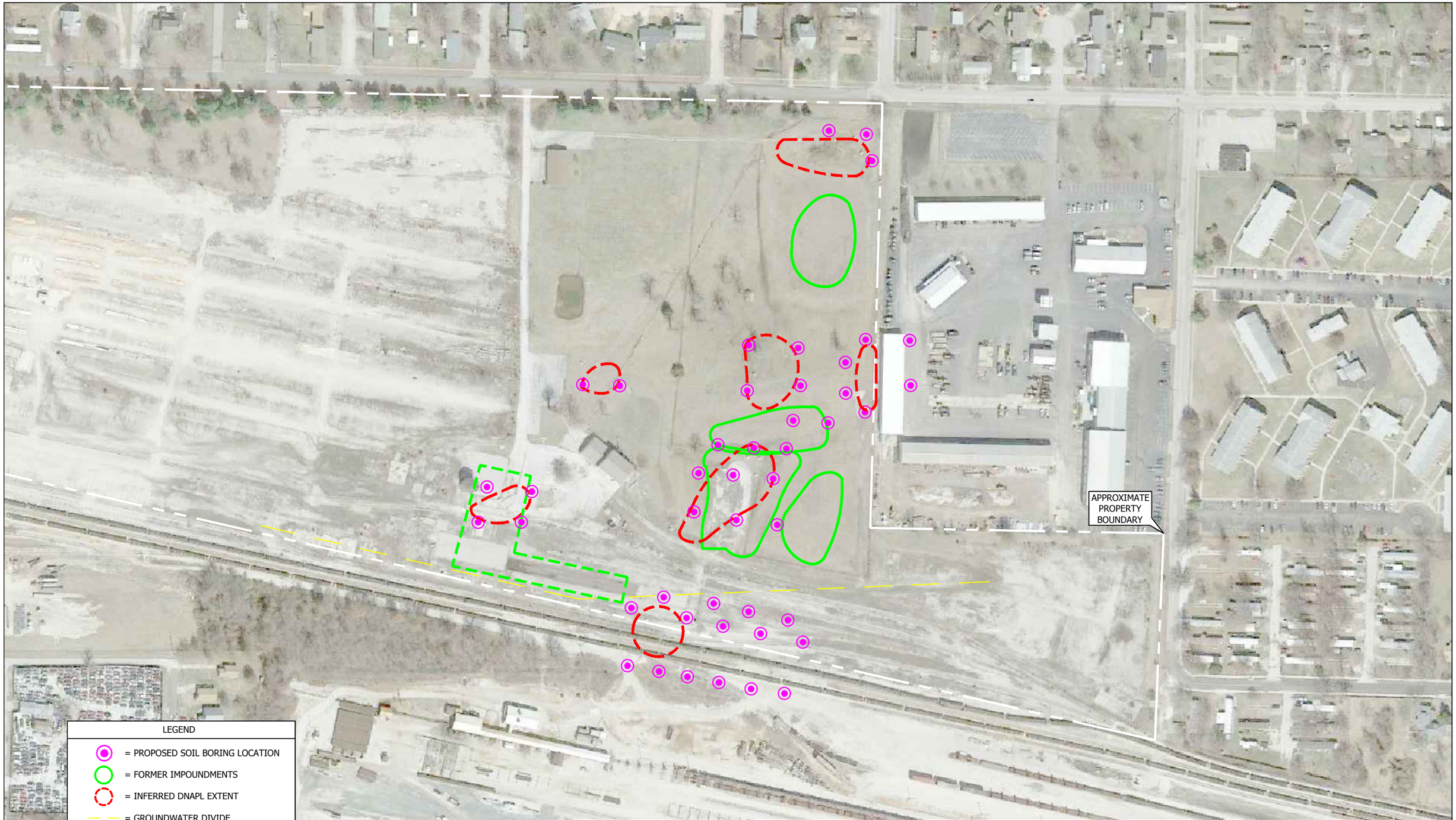
PREPARED BY:
ENVIRONMENTAL WORKS

NEW WELLS FOR SFZ VERTICAL AND HORIZONTAL DELINEATION

SPRINGFIELD SITE GREENFIELD MULTISTATE TRUST
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
11.0



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Aug. 11, 2016

SCALE IN FEET
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APPROXIMATE

PREPARED FOR:
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ENVIRONMENTAL WORKS

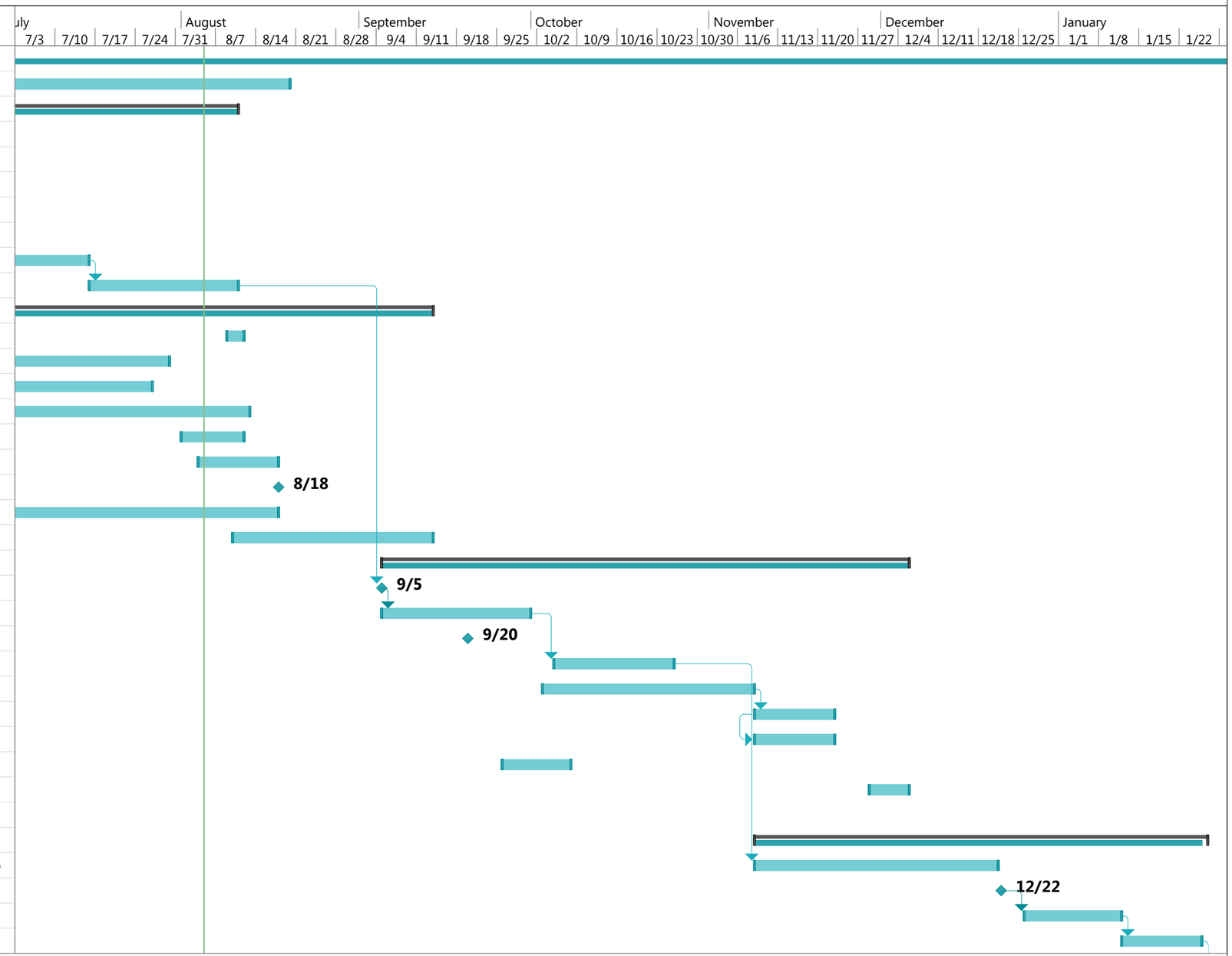
PROPOSED DNAPL DELINEATION BORINGS

KERR-MCGEE SPRINGFIELD
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
12.0

Figure 13.0 - REMEDIAL ACTION OPTIMIZATION - 2016 SCHEDULE
Greenfield Multistate Trust - Springfield, Missouri Site

ID	Task Name	Start	Finish
1	**Springfield MO RAO**		
2	Document Review & Evaluation	Fri 10/23/15	Fri 8/19/16
3	**RAO Work Plan Preparation**	Sun 11/1/15	Wed 8/10/16
4	Draft RAO Work Plan Package	Sun 11/1/15	Thu 12/24/15
5	Submit 2nd Draft RAO WP to Trust	Wed 3/16/16	Wed 3/16/16
6	Trust Review 2nd Draft RAO WP	Wed 3/16/16	Wed 3/23/16
7	Final Draft Work RAO Plan	Thu 3/24/16	Fri 4/8/16
8	Submit Final Draft Work Plan to MDNR	Thu 4/14/16	Thu 4/14/16
9	MDNR Review of Final Draft Work Plan	Fri 4/15/16	Fri 7/15/16
10	Respond Comments & Finalize WP	Sat 7/16/16	Wed 8/10/16
11	**Phase I RAO Activities**	Wed 4/13/16	Tue 9/13/16
12	Well and Surface Elevation Survey	Tue 8/9/16	Thu 8/11/16
13	Impact-Geology-Well Data Evaluation	Tue 5/31/16	Fri 7/29/16
14	Fracture & Karst Evaluation	Wed 5/25/16	Tue 7/26/16
15	Access Agreements	Wed 4/13/16	Fri 8/12/16
16	Geophys Survey Prep/Perform	Mon 8/1/16	Thu 8/11/16
17	Technical Memo on Phase I Results	Thu 8/4/16	Wed 8/17/16
18	Submit Technical Memo to MDNR	Thu 8/18/16	Thu 8/18/16
19	PC Network Capacity Eval	Wed 6/1/16	Wed 8/17/16
20	PC-1 Monitor & Pump Test	Wed 8/10/16	Tue 9/13/16
21	**Phase II RAO Activities**	Mon 9/5/16	Mon 12/5/16
22	Start RAO Phase II	Mon 9/5/16	Mon 9/5/16
23	UFZ Delineation Phase I	Mon 9/5/16	Fri 9/30/16
24	2-Week Status Call with MDNR	Tue 9/20/16	Tue 9/20/16
25	UFZ Delineation Phase II	Wed 10/5/16	Tue 10/25/16
26	SFZ Vertical Migration Eval Phase I	Mon 10/3/16	Tue 11/8/16
27	SFZ Vertical Migration Eval Phase II	Wed 11/9/16	Tue 11/22/16
28	SFZ Horizontal Delineation	Wed 11/9/16	Tue 11/22/16
29	Source Areas Investigation	Mon 9/26/16	Fri 10/7/16
30	Comprehensive Sampling	Tue 11/29/16	Mon 12/5/16
31			
32	**RAO Report**	Wed 11/9/16	Thu 1/26/17
33	Draft RAO Report	Wed 11/9/16	Wed 12/21/16
34	Draft RAO Report Submittal to Trust	Thu 12/22/16	Thu 12/22/16
35	Trust Review Draft RAO Report	Mon 12/26/16	Wed 1/11/17
36	Finalize RAO Report	Thu 1/12/17	Wed 1/25/17



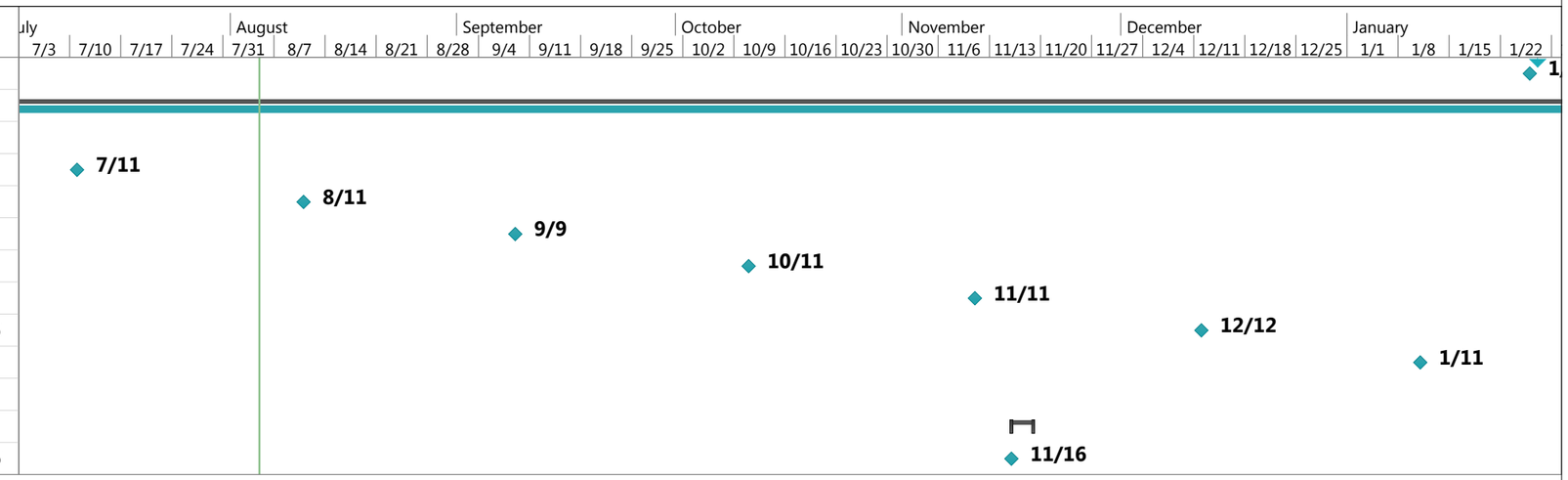
Project: Springfield RAO 2016 -
Date: Fri 8/5/16

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

Update: April 25, 2016

Figure 13.0 - REMEDIAL ACTION OPTIMIZATION - 2016 SCHEDULE
Greenfield Multistate Trust - Springfield, Missouri Site

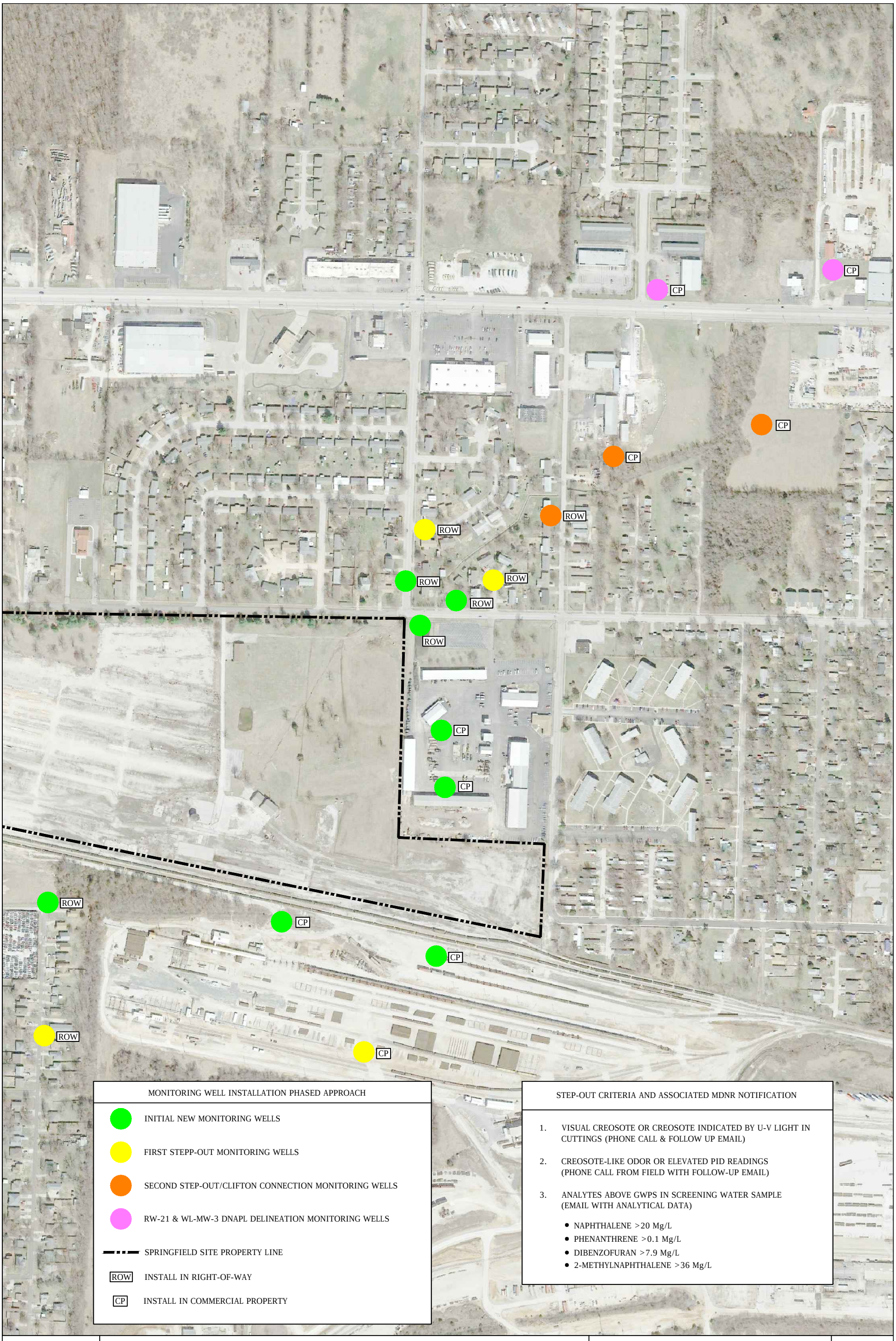
ID	Task Name	Start	Finish
37	Submit Final RAO Report to MDNR	Thu 1/26/17	Thu 1/26/17
38	**Trust Progress Reporting**	Thu 10/1/15	Fri 2/10/17
39	May 2016 Report	Fri 6/10/16	Fri 6/10/16
40	June 2016 Report	Mon 7/11/16	Mon 7/11/16
41	July 2016 Report	Thu 8/11/16	Thu 8/11/16
42	August 2016 Report	Fri 9/9/16	Fri 9/9/16
43	September 2016 Report	Tue 10/11/16	Tue 10/11/16
44	October 2016 Report	Fri 11/11/16	Fri 11/11/16
45	November 2016 Report	Mon 12/12/16	Mon 12/12/16
46	December 2016 Report	Wed 1/11/17	Wed 1/11/17
47	January 2017 Report	Fri 2/10/17	Fri 2/10/17
48	**2017 Schedule and Budget**	Wed 11/16/16	Fri 11/18/16
49	Submit 2017 Activities and Budget	Wed 11/16/16	Wed 11/16/16



Project: Springfield RAO 2016 -
Date: Fri 8/5/16

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

Update: April 25, 2016



CHECKED BY:
B. LANNING

E.W.I. # 150683
DRAWN BY: CLM
Jul. 27, 2016

PREPARED FOR:
Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

NEW UFZ MONITORING WELL STEP-OUT PLAN

SPRINGFIELD SITE - GREENFIELD MULTISTATE TRUST
2800 W. HIGH STREET
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
14.0

TABLES

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri

Table 1.0 - Regulated Constituents and Groundwater Protection Standards
Former Tronox Facility, Springfield, MO
Missouri Hazardous Waste Management Facility Permit MOD007129406

Parameter	Reference	Units	Regulatory Limit	MDL	Groundwater Protection Standard
Acenaphthene	d1	ug/L	1,200	0.1	1,200
Acenaphthylene	f	ug/L	--	0.1	0.1
Anthracene	d1	ug/L	9,600	0.1	9,600
Benzene	a	ug/L	5	0.2	5
Benzo(a)anthracene	c, e	ug/L	0.0044	0.1	0.1
Benzo(a) Pyrene	a	ug/L	0.2	0.1	0.2
Benzo(b)fluoranthene	c, e	ug/L	0.034	0.1	0.1
Benzo(k)fluoranthene	c, e	ug/L	0.0044	0.1	0.1
2-Chlorophenol	d2	ug/L	0.1	0.5	0.5
Chrysene	c, e	ug/L	0.0044	0.1	0.1
2,4 dinitrophenol	c	ug/L	70	10	70
2,4 dimethylphenol	c	ug/L	540	0.5	540
Dibenzofuran	d2	ug/L	--	0.5	7.9
Dibenzo(a,h)anthracene	c, e	ug/L	0.0044	0.1	0.1
Ethylbenzene	a	ug/L	700	0.2	700
Fluoranthene	c	ug/L	300	0.1	300
Fluorene	c	ug/L	1,300	0.1	1,300
Indeno(1,2,3-CD)pyrene	c, e	ug/L	0.0044	0.1	0.1
2-Methylnaphthalene	d2	ug/L	36	0.1	36
Naphthalene	c	ug/L	20	0.1	20
Phenanthrene	f	ug/L	--	0.1	0.1
Phenol	c	ug/L	300	0.1	300
Pyrene	c	ug/L	960	0.1	960
Toluene	a	ug/L	1,000	0.2	1,000
Xylene	a	ug/L	10,000	0.2	10,000

NOTES:

a - Limit derived from USEPA National Primary Drinking Water regulations Maximum Contaminant Level

b - Limit derived from Missouri Maximum Contaminant Level (10 CSR 60 Chapter 4), dated May 29, 2016

c - Limit derived from Missouri Water Quality Standards (10 CSR 20-7.031) for protection of groundwater, dated January 29, 2014

d1 - Limit derived from USEPA Region III Regional Screening Levels- MCL, dated January 2016

d2 - Limit derived from USEPA Region III Regional Screening Levels- Tap Water Level, dated January 2016

e - Regulatory limits are lower than ability of current analytical technology to routinely attain detection limits at or below such levels. GWPS listed is the current laboratory minimum detection level (MDL)

f - Compound is not listed in regulatory databases. Analytical MDL is assigned as the GWPS

Table 3.0 – Data Quality Objectives

Remedial Action Optimization Work Plan, Springfield, Missouri

Issue Statements	Objective	Investigation Approach	Decision Factors or Criteria
A. UPDATE MONITORING WELL ELEVATION DATA TO ENSURE ACCURATEHYDROGEOLOGIC INFORMATION			
Many original monitoring well elevations are more than 25 years old, and require verification to confirm casings have not shifted over time	Have accurate monitoring well top-of-casing elevations to generate accurate potentiometric elevations and maps for SRFI evaluations	1. Resurvey monitoring well monitoring points and land surface elevations using state-registered company 2. Revise tables with new elevations, note differences, and generate revised potentiometric maps as needed	1. Measuring point elevation differences above 0.1 ft trigger revision of potentiometric maps
Potentiometric evaluation may have combined differing UFZ hydrogeologic zones data for off-site north area; prudent to verify for all zones and wells	Accurately categorize monitoring wells for appropriate monitoring intervals of hydrogeologic zones	1. Review monitoring well geologic log data for saturation levels and likely water migration pathway horizons 2. Compare well screen depths with saturation and migration depth intervals 3. Identify wells with inappropriate screened intervals 4. Categorize wells for grouping into similar hydrogeologic zones	1. Well logs must have geologic description to evaluate 2. Migration/monitoring indicators are geologic fractures, karst, DNAPL presence, saturation, water levels 3. "Similar hydrogeologic zones" are those with migration horizons contiguous and separated by more impermeable horizons greater than 10 ft thick
B. UPDATE CHARACTERIZATION OF UPPER FLOW ZONE DNAPL – GROUNDWATER FLOW AND MIGRATION PATHWAYS			
Fracture networks and karst features appear present but not fully defined by work to-date • On-site DNAPL zones and high concentration dissolved phase plume connections are not characterized • Off-site to north: Clifton Drainage is karst trough with possible intersecting fracture zones near Kearney St; role as migration pathway not defined • Off-site north: sinkhole, DNAPL occurrence, downstream springs are pathway indicators needing evaluation • Off-site north: isolated DNAPL & high concentration plume area (RW-21, SMW-72) movement from source area is unknown • Off-site BNSF area south: Plume migration movement needs evaluation	• Primary objective is to characterize groundwater flow patterns and migration pathways. • Identify locations, depths, and orientations of plume migration hydrogeologic features explaining plume distribution • Determine if utility corridors have acted as impacted groundwater or creosote migration pathways	1. Review stratigraphic migration pathway features identified from Section A, other documents, and map their plan view and vertical distribution on- and off-site 2. Map and evaluate distribution and vertical occurrence of DNAPL from logged data 3. Perform fracture trace/lineament analysis using historical air photos and topographic maps; evaluate well horizon and drainage elevations at RW-21 4. Map locations of documented and visually identified karst features in the area 5. Evaluate contour patterns of potentiometric maps for varying recharge conditions, and evaluate head differences and variations within well groupings as indicators of fracture control 6. Screen off-site stormwater manholes, water line vaults, and other under-ground utility accesses in City ROWs in off-site Clifton drainage area for indicators of impact (visual, photoionization device readings, odor) 7. Combine all inputs above to estimate location and direction of migration-controlling features. Project features into areas needing additional delineation 8. Perform horizontal geophysical resistivity surveys in north Clifton Drainage area to localize identified fracture zones & orientations for well placement (see **Figure 7.0**) if approved as Phase I activity	1. Recharging DNAPL well locations, similar water elevations with similar variations between wells, linear orientation of high volume DNAPL locations and high concentration plume locations are indicators of hydrogeologic controls 2. Line-up of kinks/undulations in potentiometric contours may indicate hydrogeologic influence 3. Linear topographic features crossing drainage basins, stream jogs, sinkhole or other karst feature lineups, and similar features with discoloration and vegetation patterns on air photos are indicators of lineaments/fracture zones 4. Known northeast-southwest and northwest-southeast regional joint patterns are guides for lineament/fracture orientation evaluation 5. If utility corridor screening indicates potential impact, develop additional investigation approaches to further characterize potential, including screening access vaults on private property
C. UPDATE DELINEATION OF UPPER FLOW ZONE DNAPL AND DISSOLVED PHASE PLUME			
DNAPL distribution, mobility and migration are no longer fully defined	Determine DNAPL horizontal and vertical areas of concentration, identify migration pathways, and migration potential to identify potential source control corrective actions	1. Evaluate DNAPL occurrence from log reviews in Section B and recoverability extent to identify DNAPL "hot spots". Update evaluation following TarGOST investigation results 2. Match hydrogeologic migration pathways identified from evaluation above with identified DNAPL horizontal and vertical zones of concentration to evaluate potential framework for migration 3.Review history of DNAPL occurrence and recoverability in wells over time for pattern of increased recoverability moving outward from source areas	1. If likely migration pathways are identified, use information to focus location for new delineation monitoring wells. 2. Use identified hot spots and migration pathways to focus TarGOST borings 3. If offsite migration potential is likely, evaluate current recovery network and recommend changes if appropriate

Table 3.0 – Data Quality Objectives

Remedial Action Optimization Work Plan, Springfield, Missouri

Issue Statements	Objective	Investigation Approach	Decision Factors or Criteria
UFZ DNAPL and plume not fully delineated to the north and north east of the Facility. • Several PAHs at NE corner of Facility consistently exceed GWPS • No longer delineated by POC wells • Apparent creosote in residential sewer trench Feb 2009	Delineate the nature and extent of the dissolved phase plume to the north-northeast of the Facility.	1. Install up to 4 UFZ monitoring wells to 25 ft within 1,000 ft of site border in street or city right-of-ways (ROWs)(see **Figure 8.0**); field log for impact horizons 2. Check wells for DNAPL, obtain groundwater samples, and analyze for VOCs & SVOCs 3. If indicated by decision criteria, install step-out wells in outward and downgradient locations sited on fracture/karst migration orientations	1. Focus well locations along identified fracture/karst features from Section B 2. Plume edge for delineation is defined by COC concentrations greater than GWPS 3. If DNAPL present, no groundwater sampling is needed 4. If sampled groundwater results exceed GWPS, install step-out wells as a phased approach utilizing street and/or ROWs
Isolated UFZ impact in north Clifton Drainage near Kearney Street not characterized or delineated • DNAPL observed in RW-21 & WL MW-3 • High concentration COCs in SMW-72 • Connection to Facility unknown	• Define the downgradient horizontal extent of this zone and vertical impact pattern • Characterize horizontal and vertical connectivity within Clifton Drainage migration pathway	1. Utilize migration pathways evaluation from Section B to install 3 UFZ wells to 40-50 ft downgradient in fracture zones (see **Figure 7.0**), field log bores for DNAPL horizons 2. Check wells for DNAPL, sample groundwater, and analyze for VOCs & SVOCs 3. Install up to 2 UFZ monitoring wells to 30-40 ft south of impact area guided by fracture location/orientation evaluation to investigate connection with Clifton Drainage residential area impact	1. Focus well locations along identified fracture/karst features from Section B 2. Plume edge for delineation is defined by COC concentrations greater than GWPS 3. If DNAPL present, no groundwater sampling is needed 4. If groundwater sampled results exceed GWPS, evaluate need for downgradient step-out wells based on plume definition by identified fracture control and analytical data
Delineation of DNAPL and plume in isolated Kearney St area complicated by other potential sources (asphalt production plant, petrochemical liquid transporter)	• Focus extent delineation effort to avoid, as practicable, other potential sources • Determine if impact in this area is related to Site or other source	1. Use refined fracture zone locations from Section B to focus new delineation well installations in migration pathways 2. Research characteristics of other potential source locations and releases 3.Compare chemistry of DNAPL and plume COCs in wells to chemical data from other potential sources	1. Location of other source areas on/near fracture zones and in upgradient locations increases potential as source of impact; locations distant or downgradient lessens potential 2. Similar chemical signature of other source impact to chemical signature of impact in wells increases other source potential; dissimilar signature lessens potential 3. Similarity of impact chemistry in Kearney St area to Site impact chemistry increases potential 4. If other sources are more likely than Site, recommend no further characterization; if Site is likely source and new wells fail to delineate, recommend additional delineation approach
UFZ DNAPL and plume not delineated at/beyond east Facility boundary • DNAPL observed deep at east Site border (SMW-12C) • Dissolved phase plume concentrations exceed GWPS at Facility boundary	Define the UFZ horizontal extent of DNAPL and dissolved plume, and vertical distribution of DNAPL, to the east using a step-out investigation approach	1. Install 2 UFZ monitoring wells to 40 ft within 300 ft of site border northeast and southeast of Site impacted border area (see **Figure 9.0**). Field log bores to identify DNAPL horizons 2. Check wells for DNAPL, obtain groundwater samples, and analyze for VOCs & SVOCs 3. If indicated by decision criteria, install step-out wells outward to east-northeast & east-southeast along fracture/karst migration orientations from Section B	1. Focus well locations along identified fracture/karst features identified from Section B 2. Plume edge for delineation is defined by COC concentrations greater than GWPS 3. If DNAPL present, no groundwater sampling is needed 4. If groundwater sampled results exceed GWPS, install step-out wells as a phased approach utilizing street and/or ROWs
UFZ dissolved plume is no longer fully delineated to South • Higher dissolved phase concentrations have shifted south from SMW-60	Define the UFZ horizontal extent of plume in the off-site area southwest, south and southeast of Site impact, considering both fracture direction and groundwater flow direction	1. Utilize migration pathways evaluation from Section B to install 2 UFZ wells to 25 ft in the southwest off-site area (see **Figure 10.0**) 2. Install one UFZ well to 30 ft south of RW-20 (a DNAPL well) for delineation and to evaluate capture of the PC-7 pumping network at this central location	1. Focus well locations along identified fracture/karst features from Section B and downgradient flow directions 2. Plume edge for delineation is defined by COC concentrations greater than GWPS 3. If DNAPL present, no groundwater sampling is needed

Table 3.0 – Data Quality Objectives

Remedial Action Optimization Work Plan, Springfield, Missouri

Issue Statements	Objective	Investigation Approach	Decision Factors or Criteria
• Detections in SMW-62 & SMW-64 exceed GWPS • Influence from possible northeast-southwest fracture trend is unknown		2. Utilize groundwater flow direction, and any new migration pathways evaluation from Section B, to install 2 UFZ wells to 25 ft in the south and southeast off-site areas downgradient of SMW-62 & SMW-64 (see **Figure 10.0)** 3. Check wells for DNAPL, obtain groundwater samples, and analyze for VOCs & SVOCs 4. Collect water level data from new monitoring wells and other south area monitoring wells to better define groundwater flow patterns	4. If sampled groundwater results exceed GWPS, evaluate need for further step-out wells based on plume definition and analytical data
D. IDENTIFY AND CHARACTERIZE POTENTIAL EXPOSURE PATHWAYS TO DNAPL AND DISSOLVED PHASE PLUMES			
Because the nature and extent of DNAPL and UFZ plume are no longer delineated by the existing well network, it is not possible to determine if potentially complete effective exposure pathways (e.g. vapor intrusion, dermal contact, whole body contact), and construction worker) are present.	Identify potentially complete exposure pathways based on updated groundwater data and evaluate the potential for unacceptable risk	1. Perform an initial assessment of analytical results from existing wells at the northeastern and eastern Facility boundaries, reviewing concentrations and depth to groundwater by compare existing groundwater analytical data, and analytical results from newly installed wells to applicable U.S. EPA screening levels for vapor intrusion, dermal exposure, whole body contact exposure pathways . Update evaluation with recent analytical data from new monitoring well sampling 2. Complete delineation of DNAPL and dissolved phase plumes as described in Section C above. 3. Install shallow and deep soil vapor wells if VISL evaluation indicates potentially complete exposure pathway, collect vapor samples, analyze for volatile organic site COCs and naphthalene, and compare data to applicable U.S. EPA screening levels	1. If groundwater analytical data comparisons to U.S. EPA screening levels for vapor intrusion, dermal exposure, and whole body contact exposure pathways, identify potential receptors 2. Determine whether immediate action is necessary to be protective of human health while investigations are being completed 3. Identify additional sampling needed to complete potential exposure and risk evaluations. • Delineate extent of screening level exceedances in groundwater • If groundwater VISL evaluation indicates potential risk, then soil vapor wells will be installed 4. Determine next steps based on all sampling results, including implementation of interim actions, if necessary, to control potential exposure(s)
Potential for current and future on-site exposure from near surface residual contamination at former operations area has not been fully evaluated, for example: • Former Landfarm area • Drip Track area • Black Tie storage area	Determine if concentrations of residual contaminants in soil at on-site former operations areas pose potential unacceptable risk for surface uses of Facility	1. Evaluate historical soil sample analytical data from former operations areas, and compare results to appropriate U.S. EPA screening levels for potential exposure risk 2. As appropriate from historical evaluation in (1), collect shallow (< 2 ft) soil samples for analysis of Facility COCs from former operational areas with indicated risk, or from areas lacking historical data. Compare analytical results to appropriate U.S. EPA screening levels	1. If initial screening indicates Facility areas with potential risk or areas with no data, sample to obtain recent data from those areas 2. If recent sampling results indicate potential exposure risk, determine appropriate mitigation options for present and future land use
E. UPDATE UNDERSTANDING OF POTENTIAL FOR CONTAMINANT VERTICAL MIGRATION PATHWAY FROM UFZ TO SFZ			
Groundwater monitoring date indicates vertical migration (from UFZ to SFZ) may be occurring: • BMW-5A in center Site had DNAPL and fractures to 80 ft deep, with apparent hydraulic connection to BMW-5 at 138 ft • BMW-10R in southwest Site has high plume COC concentrations, and fractures spanning the UFZ and SFZ	• Identify and characterize likely vertical migration pathway to SFZ to aid in effective design of further delineation and/or corrective measures for SFZ impact • Identify SFZ migration zone and impacted horizon depths in SFZ for appropriate design of well monitoring intervals to avoid potential cross-contamination between UFZ and SFZ	Two phased approach: 1. Evaluate historical records • Review UFZ and SFZ well boring logs near BMW-5 and BMW-10R for evidence of vertical migration features and DNAPL occurrence • Evaluate head differences and changes for historical water levels in those UFZ and SFZ wells for evidence of hydraulic connectivity 2. Install one SFZ monitoring well each near BMW-5 and BMW-10R (see **Figure 11.0**) within likely footprint of northeast fracture zone, using this iterative drilling and monitoring process:	1. Well logs must have geologic description to evaluate 2. Migration/monitoring indicators are geologic fractures, karst, DNAPL presence, water entry indications 3. Small UFZ-SFZ head differences combined with lower UFZ elevations than other wells suggest hydraulic connection; similar patterns through seasons of UFZ with SFZ well vs other pairs may also indicate connectivity 4. Field evidence of UFZ-SFZ connection via fractures:

Table 3.0 – Data Quality Objectives

Remedial Action Optimization Work Plan, Springfield, Missouri

Issue Statements	Objective	Investigation Approach	Decision Factors or Criteria
• These wells lie along extension of southwest-trending Clifton Drainage karst trough	• Determine if DNAPL is present in the SFZ beyond BMW-5	• Case well 15 ft into bedrock and drill to 80 ft as open bore • Video well and collect low flow samples at 25 and 60 ft depths for VOC & SVOC analysis • Ream out 10" to 80 ft, grout in 6" casing, and open bore drill to 180 ft • Video well and collect low flow samples at 90, 125, and 175 ft depths for VOC & SVOC analysis 3. Evaluate logged, video, and vertical sampling data for indications of impact horizons and potential vertical migration potential, and compare results to monitoring intervals in other BMW wells	• DNAPL horizons spanning UFZ – SFZ • Visual vertical fractures or evidence of fracturing into the SFZ • Similar analytical data in UFZ and SFZ • Rapid recharge of water into SFZ when removed
F. UPDATE DELINEATION OF SECONDARY FLOW ZONE DISSOLVED PHASE PLUME			
On-site SFZ plume is not delineated at two locations • Southwest at BMW-10R (high COC concentrations) • North at BMW-02 (decreasing concentration trend)	• Define the on-site and off-site SFZ horizontal extent of plume in area of BMW-10R • Confirm decreasing plume COC concentration trend at BMW-02 • Determine need for/scope of corrective measures.	1. Install 2 SFZ monitoring wells in addition to the SFZ vertical delineation well from (E) to 180 ft, northwest and southwest of BMW-10R (see **Figure 11.0**). Field log bores to identify DNAPL horizons 2. Check wells for DNAPL, obtain groundwater samples, and analyze for VOCs and SVOCs 3. Evaluate plume concentration trends in BMW-2 from Permit sampling events	1. Plume edge for delineation is defined by COC concentrations greater than GWPS 2. If DNAPL present, no groundwater sampling is needed 3. If sampled groundwater results exceed GWPS, evaluate need for further step-out wells based on plume definition and analytical data
G. UPDATE IDENTIFICATION AND CHARACTERIZATION OF ON-SITE SOURCE MATERIAL			
Extent of remediation of former SWMUs is uncertain, and residual source material may be present • Ongoing DNAPL recovery north, east, central Site areas • High plume COC concentrations on-site	1. Confirm on-site source areas have been identified by previous investigations. 2. Update information on the location, volume, mobility and leachability of source material present. 3. Identify physical site characteristics that affect ability to remove, treat and/or contain source materials.	1. Perform TarGOST investigation in source areas with borings on 45-ft spacing in orthogonal grid pattern around source SWMU ponds (see **Figure 12.0**) • Grid orientation north-south, east-west to intersect northwest and northeast fracture trends that may act to collect mobile DNAPL • Target edges of former ponds where DNAPL is recovered • Extend grid lines and fill in as necessary to delineate DNAPL masses 2. Use Geoprobe borings to sample TarGOST "hot spots" for visual evaluation and to collect and analyze samples for chemical verification and geotechnical parameters that may be needed for remedial option evaluation	1. If DNAPL masses are indicated in two nearby evaluated areas, use fill-in borings to test for connection 2. If results indicate large masses of DNAPL, evaluate mobility potential (mass size, DNAPL volume estimate, proximity to migration pathways, historical recovery downgradient) 3. If DNAPL masses are present and have mobility potential, design appropriate stabilization, removal, or treatment measures options.
H. EVALUATE PUMPING CENTER 1 HYDRAULIC CAPTURE AND CURRENT CAPACITY OF PUMPING CENTERS			
Hydraulic control at Pumping Center 1 may not be consistent, and capacity to handle increased pumping is not known • Concentrations of COCs in downgradient wells remain elevated • Groundwater surface seep occurs during high precipitation recharge events	Determine strength, consistency, and potential need for increased hydraulic control in central area of Pumping Center 1 near seep	1. Evaluate historical hydraulic control at PC-1 from historical potentiometric map patterns, water level data, and pumping rate changes 2. Evaluate current hydraulic control at central PC-1 area near seep • Install unconsolidated zone piezometer at area of high recharge seep • Collect manual and automatic-recorded water levels from piezometer and immediate downgradient monitoring wells • Perform short term pumping test with higher rate pump and monitor water levels	1. Hydraulic control indicated by: • Hydraulic gradient toward pumping center • Monitoring well head decreases with increased pumping • Controlled piezometer water level during precipitation induced increased recharge events 2. Data from dry and wet seasons are needed for full evaluation
Recovery system capacities are uncertain at system Pumping Centers • Design capacity of current system pumping centers are not known	Determine current system effluent flow capacities for each pumping center, and combined centers capacity for system	1. Calculate effluent line capacity capability using piping dimensions, infrastructure restrictions, friction losses, existing pumping outputs, and treatment system in-flow mechanical arrangements for each pumping center for existing network setups	1. Calculations based on available piping data, map measurements, and current pump performance data 2. Calculations assume unobstructed pipe internal volume

Table 3.0 – Data Quality Objectives

Remedial Action Optimization Work Plan, Springfield, Missouri

Issue Statements	Objective	Investigation Approach	Decision Factors or Criteria
• Potential to increase pumping within Pumping Centers existing infrastructure has not been determined		2. Calculate maximum pump rate output for each pumping center based on calculated existing piping capacity for that pumping center	3. Friction losses and other engineering parameters for calculations will use standard textbook reference values for piping type, dimensions, and restrictions as estimated where not available from design documents 4. No field measurements or testing will be done as part of this capacity evaluation

NOTE: BLUE FONT entries are planned Phase I tasks, to be performed while RAO Work Plan is in review for finalization

Table 5.0 – Monitoring Well Installation and Development Procedures
Former Tronox Facility, Springfield, MO
Missouri Hazardous Waste Management Facility Permit MOD007129406

General Drilling Procedures		
Regulations	Missouri Well Construction Rules 10 CSR 23 Chapter 4	
Drill Method	• Air rotary / Air Hammer • Hollow Stem Augers (HSA) (HSA used if hole won't stay open in unconsolidated)	
Bit Size	Variable 14", 12", 10", 8", 6" tri-cone or air hammer	
Cuttings Management	• Wellhead Diverter with hose to drum or lift trailer • Cuttings moved to Facility (see Waste Management Plan)	
Water Management	• Berm with plastic around Wellhead • Trash pump, hoses for transfer to drums	
Well Installation	**UFZ**	**SFZ**
Borehole Size	• 10" for 6" casing if needed • 6" bore for 2" casing and screen	• 14" for 10" surface casing • 10" for 6" casing • 6" or 4" for open bore
Casing/Riser	• 2" Schedule 40 PVC (minimal impact) • 2" Steel (if creosote producer) • Centralizers if not in HSA	• 6" Schedule 40 or 80 PVC (minimal impact) • 6" Steel (creosote producer)
Screen Type	0.01" slot, PVC or steel	None – open bore
Monitoring Interval	Variable, 10 ft – 40 ft	Variable 80 ft – 170 ft
Filter Pack	10-20 sand	None – open bore
Seals	• 2-ft bentonite above sand • Bentonite chips or bentonite-cement grout for casing (24-hr set time)	• Shale basket at casing base with 2-3 ft bentonite chips • Bentonite-cement grout for casing (24-hr set time)

Table 5.0 – Monitoring Well Installation and Development Procedures
Former Tronox Facility, Springfield, MO
(Page 2)

Development	UFZ	SFZ
Method	• Calculate casing water volume • Alternate water removal with surging. Remove 5 casing volumes • Visually check clarity • Repeat until clear • Check water quality if won't clear	• Calculate casing water volume • Adjust berm for volume • Blow out water to remove residual cuttings • Repeat if recharges • Use Potable water if no well water (MDNR approval)
Equipment	• Bailer or pump • Surge Plug • YSI Water quality meter	• Additional berm materials • Drill rods & drilling air
Criteria	• Done = visually clear • Done = stable YSI parameters	• Done = minimal cuttings • Volume in casing = water volume recovered
Water Management	• Removed water to drum, dispose per Waste Management Plan (WMP)	• Berm to capture water • Pump to drum(s) • Disposal per WMP

ATTACHMENT A

DATA MANAGEMENT PLAN

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri

Attachment A

DATA MANAGEMENT PLAN

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 West High Street, Springfield, Missouri
RCRA Permit Number MOD007129406

March 18, 2016

DATA MANAGEMENT PLAN

This Data Management Plan (DMP) serves to provide a framework that ensures quality and efficient management of data related to Facility work, from the time it is collected through its primary use and preservation for future reference.

1.1 Data Collection

The first stage of data management is to collect and compile data in a standardized format that all users can understand. Implementing data collection protocols helps to guarantee that the standardized format is maintained throughout the duration of the project. Historical data should be collated, reviewed, and evaluated for use with newly collected data. The approach for investigations to meet these data collection goals and streamline data management is to record clear data parameters for each sample.

1.1.1 Field Protocol Related to Data Management

Data forms will include fields to enter data for each environmental sample collected. This data management plan is designed to mesh with a quality assurance project plan (QAPP), which contains examples of field forms.

The following parameters will be included with each sample on the appropriate field form:

- Monitoring Well or Boring ID;
- Unique sample IDs (defined in the QAPP);
- Sample Matrix (Soil, Groundwater, Vapor, DNAPL);
- Sample Method (Grab, Composite, Cumulative);
- Date and time the sample was taken (grab) or started and ended (composite);
- Name of the person who took the sample;
- Sample containers (type and volume) and preservatives (if present);
- Analyses to be performed; and
- Additional notes (anything that affects a sample uniquely).

The following additional information should be annotated in the Field Notes and other Field Logs, if applicable, based on parameters for any given sample:

- Weather conditions for the day, changes in weather throughout the day
- Other members of the sampling team
- Specific instruments used (Interface Meter (IM)-1, IM-2, YSI 556, etc)
- Instrument calibration and maintenance logs

1.2 Protocol for Existing Data

Existing data will be used during Facility work if quality is considered adequate through review of field notes, other logs, and historical reports. Existing data will be reviewed from sources, and will be used as appropriate for investigation activities. Data will be input to common project electronic files if needed for trend evaluations, numerical averaging of data sets, or evaluation activities.

Other existing historical information sources such as aerial photography, maps, figures, plans, etc. will be reviewed for potential usefulness in current investigation evaluations

1.3 Database Entry and File Retention

All data discussed above will be entered into an electronic database, e.g. Microsoft Excel®, Microsoft Access® , etc. appropriate for the intended project use. Data parameters should be included as appropriate for the type of data and need for electronic formatting of those parameters, e.g., soil horizon, soil sample depth, pump depth for water collection, method of collection, etc. for each entry in the database. Appropriate parameters can assist in sorting data out of the extensive historic and new data sets. Field work request packets, or other evaluation guideline documents, should designate the data parameters to be collected and extent of database processing needed for the particular project work.

It is the responsibility of the Field Manager (FM) or Assistant Project Manager (APM) to promptly review completed Field Work Packets, have them scanned and placed in the appropriate electronic project file folders, and periodically upload key elements to a web-based data storage center designated by the Multistate Trust. All paper files will be retained at the primary contractor (Environmental Works, Inc.) offices responsible for collection and evaluation of the data. The APM will coordinate database entry and storage with a technical secretary, or other personnel type, as appropriate. All personnel involved with data processing will be trained in the required data management and storage protocols.

1.4 Data Quality Control

The QAPP provides a quality control framework for executing field work that assures:

- Field forms are filled out completely and correctly;
- The sample naming protocol is followed; and
- The scope of usefulness associated with existing data is documented, and that only existing data of sufficient quality to meet the data quality objectives (DQOs) for the given investigation are used.

The Quality Assurance Manager (QAM) will periodically audit the DMP framework and immediately inform the SPM of any non-conformances and implement corrective action. Any data analyses that were done using data that was managed incompletely will be evaluated for feasible use and possible re-collection.

1.5 Data Processing

Database entries can be grouped and processed by categories to allow the user to evaluate investigation issues and further develop the conceptual site model. The database can be searched to readily gather relevant information for the analysis to be performed. Expected data processing for anticipated Facility work may include the following:

- Water levels for hydrograph and potentiometric studies using recent data or historic water levels and potentiometric surfaces to understand groundwater flow dynamics in hydrogeologic systems
    - Correlation between precipitation and water levels, spatial variation of the response to precipitation, seasonality trends, possible application of convolution integrals to model volumetric head loads to hydrogeologic systems to evaluate remedial efforts
- Horizontal and vertical delineation of dissolved phase plume concentrations, including “hot spots” and plume stability
    - Compilation of groundwater data for areas of the plume
    - Comparison of data to appropriate groundwater protection standards
- Plume migration pathways, including geological migration horizons, fracture or karst analysis, etc.
    - Vertical and horizontal area chemical and hydraulic changes to help define migration pathways
    - Chemical and hydraulic data trends and patterns analysis to evaluate the effectiveness of current remedial efforts
    - Chemical and water volume mass flux calculations for transects of wells in hydrogeologic horizons
- DNAPL mobility
    - Quantitative and qualitative analysis of TarGOST® data, Geoprobe® core lithologic, impact, moisture, photoionization detector readings, etc. data
    - Compilation of the above data into two- or three-dimensional representations to characterize DNAPL volume, saturation, and mobility potential
- Geophysical resistivity survey data and processing

  - Raw and processed data from geophysical transects, processed and interpreted for top of bedrock, fractures, and karst features.

- Tests and analyses for hydraulic control and remedial effectiveness
  - Pumping testing data processing, water level data change analyses using trends and numerical solutions (e.g. AQTESOLV) to calculate hydraulic parameters, e.g. hydraulic conductivity, transmissivity, flow rates
  - Predictive modeling using parameters to estimate capture zones, etc.
  - Piping capacity calculations using engineering data, e.g. lengths, diameters, friction loss, pumping rates, etc.

1.6 Data Presentation and Reporting

Data will be processed or analyzed for presentation in varied condensed formats depicting findings. Examples of presentation data for investigation reporting may include:

- Sorted summary tables of water chemistry concentrations, DNAPL levels and recovered volumes, water levels, soil concentrations, TarGOST® sensor data, etc.
- Graphical displays using bar graphs, line graphs, scatter plots, or time series plots to represent trends, cumulative DNAPL recovery, pumping test results, hydrographs, etc.
- Visual representation of data in plan maps, transect views, or cross-sections; e.g. figures depicting topography, sampling locations, iso-concentration maps, potentiometric surfaces, recovery system capture zones, DNAPL occurrence, boring logs, hydrogeologic features, well construction, etc.

Internal to subcontractor teams, processing data for above presentation types should follow established protocols. For unique data processing, detailed notes on the following should be annotated for process explanation:

- How the data was retrieved from the database
- Statement of the intended outcome
- Initial processing actions
- Summary of analytical steps
- Step-by-step explanations of calculations
- Results of the analysis
- Concise scientific conclusion with supporting technical arguments

Any data user should be able to recreate the final product of a data analysis by viewing these notes. Notes and related reports will be retained in the electronic and paper project files for availability and preservation.

Investigation databases and related raw processing tables will be submitted with investigation progress and final reports as Electronic Data Deliverables (EDDs).

1.7 Data Archiving and Storage

Upon agency approval of final reporting, all paper files will be properly archived and securely stored at a location specified by the Multistate Trust. The electronic files will remain available on the Multistate Trust's designated web-based storage site, and also on the contractor's secure server. Duplication of data for storage is essential to ensure no data loss and availability for used in future investigation, evaluation, and corrective actions at the Facility. All files will be retained indefinitely for possible re-evaluation as part of the RCRA corrective action process.

ATTACHMENT B

SITE SAFETY AND HEALTH PLAN

(document submitted separately)

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri

Former Tronox/Kerr McGee Wood Treating Facility
Site Safety and Health Plan

2800 West High Street
Springfield, Missouri 65803

Prepared For:

Greenfield Environmental Multistate Trust LLC,
Trustee of the Multistate Environmental Response Trust

Prepared in Accordance with 29 CFR By:

Environmental Works, Inc.

August 18, 2016

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ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ASTM	American Society for Testing and Materials
ANSI	American National Standards Institute
BNSF	BNSF Railway
bpm	Beats per minute
CFR	Code of Federal Regulations
CM	Compliance Manager
COCs	Chemicals of concern
CPR	Cardio pulmonary resuscitation
CRZ	Contamination Reduction Zone
CTPV	Coal tar pitch volatiles
DM	Decontamination Manager
ERC	Emergency Response Coordinator
ESLI	End of service life indicator
EWI	Environmental Works, Inc.
F	Fahrenheit
FM	Field Manager
ft	Feet or foot
GFCI	Ground fault circuit interrupter
HAZMAT	Hazardous materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
hr	Hour
IDLH	Immediately dangerous to life and health
JHA	Job Hazard Analysis
lb(s)	Pound(s)
LEL	Lower explosive limit
LOTO	Lockout/tagout
MDNR	Missouri Department of Natural Resources
mg/m^3	Milligrams per cubic meter
mil	Millimeters
Multistate Trust	Greenfield Environmental Multistate Trust LLC
MUTCD	Manual on Uniform Traffic Control Devices

NIOSH	National Institute for Occupational Safety and Health
O&M	Operation and maintenance
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
PID	Photo-ionization detector
PLHCP	Physician or other licensed health care professional
PM	Project Manager
PPE	Personal protective equipment
ppm	Parts per million
PVC	Poly vinyl chloride
QAPP	Quality Assurance Project Plan
QLFT	Qualitative fit test
QNFT	Quantitative fit test
RCRA	Resource Conservation and Recovery Act
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SCBA	Self-contained breathing apparatus
SDS	Safety Data Sheet
SIO	Site Inspection Officer
SO	Security Officer
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasures
SPM	Senior Project Manager
SRFI	Supplemental RCRA Facility Investigation
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SSN	Social security number
STEL	Short-term exposure limit
TLV	Threshold limit value
TWA	Time-weighted average
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency

VOC(s)	Volatile organic compound(s)

TITLE AND APPROVAL SHEET

This Site Safety and Health Plan is approved for use at the former Greenfield Environmental Multistate Trust former Kerr McGee (Tronox) Site, Springfield, Missouri. The signatures below denote certification/approval of the document, and agreement to abide by the procedures outlined within it.

_____ _____
Leonard Fullbright Date
Environmental Works, Inc.
Safety Professional

_____ _____
Lauri Gorton Date
Greenfield Environmental Multistate Trust
Director of Environmental Programs and Senior Strategist

_____ _____
Tasha Lewis Date
Greenfield Environmental Multistate Trust
Portfolio Manager

_____ _____
Amber Igoe Date
Greenfield Environmental Multistate Trust
Project Manager

_____ _____
Robert Lanning, PG Date
Environmental Works, Inc.
Senior Project Manager

_____ _____
Thomas Bieker, M.Sc., CHMM Date
Environmental Works, Inc.
Principal/Quality Assurance Manager

_____ _____
Brandon Thornhill, RG Date
Environmental Works, Inc.
Site Safety and Health Officer

1. INTRODUCTION

This document presents the Site Safety and Health Plan (SSHP) for work at the former Kerr-McGee/Tronox site, located at 2800 West High Street in Springfield, Missouri (Site, see Figure 1). Work at the Site is managed by the Greenfield Environmental Multistate Trust LLC (Multistate Trust), through their contractor, Environmental Works, Inc. (EWI). The SSHP program and standard operating procedures (SOPs) outlined within are mandatory safety and health practices for all contractors and subcontractors that perform work at this Site. Subcontractors are required to comply with the policies and procedures in this program, unless they have procedures that provide for equivalent means of employee safety and health. The Site Health and Safety Officer (SSHO) must approve any variances from this manual before the start of a project or task.

1.1. PURPOSE

The purpose of this SSHP is to provide Site workers, visitors, regulators, and sub-contractors with written documentation of the current SSHP Program, which includes work practices and procedures to be followed by all employees at the Site. This SSHP will be updated periodically as needed by the SSHO or his/her designee(s).

A copy of this SSHP will be maintained at the EWI corporate office located at 1455 East Chestnut Expressway, Springfield, MO, and at the Site. Copies will be distributed on an as-needed basis to project managers, EWI employees, subcontractors, visitors, and regulators who will be working on or observing activities at the Site.

All EWI employees working at the Site will participate in required training sessions covering specific topics of the SSHP Program. Concerns relating to employee health and safety arising outside of scheduled training or safety committee meetings should be brought to the attention of the SSHO.

1.1.1. DOCUMENT ORGANIZATION AND REFERENCES

This document is organized as listed below. The document was developed in compliance with 29 Code of Federal Regulations (CFR) 1910 by utilizing the 29 CFR 1910 Occupational Safety and Health Administration (OSHA) General Industry Regulations manual, OSHA's eHASP software, and www.osha.gov. References for specific topics are included below with the corresponding section.

Section 1: Introduction
Section 2: Organizational Structure - 29 CFR 1910.120(b)(2)
Section 3: Safety and Health Hazards - 29 CFR 1910.120(b)(4)(ii)(A) and 1910.120(i)
Section 4: Site Control - 29 CFR 1910.120(b)(4)(ii)(F) and 29 CFR 1910.120(d)
Section 5: Training Program - 29 CFR 1910.120(e)
Section 6: Subcontractor Safety - 29 CFR 1910.120
Section 7: Medical Surveillance -29 CFR 1910.120(f), 29 CFR 1910.1001-1052, and 29 CFR 1910.134(e)
Section 8: Personal Protective Equipment - 29 CFR 1910.120(b)(4)(ii)(C) and 29 CFR 1910.120(g)
Section 9: Respiratory Protection - 29 CFR 1910.134 and 29 CFR 1910.1000
Section 10: Exposure Monitoring - 29 CFR 1910.120(b)(4)(ii)(E) and 29 CFR 1910.120(h)
Section 11: Thermal Stress Program - 29 CFR 1910.120(h)
Section 12: Decontamination - 29 CFR 1910.120(b)(4)(ii)(G) and 1910.120(k)
Section 13: Emergency Response Planning - 29 CFR 1910.120(l) and 1910.120(b)(4)(ii)(H)
Section 14: Spill Containment Program - 29 CFR 1910.120(b)(4)(ii)(J) and (j)(1)(viii)
Section 15: Electrical Safety - 29 CFR 1910.331-339
Section 16: Permit Required Confined Space -29 CFR 1910.120(b)(4)(ii)(I) and 1910.146
Section 17: Trenching and Excavation - 29 CFR 1926.651
Section 18: Elevated Work program - CFR 1926, Subpart M, Fall Protection
Section 19: Drum handling.

Section 20: Hot Work - 29 CFR 1910.252(a)
Section 21: Hazardous Energy Control or Lockout/Tagout Program - 29 CFR 1910.147

Documents appended to this SSHP include the following:
Appendix A includes Site-specific Job Hazard Analysis Tables 1A-1K
Appendix B includes Safety Data Sheets for chemicals to be utilized at the Site.
Appendix C includes chemical hazard sheets for current associated Chemicals of Concern.
Appendix D includes forms used during specific tasks outlined in this SSHP.

2. ORGANIZATIONAL STRUCTURE

This section of the SSHP describes lines of authority, responsibility, and communication as they pertain to health and safety functions at this Site. The purpose of this section is to identify the personnel who impact the development and implementation of the Site SSHP and to describe their roles and responsibilities. This section also identifies other subcontractors involved in work operations and establishes the lines of communication among them for safety and health matters. The organizational structure of this Site's safety and health program is consistent with OSHA requirements in 29 CFR 1910.120(b)(2) and provides the following Site-specific information:

- The general supervisor has the responsibility and authority to direct all Hazardous Waste Operations and Emergency Response (HAZWOPER) activities;
- The SSHO has the responsibility and authority to develop and implement this SSHP and verify compliance;
- Other personnel needed for hazardous waste operations and emergency response and their general functions and responsibilities; and
- The lines of authority, responsibility, and communication for safety and health functions

This section is reviewed and updated as necessary to reflect the current organizational structure at this Site.

2.1. ROLES AND RESPONSIBILITIES

EWI is the Multistate Trust's representative for the Site. All EWI personnel and visitors on this Site must comply with the requirements of this SSHP. The specific responsibilities and authority of management, safety and health, for primary project personnel are detailed in the following paragraphs. An organizational chart is included as Figure 2, and includes a listing of field sampling personnel.

Senior Project Manager

The Senior Project Manager (SPM) for the Site is Robert Lanning. The SPM has responsibility and authority to direct all work operations. The SPM coordinates safety and health functions with the SSHO, has the authority to oversee and monitor the performance of the SSHO, and bears ultimate responsibility for the proper implementation of this SSHP. The SPM also has authority to delegate tasks discussed within the SSHP to the qualified alternate Project Manager (PM). The specific duties of the PM are as follows:

- Preparing and coordinating the Site work schedule;
- Providing the Field Manager (FM) with work assignments and overseeing work performance;
- Coordinating safety and health efforts with the SSHO;
- Ensuring effective emergency response through coordination with the Emergency Response Coordinator (ERC); and
- Serving as the joint Site liaison with the Multistate Trust, public agencies, officials, and Site subcontractors.

The qualified alternate Project Manager (PM) for this Site is Barbara Garcia.

Principal

The Principal for the Site is Thomas Bieker. The Principal has responsibility and authority to direct all

work operations involving daily operation and maintenance (O&M) operations and regulatory compliance. The Principal coordinates safety and health functions with the SSHO and has the authority to oversee and monitor the performance of the SSHO. The Principal also has authority to delegate tasks discussed within the SSHP to the qualified alternate PM. The specific duties of the Principal are as follows:

- Preparing and coordinating the Site work schedule;
- Providing the Compliance Manager (CM) with work assignments and overseeing work performance;
- Coordinating safety and health efforts with the SSHO;
- Ensuring effective routine O&M
- Ensuring effective routine regulatory compliance; and
- Serving as the joint Site liaison with the Trust, public agencies, officials, and Site subcontractors.

The qualified alternate Principal for this Site is AdriAnn Rode.

Site Safety and Health Officer

The SSHO for this Site is Brandon Thornhill. The SSHO has full responsibility and authority to develop and implement this SSHP and to verify compliance. The SSHO reports to the SPM/PM. The SSHO is on Site, or readily accessible to the Site, during all work operations and has the authority to halt Site work if unsafe conditions are detected. The SSHO also has authority to delegate tasks discussed within this SSHP to the qualified assistant SSHO(s). The specific responsibilities of the SSHO include the following:

- Managing the safety and health functions on the Site;
- Serving as the Site's point of contact for safety and health matters;
- Ensuring Site monitoring, worker training, and effective selection and use of personal protective equipment (PPE);
- Assessing Site conditions for unsafe acts and conditions and providing corrective action;
- Assisting the preparation and review of this SSHP; and
- Maintaining effective safety and health records as described in this SSHP and coordinating with the Emergency Response Coordinator (ERC), Site Supervisor(s), and others as necessary for safety and health efforts.

The qualified assistant SSHO for this Site is Robert Fess.

Emergency Response Coordinator

The ERC for this Site is John Rode. The ERC is responsible for assessing Site conditions and directing and controlling emergency response activities in accordance with the Site Emergency Response Plan, discussed in Section 13. The ERC reports to the SPM. The ERC will ensure the evacuation, emergency transport, and treatment of Site personnel, and will notify the appropriate emergency response units and management staff in accordance with the emergency response plan of this SSHP. The ERC also has authority to delegate tasks discussed within this SSHP to the qualified assistant ERC(s). Specific duties of the ERC include:

- Developing and reviewing the Emergency Response Plan;
- Conducting emergency response rehearsals;
- Ensuring effective emergency response to and evacuation of the Site; and

- Coordinating emergency response functions with the SSHO, and integrating Site emergency response plans with the disaster, fire, and/or emergency response plans of local, state, and federal organizations and agencies.

The qualified assistant ERC for this Site is Greg Eichmeyer.

Field Manager

The FM for this Site is Brandon Thornhill. The FM is responsible for field operations and reports to the SPM. The FM ensures the implementation of the SSHP requirements and procedures in the field. The FM also has authority to delegate tasks discussed within this SSHP to the qualified assistant FM. The specific responsibilities of the FM are the following:

- Executing the work schedule as detailed by the SPM
- Coordination with the SSHO on safety and health
- Ensuring Site work compliance with the requirements of this SSHP

The qualified assistant FM for this Site is Robert Fess.

Decontamination Manager

The Decontamination Manager (DM) for this Site is Brandon Thornhill. The DM is responsible for decontamination procedures, equipment, and supplies. The DM ensures the implementation of the SSHP requirements and procedures for decontamination when exiting the field. The DM also has authority to delegate tasks discussed within this SSHP to the qualified assistant DM. The specific responsibilities of the DM are as follows:

- Setting up decontamination lines and the solutions appropriate for the type of chemical contamination on-site;
- Controlling the decontamination of all equipment, personnel, and samples from the contaminated areas;
- Assisting in disposal of contaminated clothing and materials; and
- Ensuring all required equipment is available and in working order, and providing for collection, storage and disposal of waste.

The qualified assistant DM for this Site is Robert Fess.

Security Officer

The Security Officer (SO) for this Site is David Settles. The SO is responsible for managing and maintaining Site security. The SO also has authority to delegate tasks discussed within this SSHP to the qualified assistant SO. The specific responsibilities of the SO are:

- Conducting routine (weekly) area patrols
- Controlling facility access and egress
- Assisting with communication during an emergency
- Securing accident/incident scenes
- Maintaining a log of Site access and egress

The qualified assistant SO for this Site is Robert Fess.

Compliance Manager

The CM for this Site is Amanda Peryer. The CM is responsible for regulatory compliance and management of routine O&M and reports to the Principal. The CM ensures the implementation of the SSHP requirements and procedures in the field. The FM also has authority to delegate tasks discussed within this SSHP to the qualified assistant CM. The specific responsibilities of the CM are the following:

- Executing the work schedule as detailed by the Principal
- Coordination with the SSHO on safety and health
- Ensuring Site work compliance with the requirements of this SSHP

The qualified assistant CM for this Site is Barrett Stanke.

Operator

The Operator for this Site is David Settles. The Operator is responsible for routine Operations and Maintenance and reports to the Compliance Manager. The Operator ensures the implementation of the SSHP requirements and procedures in the field. The specific responsibilities of the CM are the following:

- Executing the work schedule as detailed by the Principal
- Coordination with the SSHO on safety and health
- Ensuring Site work compliance with the requirements of this SSHP

The qualified assistant Operator for this Site is Robert Fess.

2.2. IDENTIFICATION OF OTHER SITE CONTRACTORS

Should the need arise for the services of additional contractors or subcontractors, a copy of this SSHP will be provided to contractors or subcontractors and procedures discussed in this SSHP abided by all personnel working on site (See Section 6, Subcontractor Safety).

2.3. OTHER LOCAL/STATE/FEDERAL AGENCY REPRESENTATIVES AND THEIR ROLES AND RESPONSIBILITIES

Missouri Department of Natural Resources (MDNR) PM

The MDNR PM for this Site is Don Dicks. Serving either in the capacity as On-Scene Coordinator (OSC), Remedial Project Manager (RPM), or Site Inspection Officer (SIO), the MDNR Representative is responsible for overall project administration and contractor oversight. As part of that oversight function, MDNR will ensure that work activities meet applicable safety requirements at a minimum, and that the health and safety of all Site personnel is a primary concern. As an OSC or RPM, MDNR serves in the capacity of regulatory Site supervisor.

United States Environmental Protection Agency (USEPA) Representative

The USEPA Representative for this Site is Mike Dandurand, P.E.. The USEPA's directive is to protect human health and the environment. It is the USEPA's responsibility to see that overall operations and initiatives conform to this directive under normal operating conditions.

3. SAFETY AND HEALTH HAZARDS

This section of the SSHP has been prepared in compliance with 29 CFR 1910.120(b)(4)(ii)(A) and 1910.120(i), and describes the safety and health hazards associated with Site work and the control measures selected to protect workers. The purpose of a Job Hazard Analysis (JHA) is to identify and quantify the health and safety hazards associated with each Site task and operation, and to evaluate the risks to workers. Using this information, appropriate control methods are selected to eliminate the identified risks if possible, or to effectively control them. The control methods are documented in each task-specific JHA. The information contained in this section is essential to effective preparation of all other sections of the SSHP. This section of the SSHP includes the following:

- Site history
- JHAs
- Hazardous substance information
- Employee notification of hazards

The person responsible for ongoing JHAs at this Site is the SSHO.

3.1. SITE HISTORY

The following text describes the Site and its conditions as they relate to the need to perform hazardous substance clean-up operations.

The Site is a former wood treatment plant that treated railroad ties with creosote wood preservative. The Site was built in 1903, and operated through 2004 when Kerr-McGee ceased operations. Three surface impoundments and a land farm treatment area on site underwent a closure process, which included the removal of contaminated soil and capping of the surface impoundments. Current operations include a pump and treat system that aids in the removal of creosote from the groundwater.

3.2. JOB HAZARD ANALYSIS

Each Site-specific JHA associated with the Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation (SRFI) Work Plan is summarized on Table 1, and specific information included for each JHA as Tables 1A-1K (Appendix A). Each JHA lists a task or operation required during Site clean-up and the location(s) where that task or operation is performed. A single JHA may be used for a task/operation performed in multiple locations if the hazards, potential exposures, and controls are the same in each location. Each JHA lists the chemical hazards and exposure limits for each chemical associated with that task. Each JHA also identifies anticipated physical and biological hazards and potential exposure levels or the likelihood of exposure.

The final section of each JHA lists the control measures implemented to protect employees from exposure to the identified hazards. The information provided here is designed to satisfy the JHA requirements of 1910.120(b)(4)(ii)(A) and the workplace hazard assessment requirements of 1910.132(d). Safety Data Sheets (SDS) for specific chemical substances to be used at the Site can be found in Appendix B. The SDS provides information regarding proper storage guidelines, handling procedures, and health and safety information pertaining to each individual substance. Chemical hazard data sheets for Chemicals of Concern (COCs) encountered during activities discussed within the JHAs can be found in Appendix C.

The SSHO modifies Site-specific JHAs and the accompanying data sheets when:

- The scope of work is changed by adding, eliminating, or modifying tasks;
- New methods of performing Site tasks are selected;

- Observation of the performance of Site tasks results in a revised characterization of the hazards;
- New chemical, biological, or physical hazards are identified;
- Exposure data indicate changes in the concentration and/or likelihood of exposure; or,
- New/different control measures are selected.

When JHAs are modified, related provisions in other sections of this SSHP are modified as needed. Specific tasks addressed in the attached JHAs and potential future amendments include the following:

- Confined Space Entry
- Installation of Communication Lines
- Installation of Remedial Discharge Lines
- Operation of Remedial Wells
- Operation and Maintenance of Facilities
- Sample Drill Return Material
- Sample System Effluent
- Water Level Measurements
- Well Construction and Maintenance
- Well Sampling
- Soil Sampling
- Downloading of Data Loggers
- General Excavation Activities
- Maintenance of Site Grounds
- Electrical Activities
- Pressure Transducer/Pump Maintenance
- Wastewater Sampling
- Stormwater Sampling

4. SITE CONTROL

This Site control program has been prepared in compliance with 29 CFR 1910.120(b)(4)(ii)(F) and 29 CFR 1910.120(d), and is designed to reduce the spread of hazardous substances from contaminated areas to clean areas, to identify and isolate contaminated areas of the Site, to facilitate emergency evacuation and medical care, to prevent unauthorized entry to the Site, and to deter vandalism and theft.

The Site control program includes the elements specified in 29 CFR 1910.120(d) and provides the following Site-specific information:

- A Site map indicating Site perimeter and work zones
- Site access procedures
- Site security
- Site work zones, including standard operating procedures
- Use of the buddy system
- Both internal (on-site) and external communications

The FM is responsible for evaluating Site conditions and for verifying that the Site control program functions effectively. The Site control program is updated regularly to reflect current Site conditions, work operations, and procedures.

4.1. SITE MAP

A map showing Site boundaries, point of entry and exit, and surrounding properties is provided in Figure 1.

4.2. SITE ACCESS

Access to the Site is restricted to reduce the potential for exposure to its safety and health hazards. During hours of Site operation, Site entry and exit is authorized at the point identified in Figure 1. Entry and exit at this point is controlled by fencing, locked gate, and Site personnel. Visitors to the Site register with the FM or his representative, and are escorted at all times. Visitors are expected to comply with the requirements of this SSHP. Visitors who want to enter contaminated areas of the Site must provide documentation that they have the required training and medical evaluation, and must receive a Site-specific briefing about protecting themselves from Site hazards, recognizing Site zones demarcations, and following emergency evacuation procedures. PPE for visitors is provided by the FM, if necessary, excluding respiratory protection and Level A and B PPE.

4.3. SITE TRAFFIC CONTROL

Various activities at the Site will be conducted near areas of heavy vehicle and pedestrian traffic including residential neighborhoods. Traffic control procedures at the Site will be the responsibility of the FM or SSHO and will be conducted in compliance with the United States Department of Transportation (USDOT) Manual on Uniform Traffic Control Devices (MUTCD). Changes or modifications to the traffic control plan will be the responsibility of the FM or the SSHO. Proper traffic control procedures at this Site include the following:

- Traffic safety in temporary traffic control areas will be an integral and high-priority element of every project, from planning through design and construction.
- Traffic will be inhibited as little as practicable.

- Drivers and pedestrians will be guided in a clear and positive manner while approaching and traversing the temporary traffic control zone.
- Routine inspections of traffic control elements will be performed throughout the duration of the work being performed.
- The maintenance of roadside safety will be maintained during the life of the temporary traffic control zone due to the potential increase in hazards.
- Good public relations will be maintained with local authorities, businesses, and the surrounding residential property owners.
- Prompt notifications will be sent to all affected involving upcoming or needed road closure or impedance.

Work requiring traffic control devices will be conducted in a timely manner by trained personnel utilizing proper traffic control devices per USDOT standards. Traffic control devices used at this Site include:

- Cones
- Barricades
- Guide and warning signs
- Arrow displays

4.4. SITE SECURITY

Security at this Site is maintained during both working hours and non-working hours to prevent unauthorized entry, removal of contaminated material from the exclusion zone, exposure of unauthorized and unprotected people to Site hazards, and increased hazards due to vandalism and theft.

4.4.1. SECURITY DURING WORKING HOURS

The FM and Operator are responsible for establishing and maintaining Site security during working hours. This Site takes the following measures for security during working hours:

- Security is maintained in the Support Zone (if present), and at Access Control Points to ensure only authorized entrants access the Site.
- A fence is erected around the perimeter of the Site to prevent unauthorized entry or exit.
- Signs are posted around the perimeter of the Site to warn of the Site dangers and prohibition of unauthorized entry.
- Site personnel observe activities inside and around the perimeter of the Site on a regular basis.

4.4.2. SECURITY DURING NON-WORKING HOURS

The FM is responsible for establishing and maintaining Site security during non-working hours. The following measures have been taken for security during non-working hours:

- All doors to on-site buildings are locked and equipment is secured; and
- A locked perimeter fence is in place.

4.5. SITE WORK ZONES

Site work zones for this Site will be established for specific activities when necessary (Table 1, Appendix A). These zones include the Exclusion Zone (Section 4.5.1), Contamination Reduction Zone (CRZ) (Section 4.5.2), and the Support Zone (Section 4.5.3). These zones are characterized by presence or absence of biological and chemical hazards and the activities performed within them. If work zones are necessary, then zone boundaries will be clearly marked at all times and the flow of personnel among the zones controlled.

The Site will be monitored for changing conditions that may warrant adjustment of zone boundaries. Zone boundaries are adjusted as necessary to protect personnel and clean areas. Whenever boundaries are adjusted, zone markings are also changed and workers are immediately notified of the change. Most activities performed on site will not require the use of these work zones.

The following criteria will be considered in establishing Site work zones:

- Required clean-up activities;
- Sampling results for air contaminants;
- Potential for fire;
- Physical, chemical, toxicological, and other characteristics of substances present;
- Physical and topographical features of the Site;
- Weather conditions, particularly the direction of prevailing winds relative to the locations of the support zone and other uncontaminated areas on site; and
- The potential for explosion and flying debris.

4.5.1. EXCLUSION ZONE

The Exclusion Zone is the area where a hazardous substance is known or suspected to be present and pose the greatest potential for exposure. At this Site, the Exclusion Zone boundaries will be marked with caution tape, barricades, temporary fencing, etc., if necessary. Personnel and equipment will enter and exit the Exclusion Zone from the designated access points in the CRZ.

Personnel in the Exclusion Zone will adhere to the following criteria:

- Check in and out of this zone at the designated access point(s).
- Use the buddy system at all times.
- Wear the PPE required for this zone (see PPE section of this SSHP).
- Perform air monitoring as required for this zone (see Exposure Monitoring section of this SSHP).
- Smoking, eating, or drinking is prohibited.
- No matches, lighters, or open flame is allowed.
- Monitor self and buddy for signs of heat or cold stress or chemical overexposure.
- Alert supervisor to signs of changing or unanticipated hazards.
- Refrain from engaging in horseplay.
- Monitor self and buddy for PPE rips, tears, and/or damage.
- Use monitoring equipment and tools that are safe for the working environment.

- Use ground-fault circuit interrupters (GFCIs) when necessary to prevent electric shock.
- Use three-wire grounded extension cords for portable electric tools and appliances.
- Keep loose-fitting clothing or loose long hair away from moving machinery.
- Use signaling to direct heavy equipment operating in tight quarters.
- No refueling engines while equipment is running.
- No ignition sources within 50 feet (ft) of refueling areas.
- Lower all blades and buckets to the ground, and set parking brakes before shutting off vehicles.
- Never exceed the rated load capacity of a vehicle.

4.5.1.1. BUDDY SYSTEM

While working in the Exclusion Zone, Site workers use the buddy system. The buddy system means that personnel work in pairs and stay in close visual contact to be able to observe one another and summon rapid assistance in case of an emergency. The responsibilities of workers using the buddy system include:

- Remaining in close visual contact with partner
- Providing partner with assistance as needed or requested
- Observing partner for signs of heat stress or other difficulties
- Periodically checking the integrity of partner's PPE
- Notifying the FM, Operator or other Site personnel if emergency assistance is needed

4.5.2. CONTAMINATION REDUCTION ZONE

Based on monitoring results, the CRZ boundaries may be adjusted to ensure that the Support Zone remains uncontaminated. Workers and equipment exit the Exclusion Zone through the designated access point(s) into the CRZ. Workers and equipment are then decontaminated in the CRZ, according to the procedures specified in the Decontamination section of this SSHP. Workers and equipment then exit the CRZ into the Support Zone through the designated access points. If necessary, emergency decontamination procedures are implemented. Emergency decontamination procedures are described in the Emergency Response Program, discussed in Section 13 of this SSHP.

Personnel in the CRZ will adhere to the following criteria:

- Check in and out of this zone at the designated access point(s).
- Wear the PPE required for this zone (see PPE section of this SSHP).
- Perform air sampling as required for this zone (see Exposure Monitoring section of this SSHP).
- Use monitoring equipment and tools that are safe for the working environment.
- Smoking, eating, or drinking is prohibited.
- No matches, lighters, or open flame is allowed.
- Monitor self and buddy for signs of heat or cold stress or chemical overexposure.
- Alert supervisor to signs of changing or unanticipated hazards.
- Refrain from engaging in horseplay.
- Monitor self and buddy for PPE rips, tears, and/or damage.

4.5.3. SUPPORT ZONE

The Support Zone is the clean area of the Site, beyond the outer boundary of the CRZ. There should be no contamination in this zone. Administrative, clerical, and other support functions are based in the Support Zone. Air and surface monitoring are conducted in the Support Zone as needed to ensure that it remains uncontaminated. If contamination is detected, zone boundaries are adjusted until corrective action is taken and monitoring results indicate that this zone is again uncontaminated.

Within the Support Zone, personnel will adhere to the following criteria:

- Check in and out of this zone at the designated Site access point(s).
- Alert supervisor to signs of changing or unanticipated hazards.
- Refrain from engaging in horseplay.
- Perform air sampling as required for this zone (see Exposure Monitoring section of this SSHP).

4.6. SITE COMMUNICATIONS

Forms of communication on this Site include cellular phones carried by on-site personnel, vocal signals, and hand signals. Site personnel are trained to recognize and use hand signals when visual contact is possible but noise or PPE inhibit voice communication. These hand signals are listed below in Table 2.

Table 2 – Hand Signals

Thumbs up	OK/understood
Thumbs down	No
Clutching throat	Out of air/cannot breathe
Pointing to wrist	Out of time/watch your time
Cutting motion across throat	Immediately cease current activity
Both arms waving upright above head	Need assistance/send support
Stand with hands on waist or grab partner's wrist	Exit immediately

4.7. EMERGENCY MEDICAL ASSISTANCE

The nearest emergency medical assistance selected to support this Site is:

Organization: Cox North Hospital
Contact: Emergency Room
Address/Location: 1423 N Jefferson Ave, Springfield, MO 65802
Telephone: 417-269-3000 or 911

A map to this facility is included as Figure 3. As illustrated on the figure, directions to the hospital include east on High Street, south on Highway 13 (Kansas Expressway), east on West Division Street.

5. TRAINING PROGRAM

The Site training program has been prepared in compliance with 29 CFR 1910.120(e) and is designed to ensure that workers receive the training they need to work safely on this Site. Site safety and health training requirements are based on the JHAs contained in Section 3 of this SSHP and relevant OSHA requirements. At this Site, the SSHO oversees the implementation of this training program and is responsible for ensuring that employees are adequately and currently trained for all tasks they are asked to perform. Employees who have not been trained to a level required by their job function and responsibility are not permitted to participate in or supervise field activities.

This training program is consistent with the requirements of 29 CFR 1910.120(e) and addresses the following Site-specific information:

- Training for Site workers
- Site briefings for visitors and workers
- Initial HAZWOPER training (40 hour [hr]) and refresher update 8-hr training
- Management and supervisor training
- Qualification of trainers
- Training certification
- Emergency response training
- Refresher training
- Equivalent training
- Training records

Emergency response training is addressed in SSHP Section 13, Emergency Response Plan.

5.1. TRAINING ELEMENTS TO BE COVERED FOR SITE WORKERS

Training elements for all Site personnel and subcontractors can be found in the following sections outlined below:

- Names of personnel and assistants responsible for Site safety and health;
- Safety, health, and other hazards present on the Site;
- Work practices by which the employee can minimize risks from hazards;
- Safe use of engineering controls and equipment on the Site;
- The Site control plan detailed in Section 4 of this SSHP;
- Medical surveillance requirements detailed in Section 7 of this SSHP;
- Use of PPE detailed in Section 8 of this SSHP;
- Hearing conservation procedures detailed in Section 8.5 of this SSHP;
- Respirator use detailed in Section 9 of the SSHP;
- Decontamination procedures detailed in Section 12 of this SSHP;
- The emergency response plan detailed in Section 13 of this SSHP;
- Blood-borne pathogens detailed in Section 13.7.1 of this SSHP;
- The spill containment program detailed in Section 14 of this SSHP; and

- Confined space entry procedures detailed in Section 16 of this SSHP.

Other training received by workers that is in addition to required training elements described above is detailed below:

- Electrical safety procedures detailed in Section 15 of this SSHP;
- Trenching and excavations detailed in Section 17 of this SSHP;
- Elevated work procedures detailed in Section 18 of this SSHP;
- Drum handling procedures detailed in Section 19 of this SSHP.
- Hot work procedures detailed in Section 20 of this SSHP;
- Lockout/tagout (LOTO) procedures detailed in Section 21 of this SSHP; and
- First aid and Cardio Pulmonary Resuscitation (CPR) training.

5.2. SITE-SPECIFIC BRIEFINGS FOR VISITORS

A Site-specific briefing is provided to all Site visitors who enter this Site beyond fencing gates.
For visitors, the Site-specific briefing provides information about Site hazards, the Site layout including work zones and places of refuge, emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

5.3. SSHP INFORMATION AND SITE-SPECIFIC BRIEFINGS FOR WORKERS

Site personnel review this SSHP and are provided a Site-specific briefing prior to the commencement of work to ensure that employees are familiar with this SSHP and the information and requirements it contains. Additional briefings are provided as necessary to notify employees of any changes to this SSHP as a result of information gathered during ongoing Site characterization and analysis. Conditions for which additional briefings are scheduled include, but are not limited to, changes in Site conditions, changes in the work schedule/plan, newly discovered hazards, and incidents occurring during Site work. A tailgate safety meeting will be conducted by the FM prior to any on-site activity. A copy of the tailgate safety meeting form is located in Appendix D.

5.4. INITIAL TRAINING

Initial training requirements are based on a worker's potential for exposure and compliance with the requirements of 29 CFR 1910.120(e)(3). Personnel at this Site must successfully complete 40 hr initial HAZWOPER training consistent with the requirements of 29 CFR 1910.120(e)(3)(i) in order to work in contaminated areas. In addition, such personnel provide documentation of having received three days of supervised field experience applicable to this Site, or will receive three days of supervised field experience applicable to the Site.

5.5. MANAGEMENT AND SUPERVISOR TRAINING

On-site managers and supervisors who are directly responsible for or who supervise workers engaged in hazardous waste operations receive, in addition to the appropriate level of worker HAZWOPER training described above, eight additional hours of specialized supervisory training, in compliance with 29 CFR 1910.120(e)(4). However, hazardous waste Site management experience will be accepted in lieu of the eight hour specialized supervisory training in compliance with 29 CFR 1910.120(e)(9). Training received by managers and supervisors is summarized as follows:

- Employer's safety and health program
- Personal protective equipment program
- Spill containment program
- Management of hazardous waste Site cleanup operations

5.6. QUALIFICATION OF TRAINERS

Only instructors qualified in accordance with 29 CFR 1910.120(e)(5) are used to train workers for this Site. Qualified instructors have either completed a training program for teaching the subjects they are expected to teach, or have the academic credentials and instructional experience necessary for teaching the subjects.

5.7. TRAINING CERTIFICATION

Employees and supervisors that receive and complete the necessary training and field experience are certified when they complete the necessary training. A written certificate is given to each person so certified. Any person who has not been so certified or who does not meet the requirements of equivalent training is prohibited from engaging in hazardous waste operations on this Site.

5.8. EMERGENCY RESPONSE

Emergency response training is addressed in Section 13 of this SSHP, Emergency Response Plan.

5.9. REFRESHER TRAINING

All workers on this Site, including managers and supervisors, receive annual HAZWOPER refresher training consistent with the requirements of 29 CFR 1910.120(e)(8). Relevant topics included during the refresher training may include topics discussed in Section 5.1.

5.10. EQUIVALENT TRAINING

This Site does not accept prior academic training or job-site experience in lieu of HAZWOPER initial training for workers and supervisors. Prior Site management experience can be used in lieu of the 8-hr supervisory training, provided that initial HAZWOPER training has been completed as stated in Section 5.5.

5.11. TRAINING RECORDS

Training records for all workers and on-site personnel are located at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri.

6. SUBCONTRACTOR SAFETY

This section of the SSHP is designed to protect company and contractor employees, equipment, and facilities from injury, accident, or loss. Subcontractors are persons not directly employed by the company who provide specific labor or services. At this Site, the SSHO oversees the implementation of this program and is responsible for ensuring that subcontractors have read this SSHP and are adequately informed for all tasks they are asked to perform. The following are specific services/activities that may be performed by subcontractors for this Site:

- Landscaping
- Utility service and repair
- On-site structure construction and/or maintenance
- Drilling and well maintenance
- Mobile laboratory
- Investigation derived waste pickup and transportation
- Environmental characterization
- Environmental remediation

6.1. SUBCONTRACTOR GENERAL REQUIREMENTS

All subcontractors must comply with applicable local, state, federal regulatory requirements and company safety procedures and policies in this SSHP. Specific compliance protocol must be followed when conducting work on this Site involved with hazardous waste operations, which include the following:

- Subcontractors must have appropriate medical exams, training, and drug and alcohol screening (if necessary) before entering work areas.
- Subcontractors must receive Site-specific training before beginning work on site. This includes the contents of appropriate provisions included in this SSHP.
- Subcontractors will provide some means of visually identifying their associates on site, such as color-coded hard hats or company logos.
- Subcontractors performing hazardous waste remediation must provide EWI with their written standard operating procedures for ensuring health and safety compliance and preventing accidents.
- Subcontractors performing hazardous waste remediation must comply with OSHA regulations (29 CFR 1910.120 or 29 CFR 1926.65) pertaining to HAZWOPER.

6.1.1. SUBCONTRACTOR SITE ENTRY PROCEDURES

The FM will maintain a log of personnel on site. This will be maintained as a part of the daily activity log and will be used in an emergency to identify missing personnel. Subcontractors will be required to sign in and out of the Site on this log. A copy of this form is located in Appendix D.

Subcontractors will be given a basic orientation to the Site that includes procedures for reporting accidents, Site hazards and control measures, location of emergency equipment, and emergency procedures and evacuation routes. Subcontractors will be escorted by the FM during this orientation period to insure security and safety.

6.1.2. SUBCONTRACTOR PPE REQUIREMENTS

Subcontractors must comply with protective clothing and respiratory requirements discussed in this SSHP before entering applicable work areas. Subcontractors will be responsible for supplying their employees will appropriate PPE discussed in this SSHP to carry out their duties while on site. However, some PPE for Level D and Level C protection will be kept on site for situations when additional PPE is required. These items may include safety glasses, gloves, hard hats, hearing protection, and disposable protective clothing (Tyvek® and Tychem®).

6.2. HAZARDOUS CHEMICAL/SUBSTANCE NOTIFICATION

Subcontractors must follow the OSHA Hazard Communication Standard requirements including safe use, handling, and storage of chemicals. Subcontractors are required to inform the SSHO or FM of all hazardous substances which may be brought on to the Site property, including providing the most current SDS for each substance. All spills and leaks of hazardous chemicals must be immediately reported to the SSHO or FM.

6.3. CONFINED SPACE ENTRY

Subcontractor employees are not authorized to enter any confined spaces described in Section 16 of this SSHP unless specifically required by the service or construction contract. When confined space entry procedures are authorized and expected to be completed by the subcontractor, a copy of the most recent training for qualified confined space entry workers will be provided to EWI. Confined space entry procedures must be conducted in accordance with OSHA regulations and requirements stated in Section 16 of this SSHP.

6.4. WELDING AND HOT WORK

All hot work and welding operations must be conducted under the control of a Hot Work Permit that has been pre-approved by the SSHO. If subcontractors are required to perform hot work on this Site, requirements and procedures stated in Section 20 of this SSHP must be followed and performed under the supervision of the FM or SSHO.

7. MEDICAL SURVEILLANCE

The medical surveillance section of this SSHP has been prepared in compliance with 29 CFR 1910.120(f) and other substance-specific medical surveillance requirements found in 29 CFR 1910.1001-1052, and describes how worker health status is monitored at this Site. Medical surveillance is used when there is the potential for worker exposure to hazardous substance at levels above OSHA permissible exposure limits (PELs) or other published limits. The purpose of a medical surveillance program is to medically monitor worker health to ensure that personnel are not adversely affected by Site hazards. The provisions for medical surveillance at this Site are based on the Site characterization and JHAs specified in this SSHP, and are consistent with OSHA requirements in 29 CFR 1910.120(f). The medical surveillance program is consistent with 29 CFR 1910.120(f) and addresses the following information:

- Provisions of the Site medical surveillance program;
- Communication between the Site, physicians, and workers; and
- Medical recordkeeping procedures.

The person with responsibility for ensuring this program is implemented and maintained is the EWI Human Resources Manager.

7.1. SITE MEDICAL SURVEILLANCE PROGRAM

Medical surveillance requirements are based on a worker's potential for exposure as determined by the Site characterization and JHAs documented in Appendix A of this SSHP, and in compliance with the requirements of 29 CFR 1910.120(f)(2). The medical surveillance program provides that:

- Workers assigned to tasks requiring the use of respirators receive medical examinations in accordance with 29 CFR 1910.134(e) to ensure they are physically capable to perform the work and use the equipment.
- If a worker is injured, becomes ill, or develops signs or symptoms of possible over-exposure to hazardous substance or health hazards, medical examinations are provided to that worker as soon as possible after the occurrence and as required by the attending physician.

These medical examinations and procedures are performed by or under the supervision of a licensed physician and are provided to workers free of cost, without loss of pay, and at a reasonable time and place. In addition, the need to implement a more comprehensive medical surveillance program will be re-evaluated after any apparent over-exposure incident.

7.2. COMMUNICATION BETWEEN SITE, PHYSICIANS, AND WORKERS

The medical facility providing medical monitoring and overexposure examinations required by personnel at this Site is:

Name: Cox Hospital Systems
Location: 423 N. Jefferson, Springfield, Missouri
Phone: 417-269-3000
Physician: Cary Bisbey, M.D. or associate
Phone: 417-269-3813

EWI has provided information about Site hazards and potential exposure levels, work activities, and PPE requirements, and other information as required by OSHA in 29 CFR 1910.120(f)(6) to the above-mentioned facility and physician. EWI will also make this information available to Site personnel and/or

their personal physicians if necessary. A physician's written opinion of the results of these examinations is required for each worker, and a copy is maintained in the employee's file. The contents of the written opinion are limited to:

- A statement of the worker's health status in relation to his or her job duties and a description of any detected medical condition that could put the worker at increased risk.
- Notation of any recommended limitations in work activity or PPE use.
- Confirmation that the physician has informed the employee of the examination results and any further examination or treatment required.

7.3. MEDICAL RECORDKEEPING PROCEDURES

Corporate medical recordkeeping procedures are consistent with the requirements of 29 CFR 1910.1020. A copy of that program is available at Environmental Works, Inc., in Springfield, Missouri. The following items are maintained in worker medical records:

- Respirator fit test and selection;
- Physician's medical opinion of fitness for duty (pre-placement, periodic, termination);
- Physician's medical opinion of fitness for respirator protection (pre-placement, periodic);
- Exposure monitoring results;
- The name and social security number (SSN) of each individual; and
- Employee medical complaints related to exposure to hazardous substance.

Records required under this medical surveillance program, consistent with 1910.120(f)(8), are kept accurate and updated and are not stored on site.

7.4. PROGRAM REVIEW

Every year, the medical program is reviewed to ensure its effectiveness. The EWI Human Resources Manager is responsible for this review. At a minimum, this review consists of:

- Review of accident and injury records and medical records to determine whether the causes of accidents and illness are promptly investigated and whether corrective measures are taken wherever possible.
- Evaluation of the appropriateness of required medical tests on the basis of Site exposures.
- Review of emergency treatment procedures and emergency contacts list to ensure they are Site-specific, effective, and current.

8. PERSONAL PROTECTIVE EQUIPMENT

This section of the SSHP has been prepared in compliance with 29 CFR 1910.120(b)(4)(ii)(C) and 29 CFR 1910.120(g), and describes how PPE is used to protect against employee exposures to hazardous substances and hazardous conditions on this Site. Exposure hazards from the decontamination process are also considered. The following topics are addressed in this section:

- PPE selection criteria
- Site-specific PPE ensembles
- Criteria for PPE upgrades and downgrades
- Procedures for determining work duration
- Training in use of PPE
- Respiratory protection
- Hearing conservation
- PPE maintenance and storage
- Evaluation of this program

The person with the overall responsibility for the PPE program is the SSHO.

8.1. PPE USE AND SELECTION CRITERIA

Site safety and health hazards are eliminated or reduced to the greatest extent possible through engineering controls and work practices. Where hazards are still present, a combination of engineering controls, work practices, and PPE are used to protect employees. An initial level of PPE is assigned to each task to provide an adequate barrier to exposure hazards. Initial PPE ensembles are selected based on the anticipated route(s) of entry of the hazardous substances on site and their concentration. Materials providing the greatest duration of protection have been chosen. Tear and seam strength of the PPE are also considered to ensure ensemble durability while work is performed. When necessary, multiple layers of protection are used to accommodate the range of hazards that may be encountered. Where possible, employees are provided with a range of component sizes to ensure properly fitted PPE.

As indicated in the task specific JHA tables (Appendix A), Level A and Level B PPE are not required for routine or any anticipated tasks performed at this Site. If conditions arise that warrant the need for Level A or Level B PPE, engineering controls will be utilized, if possible, until proper authorities who are trained in the use of Level A and B PPE are notified as denoted in Section 13.8 of this SSHP. Site-specific PPE ensembles and materials are identified in Tables 3 through 6 in the following subsections and in Appendix A (Table 1V PPE Selection Guide). These ensembles are consistent with Appendix B of 29 CFR 1910.120. PPE is used in accordance with manufacturers' recommendations. Criteria used in selecting all PPE levels at this Site are discussed in the following subsections.

8.1.1. USE OF LEVEL A PROTECTION

Level A protection is used during tasks that have or potentially have the following characteristics:

- The atmosphere contains measured/potentially high concentrations of airborne vapors, gases, or particulate.
- Site tasks/operations have a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulate of materials that are harmful to skin or capable of being absorbed through the skin.

- Site tasks/operations may result in exposure to unexpected vapors, gases, or particulates that are harmful to/capable of being absorbed through the skin.
- The atmosphere contains or is suspected to contain substances with a high degree of hazard to the skin, and skin contact is possible during Site tasks/operations.
- Some Site tasks/operations will be conducted in confined/poorly ventilated areas where the absence of conditions requiring Level A has not yet been determined.

Recommended Level A PPE and limiting criteria are outlined in Table 3 below.

Table 3 – Site-Specific PPE Level A

Recommended Equipment	Limiting Criteria
LEVEL A PROTECTION -The following constitute Level A equipment and may be used as appropriate:	Fully encapsulating suit material must be compatible with the substances involved.
1. Positive pressure, full face piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA	
2. Fully encapsulating chemical protective suit	
3. Coveralls	
4. Long underwear	
5. Gloves, outer, chemical – resistant	
6. Gloves, inner, chemical – resistant	
7. Boots, chemical – resistant, steel toe and shank	
8. Hardhat (under suit)	
9. Two-way radio communications	
10. Disposable protective suit, gloves, and boots (depending on suits construction, may be worn over totally encapsulating suit.	

8.1.2. USE OF LEVEL B PROTECTION

Level B protection is used during tasks that have or potentially have the following characteristics:

- The identity and concentration of Site contaminants are known and a high degree of respiratory protection is needed.
- The atmosphere contains hazardous substances at concentrations exceeding the published exposure limit for which there is no available cartridge/canister.
- The atmosphere contains hazardous substances at concentrations which exceed the use limits (rating or maximum use factor) of the available air purifying respiratory protection.
- Contact with hazardous substances is likely, but the contaminants do not pose a skin absorption hazard.
- The atmosphere contains less than 19.5 percent (%) oxygen.
- The atmosphere contains incompletely identified hazardous substances, but the presence of high levels of chemicals harmful to/capable of being absorbed through the skin is unlikely.

- The atmosphere contains immediately dangerous to life and health (IDLH) concentrations of specific substances that present severe inhalation hazards but do not pose a skin absorption hazard.

Recommended Level B PPE and limiting criteria are outlined in Table 4 below.

Table 4 – Site-Specific PPE Level B

Recommended Equipment	Limiting Criteria
LEVEL B PROTECTION –The following constitute Level B equipment and may be used as appropriate.	Use only when the vapors or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin.
1. Positive pressure, full face piece self-contained breathing apparatus, or positive pressure supplied air respirator with escape SCBA	
2. Hooded chemical – resistant clothing (overalls and long-sleeved jacket; coveralls; one or two piece chemical splash suit; disposable chemical – resistant overalls)	
3. Coveralls	
4. Gloves, outer, chemical – resistant	
5. Gloves, inner, chemical – resistant	
6. Boots, chemical – resistant, steel toe and shank	
7. Boot covers, outer, chemical – resistant (disposable)	
8. Hardhat (under suit)	
9. Face shield	
10. Two-way radio communication	

8.1.3. Use of Level C Protection

Level C protection is used during tasks that have or potentially have the following characteristics:

- Liquid splashes, atmospheric conditions, or other direct contact with hazardous substances exist or are likely but will not adversely affect or be absorbed through exposed skin.
- The atmosphere contains hazardous substances at concentrations which can be adequately controlled using an available air-purifying respirator and cartridge/canister.
- IDLH conditions are not present.
- The atmosphere contains between 19.5 and 23.5% oxygen.

Recommended Level C PPE and limiting criteria are outlined in Table 5 below.

Table 5 – Site-Specific PPE Level C

Recommended Equipment	Limiting Criteria
LEVEL C PROTECTION –The following constitutes Level C equipment and may be used as appropriate:	Atmospheric concentration of chemicals must not exceed IDLH levels. The atmosphere must contain at least 19.5% oxygen.
1. Full face or half-mask, air purifying respirators (National Institute for Occupational Safety and Health [NIOSH] approved)	
2. Hooded chemical – resistant clothing (overalls and long-sleeved jacket; coveralls; one or two piece chemical splash suit; disposable chemical – resistant overalls)	
3. Coveralls	
4. Gloves, outer, chemical – resistant	
4. Gloves, inner, chemical – resistant	
5. Boots, outer, chemical – resistant, steel toe and shank	
6. Boot covers, outer, chemical – resistant (disposable)	
7. Hard hat	
8. Escape mask	
9. Face shield	
10. Two-way radio communications	

In accordance with 29 CFR 1910.134(d)(3)(iii)(B)(2), a cartridge/canister change schedule has been determined. Cartridges and canisters used with air-purifying respirators on this Site are replaced when any of the following occurs:

- A NIOSH-approved end of service life indicator (ESLI) is activated
- The service life identified in this SSHP has passed (see JHAs in Appendix A for service life determinations)
- Inhalation is restricted

8.1.4. Use of Level D Protection

Level D protection is used during tasks that have the following characteristics:

- The atmosphere contains no known or suspected hazardous substances at concentrations that meet or exceed the published exposure limit.
- Contact with hazardous levels of any chemicals through splashes, immersion, or by other means will not occur.
- There is no potential for unexpected inhalation or contact with hazardous levels of any chemical.

Recommended Level D PPE and limiting criteria are outlined in Table 6 below.

Table 6 – Site-Specific PPE Level D

Recommended Equipment	Limiting Criteria
LEVEL D PROTECTION –The following constitute Level D equipment and may be used as appropriate:	This level should not be worn in the Exclusion Zone. The atmosphere must contain at least 19.5% oxygen.
1. Coveralls	
2. Gloves	
3. Boots / shoes, chemical – resistant steel toe and shank.	
4. Boots, outer, chemical – resistant (disposable)	
5. Safety glasses or chemical splash goggles	
6. Hard Hat	
7. Escape mask	
8. Face Shield	

8.1.5. Criteria for PPE Upgrades and Downgrades

Task-specific criteria for PPE upgrades and downgrades are used at this Site. If the need for a PPE upgrade or downgrade is anticipated for a task or operation, the action level(s) and/or conditions that result in a PPE upgrade or downgrade are described on the JHA form in Section 3 of this SSHP. Since PPE is primarily used as a barrier to hazardous substance exposure, airborne concentrations are monitored routinely, in accordance with Section 10, Exposure Monitoring. The FM has the authority to upgrade or downgrade PPE in a timely manner to respond to changing Site conditions and to protect employee health and safety. Routine evaluation of the effectiveness of the PPE program is conducted as identified in Section 8.7 below.

8.1.6. Procedures for Determining Work Duration

The FM identifies task-specific work duration based on the following:

- Physiological requirements of the task
- PPE level for the task
- Ambient temperature and humidity
- Respiratory protection capacity (air supply or cartridge change requirements)
- Chemical protective clothing capacity (permeation rate of on-site materials)
- Acclimatization of the work force

Employees are informed about task-specific work duration by the FM, during pre-entry briefing for each task. Work duration is consistent with the requirements outlined in Section 11, Thermal Stress and the respiratory protection capacity for the assigned PPE. Work duration is continuously re-evaluated in response to changes in working conditions.

8.2. TRAINING

Employees receive general training regarding proper selection, use, and inspection of PPE during initial

HAZWOPER training (or equivalent) and subsequent refresher training. Site-specific PPE requirements, including task-specific PPE, ensemble components, cartridge/canister service times, and inspection and maintenance procedures, are communicated as identified in Section 5, Training.

8.3. RESPIRATORY PROTECTION

The type of respiratory protection used on site is identified in Section 8.2. Respiratory protection is selected, fitted, used, stored, and maintained in accordance with Section 9 of this SSHP.

8.4. HEARING CONSERVATION

When noise exposure is anticipated to meet or exceed 85 decibels, or when sound levels make normal conversation difficult to hear, EWI employees and sub-contractors on site will be required to use hearing protection. Noise exposure is listed as a physical hazard in the JHA for specific tasks/operations, and hearing protection is included as one of the control measures (PPE).

The following rules regarding hearing conservation will be enforced at the Site:

- Personal stereos, with headphones, are not permitted at the Site.
- Hearing protectors, at least two types of plugs and one type of muffs, will be provided and maintained at the Site.
- Hearing protectors and replacements will be provided at no cost to employees.
- Hearing protectors will be properly worn at all times when employees are working on tasks with possible noise exposure risks (see JHA tables in Appendix A).

Pre-formed earplugs and earmuffs should be washed periodically and stored in a clean area, and foam inserts should be discarded after each use. It is important to wash hands before handling pre-formed earplugs and foam inserts to prevent contaminants from being placed in the ear which may increase the risk of developing infections.

8.5. PPE MAINTENANCE AND STORAGE

Table 7 describes the PPE maintenance schedule for this Site. The person responsible for overseeing PPE maintenance & storage procedures and for maintaining the inspection record is the SSHO.

Table 7 – PPE Maintenance

Type of PPE	Model	Inspection Frequency	Done by	Cleaning Frequency	Done by
Tyvek Coveralls	DuPont	NA, disposable	NA	NA	NA
Tychem Coveralls	DuPont	NA, disposable	NA	NA	NA
11 mil nitrile gloves	NA	NA, disposable	NA	NA	NA
Nitrile gloves	NA	NA, disposable	NA	NA	NA
Rubber Boots	NA	Before and after each use	Employee	Before and after each use	Employee
Respiratory Protection	3M	Before and after each use	Employee	Before and after each use	Employee
Coveralls	NA	Before and after each use	Employee	Before and after each use	Employee
Leather gloves	NA	Before and after each use	Employee	NA	NA
Safety glasses	NA	Before and after each use	Employee	Before and after each use	Employee
Face shield	NA	Before and after each use	Employee	Before and after each use	Employee
Steel toe boots	NA	Before and after each use	Employee	Before and after each use	Employee
Hard hat	NA	Before and after each use	Employee	Before and after each use	Employee

Defective or damaged equipment is not used and is reported to the SSHO or FM so that the equipment can be repaired or discarded. After decontamination, reusable PPE is properly stored, according to the manufacturers' recommendations.

8.6. EVALUATION OF PPE PROGRAM

Evaluation of the effectiveness of Site PPE selections occurs throughout Site activities in response to employee exposure monitoring results and employee feedback. The inside surfaces of used PPE are checked to ensure that the equipment provides an adequate barrier throughout the work shift.

The SSHO is responsible for modifying initially selected PPE. Affected employees are immediately informed about these modifications and are provided with additional training if necessary. The JHAs in Appendix A of the SSHP are also updated as needed to reflect current information about job hazards and selected controls.

9. RESPIRATORY PROTECTION PROGRAM

The respiratory protection section of this SSHP has been prepared in compliance with 29 CFR 1910.134 and 29 CFR 1910.1000, and describes how respiratory protective equipment is used to protect against employee exposures to hazardous substances and hazardous conditions at this Site. Employees covered under this section will be provided with medical examinations (applicable to 29 CFR 1910.134), respirators, and training at no cost. The elements of this program are outlined in this section and include the following:

- Respirator selection
- Medical evaluations
- Fit testing procedure
- Maintenance and care procedure
- Training

The task specific criteria for respirator use and selection are provided in the JHAs included in this SSHP and within Tables 3 and 4.

9.1. MEDICAL EVALUATIONS

Specific medical evaluations pertaining to the proper fit and use of respiratory protective equipment has been developed in conjunction with the medical surveillance program in Section 7 of this SSHP. A medical evaluation to determine whether an employee is able to use a given respirator is necessary to prevent injuries, illnesses, and even, in rare cases, death from the physiological burden imposed by respirator use. No person will be assigned to tasks requiring use of respirators, nor fit tested, unless it has been determined that they are physically able to perform the work and use the respirator.

All medical questionnaires and examinations are confidential and handled during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire is administered so that the employee understands its content. All employees are provided an opportunity to discuss the questionnaire and examination results with their physician or other licensed health care professional (PLHCP).

Before any initial examination or questionnaire is given, the PLHCP is supplied with the following information so that he/she can make the best recommendation concerning an employee's ability to use a respirator:

- Type and weight of the respirator to be used by the employee;
- Duration and frequency of respirator use (including use for rescue and escape);
- Expected physical work effort;
- Additional protective clothing and equipment to be worn; and
- Temperature and humidity extremes that may be encountered.

The PLHCP is additionally supplied with all applicable information concerning the potential chemicals involved, the duration of the work to be performed, physical stresses exerted, and hours worked while wearing a respirator, etc. This recommendation from the PLHCP will be placed in the employee’s medical records file.

Follow-up and additional medical examination will be provided if an employee’s initial medical examination demonstrates the need for such action. This includes but is not limited to the following

situations:

- An employee reports medical signs or symptoms that are related to the employee's ability to use a respirator.
- A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be re-evaluated.
- Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee re-evaluation.
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, and temperature) that may result in a substantial increase in the physiological burden placed on an employee.

9.2. FIT TESTING PROCEDURES

Fit testing will be conducted prior to allowing any employee to wear a respirator and annually thereafter for the duration of the time an employee may be required to use respiratory protection. Fit testing for all employees will be conducted in accordance with 29 CFR 1910.134(g).

Employees are fit tested at the following times with the same make, model, style, and size of respirator that will be used:

- Before any of our employees are required to use any respirator with a negative or positive pressure tight-fitting face-piece;
- Whenever a different respirator face-piece (size, style, model, or make) is used;
- Whenever the employee reports, or our company, PLHCP, supervisor, or program administrator makes, visual observations of changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight; and
- When the employee, subsequently after passing a qualitative respirator fit test (QLFT) or quantitative respirator fit test (QNFT), notifies the company, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable. That employee will be retested with a different respirator face-piece.

Fit testing may be either qualitative or quantitative. QLFT involves the introduction of a gas, vapor, or aerosol test agent into an area around the head of the respirator user. If that user can detect the presence of the test agent through subjective means, such as odor, taste, or irritation, the respirator fit is inadequate.

In a QNFT, the adequacy of respirator fit is assessed by measuring the amount of leakage into the respirator, either by generating a test aerosol as a test atmosphere, using ambient aerosol as a test agent, or using controlled negative pressure to measure the volumetric leak rate. Appropriate instrumentation is required to quantify respirator fit.

9.3. MAINTENANCE AND CARE PROCEDURES

In order to ensure continuing protection from respiratory protective devices, it is necessary to establish and implement proper maintenance and care procedures and schedules. Neglect toward maintenance and care will negate successful selection and fit, because the devices will not deliver the assumed protection unless they are kept in good working order.

Maintenance and care procedures consist of regular cleaning of respirators per manufacturer recommendations. Respirators are inspected on a regular basis. The frequency of inspection is related to

the frequency of use and typically consists of before each use, during cleaning, and in accordance with manufacturer's recommendations. Respirators that fail an inspection or are otherwise found to be defective are removed from service and are discarded or repaired.

9.4. TRAINING

Employees are trained to ensure the proper use and limitations of respirators are known. Respirator training includes the following:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- What the limitations and capabilities of the respirator are;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- How to inspect, put on, remove, use, and check the seals of the respirator;
- What the procedures are for maintenance and storage of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements stated in Standard 29 CFR 1910.134.

10. EXPOSURE MONITORING

This section of the SSHP has been prepared in compliance with 29 CFR 1910.120(b)(4)(ii)(E) and 29 CFR 1910.120(h), and describes how employee exposures to hazardous substances are monitored. This section provides Site-specific information about:

- Air monitoring procedures
- Equipment calibration and maintenance
- The handling and management of monitoring data

The SSHO is responsible for implementing Site exposure monitoring procedures.

The PM, SSHO, ERC, and FM are qualified to use the air monitoring instruments at this Site and to interpret monitoring results.

10.1. AIR MONITORING

Employee exposures to airborne hazardous substances are fully characterized throughout Site operations to ensure that exposure controls are effectively chosen and modified as needed on a timely basis. The approach to air monitoring is consistent with OSHA requirements in HAZWOPER and includes:

- Initial monitoring prior to the beginning of Site activities to identify conditions that may cause death or serious harm and to permit preliminary selection of Site controls;
- Personal monitoring after Site activities begin so that employee exposures are quantified and fully characterized (this is for high risk employees in comparing to PELs, etc.); and
- Periodic monitoring throughout Site operations when conditions and employee exposures may change rapidly.

This can include, but is not limited to, the following situations:

- Commencement of work on another portion of the Site
- Exposure to or handling of contaminants/hazards not previously identified
- Commencement of a new task/operation
- Change in environmental conditions
- Commencement of task/operation that is likely to increase airborne concentrations of hazardous substances

Air monitoring is conducted at the Site using a photo-ionization detector (PID) and/or multi-gas meter. Air readings are taken in the breathing zones of employees expected to have the highest exposure during the task or operation being evaluated. If exposures for these employees exceed the exposure limits, additional readings are collected in the breathing zones of all employees likely to have similar exposures. If concentrations within the breathe zone of 5 parts per million (ppm) or higher are sustained for more than five minutes, compound specific Draeger tubes (or equivalent) for coal tar pitch volatiles (CTPV) and Cresol (all isomers) may be utilized to obtain compound specific concentrations. These data will provide quantitative results that can be compared to OSHA PELs and other published exposure limits. If concentrations above the 8-hr time-weighted average (TWA) PEL are present for any chemical, then respiratory protection will be required for all personnel within the monitored area. Air monitoring readings are documented on the air monitoring log (Appendix D) and filed at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri.

Task-Specific Air Monitoring Procedures in Tables 8 and 9 summarize the air monitoring procedures for this Site based on tasks and operations conducted here. These tables include action levels and required actions established based on the direct-reading instruments and the contaminants at the Site. This Site contains contaminants addressed in one or more of OSHA's substance-specific standards, specifically carbon monoxide and hydrogen sulfide. Site monitoring procedures comply with OSHA's substance-specific requirements as well as those of HAZWOPER.

Table 8 – Confined Space Air Monitoring Procedures

Task/Operation: Confined Space Entry

Monitored Hazard: **CARBON MONOXIDE** Exposure Limit: 50 ppm PEL-TWA OSHA

Sample Type: Real Time
Location(s): On-site storage/waste tanks, Discharge Sewer Vaults
Equipment: 4-gas meter
Response Factor: Measurement exceeds action level
Frequency: Throughout task
Action Level: 10 ppm
Required Action: Evacuate space

Monitored Hazard: **HYDROGEN SULFIDE** Exposure Limit: 10 ppm threshold limit value (TLV)-TWA American Conference of Governmental Industrial Hygienists (ACGIH)

Sample Type: Real Time
Location(s): On-site storage/waste tanks, Discharge Sewer Vaults
Equipment: 4-gas meter
Response Factor: Measurement exceeds action level
Frequency: Throughout task
Action Level: 5 ppm
Required Action: Evacuate space

Monitored Hazard: **NATURAL GAS** Exposure Limit: 10% lower exposure limit (LEL)

Sample Type: Real Time
Location(s): On-site storage/waste tanks, Discharge Sewer Vaults
Equipment: 4-gas meter
Response Factor: Measurement exceeds action level
Frequency: Throughout task
Action Level: 10 % LEL
Required Action: Evacuate space

Monitored Hazard: **OXYGEN** Exposure Limit: <19.5% or >23.5%

Sample Type: Real Time
Location(s): On-site storage/waste tanks, Discharge Sewer Vaults
Equipment: 4-gas meter
Response Factor: Measurement exceeds action level
Frequency: Throughout task
Action Level: <19.5% or >23.5%
Required Action: Evacuate space

Monitored Hazard: **Volatile Organic Compounds (VOCs)** TLV: CTPV- 0.2 milligrams per cubic meter (mg/m^3) Cresol-5 ppm
Sample Type: Real Time Location(s): On-site storage/waste tanks, Discharge Sewer Vaults Equipment: PID, Draeger pump and tubes or equivalent Response Factor: Measurement exceeds action level Frequency: Throughout task Action Level: CTPV- 0.2 mg/m^3, Cresol-5 ppm PEL Required Action: Don respirator (Action levels), Evacuate area (short-term exposure limits [STELs])

Table 9 – Task-Specific Air Monitoring Procedures

Task/Operation: Installation of Communication Lines and Remedial Well Manholes, Soil and Water Sampling, Water Level Measurements, Well Construction and Maintenance, Excavation Activities, Groundwater Recovery/Treatment System Maintenance, Free Product Recovery
Monitored Hazard: **VOCs** TLV: CTPV- 0.2 mg/m^3 Cresol-5 ppm
Sample Type: Real Time Location(s): Various Site Locations Equipment: PID, 4-Gas Meter, and Compound Specific Draeger Tubes or equivalent Response Factor: Measurement exceeds action level Frequency: Throughout task Action Level: CTPV- 0.2 mg/m^3, Cresol-5 ppm PEL Required Action: Don respirator (Action Levels), Evacuate area (STELs)

10.2. EQUIPMENT CALIBRATIONS AND MAINTENANCE

Instruments are calibrated and maintained according to the manufacturers' recommendations. Instruments utilized at this Site include a 4-gas meter, PID, and a Draeger pump or equivalent. Copies of the manufacturers' recommendations and instrument calibration and maintenance records are maintained and kept with the instrument or at the Site. Equipment calibration and maintenance forms can be found in Appendix D.

10.3. HANDLING AND MAINTENANCE OF MONITORING DATA

Procedures for collecting and handling samples, as well as documentation procedures for analytical results, are included in the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP). Samples are shipped to and analyzed by the laboratories listed below if necessary:

Laboratory Name: Eurofins Lancaster Laboratories LLC
Address: 2425 New Holland Pike Lancaster, PA 17601
Telephone: (717) 556-7251
Laboratory Contact: Laura Jovanovic

Air monitoring results are available in real time by the SSHO using monitoring equipment described in Section 10.3 if necessary. Employees may review general air monitoring results and may obtain copies of the results if necessary. Results from lab-analyzed samples and direct-reading monitoring results are

stored at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri.

Employees who participated in an air monitoring event will be informed of exposures per 29 CFR 1910.120(h)(4)(i). The SSHO is responsible for providing employees with their exposure monitoring results and helping them understand the information.

10.4. NOISE MONITORING

As indicated in the JHAs for this Site, employees may be exposed to sound levels that meet or exceed 85 decibels while conducting certain tasks/operations. Therefore, due to the potential for excessive noise documented for these activities, hearing protection will be utilized when conducting these activities.

11. THERMAL STRESS PROGRAM

This section of the SSHP has been prepared in compliance with 29 CFR 1910.120(h) and describes how the Site-specific environmental conditions (temperature, humidity, air movement), workloads, and PPE may expose workers to hazards resulting in illness or injury related to heat or cold stress. This Thermal Stress Prevention Program outlines exposure controls designed to protect workers working in hot or cold environments. The elements of this program are outlined in this section and include the following:

- Implementation criteria
- Prevention strategies
- Medical management
- Employee training

The SSHO is responsible for implementing this program.

11.1. IMPLEMENTATION CRITERIA/PREVENTION STRATEGIES

The Thermal Stress Prevention Program is implemented when the work area temperature rises above 90º Fahrenheit (F) or falls below 32º F. Throughout each work shift, air temperatures in the work area are monitored and the values recorded in workers notes.

11.1.1. HEAT STRESS

Work practices and exposure controls are used to reduce the risk of elevating a worker's core body temperature. These work practices and exposure controls include the following:

- Defining and adjusting worker work/rest intervals
- Monitoring for signs of heat stress
- Providing shaded rest areas protected from radiant heat
- Using a liquid replacement program

11.1.1.1. EMPLOYEE WORK / REST INTERVALS

Work/rest intervals are based on PPE, workloads, environmental conditions (temperature, humidity, air movement), and monitoring results. Work/rest intervals are determined by the FM. Work/rest intervals are adjusted throughout the work shift as needed and communicated to each worker at the conclusion of an applicable rest period, prior to re-entry into the work zone. Guidelines for work/rest schedules for this Site are provided in Table 10:

Table 10 – Heat Stress Work/Rest Intervals

Temperature Range(ºF)	PPE Level	Work Period (minutes)	Rest Period (minutes)
75-80	Level D	60 minutes	5 minutes
80-85	Level D	60 minutes	8 minutes
85-90	Level D	60 minutes	10 minutes
90-100	Level D	60 minutes	12 minutes

11.1.1.2. MONITORING

Workers monitor each other's actions, speech, and appearance for signs and symptoms of heat-related illnesses including heat exhaustion and heat stroke. Physical signs and symptoms of heat exhaustion include headache, nausea, vertigo, weakness, thirst, and giddiness. Heat exhaustion may progress to heat stroke if a worker is unable to cool and rehydrate their body. The primary signs and symptoms of heat stroke are confusion, irrational behavior, loss of consciousness, convulsions, a lack of sweating (usually), hot and dry skin, and an abnormally high body temperature. Workers should be aware of the key differences between the signs and symptoms of heat stroke and those of heat exhaustion, such as the lack of sweating, the color of the skin (red), and the rise in body temperature. Heat stroke is a medical emergency that requires immediate medical attention.

Physical signs and symptoms of heat stress are discussed with workers daily and reviewed as necessary.

11.1.1.3. REST AREAS

Rest areas that are shaded and protected from radiant heat are located:

- Inside an air conditioned vehicle
- Inside the treatment system building

Rest areas are equipped with cool (50ºF- 60ºF) liquids.

11.1.1.4. LIQUID REPLACEMENT PROGRAM

Since dehydration is a primary cause of heat illness, workers on this Site follow a regimen for liquid consumption detailed in Table 11:

Table 11 – Liquid Replacement Program

Temperature Range(ºFs)	Period Between Drink	Minimum Quantity	Liquid Type
75-80	60 minutes	1 pint	Water
80-85	55 minutes	1 pint	Water
85-90	50 minutes	1 pint	Water
90-100	48 minutes	1 pint	Water

11.1.2. COLD STRESS

Work practices and exposure controls are used to reduce the risk of lowering a worker's core body temperature. These work practices and exposure controls include the following:

- Defining and adjusting worker work/rest intervals
- Monitoring for physiological signs of cold stress
- Providing warm, sheltered rest areas
- Providing and requiring the use of warm garment or other PPE

11.1.2.1. EMPLOYEE WORK / REST INTERVALS

Work/rest intervals are based on PPE, work load, environmental conditions, and monitoring results. Work/rest intervals are determined by the FM and communicated to workers. Work/rest intervals are adjusted throughout the work shift as needed and communicated to each worker at the conclusion of an applicable rest period, prior to re-entry into the work zone. Guidelines for work/rest schedules for this Site are provided in Table 12 below. Resting workers are sheltered in a warm enclosure.

Table 12 – Cold Stress Work/Rest Intervals

Temperature Range(ºF)	PPE Level	Work Period (minutes)	Rest Period (minutes)
25-30	Level D	60 minutes	5 minutes
20-25	Level D	60 minutes	6 minutes
15-20	Level D	60 minutes	8 minutes
Below 15	Level D	60 minutes	10 minutes

11.1.2.2. MONITORING

Workers monitor each other's actions, speech, and appearance for signs and symptoms of cold-related injury including hypothermia and frostbite. The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold. Cool skin, muscle rigidity, low blood pressure, slowed or irregular pulse, and apparent exhaustion and fatigue after rest manifest as hypothermia progresses and the core body temperature falls. Frostbite can occur without hypothermia when extremities do not receive sufficient heat from central body stores. Frostbite occurs when the fluids around the tissue cells freeze and usually affects the extremities, nose, and cheeks. Damage from frostbite can result in tissue death.

Physical signs and symptoms of hypothermia and frostbite are discussed with workers daily and reviewed as necessary.

11.1.2.3. REST AREAS

Rest areas that are warm and isolated from environmental conditions are located:

- Inside a heated vehicle
- Inside the treatment system building

11.1.2.4. USE OF COLD TEMPERATURE CLOTHING

Workers don layered thermal protective clothing anytime work is conducted outside with a temperature range of less than 40°F.

11.2. MEDICAL MANAGEMENT

If a worker exhibits signs or symptoms of heat exhaustion or heat stroke, the following procedures should be used:

- Check the employee's heart rate. The employee's heart rate should be below 120 beats per minute (bpm).
- Check the employee's oral temperature if equipment is available. The employee's oral temperature should be between 98.6°F and 99°F.
- Provide a shaded area and cool liquids until vital signs stabilize.
- If vital signs do not stabilize or conditions worsen, medical attention is required immediately and the employee will need evaluation from a physician.

The physician's written opinion specifically addresses fitness for duty for under heat stress conditions. This evaluation is described in Section 7, Medical Surveillance.

11.3. TRAINING

Workers receive general training regarding thermal stress-related injuries and illnesses during initial HAZWOPER training and subsequent refresher training. The Site-specific program and procedures are described in Section 5, Training.

12. DECONTAMINATION

The decontamination section of the SSHP has been prepared in compliance with 29 CFR 1910.120(b)(4)(ii)(G) and 1910.120(k), and describes how personnel and equipment are decontaminated when they leave the Exclusion Zone. This section also describes how residual waste from decontamination processes is disposed. The Site decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may accumulate on personnel or equipment. These procedures minimize worker contact with contaminants and protect against the transfer of contaminants to clean areas of the Site and off site. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and can permeate PPE surfaces. The decontamination procedures described below are designed to meet the requirements of 1910.120(k) and include Site-specific information about:

- The location and type of Site decontamination facilities
- General and specific decontamination procedures for personnel and PPE
- General and specific decontamination procedures for equipment
- Disposal of residual waste from decontamination
- Decontamination equipment and solvents
- Monitoring the effectiveness of decontamination procedures

Emergency decontamination procedures are detailed in the Emergency Response section of this SSHP. The FM oversees implementation of Site decontamination procedures and is responsible for ensuring their effectiveness.

12.1. SITE DECONTAMINATION FACILITIES

Decontamination on this Site is conducted in the CRZ, if applicable. The CRZ acts as a buffer between the exclusion zone and the support zone. The location and design of decontamination stations minimize the spread of contamination beyond these stations. Separate facilities are used for personnel and for equipment. In the absence of a CRZ, decontamination activities are conducted in the designated facility identified on Figure 4.

12.2. DECONTAMINATION PROCEDURES FOR PERSONNEL AND PPE

Decontamination procedures at this Site are designed for the level of PPE used. Site-specific procedures for personnel and PPE decontamination minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities. Based on the nature of the hazards and duration of work, showers and change rooms are not necessary and are not provided for workers. The following are general decontamination procedures established and implemented at this Site.

- Decontamination is required for all workers exiting a contaminated area. Personnel may re-enter the Support Zone only after undergoing the decontamination procedures described in the next section.
- Personnel performing decontamination activities will wear appropriate protective clothing with splash protection as needed.
- Protective clothing is decontaminated, cleaned, laundered, maintained and/or replaced as needed to ensure its effectiveness.
- PPE used at this Site that requires maintenance or parts replacement is decontaminated prior to repairs or service.

- PPE used at this Site is decontaminated or prepared for disposal on the premises. Personnel who handle contaminated equipment have been trained in the proper means to do so to avoid hazardous exposure.
- The Site requires and trains workers that if their permeable clothing is splashed or becomes wetted with a hazardous substance, they will immediately exit the work zone, perform applicable decontamination procedures, and change into uncontaminated clothing.
- Procedures for disposal of decontamination waste meet applicable local, State, and Federal regulations.

Level C protective clothing will be stored at the Site. Level C respiratory protection and Level D PPE are stored in a storage container or locker designated to each employee and located at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri, or at employee's home office. It is the employee's responsibility to clean, maintain, and store their PPE properly.

12.3. DECONTAMINATION PROCEDURES FOR EQUIPMENT

All tools, equipment, and machinery from the Exclusion Zone or CRZ, or that have come into contact with contaminated media, are decontaminated in the CRZ prior to removal to the Support Zone. Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities. Items at this Site are decontaminated with a soap (Simple Green, Alconox, etc.)/water mixture using a pressurized or gravity flow mechanism. Decontamination water and solid materials generated during decontamination procedures are sampled, characterized, and disposed of at a licensed treatment, storage, and disposal facility. The following are general equipment decontamination procedures established and implemented at this Site:

- Decontamination is required for all equipment that has come into contact with contaminated media and is exiting a contaminated area. Equipment may re-enter the Support Zone only after undergoing the equipment decontamination procedures described in the table below.
- Vehicles that travel regularly between the contaminated and clean areas of the Site and come into contact with contaminated media are carefully decontaminated each time they exit the Exclusion Zone.
- Particular attention is given to decontaminating tires, scoops, and other parts of heavy equipment that are directly exposed to contaminants and contaminated soil.

12.4. MONITORING THE EFFECTIVENEES OF DECONTAMINATION PROCEDURES

Visual examination and sampling are used to evaluate the effectiveness of decontamination procedures, in compliance with 29 CFR 1910.120(k)(2)(iv). Visual examination is used to ensure that procedures are implemented as described and that they appear to control the spread of contaminants under changing Site conditions. Rinsate sampling is performed to ensure that decontamination procedures for sampling equipment are implemented in an effective manner. Visual examination is also used to inspect for signs of residual contamination or for contaminant permeation of PPE. Air monitoring is conducted in the clean zone to ensure that airborne contaminants have not spread to clean areas of the Site. The type and frequency of air monitoring used to ensure the effectiveness of decontamination procedures are detailed in the Exposure Monitoring section of this SSHP. Results of the inspections of decontamination procedures and documentation of any action taken to correct deficiencies are recorded and stored at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri. Personnel who work in contaminated areas of the Site (either the CRZ or the Exclusion Zone) are trained in the principles and practices of decontamination described in this section of the SSHP and in related SOPs. If Site procedures are changed as a result of inspection and monitoring, all affected employees are notified of these changes.

13. EMERGENCY RESPONSE PLAN

This section of the SSHP has been prepared in compliance with 29 CFR 1910.120(l) and 1910.120(b)(4)(ii)(H), and describes potential emergencies at this Site, procedures for responding to those emergencies, roles and responsibilities during emergency response, and training that workers must receive in order to follow emergency procedures. This plan also describes the provisions this Site has made to coordinate its emergency response planning with other subcontractors on site and with off-site emergency response organizations.

This emergency response plan is consistent with the requirements of 29 CFR 1910.120(l) and provides the following Site-specific information:

- Pre-emergency planning;
- Personnel roles, lines of authority, and communication;
- Emergency recognition and prevention;
- Safe distances and places of refuge;
- Site security and control;
- Evacuation routes and procedures;
- Decontamination procedures;
- Emergency medical treatment and first aid;
- Emergency alerting and response procedures;
- Critique of response and follow-up; and
- PPE and emergency equipment.

13.1. PRE-EMERGENCY PLANNING

This Site has been evaluated for potential emergency occurrences, based on-site hazards, the tasks discussed within this SSHP, the Site topography, and prevailing weather conditions. The results of that evaluation are shown in Table 13.

Table 13 – Potential Site Emergencies

Type of Emergency	Source of Emergency	Location of Source
Fire	Weather	Local lightning storms
Fire	Faulty connections	All electrical panels
Tornado, ice storms, blizzard	Weather	Surrounding area
Lightning	Weather	Surrounding area
Chemical Spill	Use of chemicals on-site	Various Site locations
Electrocution	Electrical components	All electrical panels
Heavy Equipment Related Accident	Heavy equipment operations	Various Site locations
Hand Tools Related Accident	Hand tool use	Various Site locations
Cold Stress	Cold	Surrounding area
Heat stress/worker collapses	Heat	Surrounding area
PPE failure	Improper PPE	All confined spaces
High winds - microbursts	Weather	Surrounding area
Flood	Weather	Surrounding area

13.2. ON-SITE EMERGENCY RESPONSE EQUIPMENT

Emergency procedures may require specialized equipment to facilitate worker rescue, contamination control and reduction, or post-emergency clean-up. Emergency response equipment stocked on this Site are listed below. The equipment inventory and storage locations are based on the potential emergencies described above. This equipment inventory (Table 14) is designed to meet on-site emergency response needs and any specialized equipment needs that off-site responders might require because of the hazards at this Site, but not ordinarily stocked.

Any additional PPE required and stocked for emergency response is also listed below (Table 15). During an emergency, the ERC is responsible for specifying the level of PPE required for emergency response. At a minimum, personal protective equipment used by emergency responders will comply with Section 8, Personal Protective Equipment, of this SSHP.

Emergency response equipment is inspected at regular intervals and maintained in good working order. The equipment inventory is replenished as necessary to maintain response capabilities.

Table 14 – Emergency Equipment

Emergency Equipment	Quantity Stocked	Location Stored
Confined space tripod	1	EWI Springfield, MO office
Fire extinguisher	1+	EWI vehicles, Treatment Building
Vacuum	1	EWI Springfield, MO office
Trash pump	1	EWI Springfield, MO office
Confined space lifeline	1	EWI Springfield, MO office
Ladder	2+	EWI Springfield, MO office
Confined space escape harness	1	EWI Springfield, MO office
Absorbent materials	Multiple	EWI Springfield, MO office
Water	Bottles	EWI Vehicles
First aid kit	1+	EWI vehicles, Treatment Building
Telephone	1+	Personal cell phones

Table 15 – Emergency PPE

Emergency PPE	Specific Type	Quantity Stocked	Location Stored
Tyvek suit	DuPont	4	EWI, Treatment Building
Tychem suit	DuPont	2	EWI Springfield, MO office
Gloves	Nitrile	2 boxes	EWI, Treatment Building
Gloves	11 mil	4 pairs	EWI, Treatment Building
Duct tape	Duck	2 rolls	EWI, Treatment Building
Safety glasses	Plastic	2	EWI, Treatment Building

Figure 5 provides a map of the Site with emergency evacuation route(s), assembly point(s), and the locations of key Site emergency equipment identified on this map. Major topographical features and the direction of prevailing winds/weather conditions that could affect emergency response planning are also marked on this map. Figure 3 indicates the route to the nearest emergency medical assistance.

13.3. ROLES AND RESPONSIBILITIES FOR ON-SITE AND OFF-SITE PERSONNEL

The ERC is responsible for implementing the emergency response plan and coordinates emergency response activities on this Site. The ERC provides specific direction for emergency action based upon information available regarding the incident and response capabilities and initiates emergency procedures, including protection of the public and notification of appropriate authorities.
Site personnel will respond to an emergency under the direction of the ERC if Level C or Level D PPE is required. In the event of an emergency requiring Level A or Level B PPE, Site personnel are evacuated and do not participate in emergency response activities, except the following:

- Coordinate communication with those outside of the Site
- Decontaminate responders or victims
- First aid
- Assist in dressing-out responders
- Initiate evacuation procedures
- Air sampling outside hot zone

13.4. EMERGENCY ALERTING AND EVACUATION

Upon discovering an emergency situation, personnel notify the FM, who will evaluate available information and initiate response. If evacuation notice is given, Site workers leave the worksite with their respective buddies, if possible, by way of the nearest exit. Emergency decontamination procedures detailed in Section 12 of this SSHP are followed to the extent practical without compromising the safety and health of Site personnel.

Appropriate primary evacuation routes and assembly areas have been identified and are shown on Figure 5. The routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by rehearsals and inputs from emergency response organizations.

Wind direction indicators are located so that workers can determine a safe up wind or cross wind evacuation route and assembly area if not informed by the emergency response coordinator at the time the evacuation alarm sounds.

Personnel exiting the Site gather at a designated assembly point. To determine that everyone has successfully exited the Site, personnel will be accounted for at the assembly Site. If any worker cannot be accounted for, notification is given to the FM so that appropriate action can be initiated.

Contractors and subcontractors on this Site have coordinated their emergency response plans to ensure that these plans are compatible and that source(s) of potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

13.5. WEATHER RELATED EMERGENCIES

In the case of severe weather, appropriate actions will be taken under the direction of the FM or ERC. Severe weather can include:

- Tornadoes
- Thunderstorms and/or rain
- Damaging winds and/or hail

- Lightning
- Blizzards or ice storms

If a severe weather watch is issued for the area, the ERC or FM will monitor the progress of the storms and may continue with work activities until conditions become unsafe due to any events listed above. If a severe weather warning is issued for the area, work will immediately cease and workers will take refuge under the direction of the ERC or FM at an appropriate shelter depending on the location of the work being performed.

13.6. EMERGENCY RESPONSE ACTIONS

Upon the recognition of emergency situations, the ERC will review relevant information, determine the level of response required for containment, rescue, medical care, and cleanup. The emergency response team is mobilized to the incident Site and supplied with sufficient members, PPE, and emergency equipment.

When the ERC determines that on-site emergency response is inadequate for the emergency or that outside assistance is needed or otherwise required, the applicable off-site organization shown below in Table 16 is contacted. The ERC provides relevant information to the responding organizations, including hazards associated with the emergency incident, potential containment problems, and missing Site personnel.

13.7. EMERGENCY MEDICAL TREATMENT AND FIRST AID

This Site will have workers present with current first aid certification assigned to provide first aid during each shift if emergency services cannot be provided. Personnel who require medical care and/or who are transferred to a medical facility are accompanied by SDSs and other applicable hazard data to apprise caregivers of the chemicals and hazards to which the victim has been potentially exposed. The emergency medical care facility for this Site is Cox North Hospital. The route to the facility is shown in Figure 3.

After every emergency incident or evacuation of this Site, the ERC and/or SSHO will evaluate the quality and safety of response activities. Any deficiencies in response actions will be included in a specific follow-up plan and corrected.

This emergency response plan is evaluated periodically throughout Site operations and updated for accuracy. Changes made to emergency response procedures as the result of rehearsals or actual response incidents are recorded in this emergency response plan. Site workers receive notification and training on changes to the emergency response plan by meetings, as applicable. The ERC and/or SSHO will complete an incident investigation report form following any emergency incident involving personal or property damage. A copy of the incident investigation reporting form can be found in Appendix D.

13.7.1. BLOOD-BORNE PATHOGENS

As stated in Section 13.7, at least one worker on site will have current first aid certification and can provide first aid during each shift if emergency services cannot be provided. Because of this practice, the Site has an exposure control plan training program in accordance with OSHA's blood-borne pathogens standard, 1910.1030 (c)(1)(i). Exposure control training for blood-borne pathogens include the following:

- Types and transmission of blood-borne pathogens;
- Explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood and other potentially infectious materials;

- Engineering controls, work practice controls and the use of PPE;
- Types, proper use, location, removal, handling, decontamination and disposal of PPE;
- Actions to take and persons to contact in an emergency involving blood or other potentially infectious materials;
- Medical Waste Disposal Procedures;
- Exposure event reporting procedures;
- Post Exposure Evaluation and Follow-up Procedures; and
- Signs, labels, and color-coding requirements.

13.8. EMERGENCY RESPONSE TRAINING

All persons who enter this worksite, including visitors, receive a Site-specific briefing about anticipated emergency situations and the emergency procedures. Prior to the commencement of work and in accordance with the Training Section of this SSHP, Site personnel are trained in the contents of this emergency response plan, including potential emergencies, personnel roles and responsibilities, evacuation routes and procedures, and the location of medical assistance. Additionally, Site workers participate in emergency response rehearsals as required in HAZWOPER paragraph (l)(3)(iv). Off-site emergency response organizations participate in the rehearsals as necessary.

Where this Site relies on off-site organizations for emergency response (see Section 13.4), the training of personnel in those off-site organizations is deemed adequate for response to this Site. Site personnel designated as emergency responders complete emergency response training in accordance with 29 CFR 1910.120(q)(6), according to the level of their responsibilities.

The Site maintains written up-to-date certification of the successful completion of applicable training requirements of each worker. Training records are maintained at the Site and at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri.

Emergency Contact Information

The list of telephone numbers below (Tables 16 and 17) are the emergency contact numbers for this Site. These emergency numbers are verified to be accurate, working numbers. Site personnel are trained and rehearsed in Site-specific emergency calling procedures. A copy of this contact information is kept at the Site.

Table 16 – EWI Site Personnel

Title	Contact	Telephone
President	Jason Smith	417-689-1940
Senior Project Manager	Robert Lanning	417-860-2625
Principal	Tommy Bieker	417-569-6252
Principal Alternate	AdriAnn Rode	417-818-7972
Project Manager Alternate	Barbara Garcia	417-380-3370
Compliance Manager	Amanda Peryer	417-619-4171
Compliance Manager Assistant	Barrett Stanke	417-818-6127
Site Safety and Health Officer	Brandon Thornhill	417-440-9135
Site Safety and Health Officer Assistant	Robert Fess	417-766-7202
Emergency Response Coordinator	John Rode	417-689-4330
Emergency Response Coordinator Assistant	Greg Eichmeyer	417-771-9643
Site Supervisor	Brandon Thornhill	417-440-9135
Site Supervisor Assistant	Robert Fess	417-766-7202
Security Officer	David Settles	417-840-3081
Security Officer Assistant	Robert Fess	417-766-7202
Operator	David Settles	417-840-3081
Operator Assistant	Robert Fess	417-766-7202
EWI Office – Springfield, Missouri	N/A	417-890-9500 877-827-9500

Table 17 – Outside Assistance

Agency	Contact	Address/Location	Telephone
Ambulance/EMS	Cox Hospital	1423 N Jefferson Ave Springfield, MO 65802	911
Springfield Police	Springfield Police Department	840 Boonville Avenue Springfield, MO 65802	911
Springfield Fire	Springfield Fire Department	830 Boonville Avenue Springfield, MO 65802	911
Northwest Wastewater Treatment Plant	NA	840 Boonville Ave. 3rd Floor Springfield, MO 65802	417-833-0697
State Police	Troop D	3131 East Kearney Street Springfield, MO 65803-5044	417-895-6868
Emergency Medical Assistance	Emergency Room	1423 N Jefferson Ave Springfield, MO 65802	417-269-4636
MDNR	Environmental Emergency Spill Line	P.O. Box 176 Jefferson City, MO 65102	573-634-2436
Poison Control Center	Poison Control	1423 N Jefferson Ave Springfield, MO 65802	800-366-8888

14. SPILL CONTAINMENT PROGRAM

This section of the SSHP describes the potential for hazardous substance spills at this Site and procedures for controlling and containing such spills. The purpose of this section of the SSHP is to ensure that spill containment planning is conducted and appropriate control measures are established. The spill containment program is consistent with OSHA requirements in 29 CFR 1910.120(b)(4)(ii)(J) and (j)(1)(viii) and addresses the following Site-specific information:

- Potential hazardous substance spills and available controls
- Initial notification and response
- Spill evaluation and response
- Post-spill evaluation

14.1. POTENTIAL SPILLS AND AVAILABLE CONTROLS

Table 18 below lists the location and type of potential hazardous substance spills at this Site. This table also describes the activities or situations in which an accidental spill could occur. Wherever spills, leaks, or ruptures can occur, this Site keeps suitable quantities of proper absorbent and USDOT-specified salvage drums/containers. Their location is noted in Table 18. In addition, all areas subject to potential spills are diked, or a means to adequately dike these areas in the event of a spill is available, so that the entire volume of the hazardous substance being spilled can be contained and isolated. The type and location of spill containment equipment is also listed in Table 18.

Table 18–Potential Spills and Controls

Hazardous Substance	Location	Source of spill	Maximum Qty of Spill	Spill Equipment Available	Equipment Location
Hydrochloric acid	Site area, well heads	Sampling	1 gallon	Shovels	Equipment Shed
				Neutralizing agent	Equipment Shed
				Earthen Materials	Site Area
Equipment fuels	Entire Site	Equipment tanks/ refueling	55 gallons	Shovels	Equipment Shed
				Neutralizing agent	Equipment Shed
				Earthen Materials	Site Area
Cleaning supplies/ Detergents	Entire Site	Maintenance activities	5 gallons	Shovels	Equipment Shed
				Neutralizing agent	Equipment Shed
				Earthen Materials	Site Area
Creosote	Tank Storage Area	Holding Tanks	24,000 gallons	Secondary Containment	Site Area
				Absorbent Material	Site Area
				Shovels	Site Area

14.2. INITIAL SPILL NOTIFICATION AND RESPONSE

Any worker who discovers a hazardous substance spill will immediately notify the ERC. The worker will, to his/her best ability, report the hazardous substance involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, and any associated injuries. The Site Emergency Response Plan, found in Section 13 of this SSHP, will immediately be implemented if an emergency release has occurred, which will include notification to the MDNR Spill Line if applicable (see Table 17).

14.3. SPILL EVALUATION AND RESPONSE

The ERC is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area will be isolated and demarcated to the extent possible. The procedures of the Emergency Response section of this SSHP are implemented when the spill is determined to require emergency precautions and action. If necessary to protect nearby community members, notification of the appropriate authorities is made.

When an incidental release occurs, cleanup personnel receive instructions in a pre-cleanup meeting as to spill conditions, PPE, response activities, decontamination, and waste handling. The following are general measures that response/cleanup personnel take when responding to a spill:

- To minimize the potential for a hazardous spill, ensure that hazardous substance and contaminated soils, control/absorbent media, drums and containers, and other contaminated materials are properly stored and labeled.
- When a spill occurs, only those persons involved in overseeing or performing spill containment operations will be allowed within the designated hazard areas. If necessary, the area will be roped or otherwise blocked off. Unauthorized personnel are kept clear of the spill area.
- Appropriate PPE, as specified during the pre-cleanup meeting, is donned before entering the spill area.
- Appropriate spill control measures are specified in the pre-cleanup meeting and applied during spill response.
- Whenever possible without endangerment of personnel, the spill is stopped at the source or as close to the source as possible.
- Ignition points are removed if fire or explosion hazards exist.
- Surrounding reactive materials are removed.
- Drains or drainage in the spill area will be blocked or surrounded by berms to exclude the spilled waste and any materials applied to it.
- Provisions are made to contain and recover a neutralizing solution, if used.
- Small spills or leaks from a drum, tank, or pipe will require evacuation of at least 10 ft in all directions to allow cleanup and to prevent employee exposure. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents are placed directly on the waste to prevent further spreading and aid in recovery.
- If any spill is large and/or continuing, an initial isolation area of at least 20 ft in all directions is used. Large spills are diked at the leading edge of the spill. Berms of earthen or sorbent material are constructed downstream of the leading edge of the spill to contain it.
- Where feasible, pumps are utilized to transfer the liquid to appropriate containers.
- Spill area is sprayed with appropriate foam where the possibility of volatile emissions exists.

- If the spill results in the formation of a toxic vapor cloud, from vaporization, or reaction with surrounding materials or by the outbreak of fire, further evacuation may be required.
- To dispose of spill waste, all contaminated sorbents, liquid waste, or earthen material will be cleaned up and placed in small quantities in approved drums for proper storage or disposal.
- The Site maintains a Spill Prevention, Control & Countermeasures (SPCC) Plan in accordance with 40 CFR 112. The SPCC Plan has detailed instructions on spill response which includes annual training requirements and notification procedures. A copy of the SPCC Plan is maintained on Site and at the EWI office in Springfield, Missouri.

14.4. POST-SPILL EVALUATION

All spill response activities will be documented in a written manner at the conclusion of clean-up operations. The documentation will include, at a minimum, the following information:

- Date of spill incident
- Cause of incident
- Spill response actions
- Any outside agencies involved, including their incident reports
- Lessons learned or suggested improvements

The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of soil, water, and/or air sampling maybe utilized in this determination as necessary. The root cause of the spill is examined and corrective steps taken to ensure the engineering and control measures in place have performed as required. If alternative precautions or measures are needed, they are made available and implemented. All durable equipment placed into use during cleanup activities is decontaminated as specified in the Section 12 of this SSHP for future utilization. All spill response equipment and supplies are replenished as required.

15. ELECTRICAL SAFETY

This section of the SSHP describes electrical safety at this Site, general requirements for electrical work, and the use of PPE when working with electrical hazards. This plan also describes the provisions this Site has made to effectively and safely work on electrically charged equipment utilizing proper safety precautions and employee training.

This electrical safety plan is consistent with the requirements of 29 CFR 1910.331-339 and provides the following Site-specific information:

- Safety precautions used to work safely on all Site panels
- PPE used when working with electrical equipment
- General requirements for all Site personnel who will be working on or operating electrical equipment
- Training required for, and identification of, authorized personnel

15.1. ELECTRICAL SAFETY REQUIREMENTS

Electrical equipment shall be maintained free from recognized hazards that are likely to cause death or serious physical harm to on-site workers. Frequent and periodic inspections by the SSHO and FM will be performed on a routine basis to establish and maintain safe working electrical conditions. Items for inspection should include:

- Identifying the work purpose and suitable electrical equipment needed to complete each task;
- Identifying the manufacturer's nameplate, label, and descriptive markings and maintaining a log of equipment failures or equipment replacements;
- Determining the mechanical strength and durability of pumps and other mechanical equipment to insure proper function;
- Observing heating and weather related effects under conditions of use including all outside panels and electrical equipment subjected to inclement weather;
- Observe any arcing effects under conditions of use;
- Insuring that all insulating materials are intact with no cuts, breaks, or incorrect splices and that proper supply power is being applied to all energized components; and
- Insuring that disconnecting and disengaging means for pumps, panels and any other electrical device on-site are identified, intact, and functioning.

15.1.1. SAFETY PRECAUTIONS

Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized. The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards.

15.1.1.1. IDENTIFICATION OF DISCONNECTING MEANS AND CIRCUITS

Each disconnecting means (breaker) for motors, panels, and appliances, as well as each service, feeder, and branch circuit at its disconnecting means or over-current device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. These markings shall be of sufficient durability to withstand the current environment involved.

15.1.2. OVER-CURRENT PROTECTION

In the event an overload device or circuit breaker trips in a distribution panel, the circuit breaker shall not be reset or returned to the "ON" position until the cause of the circuit breaker operation has been determined by qualified electrical personnel, or the FM. Once the circuit has been tested and it is determined that it can be safely re-energized, then the circuit breaker may be reset and returned to the "ON" position, restoring electrical power to the circuit it was supplying.

15.1.2.1. GROUNDING

Protective grounding systems on site use proper equipment and are designed, installed, and arranged to reduce any stray voltage to a safe level. If re-energizing occurs, the grounding impedance must be low enough to ensure the prompt operation of protective devices (for example, fuses and breakers). To ensure protective grounds will protect workers, grounding methods and controls will be inspected by the FM and SSHO before, during, and after activities involving maintenance or replacement for all panel components, instrumentation, and mechanical equipment that require electrical operation.

15.2. USE OF PPE

Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. All the equipment listed below will be available and ready for use at the time it is needed. PPE to be used by workers involved in electrical operations is consistent with Section 8, Personal Protective Equipment Program, of this SSHP. Modifications of the Level D PPE required by Section 8 are reflected below. PPE will be maintained in a safe, reliable condition and periodically inspected or tested. Modified Level D PPE for electrical work can include:

- Non-conductive head protection
- Safety glasses
- Face shields
- Rubber insulating gloves (leather outer covering is allowed)
- Rubber aprons
- Non-conductive work shoes/boots

15.3. TRAINING

Only trained, competent, authorized personnel will be allowed to energize or de-energize electrical circuits, to perform work on electrically driven equipment. These persons will perform safe-work practices and procedures to prevent electrical shock or other injuries resulting from either direct or indirect electrical contact. Special testing equipment and techniques, personal protective equipment, insulating and shielding materials, and insulated tools will be used while working on circuits or equipment that are or can be energized.

16. PERMIT REQUIRED CONFINED SPACES

This section of the SSHP has been prepared in compliance with 29 CFR 1910.120(b)(4)(ii)(I) and 1910.146, and represents the Site-specific written confined space entry program. The purpose of this section of the SSHP is to identify all permit-required confined spaces (permit spaces) on site and to describe the procedures that have been developed and implemented to ensure worker safety and health in permit-required confined spaces. In compliance with the requirements of 29 CFR 1910.120(b)(4)(ii)(I), this section of the SSHP is included even when no permit-required confined spaces are present on site, in order to indicate that a Site-specific evaluation for permit spaces has been made. See Appendix D for Confined Space Entry permit form.

This permit-required confined space program (confined space program) is consistent with 29 CFR 1910.146 and provides the following Site-specific information:

- Identification and evaluation of permit spaces
- Measures to prevent unauthorized entry
- Entry permit system
- Entry equipment and personal protective equipment
- Entry procedures
- Permit-required confined spaces training
- Rescue and emergency procedures
- Employee participation

The person with overall responsibility for the confined space program is the SSHO. The confined space program is modified to reflect changing Site conditions or work operations. This program is reviewed if any of the following conditions occur:

- Occurrence of unauthorized entry of a permit-required confined space
- Discovery of a permit-required confined space hazard not covered by the permit
- Detection of a condition prohibited by the permit
- Occurrence of an injury or near-miss during entry
- Change in the use or configuration of a confined space
- Employee complaints of confined space program ineffectiveness

Additionally, an annual review of all entries performed during the previous 12-month period is conducted. If no entries were made into a permit space, then no annual review is performed.

16.1. IDENTIFICATION AND EVALUATION OF PERMIT SPACES

The SSHO carefully evaluated this Site and determined that there are permit spaces at this Site. A copy of the evaluation is kept at Environmental Works, Inc., 1455 E. Chestnut Expressway, Springfield, Missouri. All confined spaces are treated as permit spaces until it is determined otherwise. At this Site, only EWI workers enter permit spaces. Contractors do not enter any permit spaces at this Site unless authorized, as specified in Section 6, Sub Contractor Safety. The FM performs initial monitoring to identify and evaluate any hazardous atmosphere that may exist. The monitoring data are recorded and retained at the Site.

In the evaluation testing of the confined spaces, the order of testing is as follows: oxygen, combustible

gases, and toxic gases and vapors. A confined space decision flow chart is also utilized in the evaluation of all confined spaces at this Site. A copy of the confined space decision flow chart can be found in Appendix D.

EWI workers, who enter permit spaces at this Site, or their designated representatives, are offered the opportunity to observe pre-entry testing and any subsequent testing. Results of testing are immediately provided to the entrants or their representatives. Permit spaces are re-evaluated if entrants or their representatives believe that the permit space was inadequately tested or conditions have changed.

Below in Table 19 are the permit spaces that EWI workers enter and identifies their related entry hazards.

Table 19 – On-site Permit Spaces

Permit Space Location	Configured for Alternate Entry (Y/N)	Hazardous Atmosphere	Engulfment Hazard	Equipment Configuration Hazard (Y/N)	Other Recognized Hazard	Reclassification Possible? (Y/N)
Treatment Building Storage Tanks	No	Oxygen levels below 19.5% Hydrogen Sulfide Carbon Monoxide Flammable/combustible gases VOC vapors	Yes	No	Slips/Trips/Falls, electrical, traffic, lifting equipment, inclement weather	No
Sewer Manholes	No	Oxygen levels below 19.5% Hydrogen Sulfide Carbon Monoxide Flammable/combustible gases VOC vapors	Yes	No	Slips/Trips/Falls, electrical, underground utilities, traffic, lifting equipment, inclement weather	No

When the use or configuration of a confined space is changed so that the hazards to entrants may be increased, the space will be re-evaluated to determine if it should be reclassified as a permit space.

16.2. PREVENTION OF UNAUTHORIZED ENTRY

On-site training is used to inform all workers, including subcontractors, of the location and hazards of permit spaces. Workers are trained that entry into a permit space without an authorized permit is prohibited. All entrants named on an entry permit are verified as "authorized entrants".

When an unauthorized entrant approaches a permit space, the attendant is responsible for warning that person to stay away from the permit space. When an unauthorized entrant enters a permit space, the attendant will warn the person to exit the space immediately and inform the authorized entrants and entry supervisor that unauthorized entry has occurred. The entry supervisor is responsible for removing any unauthorized person who attempts to enter a permit space.

16.3. ENTRY PERMIT SYSTEM

Before entry is made into a permit space, the pre-entry procedures specified below (Section 16.5) are completed. The entry permit for the specific permit space is completed and signed by the entry supervisor. The completed permit is made available for worker review at the time of entry.

The standard entry permit used at this Site is located in Appendix D. A permit is prepared prior to entry into any permit space identified in Section 16.1 so that appropriate hazard evaluations, safeguards, and monitoring are in place prior to and throughout entry. The entry permit is canceled by the entry supervisor at the time indicated on the permit. The entry supervisor will also evacuate a permit space and cancel the permit if a condition not allowed under the permit arises during entry.

Permit space permits are retained for the duration of the project to facilitate review of the permit space program. Any problems encountered during entry are noted on the permit and action is taken to improve entry procedures or safeguards for the permit space.

16.4. ENTRY EQUIPMENT AND PPE

Information gathered and listed in Section 16.1 is the determining factor in equipment needed for safe permit space operations. Below lists the permit space equipment required for entry. All the equipment listed will be available and ready for use at the permit space before entry begins. PPE to be used by workers involved in entry is consistent with Section 8, Personal Protective Equipment Program, of this SSHP. Modifications of the PPE required by Section 8 are reflected below. Personnel involved in confined space entry operations receive necessary training in the use and application of the following equipment:

- Monitoring instruments including the PID and 4-gas meter;
- Level D and Level C PPE that is required, as well as required PPE upgrade criteria;
- Lighting equipment including flashlights, headlamps, and temporary lighting;
- Ventilating equipment such as air blowers;
- Communication devices including visual contact, voice commands, radios, and hand signals;
- Protective barriers such as pylons, barricades, and caution tape; and
- Rescue equipment including a tripod and winch system, safety harnesses, and other extraction equipment.

16.5. ENTRY PROCEDURES

The following actions are completed prior to permit space entry:

- All equipment needed to ensure safe entry is placed near the permit space or otherwise made available to workers. The equipment required for each space is identified in 12.4, Entry Equipment and PPE, of this section of the SSHP.
- All barriers needed to protect employees from pedestrian, vehicular, or other hazards are put in place.
- The isolation procedures noted on the entry permit for the permit space are completed. These precautions comply with 29 CFR 1910.147, The Control of Hazardous Energy (LOTO), where applicable.
- The permit space is purged or ventilated in accordance with the specifications of the entry permit in order to eliminate and control atmospheric hazards.
- The atmosphere of the permit space is tested to ensure that the acceptable entry conditions

specified on the entry permit are met. The permit space atmosphere is tested in the following order: oxygen content, combustible gases, and toxic gases and vapors. Monitoring results are recorded on the entry permit. Entrants, or their designated representatives, are offered the opportunity to observe pre-entry and any subsequent testing and results.

After the above pre-entry procedures have been completed and the requirements of the entry permit satisfied, entrants can enter the permit space to perform the work specified on the entry permit. The permit space is monitored throughout entry operations, as necessary, to ensure that acceptable entry conditions are maintained. Monitoring results are recorded on the entry permit.

If any of the following conditions exist during entry operations, entrants evacuate the permit space:

- An order to evacuate is given by the attendant or entry supervisor
- An entrant recognizes any warning sign or symptom of exposure to a dangerous situation
- An entrant detects a prohibited condition
- An evacuation alarm is activated

Alternative Entry Procedures

The following alternative procedures are followed for entry into the permit space(s) indicated in Section 16.1 that allow alternative entry:

- Any conditions that exist making it unsafe to remove an entrance cover are eliminated before the cover is removed.
- When entrance covers are removed, the opening is promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall into the permit space and will protect employees in the permit space from foreign objects entering the space.
- Before an employee enters the permit space, a calibrated direct-reading instrument is used to test the internal atmosphere for oxygen content, flammable gases and vapors, and potential toxic air contaminants, in that order.
- Employees who enter permit spaces on this Site, or their designated representatives, are offered the opportunity to observe pre-entry and periodic testing of permit spaces.
- There is no hazardous atmosphere within the permit space whenever an employee is inside.
- An employee does not enter the permit space until the forced air ventilation has eliminated the hazardous atmosphere.
- The forced air ventilation is directed to ventilate the immediate areas where an employee is present and continues until all employees have left the space.
- The supply for the forced air ventilation is from a clean source and does not increase the hazards in the space.
- The atmosphere is periodically tested to ensure that the forced ventilation is preventing the accumulation of a hazardous atmosphere.
- If a hazardous atmosphere is detected, each employee immediately leaves the permit space.
- The permit space is evaluated to determine how the hazardous atmosphere developed.
- Measures are implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.
- A written certification containing the date, the location of the permit space, and the signature of the person providing the certification is generated before entry and is available to each

employee entering the permit space or to that employee's representative.

16.6. PERMIT SPACES TRAINING

All Site workers receive training to protect them from the hazards presented by the on-Site permit spaces. The level of training provided is consistent with the worker's role and responsibilities in permit spaces entry. Regardless of their level of involvement in permit space entry, all Site personnel are informed of the location and hazards of permit spaces on the Site.

Training and retraining are provided to affected Site workers in the following circumstances:

- Prior to entry into a permit space;
- Prior to a change in assigned duties;
- When a change in permit space operations presents a new hazard to employees;
- When it is determined that deviations from this plan's permit space entry procedures have occurred;
- When it is determined that an employee's knowledge is inadequate; and
- When new or revised entry procedures are introduced.

16.6.1. AUTHORIZED ENTRANT TRAINING

The authorized entrants are those Site workers who have been authorized to enter a permit space. Authorized entrants receive the following training prior to permit space work:

- Permit space hazards, including the mode, symptoms, and consequences of exposure to the hazards;
- Equipment required for entry, including the proper use of PPE;
- Procedures/means to alert the "attendant(s)";
- Evacuation procedures; and
- LOTO procedures and equipment in accordance with 29 CFR 1910.147.

16.6.2. ATTENDANT TRAINING

Attendants are those Site workers stationed outside a permit space to monitor entrants and conditions and to initiate emergency and rescue procedures/response. Attendants will receive the following training prior to permit space work:

- Permit space hazards, including the mode, symptoms, and consequences of exposure to the hazards;
- Behavioral effects of hazard exposure in entrants;
- Non-entry rescue procedures;
- Procedures/means to alert entrants to evacuate;
- Conditions that warrant evacuation of a permit space;
- Procedures/means to summon evacuation/rescue services; and
- Actions when unauthorized entrants approach or enter a permit space.

16.6.3. ENTRY SUPERVISOR TRAINING

The entry supervisor is responsible for determining if acceptable entry conditions are present, for authorizing entry, for overseeing entry operations, and for terminating entry. The entry supervisor receives the following training prior to Site work:

- Permit space hazards, including the mode, symptoms, and consequences of exposure to the hazards;
- Entry permit verification: tests have been performed and procedures and equipment in place;
- Emergency/rescue services and procedures; and
- Actions when unauthorized entrants enter or approach a permit space.

Employees are certified as proficient in their respective duties. A record of each employee's certification is retained in the employee's personnel file. The record includes each employee's name, signatures of the training providers, and the dates of training completion and certification.

The training provided to rescue personnel is detailed in the Rescue and Emergency Procedures section of the permit space program, 16.7.

16.7. RESCUE AND EMERGENCY PROCEDURES

Confined space rescue service discussed in this SSHP has been evaluated and selected based on the criteria listed in 1910.146(k)(1). EWI personnel conducting confined space entry activities on site will be trained in non-entry confined space rescue procedures, and at least one member of the confined space entry team will have current first-aid and CPR certification.

When the permit space attendant determines that entrants may be in need of assistance for escape from a permit space, he/she will first summon rescue and other emergency services via 911. After this notification, the attendant will attempt to perform a non-entry rescue. No attendant will attempt an entry rescue unless he/she is relieved by another attendant, has received the specified training listed below for rescue personnel, and is qualified to attempt such a rescue. Additional information regarding entry rescue procedures is provided in Section 16.7.2.

16.7.1. NON-ENTRY REQUIRED RESCUE

In permit spaces where the use of non-entry retrieval systems is feasible, the entrant(s) will wear a full body harness. As soon as the attendant determines that non-entry rescue must be performed, he/she will use the confined space hoist to retrieve the entrant from the permit space.

16.7.2. ENTRY REQUIRED RESCUE

When non-entry rescue is infeasible, entry into the permit space for rescue of the entrants will be performed. At all times during the entry rescue procedures, an attendant will be stationed outside the permit space to monitor activity in the space.

EWI personnel are not authorized or trained to conduct an entry required rescue. EWI will contact appropriate authorities or the Springfield, MO Fire Department confined space rescue team. The emergency contact phone number for the Springfield, MO Fire Department is (417) 864-1500 or 911.

When personnel rescued from the permit space are transferred to or treated by a medical facility or personnel as defined in the Emergency Response Section of this SSHP, the SDS or other essential hazard information are provided to the treating parties.

17. TRENCHING AND EXCAVATION

This section of the SSHP describes trenching and excavation safety at this Site, roles and responsibilities of on-site excavators, and general requirements for trenching and excavation work including heavy equipment operation. This trenching and excavation safety plan is in compliance with the requirements of 29 CFR 1926.651.

17.1. ROLES AND RESPONSIBILITIES OF EXCAVATORS

Listed below describes lines of authority, responsibility, and communication as they pertain to trenching and excavation activities at this Site. Outlined below identifies the personnel who are involved with trenching and excavation operations and describes their roles and responsibilities.

17.1.1. EXCAVATION SITE SUPERVISION

The SSHO is responsible for excavation activities at this Site. The specific responsibilities of the SSHO with regard to excavation activities include the following:

- Contacting utility companies to notify them of work to be conducted (See Appendix D for utility clearance form) and request that they establish the location of underground utility installations prior to the start of the actual excavation;
- Providing for and supporting necessary excavation safety procedures by requiring workers to follow the procedures outlined in this program; and
- Ensuring only properly trained employees work on excavation projects and equipment.

The SSHO has authority to delegate tasks discussed within this section of the SSHP to a qualified assistant SSHO.

17.1.2. EXCAVATION SITE COMPETENT PERSON

The SSHO will assume the responsibilities of the competent person during excavation activities or delegate to an assistant SSHO, if needed. The SSHO or competent person is capable of identifying existing and predictable hazards in the working area as well as working conditions which are unsanitary, hazardous, or dangerous to employees. The SSHO has authorization to take prompt corrective measures to eliminate noted risks in the working area. The specific responsibilities of the competent person during excavation activities include the following:

- Following all regulatory requirements to ensure safe excavation activities in compliance with standard 29 CFR 1926.651;
- Taking appropriate actions to ensure employees are following the same regulatory requirements and halting operations if deemed necessary;
- Conducting daily inspections of excavations and/or trenches insuring safe conditions exist during operations;
- Being responsible for providing working materials needed to insure a safe work environment;
- Protecting unmarked underground installations if encountered;
- Recognizing, testing, and controlling hazardous atmospheres;
- Recognizing and controlling hazards due to water accumulation;
- Protecting employees from loose rocks or soils; and
- Providing protective systems according to Site specific changes.

17.2. TRENCHING AND EXCAVATION GENERAL REQUIREMENTS

Excavations are defined as any open excavation in the earth's surface and include trenches. In compliance with 29 CFR 1926 Subpart P, any excavation or trench over 4 ft in depth will be evaluated by the SSHO or other authorized competent person and shall be sloped or shored. The SSHO will complete an excavation and trenching hazard checklist throughout the task to insure all safety requirements have been met. This form can be found in Appendix D. Excavation evaluations will take into consideration and eliminate the hazards from the following:

- Surface encumbrances
- Underground installations not identified during required utility location procedures
- Access and egress
- Vehicular traffic around the excavation area
- Falling loads and overhead hazards
- Excavation equipment or other machinery
- Hazardous atmospheres
- Water accumulation
- Stability of adjacent structures and spoil pile
- Loose rock or soil
- Falling hazards

17.2.1. SLOPING

Sloping is the angling of the sides of the excavation to prevent downhill slide of soil. Approximate angles for sloping during excavation activities will be in accordance with 29 CFR 1926.652.

Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless deemed unnecessary by the competent person or SSHO. The determination of the angle of repose and design of an adequate support system will the responsibility of the competent person. Design will be based on careful evaluation of pertinent factors such as depth of cut; possible variation in water content of the material while the excavation is open; anticipated changes in materials from exposure to air, sun, water, or freezing; and vibration from equipment and traffic movement.

17.2.2. SHORING AND SUPPORT SYSTEMS

Shoring or support systems will be constructed to prevent downhill slide of rock and soil into excavations or trenches as needed. Shoring will provide support to excavation or trench walls to provide safe entry and exit for personnel. Shoring design will be the responsibility of the competent person or SSHO on site.

17.3. HEAVY EQUIPMENT OPERATIONS

Heavy equipment or earth moving equipment will be required for all excavation and trenching activities on site. The FM will be responsible for all heavy equipment operation and operator safety and well-

being. Heavy equipment operation will be in compliance with standard 29 CFR 1926.602. Heavy equipment operations will include the following:

- Identifying overhead and underground utilities prior to excavation or trenching activities;
- Establishing a routine maintenance schedule for each piece of machinery involved;
- Controlling airborne or other contaminants associated with the excavation;
- Inspection of all equipment prior to the start of operations at the beginning of each day;
- Maintaining safety equipment such as seatbelts, fire extinguishers, backup alarms, and enclosure integrity; and
- Providing appropriate safety precautions including traffic management, spotters, and mounting and dismounting equipment.

Only qualified and trained personnel will operate heavy equipment on site. All personnel who are part of any heavy equipment operations are trained to ensure that they possess the knowledge, skills, and abilities to effectively and safely perform excavation and trenching activities as well as the safe operation of the heavy equipment involved.

18. ELEVATED WORK PROGRAM

This section of the SSHP has been developed in compliance with the OSHA Fall Protection standard (CFR 1926, Subpart M, Fall Protection). The purpose of the Elevated Work program is to:

- Ensure all construction areas are free from uncontrolled fall hazards.
- All employees are properly trained in fall prevention and protection.
- Fall prevention systems are inspected and monitored to ensure effectiveness.

To fulfill the purpose of this program, all practical measures possible will be taken to prevent employees from being injured by falls. Necessary steps will be taken to eliminate, prevent, and control fall hazards. The first priority is given to the elimination of fall hazards. If a fall hazard cannot be eliminated, effective fall protection will be planned, implemented, and monitored to control the risks of injury due to falling.

All employees exposed to potential falls from heights will be trained to minimize the exposures. Fall protection equipment will be provided and its use required by all employees. The SSHO will be responsible for implementation of a fall protection plan and rescue equipment/self-rescue for this Site. All accidents and serious incidents (near accidents) must be investigated, implementing changes to the fall protection plan as necessary.

18.1. HAZARD IDENTIFICATION

The FM will be responsible for identifying fall hazards for specific activities while working at the Site. The FM will evaluate each situation or work procedure where employees may be exposed to a fall of 6 ft or more. The FM will be responsible for developing a plan to eliminate the exposures, if possible, or to select the appropriate fall protection systems and/or equipment. Engineering hazard controls utilized at the Site may consist of the following:

- Personal fall protection
- Guard rail systems
- Positioning devices
- Warning line system
- Floor opening covers

Administrative hazard controls utilized at the Site may consist of the following:

- Controlled access zones
- Employee training
- Audits
- Inspections
- Supervision
- Signs

18.2. FALL PROTECTION REQUIRED

The following subsections discuss examples of situations were fall protection would be needed. These subsections do not constitute a complete list of examples, but rather the most likely situations where fall protection would be needed at this Site.

18.2.1. EXCAVATIONS

Each employee at the edge of an excavation 6 ft (1.8 meters) or more deep shall be protected from falling by guardrail systems, fences, barricades, or covers. Where walkways are provided to permit employees to cross over excavations, guardrails are required on the walkway if it is 6 ft (1.8 meters) or more above the excavation.

18.2.2. LOW-SLOPE ROOFS

Each employee engaged in roofing activities on low-slope roofs with unprotected sides and edges 6 ft or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems. They may also be protected by a combination of a warning line system and guardrail system, warning line system and safety net system, warning line system and personal fall arrest system, or warning line system and safety monitoring system. On roofs 50 ft or less in width, the use of a safety monitoring system without a warning line system is permitted.

18.3. CONTROLLED ACCESS ZONES

Controlled access zones are used to keep out workers other than those authorized to enter work areas from which guardrails have been removed. Where there are no guardrails, trained personnel are the only workers allowed in controlled access zones.

Controlled access zones, when created to limit entrance to areas where leading edge work and other operations are taking place, must be defined by a control line or by any other means that restrict access. Control lines shall consist of ropes, wires, tapes or equivalent materials, and supporting stanchions, and each must be:

- Flagged or otherwise clearly marked at not more than 6-ft intervals with high-visibility material.
- Rigged and supported in such a way that the lowest point (including sag) is not less than 39 inches from the walking/working surface and the highest point is not more than 45 inches or more than 50 inches when overhand bricklaying operations are being performed from the walking/working surface.
- Strong enough to sustain stress of not less than 200 pounds (lbs). Control lines shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge Control lines also must be connected on each side to a guardrail system or wall. When control lines are used, they shall be erected not less than 6 ft nor more than 25 ft from the unprotected or leading edge, except when precast concrete members are being erected. In the latter case, the control line is to be erected not less than 6 ft nor more than 60 ft or half the length of the member being erected, whichever is less, from the leading edge.

18.4. FALL PROTECTION SYSTEMS

When there is a potential fall of 6 ft or more, one or more of the fall protection systems discussed in the following subsections will be utilized as a means of providing protection. Equipment utilized for use in fall protection systems must meet applicable American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM) requirements.

18.4.1. PERSONAL FALL ARREST SYSTEMS

Personal fall arrest systems consist of an anchorage, connectors, and a body belt or body harness and may include a deceleration device, lifeline, or suitable combinations. If a personal fall arrest system is used for fall protection, it must do the following:

- Limit maximum arresting force on an employee to 900 pounds when used with a body belt;
- Limit maximum arresting force on an employee to 1,800 pounds when used with a body harness;
- Be rigged so that an employee can neither free fall more than 6 ft nor contact any lower level;
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 ft; and
- Have sufficient strength to withstand twice the potential impact energy of an employee free-falling a distance of 6 ft or the free fall distance permitted by the system, whichever is less.

The use of body belts for fall arrest is prohibited and a full body harness is required.

Personal fall arrest systems must be inspected prior to each use for wear damage, and other deterioration. Defective components must be removed from service.

18.4.2. SAFETY MONITORING SYSTEMS

When no other alternative fall protection has been implemented, a safety monitoring system shall be implemented. A competent person must be appointed by the SSHO or FM to monitor the safety of workers. The designated competent person must meet the following requirements:

- Is competent in the recognition of fall hazards;
- Is capable of warning workers of fall hazard dangers and in detecting unsafe work practices;
- Is operating on the same walking/working surfaces of the workers and can see them; and
- Is close enough to work operations to communicate orally with workers and has no other duties to distract from the monitoring function.

Mechanical equipment shall not be used or stored in areas where safety monitoring systems are being used to monitor employees engaged in roofing operations on low-sloped roofs.

No worker, other than one engaged in roofing work (on low-sloped roofs) or one covered by a fall protection plan, shall be allowed in an area where an employee is being protected by a safety monitoring system.

All workers in a controlled access zone shall be instructed to promptly comply with fall hazard warnings issued by safety monitors.

18.4.3. PROTECTION FROM FALLING OBJECTS

When guardrail systems are used to prevent materials from falling from one level to another, any openings must be small enough to prevent passage of potential falling objects. No materials or equipment except masonry and mortar shall be stored within 4 ft of working edges. Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear of the working area by removal at regular intervals.

During roofing work, materials and equipment shall not be stored within 6 ft of a roof edge unless guardrails are erected at the edge, and materials piled, grouped, or stacked near a roof edge must be stable and self-supporting.

18.5. SAFETY HARNESS INSPECTION

The SSHO shall designate a competent person to inspect the fall protection harnesses on a monthly basis or as needed. Harnesses will be inspected following the inspection criteria as set forth in this SSHP. Additionally, employees using the harnesses are required to inspect the equipment visually before use. If the harness is damaged, it will not be used. If during the course of work, the harness becomes damaged, the employee using the harness is required to report the damage to the competent person.

Upon finding worn harnesses that are unfit for use, the competent person shall remove from use, destroy, and order new ones (if needed) through the PM or SSHO. Any harnesses removed from use and destroyed will be documented by the competent person. Safety harness inspection forms can be found in Appendix D.

The following inspection criteria shall be used when inspecting fall protection harnesses:

- Inspect all harness webbing or leather for fraying, cuts, excessive weld burns, and other deterioration.
- Inspect all stitching, ensuring it is intact.
- Inspect all rivets and eyelets for cracks or missing.
- Inspect D-rings and buckles for cracks or misshapen.
- Inspect the body pad (if applicable) for excessive wear.
- Inspect the lanyards for excessive wear, fraying, cuts, weld burns, or other signs of deterioration.
- Ensure the safety latch/hook is of the double lock type and is functioning properly.
- Ensure the certification or data tag is present and legible.

18.6. LADDERS AND SCAFFOLDS

Ladders present unique opportunities for unsafe acts and unsafe conditions. Personnel working at this Site who use ladders must be trained in proper selection, inspection, use and storage (29 CFR 1910.25, 1910.26, and 1910.27). A ladder inspection form is included in Appendix D.

Hazards associated with the use of ladders at this Site may include the following:

- Ladders with missing or broken parts
- Using a ladder with too low of a weight rating
- Using a ladder that is too short for purpose
- Using metal ladders near electrical wires
- Using ladders as a working platform
- Objects falling from ladders

In order to avoid the hazards listed above, all ladders are inspected before use to ensure all rungs and steps are free of oil, grease, dirt, etc. and are evenly spaced, all fittings are tight, spreaders or other locking devices are in place, non-skid safety feet are in place, no structural defects are present, and that a broken ladder is not used. In addition, the type of ladder is confirmed so that the proper ladder is used. Ladder weight ratings are listed below:

- I-A 300 pounds (heavy duty)
- I 250 pounds (heavy duty)

- II 225 pounds (medium duty)
- III 200 pounds (light duty)

Limits on ladders used at the Site are as follows: a stepladder should be no more than 20 ft high, a one-section ladder should be no more than 30 ft high, and an extension ladder can extend to 60 ft, but the sections must overlap.

The following procedures will be followed when using ladders at this Site:

- Place ladder on a clean slip free level surface.
- Extend the ladder to have about 4 ft above the top support or work area.
- Anchor the top and bottom of the ladder.
- Place the ladder base one-quarter the height, of the ladder, from the wall when using an extension ladder.
- Never allow more than one person on a ladder.
- Use carriers and tool belts to carry objects up a ladder.
- Do not lean out from the ladder in any direction.
- If you have a fear of heights - don't climb a ladder.
- Do not allow others to work under a ladder in use.

18.7. TRAINING

All employees performing elevated work at this Site will be trained in the following areas:

- The nature of fall hazards in the work area;
- The correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems;
- The use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems;
- The role of each employee in the safety monitoring system when the system is in use;
- The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;
- The correct procedures for equipment and materials handling and storage and the erection of overhead protection;
- Trained on the proper care, inspection and wearing of the safety harness;
- Load carrying capacities of ladders and other fall protection equipment;
- Correct procedures for erecting, maintaining, and disassembling fall protection systems;
- Nature of fall hazards in the work area (e.g. falls, electrical, falling objects, etc.);
- Employees role in fall protection plans; and
- The OSHA fall protection standard (29 CFR 1926.503).

Employees shall be retrained when:

- Deficiencies in training are recognized.

- Work place conditions change.
- Fall protection systems or equipment changes render previous training obsolete.

Training records for all workers and on-site personnel are maintained at the Site and EWI, 1455 E. Chestnut Expressway, Springfield, Missouri.

19. DRUM HANDLING

This SSHP recognizes that incidents may occur during the handling of drums and other hazardous material containers. These potential incidents include detonation, fire, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, heavy equipment, and deteriorated drums. Proper work practices can minimize the risks to Site personnel.

19.1. PLANNING

Due to dangers associated with drum handling, every step of the operation should be carefully planned, based on all the information available at the time. A preliminary inspection of drums is the first step to safe work practices. When inspecting drums, employees should look for the following:

- Symbols, words, or other marks on the drum indicating that its contents are hazardous, e.g., radioactive, explosive, corrosive, toxic, or flammable;
- Symbols, words, or other marks on a drum indicating that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume individual containers;
- Signs of deterioration such as corrosion, rust, and leaks;
- Signs that the drum is under pressure such as swelling and bulging;
- Drum type; and
- Configuration of the drumhead.

Conditions in the immediate vicinity of the drum(s) may provide information about drum contents and their associated hazards. Monitoring should be conducted around the drums using instruments such as a PID and/or 4-gas meter.

Based on the initial inspection, drums should be classified into a preliminary hazard category such as:

- Leaking/deteriorated;
- Bulging;
- Explosive/shock sensitive; and/or
- Contains small volume individual containers of laboratory wastes or other dangerous materials.

Table 20- Special Drum Types and Their Associated Hazards

Drum Type	Possible Associated Hazards
Polyethylene or poly vinyl chloride (PVC) lined Drums	Often contain strong acids or bases. If the lining is punctured, the substance usually quickly corrodes the steel, resulting in a significant leak or split.
Exotic Metal Drums (e.g., aluminum, nickel, stainless steel, or other unusual metal)	Very expensive drums that usually contain an extremely dangerous material.
Single-walled Drums Used as Pressure Vessel	These drums have fittings for both product filing and placement of an inert gas such as nitrogen. The drum may contain reactive, flammable, or explosive substances.
Laboratory Packs	Used for disposal of expired chemicals and process samples from university laboratories, hospitals, and similar institutions. Individual containers within the lab pack are often not packed in absorbent material. They may contain incompatible materials, radioisotopes, shock sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs can be an ignition source for fires at hazardous waste sites.

19.2. HANDLING

Since accidents occur frequently during handling, particularly initial handling, drums should only be handled if necessary. The following procedures should be followed after a drum has been determined to be suitable for handling in order to maximize worker safety during drum handling and movement:

- Use proper lifting and moving techniques to prevent back injuries;
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the given road surface;
- Wear appropriate respiratory protective equipment when needed;
- Have over packs ready before any attempt is made to move the drums;
- Before moving anything, determine the proper sequence in which the various drums and other containers should be moved. For example, small containers may need to be moved first to permit heavy equipment to enter and move the drums;
- Exercise extreme caution when handling drums that are not intact and tightly sealed;
- Ensure that equipment operators have a clear view of the roadway when carrying drums. Where necessary, have ground workers available to guide the operator's motion.

20. HOT WORK

This section of the SSHP has been prepared in compliance with 29 CFR 1910.252(a) and addresses hot work operations at the Site. The purpose of this section is to establish procedures that protect workers from safety and health hazards associated with these operations. The hot work section of this SSHP is consistent with the requirements of 29 CFR 1910.252(a) and addresses the following Site-specific information:

- Designated areas and other hot work locations
- Hot work permits
- Fire watch
- Hot work procedures

The person with responsibility for implementing this plan and authorizing cutting and welding operations is the FM.

20.1. DESIGNATED AREAS AND OTHER HOT WORK LOCATIONS

Whenever possible, welding and cutting on this Site are performed in designated areas that have been made fire safe. The designated area at this Site is the gravel lot, inside fenced area.

Cutting or welding in undesignated areas is only done after a hot work permit has been obtained, as detailed in Section 20.2. Cutting and welding operations are prohibited at all times at off-site locations when windy or dry conditions are present.

20.2. HOT WORK PERMIT

A written hot work authorization is required and issued prior to any welding or cutting operation outside the designated areas. The hot work permit is authorized only after the area is inspected by the authorizing company personnel.

The hot work permit will be conspicuously posted in the area where the welding or cutting is being performed. On the permit, the authorizing worker will note any necessary precautions for the specific cutting or welding operation. These precautions include, but are not limited to, fire watch, guarding, and fire extinguishing equipment. A copy of the hot work permit can be found in Appendix D.

20.3. FIRE WATCH

Fire watch is required by the hot work permit when any of the following conditions exists:

- Potential for development of other than a minor fire;
- Appreciable combustible material, in building construction or contents, within 35 ft;
- Appreciable quantities of combustibles are greater than 35 ft away, but easily combustible;
- Wall or floor openings within 35 ft expose combustible material in adjacent areas including concealed spaces in walls or floors; and
- Combustible materials are adjacent to the opposite side of a metal partition, wall, ceiling, or roof and are likely to be ignited by heat conduction or radiation.

Fire watchers are equipped with fire extinguishing equipment as specified on the permit. They are trained in the use, operation, and limitations of the fire extinguishing equipment and familiar with emergency alerting procedures in the event of a fire. If a fire is discovered in an area under watch by the fire watcher, then he/she extinguishes the fire with the extinguishing equipment when obviously in

the capacity of the equipment, or otherwise sounds the alarm. Fire watch is maintained for not less than one-half hour after the completion of the welding or cutting to detect and extinguish possible smoldering fires.

20.4. HOT WORK PROCEDURES

The following procedures are followed for all hot work on this Site:

- Cutting and welding is performed only by suitably trained workers.
- Site subcontractors who may perform hot work or who work in proximity to hot work operations are advised about the location of flammable materials or hazardous conditions.
- Combustibles are removed from the area or protected where the work cannot be moved to designated fire safe areas.
- Openings or cracks in flooring or walls, open doorways, and open or broken windows are effectively closed or precautions taken to protect readily combustible material onto which sparks or slag may drop.
- Suitable fire extinguishing equipment is maintained and ready for use at all welding or cutting operations.
- Combustible materials are cleared within a minimum radius of 35 ft around welding or cutting operations or, where it is not possible to clear the area, the combustibles are protected with appropriate covers or shields.
- Where floors or surrounding ground are wetted, arc welding or cutting equipment operators wear appropriate PPE in accordance with 29 CFR 1910 Subpart I (Personal Protective Equipment).
- The FM has the authority and responsibility to interrupt other Site operations that might expose combustibles to ignition during cutting and welding.
- Hot work is not performed on drums, barrels, tanks, or other containers until they have been thoroughly cleaned and it is determined that hot work operations on the vessel will not produce flammable or toxic vapors.
- Pipelines or connections to drums or other containers are disconnected or blanked prior to hot work.
- All hollow spaces, cavities, and containers are thoroughly vented, and preferably purged with inert gas, to allow escape of air or gases prior to any preheating, cutting, or welding.
- **Confined spaces**: where arc welding is performed, all electrodes are removed from holders, the holders are carefully located to prevent accidental contact, and the power source to the machine is disconnected when work is suspended for any substantial period of time, such as during lunch hour or overnight; and/or
- **Confined spaces**: torch valves shall be closed and the gas supply to the torch positively shut off at some point outside the confined space on all gas welding or cutting equipment when the torch is not to be used for a substantial period of time, such as during lunch hour or overnight.

21. HAZARDOUS ENERGY CONTROL OR LOCKOUT/TAGOUT PROGRAM

This section of the SSHP has been prepared in compliance with 29 CFR 1910.147 and constitutes a Site-specific Hazardous Energy Control or lockout/tagout program. This section describes general procedures to help ensure the control of hazardous energy while equipment and machinery are serviced and maintained at this Site, as well as training and periodic inspections associated with the control of hazardous energy at the Site. The program requires the control of hazardous energy by isolating machines and equipment from their energy source(s), rendering them inoperative before any servicing or maintenance is performed.

The LOTO program includes the elements specified in 1910.147 and provides the following Site-specific information:

- Energy control procedures
  - Isolation procedures
  - Energy isolation devices and lockout/tagout devices
  - Group lockout/tagout and shift change procedures
- Periodic inspection procedures
- Training requirements

21.1. HAZARDOUS ENERGY CONTROL PROCEDURES

Energy control procedures are established for each machine and piece of equipment on this Site that requires isolation prior to service or maintenance. Those procedures are located in Section 21.2. A lockout/tagout safety checklist is utilized prior to activity to insure a safe work environment and can be found in Appendix D. The procedures listed below help to ensure that our employees follow company procedures that will protect their health and safety. They include the following:

- Intended use of the procedure;
- Steps to shut down and isolate machine/equipment;
- Steps to place, remove, or transfer lockout and/or tagout devices; and
- Steps to test equipment and verify energy control measures.

The steps for applying hazardous energy control to each machine and piece of equipment include the following:

- Preparation for shutdown;
- Shutting down;
- Isolating machine or equipment;
- Applying lockout and/or tagout devices;
- Releasing any residual stored energy, with continual verification if potential for re-accumulation of energy exists; and
- Verifying energy isolation.

Prior to re-energizing and operating equipment, the energy control procedures for each machine and piece of equipment include the following steps:

- Inspecting work area to make sure nonessential items have been removed, machine or equipment components are operationally intact, and employees are safety positioned; and
- Removing lockout/tagout devices.

In situations where lockout and/or tagout devices have to be temporarily removed and the machine or equipment is energized to test or position the machine or equipment, the following actions are followed:

- Removing unnecessary tools, materials, and personnel from work area
- Removing lockout/tagout devices
- Energizing and testing/positioning machine or equipment
- De-energizing and re-applying energy control devices (as previously detailed)

Employees who could be affected by specific lockout/tagout procedures ("affected employees") are notified before the controls are applied and after the controls are removed, and before the machine or equipment is restarted. "Authorized employees" understand the type, magnitude, and hazards of the energy to be controlled and the methods to control the energy.

21.2. LOCKOUT/TAGOUT PROCEDURES

The lockout/tagout procedure establishes the minimum requirements for the lockout of energy isolating devices whenever maintenance or servicing is done on pumps, electrical panels and other energy sources on site. It will be used to ensure that equipment is stopped, isolated from all potentially hazardous energy sources and locked out before workers perform any servicing or maintenance only where unexpected start-up of the equipment, or electrical device release of stored energy, could cause injury. Procedures followed at this Site will be done in accordance with standard 29 CFR 1910.147.

21.2.1. SEQUENCE OF LOCKOUT

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance.
2. The authorized employee shall refer to the company procedure to identify the type and magnitude of the energy that the machine or equipment utilizes, shall understand the hazards of the energy, and shall know the methods to control the energy.
3. If the machine or equipment is operating, shut it down by the normal stopping procedure (depress the stop button, open switch, close valve, etc.).
4. De-activate the energy isolating device(s) so that the machine or equipment is isolated from the energy source(s).
5. Lock out the energy isolating device(s) with assigned individual lock(s).
6. Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc.) must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down, etc.
7. Ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed, then verify the isolation of the equipment by operating the push button or other normal operating control(s) or by testing to make certain the equipment will not operate.
8. The machine or equipment is now locked out.

21.2.2. RESTORING EQUIPMENT TO SERVICE

1. Check the machine or equipment and the immediate area around the machine to ensure that nonessential items have been removed and that the machine or equipment components are operationally intact.
2. Check the work area to ensure that all employees have been safely positioned or removed from the area.
3. Verify that the controls are in neutral.
4. Remove the lockout devices and reenergize the machine or equipment.
5. Notify affected employees that the servicing or maintenance is completed and the machine or equipment is ready for use.

22. STANDARD OPERATING PROCEDURES

Work at this Site will be conducted in accordance with procedures discussed within this SSHP and the following documents listed below:

- Remedial Action Optimization Work Plan and associated QAPP
- EWI SOP Documents (provided in associated QAPP document package)

23. RAILROAD PROPERTY SAFETY PROCEDURES

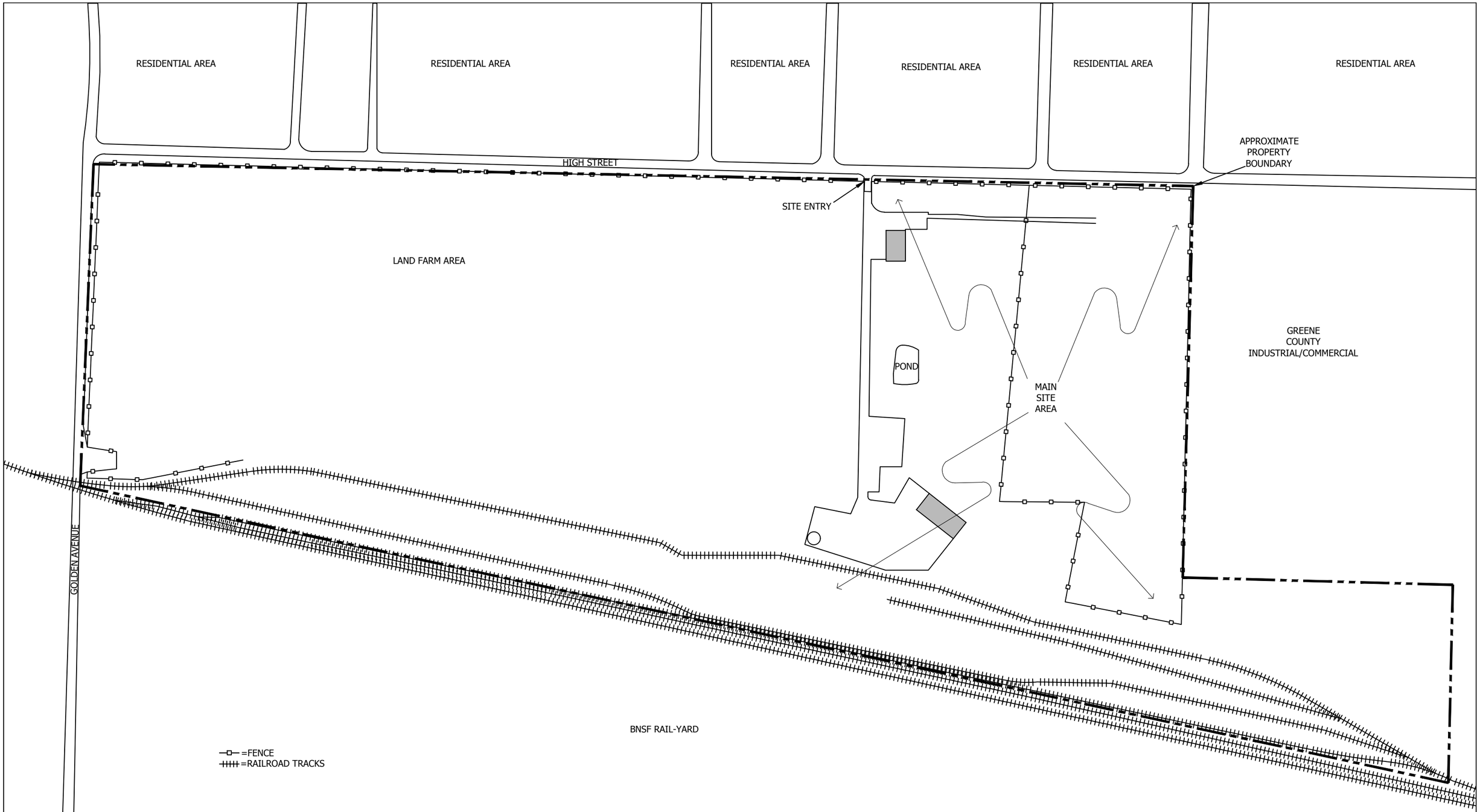
Safety procedures for activities performed on the BNSF Railway (BNSF) property to the south of the main Site (see Figure 1) will be conducted in accordance with the Contractor Safety Action Plan for the Springfield rail yard and this SSHP. Personnel conducting activities on railroad property will be trained in accordance with BNSF safety procedures, including contractor orientation training and eRailSafe training, respectively. Personnel will carry up-to-date cards referencing that training has been completed through BNSF and will carry at all times while on railroad property.

FIGURES

SITE SAFETY AND HEALTH PLAN

SITE INVESTIGATION, OPERATIONS, MAINTENANCE, AND REGULATORY COMPLIANCE

Former Tronox Facility
2800 High Street, Springfield, Missouri



NORTH

CHECKED BY: B. LANNING

E.W.I. # 150683
DRAWN BY: CLM
Aug. 18, 2016

SCALE IN FEET
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APPROXIMATE

PREPARED FOR:
Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

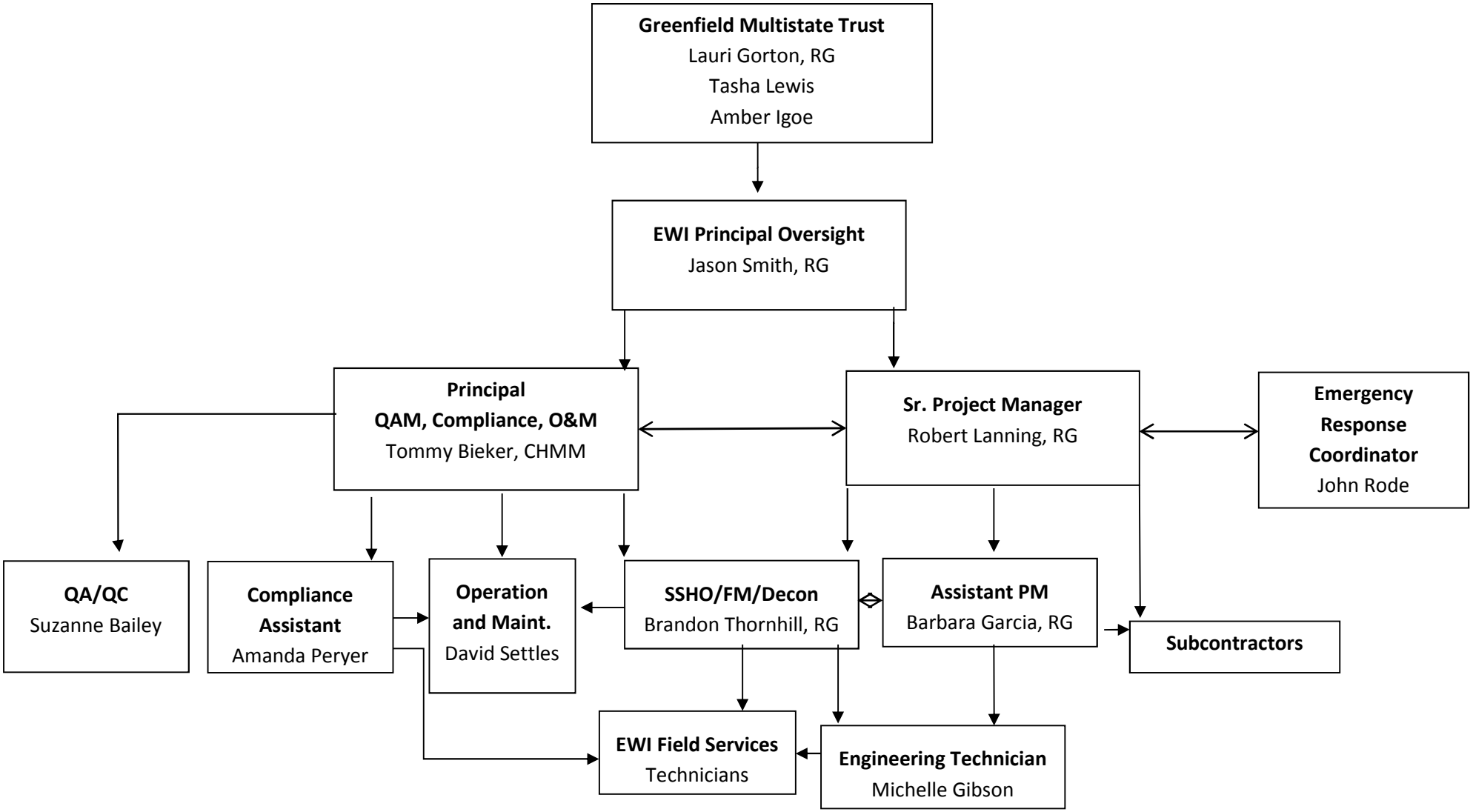
FACILITY DIAGRAM

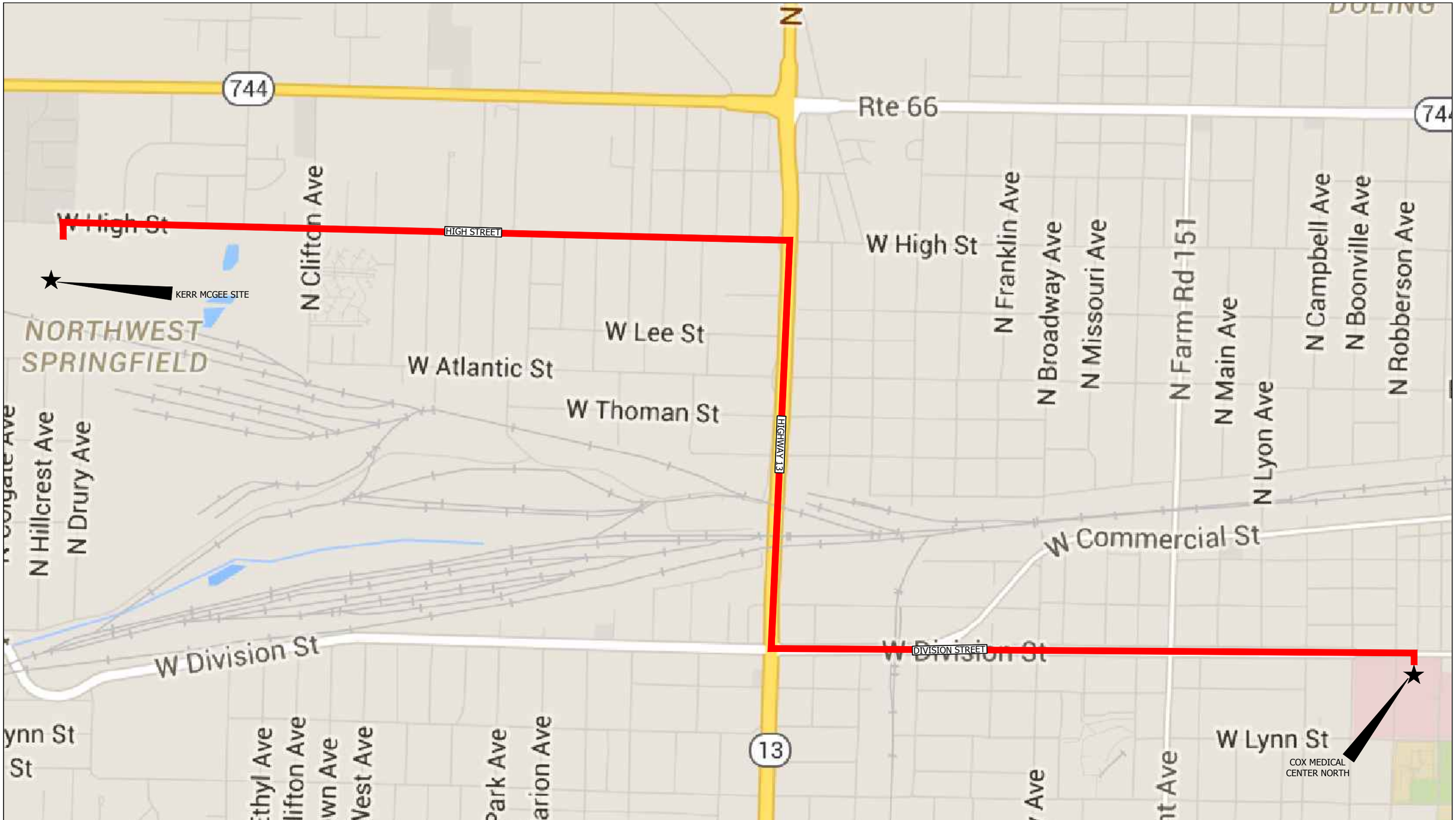
FORMER TRONOX FACILITY
2800 WEST HIGH ST.
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
1.0

Figure 2.0

Project Organization Safety Diagram





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CHECKED BY: B. LANNING

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DRAWN BY: CLM
Aug. 18, 2016

NOT TO SCALE

PREPARED FOR:
Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

EMERGENCY FACILITIES MAP

FORMER TRONOX FACILITY
2800 WEST HIGH ST.
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
3.0

NORTH

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B. LANNING

E.W.I. # 150683
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Aug. 18, 2016

SCALE IN FEET
0 125 250
APPROXIMATE

PREPARED FOR:
Greenfield Environmental Multistate Trust, LLC,
Trustee of the Multistate Environmental
Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

SITE DECONTAMINATION
FACILITIES

FORMER TRONOX FACILITY
2800 WEST HIGH ST.
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
4.0

CHECKED BY: B. LANNING	SCALE IN FEET 0 45 90 APPROXIMATE	PREPARED FOR: Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust	PREPARED BY: ENVIRONMENTAL WORKS	EMERGENCY PLANNING MAP
E.W.I. # 150683 DRAWN BY: CLM Aug. 18, 2016				FORMER TRONOX FACILITY 2800 WEST HIGH ST. SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
5.0

APPENDIX A

TABLES

SITE SAFETY AND HEALTH PLAN

SITE INVESTIGATION, OPERATIONS, MAINTENANCE, AND REGULATORY COMPLIANCE

Former Tronox Facility
2800 High Street, Springfield, Missouri

Table 1
Job Hazard Analysis
Activity Table List
Former Kerr- McGee/Tronox Site
Springfield, MO

JHA Task	Associated Table Number	Task Specific Hazards			Site Work Zones Necessary	Overall Hazard Rating
		Biological	Chemical	Physical		
Confined Space Entry	1A	Insect bites and stings, water-borne pathogens, raw sewage	Dermal contact, Inhalation	Electrical, Utilities (Underground), Slips/Trips/Falls, Traffic, Lifting Equipment, Cold Weather Operations , Hot Weather Operation, Inclement Weather	Yes	Serious
Operate and Maintain Facilities	1B	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Electrical, Utilities (Underground, Overhead), Slips/Trips/Falls, Excavation/Trenching Operations, Earth Moving Equipment, Motion of Machinery, Cold Weather Operations, Hot Weather Operations, Inclement Weather, Ladder Use	No	Low
Water Level Measurements	1C	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Electrical, Slips/Trips/Falls, Cold Weather Operations, Hot Weather Operations, Inclement Weather, Traffic, Railroad Operations	No	Low
Well Construction and Maintenance	1D	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Electrical, Utilities (Underground, Overhead), Slips/Trips/Falls, Excavation/Trenching Operations, Motion of Machinery, Drill rig Operations, Cold Weather Operations, Hot Weather Operations, Inclement Weather, Traffic, Noise	Yes	Moderate
Well Sampling	1E	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Electrical, Slips/Trips/Falls, Cold Weather Operations, Hot Weather Operations, Inclement Weather, Traffic	No	Low
Soil Sampling	1F	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Slips/Trips/Falls, Electrical, Cold Weather Operations, Hot Weather Operations, Inclement Weather, Traffic	No	Low
Electrical Activities	1G	Insect bites and stings, snakes, poisonous plants	NA	Slips/Trips/Falls, Electrical, Cold Weather Operations, Hot Weather Operations, Inclement Weather	No	Moderate
O and M of Facility	1H	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Slips/Trips/Falls, Electrical, Cold Weather Operations, Hot Weather Operations, Inclement Weather, Pinch Points	No	Moderate
Wastewater Sampling	1I	Insect bites and stings, snakes, poisonous plants	Dermal contact, Inhalation	Slips/Trips/Falls, Electrical, Cold Weather Operations, Hot Weather Operations, Inclement Weather	No	Low

Notes:
NA = not applicable

Table 1A
Job Hazard Analysis
Confined Space Entry
Kerr McGee/Tronox
Springfield, MO

Operational Phase	**Phase No**	**Location Where Task/Operation**
Active Cleanup		Site discharge sewer locations and downstream Site treatment tanks
Date(s) this JHA Conducted	**Employee Certifying this JHA Print Name**	**Signature**
12/4/2015	Brandon Thornhill	

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
Carbon Monoxide	Vault air - Inhalation	50 ppm PEL-TWA OSHA
Hydrogen Sulfide	Vault air - Inhalation	10 ppm TLV-TWA ACGIH
Natural Gas	Vault air - Inhalation	10% LEL
Oxygen	Vault air - Inhalation	<19.5% or >23.5%

Physical Hazards	**Source**	**Exposure Level**
Electrical	Junction boxes, wiring	Likely
Underground Utilities (electrical, gas, water, etc.)	City and private utilities	Likely
Overhead Utilities (electrical, phone, etc.)	City and private utilities	Likely
Slips/Trips/Falls	CSE areas	Likely
Traffic	Traffic near discharge manholes	Likely
Lifting Equipment Operation	CSE equipment	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Unlikely
Water-borne pathogens	Sewer	Likely
Raw sewage	Sewer	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis
LEL - lower explosive limit

Table 1B
Job Hazard Analysis
Maintain Site Grounds
Kerr McGee/Tronox
Springfield, MO

Operational Phase Active Cleanup	**Phase No**	**Location Where Task/Operation** Various site locations
Date(s) this JHA Conducted 12/4/2015	**Employee Certifying this JHA** **Print Name** Brandon Thornhill	**Signature**

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH

Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, wiring, mechanical	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Railroad Operations	Rail yard south of site	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1C
Job Hazard Analysis
Water Level Measurements
Kerr McGee/Tronox
Springfield, MO

Operational Phase Active Cleanup	**Phase No**	**Location Where Task/Operation** Well head Locations
Date(s) this JHA Conducted 12/4/2015	**Employee Certifying this JHA Print Name** Brandon Thornhill	**Signature**
Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH
Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, wiring, mechanical	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Railroad Operations	Rail yard south of site	Likely
Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely
PPE Required	**PPE Required If Upgraded**	
Level of PPE: D	**Level of PPE:** C	
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone	
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor	

Notes:
EQ - equalization
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1D
Job Hazard Analysis
Well Construction and Maintenance
Kerr McGee/Tronox
Springfield, MO

Operational Phase	**Phase No**	**Location Where Task/Operation**
Active Cleanup		Well Locations
Date(s) this JHA Conducted	**Employee Certifying this JHA Print Name**	**Signature**
12/4/2015	Brandon Thornhill	

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH

Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, wiring, mechanical	Likely
Underground Utilities (electrical, gas, water, etc.)	City and private utilities	Likely
Overhead Utilities (electrical, phone, etc.)	City and private utilities	Likely
Excavation/Trenching Operations	Underground wiring trenches	Likely
Motion of Machinery (Struck by hazards)	Heavy equipment	Likely
Drill rig Operations	Drill Rig	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Traffic	Traffic around site	Likely
Noise	Heavy equipment, Drill rig	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1E
Job Hazard Analysis
Well Sampling
Kerr McGee/Tronox
Springfield, MO

Operational Phase	**Phase No**	**Location Where Task/Operation**
Active Cleanup		Well Locations
Date(s) this JHA Conducted	**Employee Certifying this JHA Print Name**	**Signature**
12/4/2015	Brandon Thornhill	

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH
Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, Pump boxes	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Railroad Operations	Rail yard south of site	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
EQ - equalization
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1F
Job Hazard Analysis
Soil Sampling
Kerr McGee/Tronox
Springfield, MO

Operational Phase Active Cleanup	**Phase No**	**Location Where Task/Operation** Well Locations
Date(s) this JHA Conducted 12/4/2015	**Employee Certifying this JHA** **Print Name** Brandon Thornhill	**Signature**

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH
Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, wiring, mechanical	Likely
Underground Utilities (electrical, gas, water, etc.)	City and private utilities	Likely
Overhead Utilities (electrical, phone, etc.)	City and private utilities	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Likely
Drill rig Operations	Drill Rig	Likely
Motion of Machinery (Struck by hazards)	Heavy equipment	Likely
Hot Weather Operations	Outside Weather Conditions	Likely
Traffic	Traffic around site	Likely
Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Unlikely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:

EQ - equalization
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1G
Job Hazard Analysis
Electrical Activities
Kerr McGee/Tronox
Springfield, MO

Operational Phase Active Cleanup	**Phase No**	**Location Where Task/Operation** Various site locations / panels
Date(s) this JHA Conducted 12/4/2015	**Employee Certifying this JHA** **Print Name** Brandon Thornhill	**Signature**
Chemical Hazards	**Source**	**Inhalation Exposure Limit**
NA	NA	NA
Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, wiring, mechanical	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Traffic	Traffic around site	Unlikely
Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area, panels	Likely
Snakes	Site area, panels	Unlikely
Poisonous Plants (Ivey, Oak, Sumac)	Site area, panels	Likely
PPE Required	**PPE Required If Upgraded**	
Level of PPE: D	**Level of PPE:** NA	
Task-Specific Modifications: Use of electrical	**Upgrade Action Level:** NA	
PPE including, non conductive head protection, face	**Respirator Cartridge/Canister:** NA	
shield, rubber insulating gloves, and rubber apron, if		
necessary		
Respirator Cartridge/Canister: Not Applicable		

Notes:
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1H
Job Hazard Analysis
Operations Maintenance of Facility
Kerr McGee/Tronox
Springfield, MO

Operational Phase Active Cleanup	**Phase No**	**Location Where Task/Operation** Various site locations
Date(s) this JHA Conducted 12/4/2015	**Employee Certifying this JHA** **Print Name** Brandon Thornhill	**Signature**

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH

Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Pinch Points	Valves, vault lids, tanks	Likely
Electrical	Panels, wiring, mechanical	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Railroad Operations	Rail yard south of site	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1I
Job Hazard Analysis
Stormater Sampling
Kerr McGee/Tronox
Springfield, MO

Operational Phase Active Cleanup	**Phase No**	**Location Where Task/Operation** Well Locations
Date(s) this JHA Conducted 12/4/2015	**Employee Certifying this JHA** **Print Name** Brandon Thornhill	**Signature**

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH
Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, Pump boxes	Likely
Flowing Water	Outfalls	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Railroad Operations	Rail yard south of site	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
EQ - equalization
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1J
Job Hazard Analysis
Wastewater Sampling
Kerr McGee/Tronox
Springfield, MO

Operational Phase	**Phase No**	**Location Where Task/Operation**
Active Cleanup		Well Locations
Date(s) this JHA Conducted	**Employee Certifying this JHA Print Name**	**Signature**
12/4/2015	Brandon Thornhill	

Chemical Hazards	**Source**	**Inhalation Exposure Limit**
Coal Tar Pitch Volatiles	Water and vapor - Dermal contact, Inhalation	0.2 mg/m3-PEL/TLV; 80mg/m3 IDLH
Benzene	Water and vapor - Dermal contact, Inhalation	1 ppm PEL-OSHA
Naphthalene	Water and vapor - Dermal contact, Inhalation	10 ppm PEL-OSHA
m,o, and p-Cresol	Water and vapor - Dermal contact, Inhalation	5 ppm PEL-250 ppm IDLH
Physical Hazards	**Source**	**Exposure Level**
Slips/Trips/Falls	Site area	Likely
Electrical	Panels, Pump boxes	Likely
Cold Weather Operations	Outside Weather Conditions	Likely
Flowing Water	sampling points	Likely
Inclement Weather-Lightning, Rain, Snow, High Winds	Outside Weather Conditions	Unlikely
Hot Weather Operations	Outside Weather Conditions	Likely
Railroad Operations	Rail yard south of site	Likely

Biological Hazards	**Source**	**Exposure Potential**
Insect bites and stings	Site area	Likely
Snakes	Site area	Likely
Poisonous Plants (Ivey, Oak, Sumac)	Site area	Likely

PPE Required	**PPE Required If Upgraded**
Level of PPE: D	**Level of PPE:** C
Task-Specific Modifications: None	**Upgrade Action Level:** Sustained 5ppm organic vapor in breathing zone
Respirator Cartridge/Canister: Not Applicable	**Respirator Cartridge/Canister:** Organic Vapor

Notes:
EQ - equalization
NA - not applicable
PPE - personal protective equipment
ppm - parts per million
PEL - permissible exposure limit
TWA - time weighted average
TLV - threshold limit value
OSHA - Occupational Safety & Health Administration
ACGIH - American Conference of Governmental Industrial Hygienists
JHA - job hazard analysis

Table 1K
Job Hazard Analysis
PPE Selection Guide
Kerr McGee/Tronox
Springfield, MO

Recommended Equipment	Protection Provided	Should be used when:	Limiting Criteria
LEVEL A PROTECTION -The following constitute Level A equipment and may be used as appropriate: 1. Positive pressure, full face piece self-contained breathing apparatus, or positive pressure supplied air respirator with escape SCBA 2. Fully encapsulating chemical protective suit 3. Coveralls 4. Long underwear 5. Gloves, outer, chemical – resistant 6. Gloves, inner, chemical – resistant 7. Boots, chemical – resistant, steel toe and shank 8. Hardhat (under suit) 9. Two-way radio communications 10. Disposable protective suit, gloves, and boots (depending on suits construction, may be worn over totally encapsulating suit.	The highest available level of respiratory, skin and eye protection.	To be selected when the greatest level of skin, respiratory, and eye protection is required.	Fully encapsulating suit material must be compatible with the substances involved.
LEVEL B PROTECTION –The following constitute Level B equipment and may be used as appropriate. 1. Positive pressure, full face piece self-contained breathing apparatus, or positive pressure supplied air respirator with escape SCBA 2. Hooded chemical – resistant clothing (overalls and long-sleeved jacket; coveralls; one or two piece chemical splash suit; disposable chemical – resistant overalls) 3. Coveralls 4. Gloves, outer, chemical – resistant 5. Gloves, inner, chemical – resistant 6. Boots, chemical – resistant, steel toe and shank 7. Boot covers, outer, chemical – resistant (disposable) 8. Hardhat (under suit) 9. Face shield 10. Two-way radio communication	The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.	The atmospheric concentration of substances has been identified and requires a high level of respiratory protection, but less skin protection. This involves atmospheres with IDLH concentrations, atmospheres that do not meet the criteria for use of air purifying respirators, atmospheres containing less than 19.5% oxygen, or presence of incompletely identified vapors or gases (so long as they are not suspected of containing high levels of chemicals harmful to skin)	Use only when the vapors or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin.
Recommended Equipment	**Protection Provided**	**Should be used when:**	**Limiting Criteria**
LEVEL C PROTECTION –The following constitutes Level C equipment and may be used as appropriate: 1. Full face or half-mask, air purifying respirators (NIOSH approved) 2. Hooded chemical – resistant clothing (overalls and long-sleeved jacket; coveralls; one or two piece chemical splash suit; disposable chemical – resistant overalls) 3. Coveralls 4. Gloves, outer, chemical – resistant 4. Gloves, inner, chemical – resistant 5. Boots, outer, chemical – resistant, steel toe and shank 6. Boot covers, outer, chemical – resistant (disposable) 7. Hard hat 8. Escape mask 9. Face shield 10. Two-way radio communications	The concentrations and types of airborne substances is known and the criteria for using air purifying respirators are met.	The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin. The type of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant. All criteria for using air-purifying respirators are met.	Atmospheric concentration of chemicals must not exceed IDLH levels. The atmosphere must contain at least 19.5% oxygen.
LEVEL D PROTECTION –The following constitute Level D equipment and may be used as appropriate: 1. Coveralls 2. Gloves 3. Boots / shoes, chemical – resistant steel toe and shank. 4. Boots, outer, chemical – resistant (disposable) 5. Safety glasses or chemical splash goggles 6. Hard Hat 7. Escape mask 8. Face Shield	A work uniform affording minimal protection: used for nuisance contamination only.	The atmosphere contains no known hazard. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.	This level should not be worn in the Exclusion Zone. The atmosphere must contain at least 19.5% oxygen.

APPENDIX B

SAFETY DATA SHEETS

(to be determined when work commences)

SITE SAFETY AND HEALTH PLAN

SITE INVESTIGATION, OPERATIONS, MAINTENANCE, AND REGULATORY COMPLIANCE

Former Tronox Facility
2800 High Street, Springfield, Missouri

APPENDIX C

CHEMICAL HAZARD DATA SHEETS

SITE SAFETY AND HEALTH PLAN

SITE INVESTIGATION, OPERATIONS, MAINTENANCE, AND REGULATORY COMPLIANCE

Former Tronox Facility
2800 High Street, Springfield, Missouri

MATERIAL SAFETY DATA SHEET
Kerr-McGee Chemical LLC

Coal Tar Creosote Treated Wood

For more detailed information on the hazards of this product, contact Chemical Safety and Health Department or Medical Services Department at the address below. Consumer Information Sheet is also available.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT IDENTIFICATION

Product Name ..... Coal tar creosote treated wood
Chemical Name..... N/A
Common Name ..... Coal tar creosote treated wood
Formula..... N/A
Molecular Weight ..... N/A
Product Use..... Construction, transportation (railroad)
Canadian PIN..... N/A

MANUFACTURER

Kerr-McGee Chemical LLC
Kerr-McGee Center
Oklahoma City, OK 73125

EMERGENCY TELEPHONE NUMBER

(405) 270-1313 (24 hours)

2. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS NUMBER	CONTENT
Coal Tar Creosote	8001-58-9	6 - 15 lbs/cu. ft. in treated wood
Wood dust - Particles of varying size produced by any manual or mechanical cutting, chipping, sawing, or sanding of wood.	N/A	N/A

See Section 15 for OSHA Regulatory Status

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

The product is treated wood and wood particles of varying size and color.

WARNING! May be harmful if wood dust or preservative vapors or mist are inhaled. Contact with creosote by touching treated wood may cause eye and skin irritation.

Burning treated wood may produce toxic and irritating gases or fumes. Fine particles of wood dust present a fire and explosion hazard when exposed to heat, sparks, or flame. In case of fire, use water spray, fog, foam, dry chemical, or CO_2.

POTENTIAL HEALTH EFFECTS

PRIMARY ROUTE(S) OF ENTRY

Inhalation (breathing); eye and skin contact.

WARNING! May be harmful if wood dust or preservative vapors or mist are inhaled; may cause irritation to the

nose, throat, and lungs. Prolonged exposure can lead to inflammation of the nasal passages (rhinitis) or lung disease (e.g., bronchitis, asthma). Contact with the preservative in treated wood may cause eye and skin irritation. Dust may cause eye or skin irritation. Repeated or prolonged exposure may cause conjunctivitis (eye), allergic dermatitis (skin) or phototoxicity. Animal studies indicate that prolonged or repeated exposures to creosote may cause cancer.

SYMPTOMS OF EXPOSURE

Inhalation: Most likely symptoms associated with inhalation of treated wood dusts involve irritation of mucous membranes and respiratory tract (e.g., eye irritation and tearing, sneezing, coughing, runny nose, nose bleeds, difficulty in breathing, or wheezing). Non-specific systemic effects, such as headache, fever, might also occur under unusual circumstances.

Eye Contact: Watering, burning, pain.

Skin Contact: Irritation, redness, scaling, itching.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Pre-existing eye or skin disease, breathing or respiratory disease or disorders, sinus problems.

REPORTED AS CARCINOGEN OR POTENTIAL CARCINOGEN

_ Not Applicable
✓National Toxicology Program (NTP)
(See Section 11)

_ OSHA
✓ International Agency for Research on Cancer (IARC)

4. FIRST AID MEASURES

Inhalation: Remove from contaminated area to fresh air. Obtain immediate medical attention if respiratory symptoms or breathing difficulty develop.

Eye contact: Do not rub eyes. Immediately rinse eyes with water. Remove any contact lenses if possible, and continue flushing eyes with running water for at least 15 minutes. Hold eyelids apart to ensure rinsing of the entire surface of the eyes and lids with water. Obtain immediate medical attention.

Skin Contact: Wash affected skin with plenty of water and soap for 15 minutes. Do not rub skin until creosote is rinsed off. Remove contaminated clothing and shoes. If skin irritation or burns develop, obtain immediate medical attention. Wash clothing and decontaminate shoes before reuse.

Ingestion: Contact local poison control center or seek immediate medical attention.

NOTE TO PHYSICIAN

Chemical of exposure is wood treated with coal tar creosote or dust from this wood. Both coal tar creosote and wood dust are eye, skin, and respiratory tract irritants. Creosote may cause a sunlight induced phototoxic skin reaction. Wood dust is a potential respiratory and skin sensitizer.

5. FIRE FIGHTING MEASURES

Flash Point and Method ..... N/A

GENERAL HAZARD

Fine particles of wood dust are a strong to severe explosion hazard. Burning coal tar creosote treated wood may produce toxic and irritating gases or fumes.

EXTINGUISHING MEDIA

For small fires, use water spray, foam, CO_2, or dry chemical. For large fires, use water spray, fog, or alcohol foam.

SPECIAL FIREFIGHTING INSTRUCTIONS

Use water to wet down wood dust to prevent generation of dust clouds. Remove burnt or wet wood dust to an open area after fire is extinguished.

FIREFIGHTING EQUIPMENT

As in any fire, wear NIOSH approved, positive-pressure self-contained breathing apparatus and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Wear appropriate protective equipment (See Section 8).

ON LAND

Avoid generating dust. Sweep up dust and place in a container for later disposal.

7. HANDLING AND STORAGE

HANDLING

Wear appropriate protective equipment (See Section 8). Avoid breathing dust and contact with eyes or skin. Wash thoroughly after handling, and before eating, smoking and using the toilet.

STORAGE

Store in a dry place, away from heat, sparks, flame, or other sources of ignition. Keep away from oxidizers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS

If operations generate wood dust, use explosion-proof ventilation equipment to keep airborne levels below established exposure limits. Use local exhaust and general ventilation techniques to assure that exposure limits for creosote are not exceeded.

PERSONAL PROTECTION

Respirator:	In operations that generate dusts or preservative vapors which may exceed exposure limits, use a NIOSH approved respirator that has been selected by an industrial hygienist or other technically qualified person for the specific work conditions. If respirators are used, OSHA requires compliance with its Respiratory Protection Standard (29 CFR 1910.134).
Eye Protection:	Wear safety glasses or vented safety goggles.
Gloves:	To protect exposed skin against the photoxicity of creosote, apply commercially available sun block agents (Sun Protection Factor >15) under barrier creams. Gloves should be selected to

protect against creosote skin exposure. Use of Neoprene liners under leather work gloves should be adequate for most working conditions. Do not wear only cotton or leather gloves without impermeable liners.

Clothing: Wear easily washable clothing with long sleeves and pants. Wash clothing after each shift, or more often if clothing becomes contaminated. Segregate work clothing from household laundry and wash separately.

Other: Eye wash.

Hygiene Practices: Wash creosote off skin even during a work shift, using plenty of water and soap. Shower at the end of the work shift, using soap.

EXPOSURE CONTROLS

COMPONENT	OSHA PEL		ACGIH TLV	
	TWA	STEL	TWA	STEL
Coal tar pitch volatiles, as benzene solubles	0.2 mg/m^3	N/E	0.2 mg/m^3	N/E
Wood dust (certain hardwoods as beech & oak)	N/E	N/E	1 mg/m^3	N/E
Wood dust - Soft wood	N/E	N/E	5 mg/m^3	10 mg/m^3

9. PHYSICAL AND CHEMICAL PROPERTIES

State ..... Solid
Color ..... Varies, depending upon wood species
Odor ..... Varies, depending upon wood species
Vapor Pressure ..... N/A
Melting Point °C ..... N/A
Boiling Point °C ..... N/A
Bulk Density, lb/cu. Ft ..... N/D
Specific Gravity @ 20 °C ... N/A
Water Solubility ..... N/D
pH ..... N/A

10. STABILITY AND REACTIVITY

REACTIVITY

Stable

INCOMPATIBILITIES

Strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Under fire conditions or at elevated temperatures, the following may be produced: carbon monoxide and/or carbon dioxide as well as toxic coal tar fumes.

CONDITIONS TO AVOID

Dust generation; sources of ignition.

11. TOXICOLOGICAL INFORMATION

The following are for untreated wood:

Wood Dust:

IARC Cancer Review: Group 1 (carcinogenic to humans.).

Beech Wood Dust, Extract:

0

Dermal TD_{Lo} (mouse)..... 3,900 gm/kg; Effect: tumorigenic, tumors at site of application.

IARC determined that furniture and cabinet making entail exposures that are carcinogenic to humans (Group 1). Case reports and epidemiological studies have corroborated an increased risk of nasal adenocarcinoma among workers in the furniture and cabinet-making industry.

IARC evaluated exposures in the pulp and paper industries and determined that these are not classifiable as to their carcinogenicity to humans (Group 3).

Some studies have suggested that workers in the lumber and sawmill industries (including logging), and in the Carpentry and Joinery Trades may have an increased incidence in nasal cancers and Hodgkin's disease. However, IARC concluded that the epidemiological data do not permit a definite assessment.

For Creosote:

RTECS

Dermal TD_{Lo}(mouse)..... 99 gm/kg33W/I; Effect: tumorigenic.
Oral LD_{50} (rat) ..... 725 mg/kg; Effect: somnolence.
Oral LD_{50} (mouse)..... 433 mg/kg; Effects: convulsions and seizures, coma.

Creosote has been categorized as a Group 2A carcinogen (probably carcinogenic to humans) by IARC. The National Toxicology Program (NTP)concluded that there is limited evidence for the carcinogenicity of creosotes (listed under "Tars and Mineral Oils") in humans. The Environmental Protection Agency has categorized creosote as Group B1 (probable human carcinogen). Epidemiological studies of workers in the wood-treating industry have shown no significant health effects due to occupational exposure to creosote.

12. ECOLOGICAL INFORMATION

For a 60:40 mixture of creosote and coal tar:

Hazardous Substance Data Bank

24hr. TL_{50} (rainbow trout) .... 3.72 ppm
24hr. TL_{50} (bluegill)..... .... 4.42 ppm
24hr. TL_{50} (goldfish)..... .... 3.51 ppm
LD_{50} (bob white quail).. .... 1,260 ppm/8 days (unspecified route)
LD_{50} (mallard duck)..... .... 10,388 ppm/8 days (unspecified route)

13. DISPOSAL CONSIDERATIONS

RCRA Waste Code:..... U051 (Creosote)

Treated wood must not be burned in open fires or in stoves, fireplaces, or residential boilers. It may be burned in industrial boilers and incinerators, if allowed under applicable air and hazardous waste permits.

Creosote and hazardous debris contaminated with this preservative are prohibited from land disposal unless treated according to the standards in 40 CFR 268.45

Observe all applicable federal, state, and local regulations.

14. TRANSPORT INFORMATION

DOT Hazard Class ..... Not regulated
TDG Hazard Class ..... Not regulated

15. REGULATORY INFORMATION

OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200)

✓Hazardous _ Non-Hazardous

CERCLA/SUPERFUND (40 CFR 117, 302)

Chemical Name	RQ (lbs)/(kg)
Creosote	1

SARA EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355)

Chemical Name	TPQ (lbs)	RQ (lbs)
N/A		

SARA HAZARD CATEGORIES (40 CFR 370)

✓ Acute ✓ Chronic _ Fire _ Pressure _ Reactive _ None

SARA TOXIC CHEMICALS (40 CFR 372)

Chemical Name	CAS Number	%
Creosote	8001-58-9	6-15 lbs/ft^3 (12-30% by weight, assuming wood density of 50 lbs/ft^3)

INVENTORY STATUS

The chemicals in this product are listed on the US TSCA Chemical Substance Inventory and on the Canadian Domestic Substances List.

TOXIC SUBSTANCES CONTROL ACT

No specific regulations apply.

CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (CPR Section (33))

This product has been classified according to the hazard criteria of the Controlled Products Regulations, and the MSDS contains all required information.

✓Controlled Product; Classification: D2A, D2B _ Not a Controlled Product

STATE REGULATIONS

California Proposition 65 ..... WARNING: This product contains a chemical known to the State of California to cause cancer.
Florida Hazardous Substance List ..... Creosote.
Massachusetts Right to Know List ..... Creosote.
Minnesota Hazardous Substance List ..... Creosotes.
New Jersey Right to Know List ..... Creosote: Substance No. 0517; Special Health Hazard; Carcinogen.
Pennsylvania Right to Know List ..... Creosote; Special Hazardous Substance.

16. OTHER INFORMATION

ABBREVIATIONS

C - Ceiling limit
LC_{Lo} - The lowest concentration of a substance in air that causes death in a test animal within a certain exposure period.
LC_{50} - The concentration of a substance in air that causes death in 50% of test animals within a certain exposure period.
LD_{50} - The dose that causes death in 50% of test animals.
TD_{Lo} - Lowest dose at which a specific toxic effect occurs.
TL_{50} – Concentration or dose of a substance a living organism can endure with ill effects (tolerance limit)
N/A - Not applicable
N/D - Not determined
N/E - Not established
N/K - Not known
NAERG - North American Emergency Response Guidebook
PIN – Product Identification Number
RQ - Reportable Quantity
TPQ - Threshold Planning Quantity

PREPARATION INFORMATION

Prepared by .... Chemical Safety and Health Department
MSDS No. B-5090
Date Revised: ... . November 18, 2002 Replaces: April 30, 1999
Date of Issue: .. .. November, 2002

REVISION INFORMATION

Section 2 - Modified composition statement for creosote and Content.
Section 3 – Revised irritation statements in Emergency Overview and Signs and Symptoms.
Section 4 – Revised First Aid statement for skin contact.
Section 7 – Modified last sentence under Handling.
Section 8 – Added reference to OSHA Respiratory Standard. Modified glove statement and Hygiene Practices.
Section 11 – Reformatted and reworded information.
Section 12 – Corrected fish species.
Section 15 – Revised SARA Toxic Chemicals for updated content. Corrected entry for Minnesota.

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BENZENE

ICSC: 0015

Cyclohexatriene Benzol C_6H_6 Molecular mass: 78.1 ICSC # 0015	CAS # 71-43-2 RTECS # CY1400000 UN # 1114 EC # 601-020-00-8 June 05, 2003 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Risk of fire and explosion: see Chemical Dangers.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Convulsions. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! Dry skin. Redness. Pain. (Further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
•EYES	Redness. Pain.	Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.

•INGESTION	Abdominal pain. Sore throat. Vomiting. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: complete protective clothing including self-contained breathing apparatus.	Fireproof. Separated from food and feedstuffs oxidants and halogens .	Do not transport with food and feedstuffs. Note: E F symbol T symbol R: 45-46-11-36/38-48/23/24/25-65 S: 53-45 UN Hazard Class: 3 UN Packing Group: II

ICSC: 0015	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

ICSC: 0015

BENZENE

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. PHYSICAL DANGERS: The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated. CHEMICAL DANGERS: Reacts violently with oxidants, nitric acid, sulfuric acid and halogens causing fire and explosion hazard. Attacks plastic and rubber. OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.5 ppm as TWA; 2.5 ppm as STEL; (skin); A1; BEI issued; (ACGIH 2004). MAK: H; Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004). OSHA PEL: 1910.1028 TWA 1 ppm ST 5 ppm See Appendix F NIOSH REL: Ca TWA 0.1 ppm ST 1 ppm See Appendix A NIOSH IDLH: Ca 500 ppm See: 71432	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation , through the skin and by ingestion . INHALATION RISK: A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C. EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes , the skin and the respiratory tract . Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system , resulting in lowering of consciousness . Exposure far above the occupational exposure limit value may result in unconsciousness and death . EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The liquid defats the skin. The substance may have effects on the bone marrow and immune system , resulting in a decrease of blood cells. This substance is carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 80°C Melting point: 6°C Relative density (water = 1): 0.88 Solubility in water, g/100 ml at 25°C: 0.18 Vapour pressure, kPa at 20°C: 10 Relative vapour density (air = 1): 2.7	Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2 Flash point: -11°C c.c. Auto-ignition temperature: 498°C Explosive limits, vol% in air: 1.2-8.0 Octanol/water partition coefficient as log Pow: 2.13

ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms.

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Card has been partly updated in October 2004. See sections Occupational Exposure Limits, EU classification, Emergency Response.

Transport Emergency Card: TEC (R)-30S1114 / 30GF1-II

NFPA Code: H2; F3; R0

ADDITIONAL INFORMATION

ICSC: 0015 BENZENE

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Providing National and World Leadership to Prevent Workplace Illnesses and Injuries NIOSH

BENZO(a)PYRENE

ICSC: 0104

Benz(a)pyrene 3,4-Benzopyrene Benzo(d,e,f)chrysene $C_{20}H_{12}$ Molecular mass: 252.3 ICSC # 0104	CAS # 50-32-8 RTECS # DJ3675000 EC # 601-032-00-3 October 17, 2005 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION			
EXPOSURE	See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.	AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
•SKIN	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES		Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING

Evacuate danger area! Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT let this chemical enter the environment. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.	Separated from strong oxidants.	T symbol N symbol R: 45-46-60-61-43-50/53 S: 53-45-60-61
ICSC: 0104	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.	

ICSC: 0104

BENZO(a)PYRENE

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: PALE-YELLOW CRYSTALS PHYSICAL DANGERS: CHEMICAL DANGERS: Reacts with strong oxidants causing fire and explosion hazard. OCCUPATIONAL EXPOSURE LIMITS: TLV: Exposure by all routes should be carefully controlled to levels as low as possible A2 (suspected human carcinogen); (ACGIH 2005). MAK: Carcinogen category: 2; Germ cell mutagen group: 2; (DFG 2005).	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion. INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed. EFFECTS OF SHORT-TERM EXPOSURE: EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: This substance is carcinogenic to humans. May cause heritable genetic damage to human germ cells. Animal tests show that this substance possibly causes toxicity to human reproduction or development.
PHYSICAL PROPERTIES	Boiling point: 496°C Melting point: 178.1°C Density: 1.4 g/cm^3	Solubility in water: none (<0.1 g/100 ml) Vapour pressure : negligible Octanol/water partition coefficient as log Pow: 6.04
ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms. Bioaccumulation of this chemical may occur in fish, in plants and in molluscs. The substance may cause long-term effects in the aquatic environment.	

NOTES

Do NOT take working clothes home. Benzo(a)pyrene is present as a component of polycyclic aromatic hydrocarbons (PAHs) in the environment, usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco.

ADDITIONAL INFORMATION

ICSC: 0104	BENZO(a)PYRENE

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COAL-TAR PITCH

ICSC: 1415

Pitch ICSC # 1415	CAS # 65996-93-2 RTECS # GF8655000 EC # 648-055-00-5 July 03, 2002 Validated Pi, Study (1st batch of chemical part)

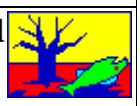
TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Foam, dry powder, carbon dioxide.
EXPLOSION			
EXPOSURE		AVOID ALL CONTACT! PREVENT DISPERSION OF DUST!	
•INHALATION	Sneezing. Cough. See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.	Closed system and ventilation.	Fresh air, rest.
•SKIN	MAY BE ABSORBED! Redness. Burning sensation.	Protective gloves. Protective clothing.	Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety goggles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.	Do not eat, drink, or smoke during work. Wash hands before eating.	Give plenty of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING

Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: A/P2 filter respirator for organic vapour and harmful dust.)	Separated from strong oxidants. Separated from food and feedstuffs .	Do not transport with food and feedstuffs. Note: H T symbol R: 45 S: 53-45
ICSC: 1415	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.	

ICSC: 1415

COAL-TAR PITCH

IMPORTANT DATA	PHYSICAL STATE; APPEARANCE: BLACK TO BROWN PASTE PHYSICAL DANGERS: CHEMICAL DANGERS: The substance decomposes on heating above 400°C producing toxic fumes . Reacts with strong oxidants . OCCUPATIONAL EXPOSURE LIMITS: TLV: (as benzene soluble aerosol for coal tar pitch volatiles) 0.2 mg/m^3 as TWA A1 (ACGIH 2001). OSHA PEL: TWA 0.2 mg/m^3 (benzene-soluble fraction) 1910.1002 See Appendix C NIOSH REL: Ca TWA 0.1 mg/m^3 (cyclohexane-extractable fraction) See Appendix A See Appendix C NIOSH IDLH: Ca 80 mg/m^3 See: 65996932	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation and through the skin and by ingestion. INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed and when heated. EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes , the skin and the respiratory tract .Exposure to sun may enhance the irritating effect of coal tar pitch on skin and eyes and lead to burns. EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis and hyperpigmentation of skin. This substance is carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: >250°C Melting point: 30-180°C Density: >1 g/cm^3 Solubility in water: at 20°C none	Vapour pressure, kPa at 20°C: <0.01 Flash point: >200°C o.c. Auto-ignition temperature: >500°C Octanol/water partition coefficient as log Pow: 6.04 conductivity: 1.7 10 exp-9 S/m at 30C (IUCLID)
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to soil contamination and aquatic organisms. The substance may cause long-term effects in the aquatic environment. 	

ADDITIONAL INFORMATION

ICSC: 1415 COAL-TAR PITCH

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m-CRESOL

ICSC: 0646

3-Cresol 3-Methylphenol 3-Hydroxytoluene 1-Hydroxy-3-methylbenzene C_7H_8O / $CH_3C_6H_4OH$ Molecular mass: 108.1 ICSC # 0646	CAS # 108-39-4 RTECS # GO6125000 UN # 2076 EC # 604-004-00-9 November 13, 2008 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION	Above 86°C explosive vapour/air mixtures may be formed.	Above 86°C use a closed system, ventilation.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Cough. Sore throat. Burning sensation. Headache. Nausea. Vomiting. Shortness of breath. Laboured breathing.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer immediately for medical attention.
•SKIN	MAY BE ABSORBED! Redness. Pain. Blisters. Skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer immediately for medical attention.
•EYES	Redness. Pain. Severe deep burns.	Face shield or eye protection in combination with breathing protection.	Rinse with plenty of water (remove contact lenses if easily possible). Refer immediately for medical attention

•INGESTION	Burns in mouth and throat. Burning sensation in the throat and chest. Nausea. Vomiting. Abdominal pain. Shock or collapse.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Refer immediately for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Personal protection: Chemical protection suit; filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment.	Separated from strong oxidants, food and feedstuffs. Ventilation along the floor. Store in an area without drain or sewer access. Provision to contain effluent from fire extinguishing.	Do not transport with food and feedstuffs. Note: C T symbol C symbol R: 24/25-34 S: 1/2-36/37/39-45 UN Hazard Class: 6.1 UN Subsidiary Risks: 8 UN Packing Group: II Signal: Danger Corr-Skull-Health haz Toxic if swallowed Harmful in contact with skin Fatal if inhaled vapour Causes severe skin burns and eye damage Causes damage to the central nervous system and blood cells Causes damage to nervous system and blood cells through prolonged or repeated exposure Toxic to aquatic life

ICSC: 0646	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

ICSC: 0646

m-CRESOL

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: COLOURLESS TO YELLOW LIQUID , WITH CHARACTERISTIC ODOUR. PHYSICAL DANGERS: CHEMICAL DANGERS: Reacts violently with strong oxidants . The solution in water is a weak acid. OCCUPATIONAL EXPOSURE LIMITS: TLV: 5 ppm as TWA (skin) (ACGIH 2008). MAK: skin absorption (H); Carcinogen category: 3A; BAT issued; (DFG 2008). OSHA PEL: TWA 5 ppm (22 mg/m^3) skin NIOSH REL: TWA 2.3 ppm (10 mg/m^3) NIOSH IDLH: 250 ppm See: cresol	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its vapour, through the skin and by ingestion. Serious local effects by all routes of exposure. INHALATION RISK: A harmful contamination of the air will not or will only very slowly be reached on evaporation of this substance at 20°C. EFFECTS OF SHORT-TERM EXPOSURE: The substance is corrosive to the eyes, the skin and the respiratory tract. Corrosive on ingestion. Inhalation may cause lung oedema, but only after initial corrosive effects on eyes and/or airways have become manifest. The substance may cause effects on the central nervous system , resulting in lowering of consciousness. The substance may cause effects on the blood , resulting in destruction of blood cells. Exposure far above the OEL may result in death . Medical observation is indicated. EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the nervous system , resulting in impaired functions. The substance may have effects on the blood , resulting in anaemia.
PHYSICAL PROPERTIES	Boiling point: 202°C Melting point: 11-12°C Relative density (water = 1): 1.03 Solubility in water, g/100 ml at 20 °C: 2.4 (moderate) Vapour pressure, Pa at 20°C: 13 Relative vapour density (air = 1): 3.7	Relative density of the vapour/air-mixture at 20°C (air = 1): 1.0 Flash point: 86°C Auto-ignition temperature: 575°C Explosive limits, vol% in air: 1.0-? Octanol/water partition coefficient as log Pow: 1.96 Viscosity, mm2/s at 50 °C: 4.05

ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms. It is strongly advised that this substance does not enter the environment.

NOTES

Transport Emergency Card: TEC (R)-61GTC1-II

NFPA Code: H3; F2; R0;

ADDITIONAL INFORMATION

ICSC: 0646 m-CRESOL

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Providing National and World Leadership to Prevent Workplace Illnesses and Injuries NIOSH

o-CRESOL

ICSC: 0030

2-Hydroxy-1-methylbenzene 2-Methylphenol ortho-Hydroxytoluene 2-Cresol C_7H_8O / $CH_3C_6H_4OH$ Molecular mass: 108.1 ICSC # 0030	CAS # 95-48-7 RTECS # GO6300000 UN # 3455 EC # 604-004-00-9 November 13, 2008 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION	Above 81°C explosive vapour/air mixtures may be formed.	Above 81°C use a closed system, ventilation.	
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Cough. Sore throat. Burning sensation. Headache. Nausea. Vomiting. Shortness of breath. Laboured breathing.	Local exhaust or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer immediately for medical attention.
•SKIN	MAY BE ABSORBED! Redness. Pain. Blisters. Skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer immediately for medical attention.
•EYES	Redness. Pain. Severe deep burns.	Face shield or eye protection in combination with breathing protection.	Rinse with plenty of water (remove contact lenses if easily possible). Refer immediately for medical attention

•INGESTION	Burns in mouth and throat. Burning sensation in the throat and chest. Nausea. Vomiting. Abdominal pain. Shock or collapse.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Refer immediately for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Personal protection: filter respirator for organic gases and particulates adapted to the airborne concentration of the substance . Chemical protection suit. Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Separated from strong oxidants, food and feedstuffs . Store in an area without drain or sewer access. Provision to contain effluent from fire extinguishing.	Do not transport with food and feedstuffs. Marine pollutant. Note: C T symbol C symbol R: 24/25-34 S: 1/2-36/37/39-45 UN Hazard Class: 6.1 UN Subsidiary Risks: 8 UN Packing Group: II Signal: Danger Corr-Skull-Health haz Toxic if swallowed Toxic in contact with skin Causes severe skin burns and eye damage Causes damage to the central nervous system and blood cells Causes damage to nervous system and blood cells through prolonged or repeated exposure Toxic to aquatic life

ICSC: 0030	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

ICSC: 0030

o-CRESOL

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: COLOURLESS CRYSTALS , WITH CHARACTERISTIC ODOUR. TURNS DARK ON EXPOSURE TO AIR AND LIGHT . PHYSICAL DANGERS: CHEMICAL DANGERS: Reacts violently with strong oxidants . The solution in water is a weak acid. OCCUPATIONAL EXPOSURE LIMITS: TLV: 5 ppm as TWA (skin) (ACGIH 2008). MAK: skin absorption (H); Carcinogen category: 3A; BAT issued; (DFG 2008). tions for the allocation into the category 4 or 5 would be fulfilled but there is not enough information to derive a MAK-value. OSHA PEL: TWA 5 ppm (22 mg/m^3) skin NIOSH REL: TWA 2.3 ppm (10 mg/m^3) NIOSH IDLH: 250 ppm See: cresol	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion. Serious local effects by all routes of exposure. INHALATION RISK: A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. EFFECTS OF SHORT-TERM EXPOSURE: The substance is corrosive to the eyes, the skin and the respiratory tract. Corrosive on ingestion. Inhalation may cause lung oedema, but only after initial corrosive effects on eyes and/or airways have become manifest. The substance may cause effects on the central nervous system , resulting in lowering of consciousness. The substance may cause effects on the blood , resulting in destruction of blood cells. Exposure far above the OEL may result in death . Medical observation is indicated. EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the nervous system , resulting in impaired functions. The substance may have effects on the blood , resulting in anaemia.
PHYSICAL PROPERTIES	Boiling point: 191°C Melting point: 31°C Density: 1.05 g/cm^3 Solubility in water, g/100 ml at 25°C: 2.5 (moderate) Vapour pressure, Pa at 25°C: 33	Relative vapour density (air = 1): 3.7 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.00 Flash point: 81°C c.c. Auto-ignition temperature: 555°C Explosive limits, vol% in air: 1.3-? Octanol/water partition coefficient as log Pow: 1.95

ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms. It is strongly advised that this substance does not enter the environment.

NOTES

Transport Emergency Card: TEC (R)-61GTC2-II

NFPA Code: H 3; F 2; R 0;

ADDITIONAL INFORMATION

ICSC: 0030 o-CRESOL

(C) IPCS, CEC, 1994

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

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Content source: Centers for Disease Control and Prevention (http://www.cdc.gov/)

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p-CRESOL

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4-Hydroxy-1-methylbenzene 4-Methylphenol para-Hydroxytoluene 4-Cresol C_7H_8O / $CH_3C_6H_4OH$ Molecular mass: 108.1 ICSC # 0031	CAS # 106-44-5 RTECS # GO6475000 UN # 3455 EC # 604-004-00-9 November 13, 2008 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION	Above 86°C explosive vapour/air mixtures may be formed.	Above 86°C use a closed system, ventilation.	
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Cough. Sore throat. Burning sensation. Headache. Nausea. Vomiting. Shortness of breath. Laboured breathing.	Local exhaust or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer immediately for medical attention.
•SKIN	MAY BE ABSORBED! Redness. Pain. Blisters. Skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer immediately for medical attention.
•EYES	Redness. Pain. Severe deep burns.	Face shield or eye protection in combination with breathing protection.	Rinse with plenty of water (remove contact lenses if easily possible). Refer immediately for medical attention

•INGESTION	Burns in mouth and throat. Burning sensation in the throat and chest. Nausea. Vomiting. Abdominal pain. Shock or collapse.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Refer immediately for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Personal protection: filter respirator for organic gases and particulates adapted to the airborne concentration of the substance . Chemical protection suit. Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Separated from strong oxidants, food and feedstuffs . Store in an area without drain or sewer access. Provision to contain effluent from fire extinguishing.	Do not transport with food and feedstuffs. Marine pollutant. Note: C T symbol C symbol R: 24/25-34 S: 1/2-36/37/39-45 UN Hazard Class: 6.1 UN Subsidiary Risks: 8 UN Packing Group: II Signal: Danger Corr-Skull-Health haz Toxic if swallowed Toxic in contact with skin Fatal if inhaled vapour Causes severe skin burns and eye damage Causes damage to the central nervous system and blood cells Causes damage to nervous system and blood cells through prolonged or repeated exposure Toxic to aquatic life

ICSC: 0031	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

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PHYSICAL PROPERTIES	Boiling point: 202°C Melting point: 35°C Density: 1.02 g/cm^3 Solubility in water, g/100 ml at 25°C: 1.9 (moderate) Vapour pressure, Pa at 25°C: 15	Relative vapour density (air = 1): 3.7 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.00 Flash point: 86°C c.c. Auto-ignition temperature: 555°C Explosive limits, vol% in air: 1.0-? Octanol/water partition coefficient as log Pow: 1.94

ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms. It is strongly advised that this substance does not enter the environment.

NOTES

Transport Emergency Card: TEC (R)-61GTC2-II

NFPA Code: H 3; F 2; R 0;

ADDITIONAL INFORMATION

ICSC: 0031 p-CRESOL

(C) IPCS, CEC, 1994

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APPENDIX D

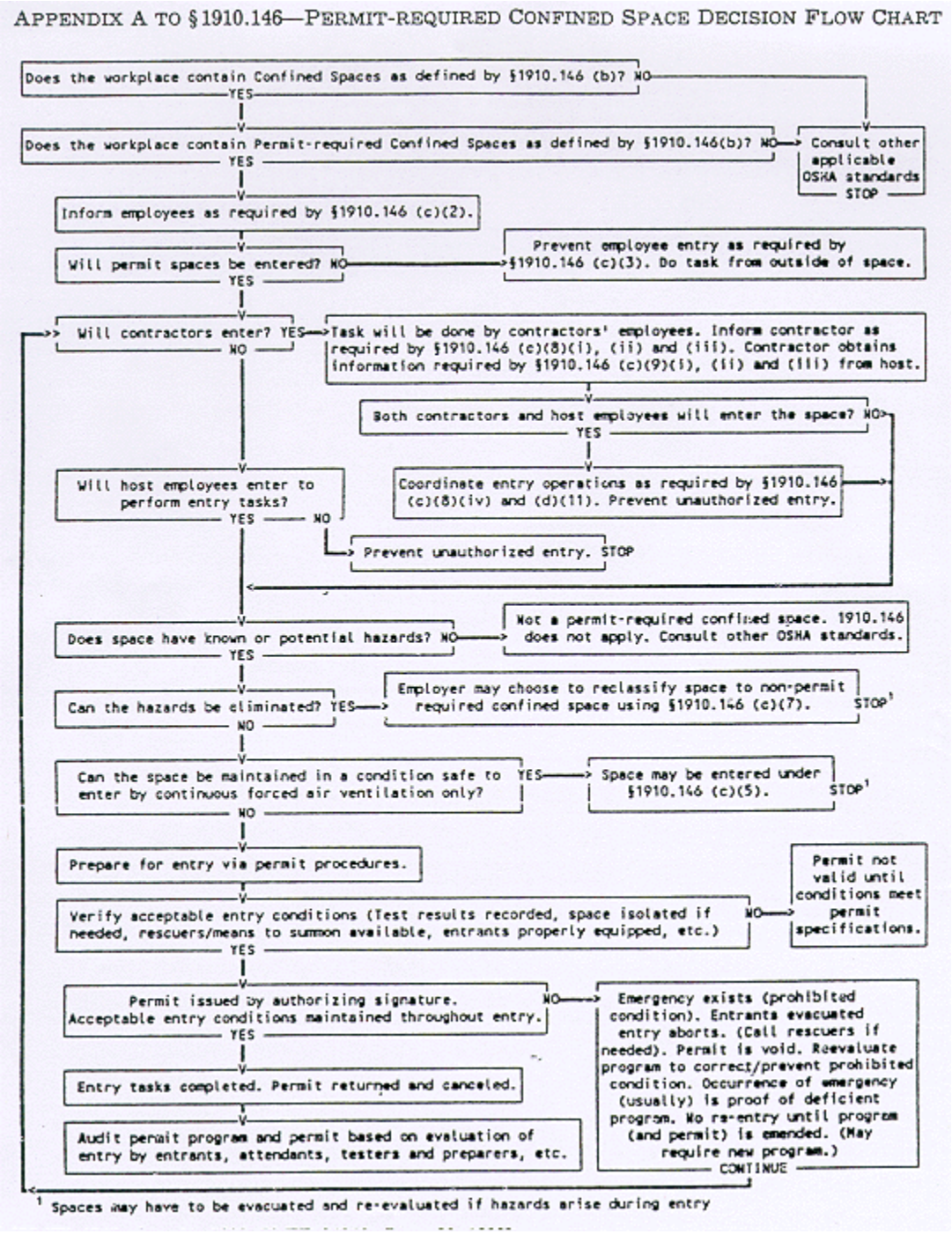
FORMS

SITE SAFETY AND HEALTH PLAN

SITE INVESTIGATION, OPERATIONS, MAINTENANCE, AND REGULATORY COMPLIANCE

Former Tronox Facility
2800 High Street, Springfield, Missouri

Permit Required Confined Space Decision Flow Chart



EWI Confined Space Entry Permit

Date: _____ Time of Entry: _____ Permit expiration date / time: _____

Description of space to be entered: _____

(Include Site Location, Client Code, and Project Number)

HAZARD ASSESSMENT:

Hazard	Acceptable Entry Conditions	Hazard Possible in Space		Measured Conditions Before Entry	Periodic Measurements During Entry					
		Yes	No							
Oxygen Level	19.5% - 23.5%									
Flammable gases or vapors	Less than 10% of the LEL* (no oxygen reading above 22%)									
Toxic gases or vapors Less than PEL** for the specific toxin	Carbon Monoxide (CO)									
	Hydrogen Sulfide (H_2S)									
Corrosive	pH between 6-8									
Temperature	Between 32F and 105F									
Noise	Less than 90 dBA									
Radiation	Contact Specialist for acceptable entry conditions									
Other										
Entrapment / Engulfment Hazard	Provide rescue equipment / team, harness, and lifeline. Drain if possible to prevent engulfment hazard									
Electrical	Disconnect and Lockout electrical hazards prior to entry									
Mechanical	Disconnect and Lockout mechanical hazards prior to entry									
Entry and Exit limitations	Provide a safe means of entry and exit to the space									
Other										

EQUIPMENT REQUIRED FOR ENTRY AND WORK:

Equipment	Yes	No	Specific Type of Equipment or Notes
Respirator			__Half __ Full __ SCBA Cartridge type _____
Lifeline and Safety Harness			
Protective Clothing			
Hearing Protection			
Other:			

PREPARATION:

Initial when completed or N/A	
Notify affected departments of service interruption	
Isolate – blanked or double valve, with lock and tag	
Zero energy state (Lockout all energy sources)	
Cleaned, drained, washed, and purged	
Ventilation to provide fresh air	
Emergency Response team available	
Employees informed of specific confined space hazards	
Procedures reviewed with all affected entrants, attendants, supervisors of permit space	
Atmospheric test in compliance with OSHA regulations	
Attach hot work or other required permits	

1) _____

2) _____

3) _____

Entrant Signature(s)

_____

Attendant Signature

_____

Entry Supervisor Signature

_____

*LEL – Lower Explosive Limit (refer to MSDS or NIOSH Pocket Guide to Chemical Hazards)

**PEL – Permissible Exposure Limit (refer to OSHA 29 CFR 1910.1200 Table Z-1, Z-2, and Z-3; NIOSH Pocket Guide to Chemical Hazards; and / or MSDS for specific chemical)

Other:	

Notes:

Instructions

Hazard Assessment Section:

1) For EACH line item, indicate if that hazard is present or anticipated to be present in the confined space by marking YES or NO.

2) For EACH hazard that is present or anticipated to be present in the confined space, provide the pre-entry readings/measurements.

3) For EACH hazard that is present or anticipated to be present in the confined space, provide the periodic readings/measurements.

Equipment Required for Entry Section:

1) For EACH line item indicate if the specific equipment is required for entry by marking YES or NO.

2) For EACH line item indicated as "required" for entry, provide specific information on the type of equipment required if necessary. This is required for respiratory protection.

Preparation Section:

1) For EACH line item, indicate completion or not applicable (N/A) by initialing or writing N/A in the far right column.

2) Signature block – EACH entrant, entry attendant, and the entry supervisor must sign the permit after having reviewed all permit conditions.

*LEL – Lower Explosive Limit (refer to MSDS or NIOSH Pocket Guide to Chemical Hazards)

**PEL – Permissible Exposure Limit (refer to OSHA 29 CFR 1910.1200 Table Z-1, Z-2, and Z-3; NIOSH Pocket Guide to Chemical Hazards; and / or MSDS for specific chemical)

Date: _____

KERR MCGEE/TRONOX
SPRINGFIELD, MO SITE
SUB-CONTRACTOR and VISITOR SIGN-IN / SIGN-OUT LOG

Date	Name (Please Print)	Company Name	Time In	Initial In	Time Out	Initial Out	Work or Materials Being Provided	Notes

Date: _____

KERR MCGEE/TRONOX
SPRINGFIELD, MO SITE
SUB-CONTRACTOR and VISITOR SIGN-IN / SIGN-OUT LOG

Date	Name (Please Print)	Company Name	Time In	Initial In	Time Out	Initial Out	Work or Materials Being Provided	Notes

Ladder Inspection Form

Environmental Works, Inc. Name: _____ Facility Address: _____

Manager/Supervisor: _____ Date/Time: _____ _____

Inspector(s): _____

Yes	No	NA	Corr Date	Area Inspected
				1. Ladders inspected and maintained in good condition?
				2. Non-slip feet provide on each ladder and each rung?
				3. Ladder rung and steps free of grease and oil?
				4. Employees trained in the proper use and operation of ladders?
				5. Is it prohibited to place ladders on boxes, barrels, or other unstable bases to obtain extra height?
				6. Ladder with broken, missing steps, rungs, or cleats, broken side rails or other faulty equipment removed from service?
				7. Employees instructed to face ladder when climbing or descending?
				8. Employees instructed not to use top step of stepladders as a step?
				9. When in use, do ladders extend at least 3 feet above elevated surface?
				10. Metal ladders legibly marked with signs cautioning against using them around electrical power sources?
				11. Rungs of ladders uniformly spaced at 12 inches, center to center?

If any item pertaining to the physical condition of the ladder is marked “NO” the ladder must be tagged with a **“DO NOT USE”** tag and removed from service until it is repaired or replaced.

Safety Harness Inspection Report

OK	NO	N/A	Inspection Items
			Inspect all harness webbing or leather for fraying, cuts, excessive weld burns and other deterioration.
			Inspect all stitching, ensuring it is intact.
			Inspect all rivets and eyelets for cracks or missing.
			Inspect D-rings and buckles for cracks or misshapen.
			Inspect the body pad (if applicable) for excessive wear.
			Inspect the lanyards for excessive wear, fraying, cuts, weld burns or other signs of deterioration.
			Ensure the safety latch/hook is of the double lock type and is functioning properly.
			Ensure the certification or data tag is present and legible.
Date:			Completed by:

If all responses are “OK” or “NA” the harness is okay to use.

Any “NO” response indicates a potential critical safety failure and the equipment must be removed from service and repaired or replaced. Tag the safety harness with a **“DO NOT USE”** Tag and turn in to the Corporate Health and Safety Officer or the Project Manager for repair or replacement.

ACCIDENT / INCIDENT INVESTIGATION REPORT

Office	Department / Department Manager	
Location of Incident	Date of Incident Time ☒ AM ☐ PM	Date Reported
Property Owner		

PERSONAL INJURY		PROPERTY DAMAGE	
Injured's Name		Property Damaged	
Occupation	Injured Part of Body	Estimated Costs	Actual Costs
Nature of Injury		Nature of Damage	
Object/Equipment/Substance		Object/Equipment/Substance/Inflicting Damage	
Person With Most Control of Object/Equipment/Substance		Person With Most Control of Object/Equipment/Substance	

Post Accident Drug Test Required? Yes _____ No
For Injured? Yes _____ No
For Contributing Parties: List Names

Testing Scheduled By: Date of Test:

DESCRIPTION
Describe Clearly How The Accident Occurred: Attach Accident Diagram For All Motor Vehicle Accidents.

ANALYSIS
What Acts, Failures To Act And/Or Conditions Contributed Most Directly To This Accident?

LOSS SEVERITY POTENTIAL	PROBABLE RECURRENCE RATE
☐ Major ☐ Serious ☒ Minor	☐ Frequent ☐ Occasional ☒ Rare

PREVENTION
What Action Has Or Will Be Taken To Prevent Recurrence? Place X by Items Completed.
1. ☒ Date:
2. ☐ Date:
3. ☐ Date:
4. ☐ Date:
5. ☐ Date:
6. ☐ Date:

Investigated By:_____ Date:_____

Reviewed By: ____ Date: _____

Insurance Agent Notified By: ____ Date: _____

Client Notified By: _____ Date: _____

Four Gas Meter Calibration Log

Date	Time	O_2		CO		H_2S		LEL		Comments
		Standard	Measured	Standard	Measured	Standard	Measured	Standard	Measured	

Four Gas Meter Calibration Log

Environmental Works, Inc.

AIR MONITORING REPORT

Sheet ____ of ____

Project Name and Site:	Project Manager:	Project Number:	Date:
Employee:	Weather Conditions:		

Direct Reading Data

Location	Task Description (Drilling, Sampling, etc.)	Time	Instrument Type	Suspect Agent	Concentration	Source: S Breathing Zone: B

Comments:

PID Calibration/Maintenance Log

Date	Time	Instrument	Standard Value	Measured Value	Comments	Initials

ENVIRONMENTAL WORKS INC.
1455 E. CHESTNUT EXPRESSWAY • SPRINGFIELD, MO 65802 • (417) 890-9500 • FAX: (417) 823-9659

HOT WORK PERMIT

BEFORE INITIATING HOT WORK, ENSURE PRECAUTIONS ARE IN PLACE!
MAKE SURE AN APPROPRIATE FIRE EXTINGUISHER IS READILY AVAILABLE!

This Hot Work Permit is required by NFPA 51 B for any operation involving open flames or producing heat and /or sparks. This includes, but is not limited to: Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch-Applied Roofing, and Cadwelding.

INSTRUCTIONS

A. Verify precautions listed at right **(or do not proceed with the work)**.
B. Complete and retain this permit.

HOT WORK BEING DONE BY
- ❑ EWI employee _____
- ❑ Contractor _____

DATE	JOB NO.

LOCATION

NATURE OF JOB/OBJECT

NAME OF PERSON DOING HOT WORK

SIGNATURE OF PERSON CONDUCTING HOT WORK

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for work.

SIGNATURE OF FIELD SUPERVISOR

PERMIT EXPIRES:	DATE	TIME AM PM

CANCELLATION:
I verify the Hot Works job as outlined on this permit has been completed, all requirements have been met, and termination of the permit is requested.

SIGNED:	DATE	TIME AM PM

IN CASE OF FIRE EMERGENCY
CALL 911

Required Precautions Checklist

- ❑ Available sprinklers, hose streams, and extinguishers are in service/operable.
- ❑ Hot work equipment in good repair.

Requirements within 10 m (35 ft) of work
- ❑ Flammable liquids, dust, lint and oil deposits removed.
- ❑ Explosive atmosphere in area eliminated.
- ❑ Floors swept clean.
- ❑ Combustible floors wet down, covered with damp sand or fire-resistant sheets.
- ❑ Remove other combustibles where possible. Otherwise protect with fire-resistant tarpaulins or metal shields.
- ❑ All wall and floor openings covered.
- ❑ Fire-resistant tarpaulins suspended beneath work.

Work on wall and floor openings covered.
- ❑ Construction is noncombustible and without combustible covering or insulation.
- ❑ Combustibles on other side of walls moved away.
- ❑ Enclosed equipment cleaned of all combustibles.
- ❑ Containers purged of flammable liquids/vapors.

Fire watch/hot work area monitoring
- ❑ Fire watch personnel will be provided during and for 30 minutes after work, including any breaks.
- ❑ Fire watch personnel are supplied with suitable extinguishers.
- ❑ Fire watch personnel are trained in use of this equipment and in sounding alarm.
- ❑ Fire watch personnel may be required for adjoining areas above and below.
- ❑ Monitor hot work area for 30 minutes after job is completed.

Other precautions taken
- ❑ Confined space entry permit.
- ❑ Area protected with smoke or heat detection.
- ❑ Ample ventilation to remove smoke/vapor from work area.
- ❑ Lockout/tagout.

Supervisors' Safety Checklist – Lockout Tagout

Supervisor:

Date: **Department/Area**

Yes	No	
Area Safety Check		
		No broken valve hand-wheels, controls or switches
		All controls, valves and switches are labeled
		Each authorized employees has been issued locks & tags
		Locks & tags are standardized throughout facility
		Locks & tags are identifiable to a specific employee
		Locks & tags are not used for other purposes
		Locking devices are available for every type isolation device
		Material used to affix tag rated at 50 pounds or greater - no strings allowed
		All breakers are labeled
Employee Training -workers are trained		
		That only authorized employees may attach a lock & tag
		That only the person who attached the lock & tag may remove it
		To verify isolation before beginning work
		To notify "affected" employees before locking out equipment
		To re-install machine guards before removing locks & tags
		To notify "affected" employees before removing locks or re-starting

EWI SAFETY POLICY STATEMENT

Environmental Works, Inc. places primary importance on the health and safety of each individual of this company. We will maintain a health and safety program that encompasses all regulatory requirements as well as corporate standards that will ensure a safe work environment. To be successful, such a program must embody the proper attitudes toward injury and illness prevention on the part of supervisors and employees. Only through such a cooperative effort can a safety program be in the best interest of all.

Eliminating or controlling hazards is one way accident prevention will be provided. This will be accomplished through the use of engineering controls, safe work practices and personal protective equipment. Environmental Works, Inc. employees will be thoroughly trained in the above areas.

Environmental Works, Inc. will comply with all applicable safety and environmental regulations and codes. Accepted safe work practices will be followed in all operations. Site specific safety rules and procedures will be established and followed for each project in response to site-specific contaminants, physical conditions and scope of work.

Accident prevention and health and safety are of primary importance at Environmental Works, Inc. This can only be accomplished through an atmosphere of open communication, responsive alleviation of problems, concern and caring. While Environmental Works, Inc. strives to create a safe work atmosphere, it will take the commitment of each individual employee to accomplish this mission.

All EWI employers and contractors will respect confidentiality of trade secrets when EWI safety policy, procedures and information are shared.

Signature_____ Date_____
Robin Melton, CHMM President

Signature_____ Date 6-22-11
Dave Mosby, ARM, Safety and Risk Management Director

ENVIRONMENTAL WORKS

TAILGATE SAFETY MEETING

Project Name:	KERR MCGEE/TRONOX	**Date:**	
Project Number:	150683	**Time:**	
Location:	Springfield, MO	**Meeting Conducted By:**	
Activity Description:			

SAFETY TOPICS PRESENTED

Physical Hazards:

Chemical Hazards:

Required PPE:

Emergency Procedures:

Hospital/Clinic:		**Phone:**	
Ambulance:		**Phone:**	
Directions:			
Other:			

ATTENDEES

Print Name	Signature

REQUIRED LOCATE REQUEST INFORMATION
MISSOURI ONE CALL SYSTEM, INC.
1-800-DIG-RITE (344-7483)

Dig Safely.

Phone #: ( ) _____

Callers name (first & last): _____

Company name: _____

Fax #: ( ) _____ Email: _____

Contact name: _____

Contact #: _____

Does the contact phone # have recording device? (circle one) YES NO UNKOWN

Excavator name: _____ Phone #: ( ) _____

Excavator address: _____

Type of work: _____

Type of equipment: _____

Work being done for: _____

Tunneling? (circle one) YES NO UNKNOWN

Horizontal boring? (circle one) YES NO UNKNOWN DEPTH: _____

Explosives? (circle one) YES NO UNKNOWN

County: _____ Town: _____

Is entire job inside town boundaries? (circle one) YES NO

Address number(s) _____ Dig street: _____ Suffix: _____

Nearest street intersecting dig street: _____ Suffix: _____

Is entire job within 1 block of intersection? (circle one) YES NO

If not, then how far? (circle one) (in miles) 1/8 1/4 1/2 1 Direction N S E W

What side(s) of the road is the work on? (circle) N S E W

Location: _____

_____

Remarks: _____

* Call to set meeting? (circle one) YES NO

Mark lines at meeting? (circle one) YES NO

Start Date/Time: _____

*TWP: _____ N RANGE: (circle one) E or W SEC: _____ QS: _____

*NAD 83 LAT: _____ LON: _____

Ticket Serial #: _____

Utilities notified: _____

_____

_____

Daily Excavation Safety Checklist

Company		**Date**	
Project Name		**Approx. Temp.**	
Project Location		**Approx. Wind Dir.**	
Job Number		**Safety Rep**	
Excavation Depth & Width		**Soil Classification**	
Protective System Used			
Activities In Excavation			
Competent Person			

Excavation > 4 feet deep? ___Yes ___No If *YES,* fill out a Confined Space Permit *PRIOR* to *ANY* person entering the excavation.

***NOTE:* Trenches over 4 feet in depth are considered excavations. Any items marked *NO* on this form *MUST* be remediated prior to any employees entering the excavation.**

YES	NO	N/A	DESCRIPTION
			GENERAL
			Employees protected from cave-ins & loose rock/soil that could roll into the excavation
			Spoils, materials & equipment set back at least 2 feet from the edge of the excavation.
			Engineering designs for sheeting &/or manufacturer's data on trench box capabilities on site
			Adequate signs posted and barricades provided
			Training (toolbox meeting) conducted w/ employees prior to entering excavation
			UTILITIES
			Utility company contacted & given 24 hours notice &/or utilities already located & marked
			Overhead lines located, noted and reviewed with the operator
			Utility locations reviewed with the operator, & precautions taken to ensure contact does not occur
			Utilities crossing the excavation supported, and protected from falling materials
			Underground installations protected, supported or removed when excavation is open
			WET CONDITIONS
			Precautions taken to protect employees from water accumulation (continuous

			dewatering)
			Surface water or runoff diverted /controlled to prevent accumulation in the excavation
			Inspection made after every rainstorm or other hazard increasing occurrence
HAZARDOUS ATMOSPHERES			
			Air in the excavation tested for oxygen deficiency, combustibles, other contaminants
			Ventilation used in atmospheres that are oxygen rich/deficient &/or contains hazardous substances
			Ventilation provided to keep LEL below 10 %
			Emergency equipment available where hazardous atmospheres could or do exist
			Safety harness and lifeline used
			Supplied air necessary (if yes, contact safety department)
ENTRY & EXIT			
			Exit (i.e. ladder, sloped wall) no further than 25 feet from ANY employee
			Ladders secured and extend 3 feet above the edge of the trench
			Wood ramps constructed of uniform material thickness, cleated together @ the bottom
			Employees protected from cave-ins when entering or exiting the excavation

KEEP 1 COPY OF EACH DAILY EXCAVATION CHECKLIST ON SITE FOR THE PROJECT DURATION, AND FORWARD THE ORIGINAL TO THE CORPORATE HEALTH AND SAFETY OFFICER.

ATTACHMENT C

WASTE MANAGEMENT PLAN

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri

Attachment C

WASTE MANAGEMENT PLAN

REMEDIAL OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 West High Street, Springfield, Missouri
RCRA Permit Number MOD007129406

April 4, 2016

WASTE MANAGEMENT PLAN

Expected investigation-derived waste (IDW) materials are soil, rock cuttings, miscellaneous solid wastes, and possibly groundwater from drilling operations; groundwater from well development and sampling purge; and decontamination water from all investigation operations. DNAPL may be recovered during field work, and will be input directly to the treatment system creosote storage tank. All IDW will be temporarily contained in appropriate containers or bermed areas until disposition. For larger well drilling, care will be taken to safely divert drilling fluids, solids, and water removed from the borehole into a contained berm, co-located at the well site. These drill site wastes will be transported in 55-gallon Department of Transportation (DOT)-approved drums or waste collection trailers to the main Facility area for further management. All fluids and cuttings from well drilling will be assumed contaminated until analytical testing demonstrates otherwise

1.1 Decontamination Procedures

Decontamination activities will generate IDW from cleaning direct-push and other drilling methods, and related equipment. Wastes from such activities will be managed as follows.

Prior to drilling activities, a decontamination area will be designated, and the drilling contractor will construct a bermed, plastic-lined decontamination pad. Drill equipment and associated tools will be decontaminated prior to field operations and between borings. Drill and probe rods and other non-sampling equipment will be placed in the decontamination area and cleaned using a high-pressure, water sprayer or steam cleaning machine and laboratory-grade detergent. The exposed exterior and surfaces of drill rods, augers, and other non- sampling equipment will be cleaned until visible soil is removed. Spent acetone or other solvent used for decontaminating DNAPL equipment and contained on absorbents or other wiping materials, will be included with solid waste. All solids and decontamination fluids will be collected from the decontamination berm and placed in appropriate containers for further management and disposition.

The decontamination area will be approved by the Field Manger prior to use. Waste generated during the decontamination procedures will be managed and disposed as described below.

1.2 Solid Waste Management, Storage and Disposal

All solid wastes will be separated, keeping materials expected to contain hazardous constituents at a minimal volume and isolated from other waste for further characterization for disposal. Small quantities of waste will be placed in DOT- approved 55-gallon drums and appropriately labeled. Bulk waste soil, cuttings, etc. will be temporarily stored within a minimum 6-mil plastic-lined berm for dewatering, and covered with polyethylene film in a central location at the Facility.

All solids will be managed as hazardous, i.e. contained, with measures to protect workers from exposure and protected from the elements. Characterization sampling will be performed to determine the hazardous nature and classification of the waste so appropriate disoposal procedures and receiving facilities can be planned.

All other solid waste with minimal chemical impact, including all personnel protective equipment (PPE), rope, bailers, pump tubing, paper towels, empty water bottles, etc., will be placed in trash bags for disposal at the Springfield municipal landfill.

1.3 Liquid Waste Management, Storage and Disposal

Decontamination, development, sampling purge, pumping test, and bulk solids drained water will be temporarily stored in DOT-approved, 55-gallon drums or tanks at locations of generation. When activities at those external locations are completed, the drums or tanks will be transported to the Facility for further management and disposal. Accumulated fluids in the decontamination berm will be transferred using a sump pump into DOT-approved, 55-gallon drums to facilitate management and disposal. The intention is to obtain Agency approval to input liquid wastes directly to the on-site treatment system as a disposal mechanism.

1.4 Waste Sampling and Disposal

Since all solid waste will assume to be impacted, representative characterization samples will be collected to ascertain appropriate disposal. Sampling will be done by collecting aliquots from drums and the planned bulk drill cuttings pile to yield representative composite samples. for each roll-off of waste disposed of. Analyses will be those required by the receiving approval waste disposal facility uality control framework for executing field work that assures:

- Field forms are filled out completely and correctly;
- The sample naming protocol is followed; and
- The scope of usefulness associated with existing data is documented, and that only existing data of sufficient quality to meet the data quality objectives (DQOs) for the given investigation are used.

Waste suspected of containing hazardous materials will be sampled for waste profiling, and properly disposed at an appropriate landfill or other disposal facility with any necessary manifesting for transport and disposal.. Characterization samples will consist of a representative composite sample for each roll-off of waste disposed of. Analyses will be those required by the receiving approval waste disposal facility

ATTACHMENT D

QUALITY ASSURANCE PROJECT PLAN

(document submitted separately)

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 West High Street, Springfield, Missouri
RCRA Permit Number MOD007129406

August 18, 2016

For Submittal To:
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102-0176

Prepared By:

GREENFIELD ENVIRONMENTAL TRUST GROUP

Greenfield Environmental Multistate Trust LLC,
Trustee of the Multistate Environmental Response Trust

and

ENVIRONMENTAL WORKS

A1 - Title and Approval Page

This Quality Assurance Project Plan (QAPP) is approved for use in implementation of the Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation Work Plan at the Kerr-McGee (Tronox) RCRA corrective action Facility in Springfield, Missouri. The signatures below document approval of this QAPP and imply intent to abide by the data quality framework outlined within it.

_____ _____
Lauri Gorton Date
Greenfield Environmental Multistate Trust
Director of Environmental Programs and Senior Strategist

_____ _____
Tasha Lewis Date
Greenfield Environmental Multistate Trust
Portfolio Manager

_____ _____
Amber Igoe Date
Greenfield Environmental Multistate Trust
Project Manager

_____ _____
Jason Smith, RG Date
Environmental Works, Inc.
Principal Scientist

_____ _____
Thomas Bieker, M.Sc., CHMM Date
Environmental Works, Inc.
Quality Assurance Manager

_____ _____
Don Dicks Date
Missouri Department of Natural Resources
Project Manager

_____ _____
Mike Dandurand, P.E. Date
U.S. Environmental Protection Agency, Region VII
Missouri State Coordinator

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LIST OF ACRONYMS

ºC	Degrees Celsius
A2LA	American Association for Laboratory Accreditation
Agencies	Missouri Department of Natural Resources and United States Environmental Protection Agency
AOI	Area of Influence
APL	Aqueous Phase Liquid
BMW	Bedrock Monitoring Well
BTEX	Benzene, toluene, ethylbenzene, total xylenes
CAD	Computer aided drafting
City	City of Springfield
CIH	Certified Industrial Hygienist
COCs	Chemicals of Concern
C-O-C	Chain of Custody
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DOT	Department of Transportation
DQOs	Data Quality Objectives
EDDs	Electronic Data Deliverables
EUROFINS	Eurofins Lancaster Laboratories Environmental LLC
EQPM	Environmental Quality Policy Manual
EWI	Environmental Works, Inc.
FM	Field Manager
GWPS	Groundwater Protection Standard
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&P	H&P Mobile Geochemistry
IATA	International Air Transport Association
IDW	Investigation Derived Waste
IT	Information Technology
LCS, LCSD	Laboratory Control Sample, LCS Duplicate
L	Liter
MDNR	Missouri Department of Natural Resources
MGS	Missouri Geological Survey
MHWMF	Missouri Hazardous Waste Management Facility
mL	Milliliter
mL/min	Milliliters per minute
MS/MSD	Matrix Spike/Matrix Spike Duplicate
Multistate Trust	Greenfield Environmental Multistate Trust LLC
MW	Monitoring Well
MWCR, MWCC	Missouri Well Construction Rules / Code

NELAP	National Environmental Laboratory Accreditation Program
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PDC	PDC Laboratories
PADEP	Pennsylvania Department of Environmental Protection
PE	Professional Engineer
PID	Photoionization Detector
PS	Principal Scientist
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RG	Registered Geologist
RL	Reporting Limit
SAF	Sample Acknowledgement Form
SB	Soil Boring
SDS	Safety Data Sheet
SFZ	Secondary Flow Zone
SM	Standard Method
SMW	Shallow Monitoring Well
SOPs	Standard Operating Procedures
SPM	Senior Project Manager
SRDL	Sample Result Documentation Log
SSHP	Site Safety and Health Plan
SV	Soil Vapor
SVOCs	Semi-Volatile Organic Compounds
UFZ	Upper Flow Zone
USEPA	United States Environmental Protection Agency
VISL	Vapor Intrusion Screening Level
VOCs	Volatile Organic Compounds
YSI	Yellow Springs Instrument

A3 - Distribution List and Contact Information

The following individuals and organizations will be provided with copies of the approved QAPP and any subsequent revisions.

Lauri Gorton	**Primary Contact for the Multistate Trust** Greenfield Environmental Multistate Trust, LLC 2116 East Estess Street Milwaukee, Wisconsin 53207 (414) 732-4515 lg@g-etg.com
Tasha Lewis	**Greenfield Multistate Trust Portfolio Manager** Greenfield Environmental Multistate Trust, LLC 2824 E. Donner Drive Phoenix, AZ 850412 (602) 312-6993 tl@g-etg.com
Amber Igoe	**Greenfield Multistate Trust Project Manager** Greenfield Environmental Multistate Trust, LLC 3669 Longfellow Road Tallahassee Florida 32311 (850) 322-8033 ai@g-etg.com
Don Dicks	**RCRA Corrective Action Project Manager** Missouri Department of Natural Resources 1730 East Elm Street Jefferson City, Missouri 65101 (573) 751-3553 don.dicks@dnr.mo.gov
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Brandon Thornhill	**Field Manager** Environmental Works, Inc. Springfield, Missouri 65802 (417) 890-9500 brandon@environmentalworks.com

The following parties *may* be included in the mailing list at the discretion of the Multistate Trust, and their contact information should be available to all parties that may utilize this QAPP:

Laura Jovanovic	**Account Manager** Eurofins Lancaster Laboratories Environmental, LLC 2425 New Holland Pike Lancaster, PA 17601 (312) 350-2568 laurajovanovic@eurofinsUS.com
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Kevin Lambeth	**Missouri Licensed Surveyor** Anderson Engineering 2045 West Woodland Springfield, Missouri 65807 (417) 866-2741 klambeth@aeincmo.com
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Tim Sterling, CIH	**Industrial Hygiene Review** Novus Sterling, LLC 911 Marynell Lane Nixa, Missouri 65714 (417) 725-8151 tsterling@safetyconsultants.org

A4 - Project Organization and Management

Facility work process will be managed by the Greenfield Environmental Multistate Trust, LLC (MultistateTrust), and implemented through their contractor, Environmental Works, Inc. (EWI) through coordination with Missouri Department of Natural Resources (MDNR) and the U.S. Environmental Protection Agency (USEPA) (collectively referred to as the Agencies), and the City of Springfield (City). Figure 1 is a project Organization Chart which identifies lines of responsibility and communication. Key project personnel involved with specific Quality Assurance/Quality Control (QA/QC) responsibilities for Facility work are discussed in this section.

Greenfield Environmental Multistate Trust LLC

The Multistate Trust is the owner of the Facility. Lauri Gorton will serve as the Multistate Trust representative, with primary responsibility to ensure that the project objectives are being met through implementation of any Facility work plans. Also, the Multistate Trust will serve as the communication channel between EWI and the Agencies.

Missouri Department of Natural Resources (MDNR)

MDNR is the lead regulatory agency for the Facility. Responsibilities specific to MDNR are elaborated in the following sections.

Project Manager

Don Dicks will serve as the MDNR Project Manager. The MDNR Project Manager's primary responsibilities are to:

- Review and approve work plans and reports for Facility work
- Ensure compliance with the Missouri Hazardous Waste Management Laws
- Maintain the Missouri Hazardous Waste Management Facility Permit under which the Facility is operating

Public Involvement Coordinator

Heidi Rice will serve as the MDNR Public Involvement Coordinator. Her primary responsibility is to represent the public as a stakeholder in all aspects of Facility work.

United States Environmental Protection Agency (USEPA)

USEPA is the support agency for regulatory oversight at the Facility. Mike Dandurand, P.E. is the USEPA Missouri State Coordinator, with a primary responsibility to ensure that MDNR oversight is equivalent to USEPA oversight, covering all regulatory requirements.

Environmental Works, Inc. (EWI)

EWI will have the primary responsibility to prepare project plans, perform field activities, and produce documentation and reports for work activities. Responsibilities specific to EWI are elaborated in the following sections.

Principal Scientist (PS)

The PS will provide guidance, direction, and support to the EWI project team and will be ultimately responsible to the Multistate Trust for all aspects of EWI involvement with the project. The PS will also be responsible for final internal review of any Facility work plan,

related reports, and any revisions or addendums. The PS may delegate project responsibilities such as communication with the Multistate Trust or field oversight to a project team member such as the Senior Project Manager (SPM), Field Manager (FM), or other qualified individual.

Senior Project Manager (SPM)

The SPM will aide the PS with the above-stated responsibilities, and will be the primary EWI planner, coordinator, and supervisor for implementation of Facility work activities. The SPM will prepare all documents for the PS review.

Quality Assurance Manager (QAM)

The QAM is a principal-level EWI member who will review data and project deliverables as well as complete periodic QC audits. The QAM will not actively perform Facility activities, but will be an independent reviewer. Audits entail comparison of actual Facility operations carried out by EWI team members or subcontractors versus the QC framework of this QAPP. The QAM also reviews data to ensure that it is of sufficient quality to use in the context of WORK objectives. The QAM may delegate responsibilities to another qualified senior individual who is also independent of the project.

Field Manager (FM)

The FM is responsible for implementing and completing all field activities. The FM will work directly with the PS and SPM to coordinate Facility field activities. The FM will be the primary communication channel between the EWI PS/SPM and all contracted services (e.g., laboratories, labor, etc.). FM responsibilities include:

- Implementing adequate internal controls and review procedures to eliminate conflicts, errors, and omissions
- Verify technical accuracy during work plan implementation
- Ensure compliance with this QAPP

The FM responsibilities are internal to the implementation of Facility Work Plans, which are separate from the QAM responsibilities that are independent, or external of field activities. The FM may delegate responsibilities to another qualified individual.

A5 - Problem Definition/Background

The former Kerr-McGee (Tronox) Wood Treating Facility (the Facility) is located in Section 9, Township 29N, Range 22W at 2800 West High Street, Springfield, Greene County, Missouri, and covers approximately 68 acres (see Figure 2). Approximately 32 acres of the Facility are associated with former wood treating operations. Tronox and predecessors owned and operated the wood treating facility from 1907 to 2004, with demolition and decommissioning completed in June 2004. Lumber was treated at the facility using creosote-tar wood preserving products. Due to the nature of operations, the Facility fell under the RCRA regulatory framework, and eventually became subject to RCRA corrective action. The Multistate Trust, in its representative capacity as Trustee for the Multistate Environmental Response Trust, assumed responsibility for the Facility in connection with the Tronox LLC bankruptcy settlement, which was approved by the U.S. Bankruptcy Court on February 14, 2011. The Multistate Trust

is responsible for implementing all environmental actions at the Facility under the regulatory power of the Agencies.

The Agencies issued Missouri Hazardous Waste Management Facility Permit (MHWMF Permit, or Permit) for the Facility (MOD007129406) on September 25, 2002, and the Corrective Action Plan and Post Closure Care Plan for the Facility are regulated by Part 1 of this permit. In August 2012, the Multistate Trust submitted a draft RCRA Part B Permit Application to the Agencies which sought, amongst other things, to refine the groundwater monitoring program to support remedial objectives and long term goals with the Facility and evaluate the effectiveness of the groundwater recovery well system. This is the basis of the remedial optimization Work Plan.

This QAPP is included with Facility Work Plan in order to define the specifications and quality assurance framework for implementation of the Work Plan. The QAPP can be viewed as the necessary underlying framework by which execution of field work, data analysis, and reporting activities is guided by to ensure that data quality requirements are met. It also establishes the management policies, a communication plan, project organization, and functional roles of individuals for specific QA/QC activities. This QAPP was developed following applicable USEPA guidance documents:

- *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5 (2001)
- *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5 (2002).

A6 – Project/Task Description

The remedial action optimization Work Plan defines specific actions that will accomplish the Multistate Trust's objectives:

1. Understand site hydrogeological and contaminant occurrence, fate and transport conditions, including vertical contaminant migration

2. Delineate horizontal and vertical dense non-aqueous phase liquid (DNAPL) and aqueous phase liquid (APL) plume boundaries

3. Assess potential off-site migration pathways to the northeast, east, and south

4. Assess potential receptors and exposure pathways of confirmed off-site migration

5. Evaluate performance of existing corrective measures to meet groundwater protection requirements of Special Permit Condition II.E. of the MHWMF Permit

Actions will be performed in a phased approach to meet the above objectives, with specific work in subsequent actions modified as appropriate based on results of the previous phase of work. The first four objectives above provide data to update the conceptual site model (CSM), which will form the basis for the fifth objective's evaluation of corrective measures performance. The overall goals of corrective measures are to protect human health and the environment, and ultimately result in productive economic re-use of the Facility.

A7 – Quality Objectives and Criteria

Valid data of known and documented quality are needed to support the objectives outlined above. The USEPA recommends a systematic planning process for defining criteria to prepare for a data collection activity, including when to collect samples, where to collect samples, how many samples to collect, and the tolerable level of decision errors for the study. This systematic process includes developing data quality objectives (DQOs) which are qualitative and quantitative statements that clarify study objectives, define the type of data needed, and establish error limits for the quality and quantity of data needed to support decisions, as outlined in the ***Guidance for the Data Quality Objectives Process*** (USEPA, 2000b).

The overall DQO is collection of a sufficient quantity and quality of environmental data to support the project objectives stated above. Specific DQOs are as follows:

- Install new wells at appropriate locations and depths to define horizontal and vertical delineation of DNAPL occurrence and the APL plume.
    - *Appropriate locations* are downgradient with respect to DNAPL movement and groundwater flow direction(s) from the furthest monitoring points that contain DNAPL or groundwater exceeding groundwater protection standards (GWPS).
    - *Appropriate depths* are vertical monitoring intervals that intersect likely DNAPL horizons of movement or groundwater migration pathways.
- Collect groundwater chemical data of sufficient quality at new well locations to delineate the plume to regulatory GWPS.
    - *Sufficient quality* means (1) samples of groundwater representative of natural conditions determined by measured water quality data, and (2) data that meets quality control standards defined by laboratory Level 2 internal quality control tests and results criteria.
    - GWPS are concentration limits specific to each of the Chemicals of Concern (COCs) as established by the MHWMF Permit.
- Correctly assess vapor inhalation risk for potential residential receptors.
    - Collect groundwater chemical data at appropriate locations and of sufficient quality for comparison to established USEPA vapor intrusion screening tool (VISL) criteria. Appropriate locations are monitoring points within the plume area within residential areas; *sufficient quality* is as defined above.
    - If utilized, install vapor monitoring wells at *appropriate locations* (as defined immediately above), and sample vapor wells per EWI Standard Operating Procedure (SOP) #10 (see Appendix 3) to yield quality soil vapor data for comparison to regulatory standards.
- Correctly assess plume hydraulic dynamics to effectively support delineation, risk assessment, and remedial actions.
    - *Correctly assess* means (1) review and evaluate all historical water level data for investigation areas, and (2) collect water level data during Facility work from all existing and new wells to provide a complete data set for each investigation area.

  - *Effectively support* means obtain water level data for calculating potentiometric conditions during both wet and dry seasons encompassing the areas needing delineation, risk assessment, or remedial actions.

- Collect sufficient data to evaluate DNAPL mobile or residual occurrence in source areas.
  - *Sufficient data* means (1) design investigation grids with sample points that encompass areas to be evaluated, (2) collect data types needed to identify creosote DNAPL, e.g., TarGOST, Geoprobe® samples for visual and ultraviolet observation, chemical analysis for indicator chemicals, and (3) collect data from complete vertical spans to bedrock, at screening spacings with appropriate fill-in points to provide three-dimensional data set construction.
- Collect sufficient data needed to determine efficacy of the current remedial efforts to support effective upgrade planning.
  - *Sufficient data* means the right type and quantity of data to evaluate specific portions of the remedial system; e.g., pumping rates and capacity for evaluating pumping wells, changes in groundwater level to evaluate pumping radius of influence, and effluent flow rates and volumes for segments of the effluent piping network.
  - *Support effective upgrade planning* requires complete sets of quality data for each aspect of the remedial system; e.g. pumping system, effluent piping system, effluent treatment system.

Data will be collected, verified, validated, and reported according to procedures outlined in this QAPP. Chemical and hydraulic data will also be compared to historical data to determine if it falls within expected values. The following sections discuss performance and acceptance criteria and limits on decision errors of obtaining sound data.

A7.1 Performance and Acceptance Criteria

Performance and acceptance criteria are often expressed in terms of data quality indicators, and data quality depends on many factors, including sampling methods, sampling preparation and handling, analytical methods, quality control, and documentation. After all data have been assembled and validated, the data will be further evaluated for data quality indicators (precision, accuracy, representativeness, completeness, and comparability of the data). These indicators are summarized on Table 1.

Laboratory performance criteria are presented in Table 2 and include quantification and detection limits, bias, precision, completeness, and holding times. Attainment of these quantitative performance criteria will ensure that the data collected are sufficient and of adequate quality for their intended uses. Otherwise, data that do not meet these criteria will be qualified during data validation, and their limitations will be noted. The following qualitative criteria for representativeness and comparability will also be implemented for measurements to ensure that the resulting data are representative of environmental conditions and are comparable with results from previous investigations:

- Soil sample collection will be targeted to observed changes in lithology, areas of high photoionization detector (PID) detections, areas of visual impact and/or staining, and at the soil/bedrock interface. Soil samples may also be biased in location of the boring, and location of the sample within the boring based on direct push TarGOST results;

- Groundwater samples will be collected via methods that have been used at the Facility in the past and analyzed at the same laboratory that has been used in the past;
- QC samples will be collected to facilitate necessary quality analyses to be conducted (e.g., field QC samples, laboratory QC analyses), for verification of representative values of the original samples.
- A minimum of 10% duplicate samples from suspected impacted media, MS/MSD from suspected clean media, one rinsate blank and field blank per sampling event, one trip blank per cooler with volatile organic compounds (VOCs) samples will be collected.

Acceptance criteria will be utilized to evaluate usability of data collected during Facility work. Generally, criteria for precision are based on the USEPA method QC acceptance criteria and on the predicted method bias in environmental samples. Detection limits for groundwater will meet the Permit GWPS, except where technically unfeasible. For soil, minimum laboratory detection limits per laboratory capabilities are required to provide soil data that can be practically compared to soil saturation levels of DNAPL chemical components. Historical data used during Facility work is assumed to be of sufficient quality because it was already Agency approved, unless data was obtained using a method that is known today to have had problems at the time of the method's use, or if elevated detection limits render the data non-informative.

A7.2 Limits on Decision Errors

The following represent potential decision errors and their likely causes and/or results for the following fundamental questions to be answered by Facility work:

1. Have DNAPL and the APL plumes been adequately delineated?
2. Have secondary porosity migration pathways been adequately identified to evaluate vertical and horizontal contaminant migration?
3. Has exposure risk in residential areas been adequately screened?
4. Has mobile DNAPL potential in former source areas been adequately determined?
5. Is the pumping network capable of hydraulic control of impacted groundwater?

Two decision errors are described for each of these questions under the headings below: a false "yes" error and a false "no" error for each. Possible causes, ramifications, and need for mitigation measures are provided.

<u>DNAPL and APL Plume Delineation Complete?</u>

- Determining that plume is delineated when it is not – This could happen if karst features are not properly identified to position wells, or if insufficient wells are installed. Adequate fracture and potentiometric evaluation should minimize this potentiality. A missed migration pathway is likely to be a minor feature, resulting in minimal, if any, impact beyond known delineation and likely needing no mitigation measures.
- Determining that plume is not delineated when it is – This decision error is not likely to happen unless quality issues cause false positives with sample results. Resampling should verify true results.

<u>Secondary Porosity Migration Pathways Identified?</u>

- Determining a void, fracture, etc.is present when it is not – Could occur if exact location or direction of an interpreted feature "off course". Could result in a well placed outside a feature, which will be evident during drilling. Wells in proximity to secondary porosity features may still detect impact in groundwater.

- Determining no void, fracture, etc. is present when one exists – This could happen if insufficient evidence inputs are available in the fracture or geophysical fracture evaluation to identify a feature, and would result in the first error decision of question #1. Most features large enough to be a significant migration pathway will have evidence of existence that will be useful.

Residential Exposure Risk Screening Adequate?

- Determining no risk for residential vapor intrusion when there is – Could result if collected data has quality issues or data source locations are not properly placed. Would have adverse consequences, but can be prevented by following QAPP procedures, effectively selecting sampling locations, and collecting repeat samples.

- Determining a vapor intrusion risk exists when it does not – Could only occur with QC errors resulting in false positives in multiple samples, which is not likely. Mitigated by multiple and repeat sampling.

Mobile DNAPL Potential Determined?

- Determining no mobile DNAPL is present when mobile DNAPL is present – Could result if investigation misses areas with DNAPL, or if quality issues affect multiple lines of evidence investigated. Result would be prolonged risk potential and extended remedial efforts. Mitigated by employing multiple lines of evidence and adhering to QAPP procedures.

- Determining mobile DNAPL is present when it is not – Could result if investigation results are biased by quality issues or interpretation. Any additional DNAPL delineation work in the suspected area would reveal actual conditions.

Pumping Network Capable of Hydraulic Control?

- Determining that the pumping system exercises adequate hydraulic control when it does not – Could occur by overestimating hydraulic area of influence (AOI) by pumping operations, or underestimating the hydraulic load to the Upper Flow Zone (UFZ) during major rain recharge events when testing during dry season conditions. Main concern is the Clifton drainage area, and would result in loss of capture and off-site release of APL, for temporary period. This would increase potential exposure risk and prolong remedial efforts. Error mitigated by performing adequate testing and hydraulic monitoring of pumping system during wet season conditions.

- Determining that the pumping system is inadequate for hydraulic control when it is adequate – Could occur if system testing and evaluation is cursory with insufficient water level data collected and interpreted results biased to the negative. Result would be enhancement to the pumping network, which would increase costs but strengthen the effectiveness of the system. Mitigated by conducting adequate testing and monitoring during wet season conditions.

A8 – SPECIAL TRAINING REQUIREMENTS / CERTIFICATION

Special training requirements or certifications for this project include the following:

- Professional geologist and professional engineer licensed personnel, to ensure proper technical expertise in planning, implementing, and evaluating WORK actions and results.
- Medical certification (fit to work as determined by an occupational medicine professional);
- Respirator fit testing;
- 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Reponses (HAZWOPER) training; and
- Current 8-hour OSHA HAZWOPER refresher.

All workers involved in any intrusive work or those who may be exposed to subsurface soils, groundwater, or waste-impacted materials must provide evidence of medical certification, respirator fit test, 40-hour and 8-hour refresher OSHA HAZWOPER training prior to the start of work. Additional information regarding training and certifications may be found in the Site Safety and Health Plan (SSHP).

For certain tasks, some additional training requirements may apply. EWI personnel will follow the instruction manual or other documentation provided with rented equipment if not already knowledgeable in the operation of that equipment. Training for drilling and other subcontractors working on the Facility will be verified. For specialized sensory or other equipment, only designated operators and support crew trained on use of that equipment will be allowed to operate it. To support the DQOs of this project, training for such specialized equipment should have been performed through the manufacturer of the equipment. If it is determined that the operators assigned to such equipment may be lacking in sufficient training, the subcontractor or vendor will be required to provide a qualified individual.

The EWI PS and SPM are responsible for assuring that the project team and any subcontractors have the appropriate training and certifications. Certifications will be kept on file at the Facility, and training records will be documented in personnel files. Training will be augmented by debriefing personnel shortly after their tasks have begun, to correct and clarify appropriate practices.

A9 – DOCUMENTS AND RECORDS

All sampling and analytical results will be provided to the Agencies in the deliverables listed below:

Work Plan	1 submission per review period until approval is obtained
Work Plan Addendum	As needed basis
Progress Reports	Monthly letter reports that include new data
Final Report	1 submission per review period until approval is obtained

Data will be tabulated and presented to the Agencies in an appropriate reporting format per the Data Management Plan and examples in Appendix 4. The following documents and records may be produced or available from vendors during Facility work:

Sample Collection Records	Groundwater Purging and Sampling Logs Soil Sampling Logs/Direct Push Sensing Log Soil Boring Logs and Drilling Logs Soil Vapor Sampling Forms Well Development Forms Yellow Springs Instruments (YSI) Calibration Logs Pressure Transducer Calibration Logs PID Calibration Logs QC Sample Logs
Other Field Records	Tailgate Safety Meeting Forms Daily Activity Logs Air Monitoring Logs Photo logs Facility Maps and Related Computer Aided Drafting (CAD) Figures QA/QC Forms Field Work Variance Log
Analytical Records	Laboratory Analytical Reports Chains of Custody (C-O-C) forms Summary Tables of Data Electronic Data Deliverables (EDDs) Sample Receipt Forms Data Quality Evaluation Memos Graphs Figures Raw Data Downloads
Equipment Manuals	Geoprobe® Manual and Direct Push Sensors Photoionization Detector Pressure Transducers YSI Four-Gas Meter Manuals for Components of Pump and Treat System Interface Probe Manual
Miscellaneous	SOPs (See Appendix 3) Soil Boring Abandonment Registration Forms Monitoring Well Certification Forms Well Construction and Abandonment Forms Disposal Manifests Safety Data Sheets (SDS)

Examples of typical forms are provided in Appendix 4. Neither Appendix 4 nor the above list is an exhaustive list of all forms that may be used during Facility work. They are intended to show general examples of field records. Forms that do not already exist will be created when needed.

The most current version of this QAPP will be maintained by the Multistate Trust and distributed to parties on the distribution list via mail delivery if there are revisions. Revisions to the QAPP may be readily identified by the revision number and date appearing in the footer of this document. The most recent revision must be signed by all parties on A1 – Title and Signature Page to be considered an official document.

All field data will be entered into dedicated notebooks or electronic field sampling forms. Record-keeping and documentation procedures are discussed in detail in subsequent sections of the QAPP, and in the Data Management Plan. Field notebooks, C-O-C records, field data sheets, disks, and lab reports will be filed and stored at a location specified by the Multistate Trust for at least five years and then may be moved to a local storage facility. All documents associated with Facility work will be kept for a minimum of six years after the Agencies certify completion of the work.

B1 – DATA COLLECTION PROCESS DESIGN

The sampling and analysis plan can be found in the associated Work Plan, and a summary of intended work activities is given below:

Historical Data Review

- Historical lab data will be reviewed to gain an initial understanding of the contamination plume and identify areas that warrant further investigation.
- Available boring logs for the Facility will be reviewed to understand karst features and DNAPL occurrence and movement to guide investigation monitoring.
- Historical recovery system data will be used to help evaluate current remedial efforts.
- Historical Facility investigation and reporting documents will be reviewed to gain an understanding of the Facility chemical and hydraulic trends, and the current conceptual site model.

Fracture Evaluation

- Existing Facility data from maps, logs, investigation observations, historical aerial photographs, and topographic maps will be used to perform a fracture evaluation.
- Geophysical resistivity surveys will be used in critical areas to better localize fracture locations for siting monitoring wells.
- Results of the evaluation will be used to identify likely groundwater and DNAPL migration pathway locations to target for monitoring wells.

TarGOST®

- TarGOST® direct push sensing will be used to delineate DNAPL in source areas.
- Location of TarGOST® borings will be grid-based and fill-in locations biased by field results during the investigation.
- All TarGOST® profiles will be considered representative of the soil adjacent to the sample location and will be combined with other boring data for the area investigated to allow a three-dimensional interpretation of DNAPL distribution and evaluation of mobility potential for the source areas.

Soil

- Biased soil sample locations will be chosen based on Facility knowledge and results of the TarGOST® investigation.
- All soil borings advanced will be considered representative of the soil adjacent to the sample location and will be evaluated in conjunction with other data for the area allowing for a better understanding of contaminant distribution throughout the area as a whole.
- All soil samples collected during Facility work will be collected utilizing a Geoprobe® Macro-Core® sampling system.

- If soil samples become damaged or are unable to be analyzed by the laboratory, additional samples adjacent to the original sampling location will be collected if data from that location is deemed necessary for a complete evaluation.

Groundwater

- Groundwater samples will only be collected from properly constructed monitoring or recovery wells.
- The locations of new wells will be biased based knowledge gained from the initial activities combined with new fracture evaluation.
- All groundwater samples will be considered representative of the aquifer adjacent to the sample location and will be evaluated in conjunction with other data to allow for a better understanding of contaminant distribution throughout the area as a whole.
- All groundwater samples will be collected using historically used methods to ensure data is comparable to historical data. Any change in groundwater sampling methodology will include a comparability study.
- Each sampling event at the Facility is relatively short in duration (one week); therefore variability across a single sampling event is not expected. Sampling events will be planned during stable weather forecast conditions to avoid rain recharge producing a large volume of water influx to weathered bedrock zone features. If unexpected rain recharge occurs during an event, collection of samples at that time versus delaying until stable groundwater conditions return will be evaluated.
- If groundwater samples become damaged or are unable to be analyzed by the laboratory, resampling of the well will be evaluated and discussed with Multistate Trust and MDNR. Appropriate coordination with property owners for accessibility agreements will be undertaken prior to mobilizing for sampling.

Water Quality Monitoring

- Water quality parameters will be measured with a YSI 556, or equivalent, water quality meter, and include temperature, conductivity, pH, oxidation reduction potential (ORP), dissolved oxygen (DO), and turbidity.
- These data will be used to determine when removed groundwater has become representative of the water quality groundwater in that portion of the aquifer, and is therefore suitable for sampling.

Soil Vapor Samples

- Soil vapor (SV) samples will only be collected if SV wells are installed following screening indicating potential vapor intrusion risk using groundwater analytical data.
- SV samples will only be collected by properly installed SV wells; SV well locations will be located in the immediate area of evaluated potential risk.
- SV samples will be considered representative of the impact at the sample location and horizon and may be interpreted as reasonably representative of other locations having similar water quality and hydrogeologic conditions.
- All SV samples will be collected using established industry standard methods.

- Each SV sampling event can be accomplished in one day. Sampling events will be planned and performed during stable weather forecast conditions and will avoid recent rain events that could produce recharge water influx to upper soil zones. One event will be in hot climate conditions, and one will occur during cold conditions.
- If SV samples become damaged or are unable to be analyzed by the laboratory, resampling of the SV well will be evaluated and discussed with Multistate Trust and MDNR. Appropriate coordination with property owners for accessibility agreements will be undertaken prior to mobilizing for sampling.

Evaluation of Groundwater Recovery and Treatment System

- Hydrograph studies using pressure transducers with automatic data collection devices and pumping tests may be used to evaluate the recovery system.
- Pumping testing of the recovery system will be done during wet season conditions to ensure evaluation during higher hydraulic load conditions.
- Efficiency of the pumping network effluent piping may involve pressure testing, flow evaluations, and visual monitoring techniques to evaluate blockage.

Miscellaneous Sampling

Miscellaneous samples will be collected that are related indirectly to Facility work goals:

- Waste characterization samples
- Additional QA/QC samples

B2 – FIELD DATA COLLECTION METHODS

This section summarizes methodologies for collection of the aforementioned data. Referenced SOPs can be found in Appendix 3. During all field activities, details of work performed each day will be recorded on various field note and data forms. These forms will be compiled into a field logbook that is maintained by the FM.

B2.1 Pre-Sample Collection Activities

Prior to the start of a field sampling event, the FM will prepare a Field Work Request packet that contains:

- A concise scope of work;
- Supplies list;
- All necessary sampling forms and other data forms (such as field notes and tailgate safety meeting forms);
- Maps or figures; and
- Any other supporting information.

The FM will also ensure that all necessary expendable supplies and equipment are available to complete the work. This check will be completed as part of putting together the Field Work

Request packet. The team members that will perform the field work will review the associated SOPs.

B2.2 Geophysical Methods

Geophysical studies will be subcontracted to a competent professional, the methodology for geophysical resistivity surveys can be found in the remedial action optimization Work Plan.

B2.3 Sampling and Data Collection Methods

The following describe the various sampling and data collection methods that will be employed.

B2.3.1 Soil Sampling Methods

Soil data will be collected in a variety of ways:

- TarGOST® direct push sensing:
    - The TarGOST® probe is attached to the end of Geoprobe® rods.
    - The Geoprobe® operator uses the hammer to push probe to depth at the rate suggested by the TarGOST® contractor.
    - The TarGOST® contractor uses software to interpret data and provides EWI team member with a printout in the field that shows the vertical DNAPL distribution at that point.

- Soil samples to be sent to lab for analysis will be collected using a Geoprobe® Macro-Core® sampling:
    - The direct push core will be taken from surface to refusal on bedrock. Hollow Macro-Core® barrels use an acetate liner to contain the boring. The liner is removed from the core barrel and cut open using a razor blade.
    - The core will be brought to the logging station, open and ready to screen.
    - A PID will be used to field screen the core for sample locations and logged on a soil core form according to EWI SOPs.
    - Portions of the core may be collected for laboratory analysis depending on PID screening, and other considerations.
    - Upon completion of logging and sampling the core, it will be photographed with a reference tape measure, then drummed or piled for disposal.

B2.3.2 Groundwater Sampling Methods

For sampling activities, either low flow or bailer methods will be used to collect groundwater samples. Low flow is the desired method, but if low flow sampling is not possible, bailers will be used. In both cases the goal is to confirm that water being collected is representative formation water by measuring water quality parameters.

- Low Flow Sampling
    - Place pump at well with tubing inserted to desired depth and withdraw water at a rate that limits drawdown in the well to 1/3 foot. Flow rates should remain below 300 milliliters per minute (mL/min)

- Pumped water is directed to a flow through cell where the YSI 556 measures water quality parameters. Parameters are recorded at regular intervals on the sample form.
- Once parameters have stabilized and are in line with expected values for the hydrogeologic zone being sampled, collect sample.

Full details of each method, including stabilization criteria, can be found in the EWI SOPs, Appendix 3.

B2.3.3 Water Quality Data Collection Methods

Water quality parameters will be obtained one of three ways:

- From a flow-through cell connected to a pump.
- Water carefully placed into an open mouth jar of sufficient volume (1 liter [L]) and measurements rapidly taken with the YSI probe to capture representative values.
- Direct immersion of YSI probe into a surface water body.

The measurement probe will be decontaminated after each use.

B2.3.4 Soil Vapor Collection Methods

SV samples will be collected as follows:

- Samples will be collected from installed SV wells containing dedicated screen points and tubing.
- With the sampling train assembled (tubing, vacuum gauge, two-way valve, syringe); an appropriate purge volume will be removed as calculated for the size and length of tubing for that SV well.
- Following purging, a Tedlar bag will be connected and filled to the designated volume (between 85 milliliters [mL] and 300 mL).
- Samples will be shipped in protective containers to the designated subcontracted laboratory for analyses.

Procedures, including duplicate and leak detection sampling, are provided in SOP #10 in Appendix 3.

B2.3.5 Miscellaneous Sampling

These data will be used for waste characterization purposes. Additional information regarding sampling methods is discussed below in greater detail.

- **Decontamination water** – will be introduced into the on-site treatment system, no sampling necessary.
- **Solids** – Solid waste will be handled as F034 listed waste mixed with soil, making the whole mixture F034. A composite sample will be collected from the waste pile to confirm its characteristics.

B2.4 Post-Sample Collection Activities

The FM is responsible for verifying that the appropriate sample information is submitted for each sample, the correct sample container(s) was used, the samples were correctly preserved or maintained at the appropriate temperature, and the assigned QA/QC samples were collected.

Special attention will be given to the preplanned information such as sampling method, sample depth, etc. that is retrieved by the form.

The FM is responsible for verifying the accuracy and completeness of the C-O-C form for the sample shipment being made. The FM is responsible for the contents of each cooler shipped and the accompanying documentation. At the close of each sampling day, a copy of the C-O-C will be submitted to the QAM and the associated laboratories notified of sample shipment.

The FM is responsible for documenting any variance or nonconformance to this QAPP with respect to sample collection, preservation, packaging, documentation, and shipment. The QAM will be notified and consulted regarding any such documentation.

B2.5 Sample Containers, Preservatives, and Holding Times

Samples must be placed in sample containers certified by the manufacturer to be pre-cleaned to USEPA specification that are compatible with the matrix and intended analysis, and properly prepared and preserved to maintain sample integrity.

Contracted analytical laboratories often have a laboratory-specific quantity requirement, and therefore, will furnish the sampling teams with sufficient quantity of containers to complete a sample task. The sample containers, preservatives, and analyses to be performed are identified in Table 3.

B2.6 Decontamination of Sampling Equipment

All sampling equipment that will come in contact with samples and is not designated to be disposable will be cleaned prior to and following sampling. The standard cleaning protocol will include:

- Removing any excess dust or dirt from the equipment with paper towels and/or wire brushes and tap water if needed;
- Washing the equipment with a water solution containing a detergent, such as Alconox® or similar laboratory-grade detergent;
- Rinsing the equipment with tap water;
- Rinsing the equipment with distilled water; and
- Wrapping the sampling equipment in plastic wrap or other non cross-contaminating material until the equipment is used.

Sampling equipment will be used immediately following cleaning procedures or wrapped for later use. Equipment will be cleaned between each sample and at the start of each day's sampling event. Disposal of decontamination related waste is discussed in the following section.

B2.7 Investigation Derived Waste Storage and Sampling

Investigation derived waste will include wastewater and solids. Wastewater (purge water, decontamination water, etc.) will be introduced into the on-site treatment system. For larger well drilling, care will be taken to safely divert drilling fluids, solids, and water removed from the borehole into a contained berm, co-located at the well site. Accumulated fluids in the berm will be transferred using a sump pump into a storage container (e.g. 55-gallon drums, 500-gallon

tank) to facilitate management and disposal. All fluids and cuttings from the drilling of the well will be assumed contaminated until analytical testing demonstrates otherwise.

Solid drill cuttings will be stored at the Facility until proper disposal methods are secured. For draining wet samples, solid waste may be temporarily stored in a minimum 6-mil plastic lined berm, with plastic covering. Accumulated soil will be sampled prior to shipment to confirm it meets the specified requirements of the disposal facility. Solids will be kept in a covered roll-off dumpster for characterization prior to disposal. All solids will be assumed F034 RCRA Listed Hazardous Waste. Characterization samples will consist of a representative composite sample for each roll-off of waste disposed of. Analyses will be those required by the receiving approval waste disposal facility.

B2.8 Facility Surveying and Well Measurements

All pertinent locations/objects of interest will be surveyed to obtain location and elevation data following soil sampling and monitoring well installation. Surveying data must meet the following QA criteria:

- Distance ± 0.10 ft.
- Elevation ± 0.10 ft.

Water level meter accuracy is ± 0.01 ft for measuring water levels in wells. Measurements will be taken at designated, marked locations on the top of casing, or other designated measuring point. In the absence of an indentifying mark, measurements will be taken at the north side of the measuring point.

B2.9 Drilling Methods

The selection of drilling and well completion methods for groundwater monitoring and SV well construction will be based upon the type of geologic materials to be penetrated, the anticipated depth of drilling, the well diameter, required, and the availability of construction equipment and materials. Drilling will be performed by a licensed driller. Prior to the initiation of drilling, the drill rig will be checked to ensure that there are no hydraulic fluid or oil leaks. Care will be taken to clean the drill rig and all other equipment and well components with high-pressure steam prior to mobilization to the drilling site, and between drilling locations. Cleaning of drilling equipment and well-construction materials will occur within the fenced area of the Facility on a decontamination pad surrounded by a berm. The possible drilling methods and well construction to be utilized during Facility work are discussed in the following sections.

B2.9.1 Air Rotary

Air rotary techniques are the anticipated drilling method for bedrock wells. Air rotary drilling is conducted by pressurized air through the drill rod to remove the cuttings up the well annulus, and to help power the bit (for air hammer technique). Two drill bit types are used for air rotary drilling: tri-cone and air hammer. A tri-cone bit drills using rotary motion with downward pressure. A pneumatic air hammer primarily uses a percussive, chipping force supplied by the pressurized air. The pneumatic air hammer, with a penetration rate in hard rock that is faster than a roller bit, will most likely be used to drill through bedrock. If conditions or equipment constraints warrant, a rotary type bit may be used. Air introduced to the borehole will be filtered ensure that oil from the compressor is not introduced into the hydrogeologic zones to be monitored.

B2.9.2 Monitoring Well Construction

The construction of monitoring wells will be accomplished in a manner that minimizes the disturbance of the materials in which the well is constructed. Wells will be completed in accordance with the Missouri Monitoring Well Construction Code (MWCC, 10 CSR 23-4) and the SOP in Appendix 3.

Casing Installation, Grouts, and Seals

The driller will take appropriate steps during well set up and drilling to assure a straight and plumb well is being installed. If a well is sufficiently plumb to allow proper installation of the casing, no action will be taken. If well misalignment is too great to allow the proper installation of the well casing, the well will be abandoned in accordance with the MWCC and will be drilled in a nearby location. The remedial action optimization Work Plan and the SOP in Appendix 3 herein have details of well construction.

Well Protection and Finishing

All wells will be fitted with “J-plugs” or caps which can be tightened to present surface water infiltration, and capable of locking. The casing and plug shall be encased in a steel protector pipe (pedestal completion) or subsurface vault. For pedestal completion, the steel protector pipe will be embedded in the annular seal between the casing and bore hole. Bollards will be installed on each side of the pedestal completion for additional protection. The protector pipe shall be fitted with a locking cap to prohibit unauthorized access to the well and vented with a weep hole to allow water to drain. For wells completed below grade, a below-ground vault will be constructed. The vault will be traffic rated, of a dimension large enough to allow for easy access for monitoring equipment or maintenance, have seals to avoid surface water entering the well vault, and the plug will be secured to prevent unauthorized access.

Well Construction Documentation

The construction details of each well or sampling point will be documented by both a drilling lithologic log and a well construction diagram, which are included in Appendix 4. Also, wells will be certified with the Missouri Geological Survey (MGS).

B2.9.3 Well Development

The newly installed monitoring wells will be developed according to industry standards and the SOP in Appendix 3 to provide groundwater samples that are representative of the surrounding aquifer. Effective development procedures involve inducing a hydraulic gradient into and/or out of the well at high velocities to loosen and remove fine grained particulates/mud from the filter pack material around the well screen, and to set the grains within the sand filter pack. This step is followed by pumping, bailing, or air lifting to remove these fine materials from the well. This procedure will be repeated until the water pumped from the well is visually free of suspended materials. A maximum of 10 well volumes will be removed from the well during the development process. Water quality parameters will be taken during the development process using a flow-through cell with the YSI 556 where water clarity does not appear to be clearing, to measure water quality stability. A well development log form will be completed as each newly installed well is developed. The form is included in Appendix 4.

B2.9.4 Soil Vapor Well Installation and Construction

Soil vapor wells will be installed using direct push technology, e.g. Geoprobe® system. Two SV well points will be installed at each planned location within the vadose zone at depths of 3.0 feet and 8.0 pending location of the water table in the area of installation. The objective is to install and obtain a sample above the water table, and to monitor for residences that are completed on slabs and those with basements.

A borehole will be created by pushing solid drill rods with a 1.5-inch expendable drive point to a depth of 6 to 12 inches below the desired monitoring point elevation. The SV monitoring point is a small, metal screen attached to ¼-inch O.D. / 3/16 inch I.D. tubing, set in a sand filter pack, and sealed off from surface communication using both hydrated and dry bentonite. The SV screen point will be set with a minimum of six inches of sand below and six inches of sand above, with the tubing extending to the surface. One foot of dry, granular bentonite will be placed above the top of the sand pack, and then the remaining bore filled with hydrated bentonite to the surface completion. The surface completion will be a subsurface, flush-mount vault set in concrete at a depth of one foot within a 14-inch diameter hole. The tubing extending into the vault will have a temporary cap to prevent water, debris, insects, etc. from entry.

No development is required for the SV well.

B3 – SAMPLE HANDLING AND CUSTODY

The following sections describe the requirements for sample handling and custody in the field once collected, and the transport of the samples to the laboratory. It is intended to provide a framework by which a sample can be tracked from the time it is collected until it is analyzed and ultimately discarded.

B3.1 Sample Nomenclature, Labels, and Documentation

All samples for laboratory analysis will be placed in an appropriate laboratory-provided sample container, normally a plastic cooler, for shipment to the contract laboratory. Samples will be adequately marked for identification and logged on a C-O-C from the time of collection and packaging through shipping and receipt at the laboratory. The sample identification and collection information will be presented on a label attached to the sample container. The label will be completed using permanent ink.

Sample labels will include the following sample information:

- Sample ID (see below);
- Project name and number;
- Analysis requested for the sample collected;
- Method of preservation/conditioning;
- Date and time of collection; and
- Sampler's Initials

The following nomenclature provides a unique sample ID to track the sample from the time it is taken through receipt at the laboratory. They also provide relevant information such as the month/year the sample was taken and in what context it was collected.

- Groundwater Samples: "Well Series-Well#_MonthYear" (BMW-1_0116)
- Soil Samples: "SB-Boring#_Centered Depth" (SB-1_20.5)
- Water Quality Samples: Water quality data will be recorded on the sampling logs for each groundwater sample and not individually named.
- Soil Vapor Samples: "SV-Well#_MonthYear" (SV-1_0116)
- Surface Water Samples: "Name of Surface Water Body/Location_MonthYear)
- Quality Control Samples: "Type QC--#_MonthYear" (Trip-1_0116)

Each sample has an associated collection form that must be filled out as part of the sample process. These sample forms will be reviewed by the FM daily and retained in the project file. Completely filled out and accurate forms are necessary for meeting the DQOs and the objectives of this QAPP. If forms are not complete and accurate, the FM will immediately implement corrective action. Also, each set of sample bottles will be placed into individual plastic bags with the Sample ID and date/time of collection before being placed in the cooler.

This allows sample info to be obtained without further disturbing the individual sample containers.

B3.2 Sample Hold Times, Laboratory Turn-around Times, Sample Retention

Maximum hold times for each laboratory analysis are shown in Table 3. The amount of time a sample will be held outside of laboratory custody will be minimized by overnight shipping samples at the end of each day when possible. Standard turn around time for laboratory processing is 10 business days after receipt for an electronic report and data deliverable to be delivered to the SPM. Samples will be retained for 60 days before being discarded, in case a need for re-analysis arises.

B3.3 Chain-of-Custody, Sample Packing, and Shipping

The purpose of C-O-C protocols is to track sample custody from the time the sample was taken until it is disposed of. Every sample sent to the contract laboratory will be recorded on a C-O-C form provided by the laboratory. The C-O-C also serves as an order form for which samples need which analyses. The C-O-C form will be attached to the laboratory results and will be included in the project file as part of the permanent records.

The FM or sampling team leader will maintain overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the laboratory. All shipping or sample transfer information will be recorded at the end of each day in the field log book.

Custody and shipping procedures are as follows:

- Labeled sets of samples will be placed into the shipping container (cooler or box) in a single layer with all sample containers kept vertical within sealable plastic bags to separate samples from the remaining packing material. As samples are placed into the cooler, the information input for the samples COCs should be verified against the information written on the individual bags each set of samples was placed in.
- The completed C-O-C form will be taped in a sealable bag to the inside of the top lid of the shipping container, with a copy retained by the FM. The C-O-C form will be signed as relinquished by the person packing the cooler before sealing the cooler. The FM or his designee will keep custody of the samples until they are shipped to the contract laboratory.
- If samples are to be iced, ice will be placed in sealable bags to fill space around and overlying the samples, as available in the cooler. Whether iced or not, packing materials such as bubble wrap or packing peanuts will be used to fill the remaining space.
- Shipping containers must be secured with custody seals prior to shipment to the laboratory. Custody seals will be signed and dated by the person relinquishing custody of the samples being shipped. The seal will be placed on each container so that the container cannot be opened without breaking the seal. The seal should also be taped to the container using clear wide packing tape.
- Each time responsibility for custody of the sample changes, the new and relinquishing custodians will sign and date the record. This does not include overnight courier personnel whenever samples are shipped in coolers that have been sealed with signed custody seals.

- Samples transported by common carrier, or any other means, other than hand-carrying, to the off-site laboratory or direct transport by a laboratory courier, must be prepared in accordance with the applicable United States Department of Transportation (USDOT) and/or the International Air Transport Association (IATA) regulations and specifications. These regulations and specifications may stipulate the use of sealed, inner packaging (e.g., metallic paint cans, fiberboard canisters) and outer packaging that meets specific testing requirements and is listed by specification number in the shipping regulations.
- Samples will be shipped by overnight carrier for next morning delivery to the subcontract analytical laboratory(ies).

B3.4 Laboratory Sample Custody

The C-O-C shall be maintained upon receipt by the laboratory. The laboratory sample custodian signs the C-O-C form and verifies the condition and receipt of all samples included on the C-O-C form. Any discrepancies are immediately forwarded to the QAM for resolution. The laboratory shall also employ an internal C-O-C procedure that minimizes any potential for tampering or adulteration of field samples prior to analysis. Copies of completed C-O-C forms and internal custody records shall be included in the data deliverables associated with each sample delivery group.

The laboratory will complete a Sample Receipt Documentation Log (SRDL) upon receipt of the sample shipment, including the temperature of the samples upon receipt (4 ± 2 degrees [º] Celsius [C]). The laboratory will sign the SRDL and generate a Sample Acknowledgement Form (SAF). The SRDL, SAF, and C-O-C are scanned and emailed to the PS or FM to confirm receipt of the samples by the laboratory. The original C-O-C form will remain with the samples until final disposition of the samples is determined. A signed copy of the C-O-C form will be included with the analytical results provided by the laboratory. An original copy will be provided by the laboratory upon final disposition of the samples that are disposed of or returned.

B4 – ANALYTICAL METHODS

Analytical methods to be utilized for analysis of the COCs detailed in the Work Plan are listed below. Primary soil and groundwater samples collected during the investigation will be shipped to Eurofins Lancaster Laboratory Environmental LLC (Eurofins) for preparation and analysis. Soil vapor samples will be sent to Eurofins or H&P Mobile Geochemistry (H&P) laboratory, and waste delineation samples will be sent to an appropriate, approved laboratory for analyses per disposal facility requirements.

- **Benzene, toluene, ethylbenzene, total xylenes (BTEX)** – USEPA method 8021B for Soil and Water media

  USEPA Method TO-15 or 8260SV for Air/Vapor media
- **Project Specific Semi-Volatile Organic Compounds (SVOCs)** – USEPA method 8270C for Soil and Water media

  USEPA Method TO-13
- **Moisture** – Standard Method (SM) 2540 G-1997 for Soil Media

All methods discussed above will follow the applicable USEPA or SM SOP listed. The QA/QC framework that ensures these SOPs are followed is maintained by the contract laboratory and credibility is implied by the laboratories national certification. The identification procedures to be followed when failures occur, including the identification of the individual(s) responsible for corrective action and appropriate documentation, as well as sample disposal procedures are discussed within the contract laboratories QA Manual. If conditions are encountered that require modification of the analytical procedures, the laboratory representative will notify the QAM. The QAM will review all variances and will make any recommendations to management that may be necessary to address recurring problems, any deficiencies in the process, or opportunities for improvement.

B5 – QUALITY CONTROL

The following sections discuss quality assurance and quality control for collecting field samples.

B5.1 Sample Quality Control Procedures

Field QC samples will be taken to ensure that the appropriate sampling and decontamination protocol is being executed consistently and in a quality manner, and that situations leading to potential error are recognized, and through the QC samples become documented. QC samples will have their own nomenclature as described above, and a QC log kept by the sampling team will contain their purpose.

- Groundwater and soil samples will be duplicated at a 10% frequency to evaluate laboratory precision. Duplicates will use the same sample containers, preservatives, and analyses. Duplicates will be obtained from a location with known contamination. If a single event will have less than 10 samples, one duplicate sample will be collected regardless.
    - For water duplicates, sufficient volume will be collected to split the sample into the necessary sample containers.
    - For soil duplicates, the sample interval in the soil core will be split between the two sample containers. If 5035 kits are used, all plugs will be collected from the same sample interval. Duplicate samples from soil borings may have different analytical results due to known heterogeneity of Facility soil.
    - For vapor duplicates, the Tedlar® bags will be filled sequentially. Vapor will be pulled from the soil slowly per the SOP to avoid depletion of the area around the soil vapor point.
- One equipment/rinsate blank per sampling event for non-disposable sampling device will be collected. It is critical that equipment be decontaminated the same way after each sample is taken so that the equipment blanks are not biased.
    - For soil sampling, distilled water will be poured through two decontaminated Macrocore® rods and over the sampling trowel into a clean container then split into sample containers for methods 8021 and 8270C.
    - For water samples using a pump, distilled water will be poured over and through the pump into a clean container then split into sample containers for methods 8021 and 8270C.
    - For soil vapor samples, atmospheric air will be pushed through a carbon canister, then through the reusable vacuum gauge into a Tedlar® bag and analyzed for the same COCs as the other soil vapor samples. All other components of the soil vapor sampling system are expendable.
- One trip blank will be shipped with each cooler containing VOC samples. Trip blanks are provided by the laboratory and identify several possible issues including sample bottle contamination, laboratory water contamination, and preservative contamination.

They can also identify, when combined with a field blank, whether VOCs from a highly contaminated sample in the cooler transfer to the other samples during shipment.

- One field blank (water) will be collected per sampling event. Field blanks are used to identify ambient contamination entering the samples during the sampling process. Clean sampling containers are filled with distilled water and left open at the sample location for the duration of sampling that location. The containers are closed when all of the other sampling at that location is completed

- One matrix spike/matrix spike duplicate (MS/MSD) sample per each 20 samples will be collected during soil sampling activities (minimum of one per event if less than 20 samples). One MS/MSD sample per event will be collected during groundwater sampling activities. MS/MSD samples will be collected as duplicates of select samples from locations anticipated as being most representative of the Facility's overall COC content, and labeled with a unique identification to notify the laboratory of the sample's purpose.

At the end of each day in the field, a count will be completed to ensure that the appropriate numbers of QC samples have been collected.

Upon receipt of analytical reports from the laboratory, all field and laboratory-internal QC sample data will be processed and evaluated for quality assurance. Any quality issues identified will be addressed promptly in an appropriate manner to ensure that data quality objectives are met.

B5.2 DRILLING

QA/QC procedures for drilling and well installation include the following:

- Direct measurements of: (1) the length of drill rods and bits for accurately observing depths while drilling, (2) the depth of the borehole to verify the total depth of the well, (3) the length of the riser and screen to verify the appropriate depth and screen length, and (4) the progressive depths during installation of the filter pack, bentonite seal, and concrete seal to verify proper installation.
- Decontamination of well drilling equipment between each borehole using steam pressure washing.

B5.3 OTHER MEASUREMENTS

QA/QC procedures for other data measurements (e.g. PID readings, water quality measurements, water level measurements, etc.) are per manufacturer's specifications and specifications in the SOPs. Water level meter accuracy is ± 0.01 ft.

All pertinent locations/objects of interest will be surveyed to obtain location and elevation data. Surveying data must meet the following QA criteria:

- Distance ± 0.10 ft.
- Elevation ± 0.10 ft.

B5.4 Laboratory Analytical Quality Control Procedures

In order to document the precision and bias of laboratory methods used, the following QC samples will be reported by the off-site laboratory in analytical reports:

- **Method Blank** – used to assess possible laboratory contamination of samples associated preparation and analysis of sample extracts. Blank corrections will not be applied by the laboratories to the original data.

- **Laboratory Control Sample (LCS)/LCS Duplicate (LCSD)** – LCSs are 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 and taken through all sample preparation and analytical steps of the procedure unless otherwise noted. 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.

- **MS/MSD** – used to evaluate the effect of sample matrices on the quantification of contaminant concentrations and therefore the bias of the method for the analytes of interest and the matrix. A matrix spike is a sample, prepared in duplicate, to which a known concentration of pure analyte is added prior to digestion or extraction and analysis.

- **Surrogates** – compounds that reflect the chemistry of target analytes, but unlikely to be found in environmental samples, are added to samples for organic analysis to monitor the effect of the sample matrix on compound recovery.

Additional information regarding the above QC samples, as well as others such as machine calibrations, and the corrective action procedures implemented upon the exceedance of control limits can be found in the contract lab's quality assurance manual.

B5.5 Subcontractor QC Programs

The following pertains to subcontractor QA/QC programs.

Eurofins Lancaster Laboratories Environmental, LLC

Chemical analyses related to Facility work will be performed by Eurofins located in Lancaster, PA. Eurofins is currently the Agency-approved laboratory for the Facility. Eurofins implements a QA/QC program according to their *Environmental Quality Policy Manual rev. 13* (EQPM, 2014). Implementation of this manual is certified by The Pennsylvania Department of Environmental Protection (PADEP) Laboratory Accreditation Program, which is a NELAP recognized accreditation body. Eurofins is also accredited by the American Association for Laboratory Accreditation (A2LA), and will be capable of achieving project-required method reporting limits (RLs), as well as project performance criteria for accuracy, precision, and bias to the extent that is technically feasible using standard technology. A copy of the EQPM is readily available upon request form the laboratory, and can be found in Appendix 5.

PDC Laboratories

Although the majority of chemical analysis related to Facility work will be performed by Eurofins, it is beneficial to have a local laboratory available in the event of emergency or other time sensitive situation. PDC Laboratories (PDC) of Springfield will perform

analyses in these situations. PDC implements a QA/QC program according to their *Quality Manual rev. 15* (QM, 2013). Implementation of this manual is certified by the MDNR and numerous other states, for both solid and water analyses.

Professional Engineer Review

Principal level Professional Engineer (PE) review will be contracted to Gary Smythe, PE of Smythe Consulting. Gary Smythe, PE holds License 2009012208 with a Certificate of Authorization 2009015459 issued by the Missouri Division of Professional Registration, Board for Architects, Professional Engineers, Professional Land Surveyors, and Professional Landscape Architects.

Bedrock Drilling

Bedrock drilling will be subcontracted to Sunbelt Environmental Services, Inc. Neal Ferrar is a Missouri licensed unrestricted well contractor and will comply with all regulations set forth in 10 CSR 23 – Monitoring Well Construction Rules (MCWR). Robert Lanning, RG, is also an unrestricted Missouri drilling contractor (permit 1842-PM) and will provide QA/QC review to ensure compliance with MWCR.

Surveying

Surveying will be subcontracted to Anderson Engineering. The survey will be performed by a licensed surveyor with the Missouri Division of Professional Registration.

Geophysics

Geophysical studies will be subcontracted to Dr. Kevin Mickus, Professor of Geophysics at the Missouri State University, Springfield, Missouri.

Industrial Hygiene

Review of the SSHP by a Certified Industrial Hygienist (CIH) will be contracted to Novus Sterling, LLC. The purpose of CIH review is to ensure that the site health and safety plan meets industry standards. The SSHP will be imposed on all subcontractors who perform work on-site through health and safety oversight by qualified field management personnel.

B6 – INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

All instruments and equipment will be cleaned and inspected for damage daily under the direction of the FM. Routine maintenance and storage will be conducted per the manufacturer's instructions. Any issues with equipment will be recorded in the equipment log/calibration book. The FM or other qualified personnel will re-inspect equipment after the equipment has been replaced or repaired. Spare parts for equipment (such as batteries, filters, vials, etc.) will be stored on-site and/or at the FM company office.

The QAM or other designated, qualified person not performing the work will conduct periodic audits of the instruments and equipment.

B7 – INSTRUMENT / EQUIPMENT CALIBRATION AND FREQUENCY

All instruments and equipment will be calibrated per manufacturer's instructions and checked using standards daily. All standards used for calibration will be traceable to a national standard. An instrument calibration log will be maintained by the FM as part of the field log book.

B8 – INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All sample containers, shipping coolers and corresponding labels and sampling C-O-C forms will be provided by the analytical laboratory to the FM or other responsible person and inspected upon receipt. Sample containers provided by the laboratory were cleaned according to industry standards. Other supplies and consumables are listed in Table 4, along with the inspection and acceptance requirements. Supplies and consumables are received at the FM contractor office and stored accordingly. Field team personnel will notify the FM of needed supplies to order. The FM will maintain an inventory of all supplies and consumables for the project.

B9 – NON-DIRECT MEASUREMENTS DATA

This section identifies existing data that will be obtained from non-direct-measurement sources, discuss how the data will be used, and acceptance criteria and/or limitations for using the data.

Historical Facility data have already been subjected to data review, verification, and validation activities by previous consultants and the Agencies, and will generally be accepted within the context of their intended use, recognizing potential limitations as knowledge of the field has advanced. Specific acceptance criteria for these data will consist of qualitative indicators of representativeness and comparability. Before using existing data, it will be reviewed to the extent practicable to ensure that measurements were made and samples were collected in such a manner that the results appropriately reflect the environment or condition being measured or studied. Analytical methods will be noted in the metadata for the source (see Data Management Plan). Other non-direct measurements will come from databases (aerial photos, GeoSTRAT, etc.) that are generally accepted by the groundwater remediation field.

B10 – DATA MANAGEMENT

Facility work will follow a systematic process for acquiring and managing data. The data flow from the laboratory and the field to the project team and data users shall be sufficiently documented to ensure the data are properly tracked, reviewed, and validated for use. The primary elements of the data acquisition and management process include:

- Project planning;
- Field sampling;
- Laboratory analysis and reporting;
- Data entry and storage;
- Data review and validation; and
- Data reporting.

The data reduction, review, validation, reporting, and record keeping procedures described in this section will ensure that complete documentation is maintained, transcription and data reduction errors are minimized, the quality of the data is reviewed and documented, and the reported results are properly qualified.

During the course of the project, all electronic and hardcopy data deliverables will be maintained as part of the project file. Following completion of the project, or as otherwise required by contract, all records, including C-O-C forms, logbooks, log forms, hardcopy data packages, validated data and records, and other field records may be transferred to the Multistate Trust for long-term storage. Data can be retrieved from archive by notifying the Multistate Trust.

The management and transmittal procedures for field collected data are defined in the Data Management Plan within the Work Plan. Hard copies of field data (i.e. field notes, PID readings, sampling logs, etc.) will be stored with the FM and then transferred to archive after completion of the project. Electronic files of data will be stored on the EWI server and then transferred to a recordable compact disc for archive. Retrieval of the information from archive is discussed above. All documents throughout the transmittal from the field to the office are dated and stored in appropriate folder format (e.g. analytical data, field forms, monitoring well logs, etc.).

The SPM will receive electronic and/or hard copy analytical reports from the laboratories and will transfer the reports to the QAM or delegated personnel for QA/QC review. The data will then be transferred back to the SPM, and the SPM will delegate the data to project team personnel for tabulation/compilation. Tabulated data will be saved to the EWI server and checked by the SPM or delegated personnel for accuracy. Data will then be presented to the Agencies in report format and submitted to archive after completion of the project.

Software and hardware configurations utilized for data management are maintained by the EWI Information Technology (IT) department. Any changes needed for software or hardware are first approved by the IT department and then installed/implemented.

C1 – ASSESSMENTS AND RESPONSE ACTIONS

Throughout the work process, routine assessment by the QAM will take place to ensure that this QAPP is being implemented as approved. The following sections describe assessments planned, a schedule for assessments and their reports, identification of participants involved with the assessments, and response actions, including the reporting of assessment results, to be utilized during the course of the project.

C1.1 – Readiness Review

One readiness review will be performed by the QAM prior to start-up of each work phase to verify that all systems and procedures are in place to ensure collection of quality data. A report of the findings will be presented to the SPM prior to the initiation of field activities. The readiness review will include the following areas:

- Project organization and responsibilities are defined and practical
- Management is aware of work and able to communicate concerns
- FM has put due diligent planning into upcoming work, all supplies and equipment are available
- Identification of training or other requirements for workers and certifications are on file
- Training and other pertinent requirements for subcontractors are verified
- Utility assessments and dig permits are/will be completed
- SOPs are available and have been reviewed by applicable staff
- Laboratory contact is aware of incoming samples and QA/QC requirements
- Sample packing and shipping requirements are understood by team members
- Data and information management system is ready for use (field logbook, etc.)
- Personnel understand data flow so that field data ends up in proper location
- Personnel understand documentation requirements of the upcoming work
- Project management understands reporting requirements for work to be completed

C1.2 – Field Assessments and Surveillance

The QAM will schedule and coordinate periodic assessments and surveillances of field activities to evaluate the execution of:

- Sample collection (SOPs, sample containers, consistency across sampling individuals)
- Sample identification (proper sample IDs and labelling procedures)
- Sample Custody
- Field Work Documentation

Field assessments mirror some components of the readiness review and are informal reviews performed routinely by management, or a designee, to ensure that work is being performed in a consistent manner and to identify any problems early in the process.

One assessment/surveillance per phase (e.g., drilling/well installation, groundwater sampling, soil sampling, etc.) of work is anticipated. Reports of the assessments/surveillances will be presented to the SPM and PS within one week following said activities. Any non-conformance with the QAPP will be immediately corrected in the field and reported to management. Based upon the observations and recommendations noted by the QAM, the SPM or PS will have the authority to issue a stop work order on all or specific activities associated with the non-conformance noted, and initiate corrective action procedures.

Any field measurements will be randomly spot-checked to determine whether the instrument is functioning properly, has been calibrated, and if the sensitivity range of the instrument is appropriate for the project.

C1.3 – Laboratory QA Program Assessment

Level II quality assurance report packages will be requested for all data submitted to certified laboratories. The Level II data package will include:

- Sequentially numbered pages
- A table of contents referencing individual sections in the data package
- An explanation of data flags
- A case narrative documenting any non-compliance with the laboratory quality assurance manual and corrective action of noncompliance events
- Documentation of the necessary QA/QC samples described previously, including method blanks, LCS/LCS duplicates, surrogate spikes, MS/MSDs, etc.
- Original C-O-C forms and sample check-on forms

Assessment of each laboratory data package submitted by the contract laboratories will be performed by the QAM to evaluate laboratory QC procedures and data reporting with respect to parameters discussed in Section B5. This assessment will be completed using EWI's "QA/QC Review of Laboratory Analytical Reports" form and attached to analytical reports that are included in WORK reports.

Reports of the assessments will be presented to the SPM and PS within two weeks following said activities. Any areas of concern and/or non-compliance will be identified in the assessment report and recommendations noted, if applicable. Based upon the observations and recommendations noted in the report(s), the SPM or PS will have the authority to adjust the scope of the respective laboratory's QC procedures outlined for this project and/or issue a stop work order, if applicable.

C1.4 – Corrective Actions

Following the receipt of assessment reports from the QAM, the PS or SPM have the authority to implement corrective actions. Examples of corrective actions may include delaying the initiation of sampling activities, production of additional forms, adjustment of QA requirements, implementation of additional training, adjustment of data collection/sampling procedures, resampling, adjustment of QC sampling procedures, etc. Any corrective actions implemented at will be documented and reported within the applicable report.

C2 – REPORTS TO MANAGEMENT

Quality assurance reports will be provided to management for the duration of Facility work as follows:

- Readiness Reviews
  - One readiness review will be performed by the FM per broad phase of Facility work.
  - Findings will be presented to the QAM.
- Assessments/Surveillances
  - Once assessment/surveillance will be performed by the QAM per broad phase of Facility work.
  - Findings will be presented to the SPM and PS.
- Laboratory QA Assessment
  - The QAM will assess the contract laboratories QA framework vs. initial analytical reporting once at the beginning of Facility work.
  - Detailed QA evaluation of each laboratory analytical report will be done by the QAM or his designated, qualified person.
  - Findings will be presented to the SPM and PS.
- Final QA Oversight Report
  - The QAM will assess overall implementation of this QAPP at the end of Facility work to qualify the study as a whole.
  - Findings will be presented to the SPM, PS, and the MultistateTrust.

D1 – DATA REVIEW, VERIFICATION, AND VALIDATION

Verification of the laboratory results will be assessed through evaluation of the results of the submitted QA/QC samples (method blanks, field duplicates, MS/MSDs, etc.) and laboratory internal QA/QC samples (blanks, duplicates, LCS/LCSDs, etc.). A QA/QC verification checklist for laboratory data is included in Appendix 4. Data validation will include a review of the data and comparison to the performance criteria outlined earlier in this QAPP (Table 2). Data qualifiers, when appropriate, will be added to the tabulated data.

Field data verification and validation methods are discussed in Section D2.

D2 – VERIFICATION AND VALIDATION METHODS

Data validation methods evaluate the quality of field and laboratory activities and document the quality of data generated. The goals of data validation are to:

1. Evaluate achievement of DQOs for the project
2. Ensure achievement of all project contractual requirements
3. Determine the impact of DQOs that were not met
4. Document the results of the data validation process.

The intent is to evaluate the data against project DQOs and planning documents to ensure that goals are met. Ideally, the end result of validation is a technically sound, statistically valid, legally defensible, and properly documented data set for decision-making purposes. General information pertaining to verification and validation activities is provided in the *Guidance on Environmental Data Verification and Data Validation* (USEPA, 2002).

Data validation requires knowledge of the type of information that is validated. Therefore, a person familiar with field activities, such as the FM, is typically assigned to the validation of field activities, documents, and records. Likewise, a person familiar with analytical methodology, such as the QAM, is typically assigned to the validation of laboratory documents and records. EWI evaluates data quality through the evaluation of both field and laboratory QC data.

Validation is initiated at the time of first sample collection. Field documents are reviewed by the FM or a designee to determine that all samples and analyses were appropriately collected, containerized, labeled, and submitted to the laboratory. These items will be verified daily during sampling activities. Additionally, the FM or designee will be in communication with the laboratory during sample collection and analysis to verify condition of sample receipt, appropriate sample log-in, etc. If problems are noted at this point, they can easily be corrected or locations resampled, if needed, while the field crews are still mobilized.

Following analysis, the laboratory data submittal is verified by the QAM for conformance with method, procedural, and contractual requirements. The contracted laboratory will be responsible for accurately performing the prescribed methods per USEPA protocols. This includes all procedures, QC checks, corrective actions, and data storage. In general, chemical data are validated by evaluation of the laboratory submittal against any requirements established in the analytical method and this QAPP. Following receipt of the analytical data

packages, the EWI QAM will perform chemical validation to include a review of the following items:

- COC appropriately completed;
- Requested analyses performed;
- Analysis occurred within holding times;
- Blank results (method blank and rinsate blank);
- Duplicate results (laboratory duplicates, MS/MSD, LCS/LCSD, and field duplicates);
- Spike recovery results (LCS/LCSD, and MS/MSD);
- Achievement of required reporting limits; and,
- Completeness (field completeness and laboratory completeness).

The validation will include a review of any method-specific criteria for the items listed. Data qualifiers, when appropriate, will be added to the data. However, data validation extends beyond method, procedural, and contractual compliance to determine the quality of the data set and the types of uncertainty introduced by a failure to meet requirements. It includes a determination, where possible, of the reasons for any failure to meet requirements, and an evaluation of the impact of the failure upon the overall data set. In this manner, the effect of any data rejection is presented in terms of its impacts on the overall uncertainty and usability of the data set.

Following verification and validation, the EWI PS will work with the QAM to perform a global review of the findings to determine overall usability of the data set for its intended purpose.

D3 – RECONCILIATION WITH USER REQUIREMENTS

The decision process for this project will be based directly on field and laboratory data in order to meet the project objectives discussed below. Accordingly, these decisions need to be supported by valid and defensible data. As previously described, quality control measures will be implemented and evaluated in order to assure data quality for the project. Validated data will be used to meet the project objectives:

1. Understand site hydrogeological and contaminant occurrence, fate, and transport conditions, including vertical contaminant migration.
2. Delineate horizontal and vertical DNAPL and dissolved phase plume boundaries.
3. Assess potential off-site migration pathways to northeast, east, and south.
4. Assess potential receptors and exposure pathways of confirmed off-site migration.
5. Evaluate performance of existing corrective measures to meet groundwater protection requirements of section II.E of the MHWMF Permit.

Objective 1, 2, 3, and 4 will be achieved through the completion of Work Plan activities, including soil sampling, well installation, and direct push sensing, groundwater sampling, soil vapor sampling, and evaluation of existing data. Objective 5 will be a final evaluation based on the results from objectives 1 through 4. This evaluation will be documented in the Final Report.

To ensure data usability, the QAM will evaluate all data by considering the QC parameters outlined in this QAPP and record any data quality failures. Following review of all data quality failures, the SPM and PS will evaluate these failures relative to data usability and overall significance with regard to project objectives and assessment decisions.

If deficiencies are noted through data validation that can be addressed without conducting additional fieldwork, the appropriate corrective measures (e.g., laboratory reanalysis, recalibration, etc.) will be sought. However, if deficiencies that have significantly compromised overall data quality are noted, and cannot be addressed through corrective measures, additional field activities will be discussed with the Multistate Trust and may be conducted to collect additional data.

Data quality failures requiring response actions will be documented in the appropriate data validation sections of the Final Report, in addition to the specific corrective measures taken in response to the failure (e.g., reanalysis, resampling, etc.). If observed data quality failures are not addressed due to time constraints, Facility accessibility, etc., the SPM will document such conditions in a written opinion addressing usability and significance relative to overall project objectives. The resulting opinion will be incorporated as an element of uncertainty in the Final Report. If no data quality failures are noted by the PS, no written opinion will be included in the Final Report.

APPENDIX 1

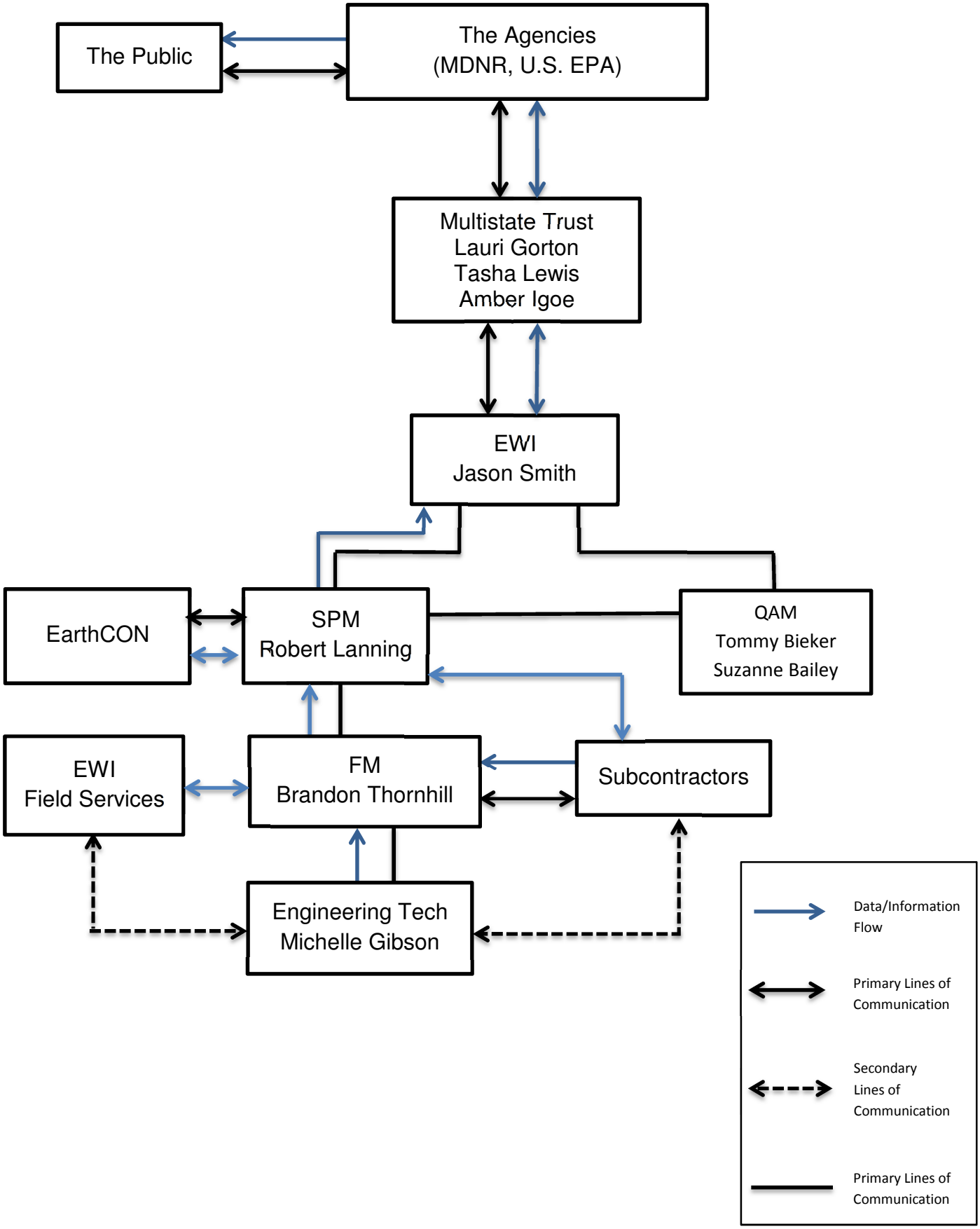
FIGURES

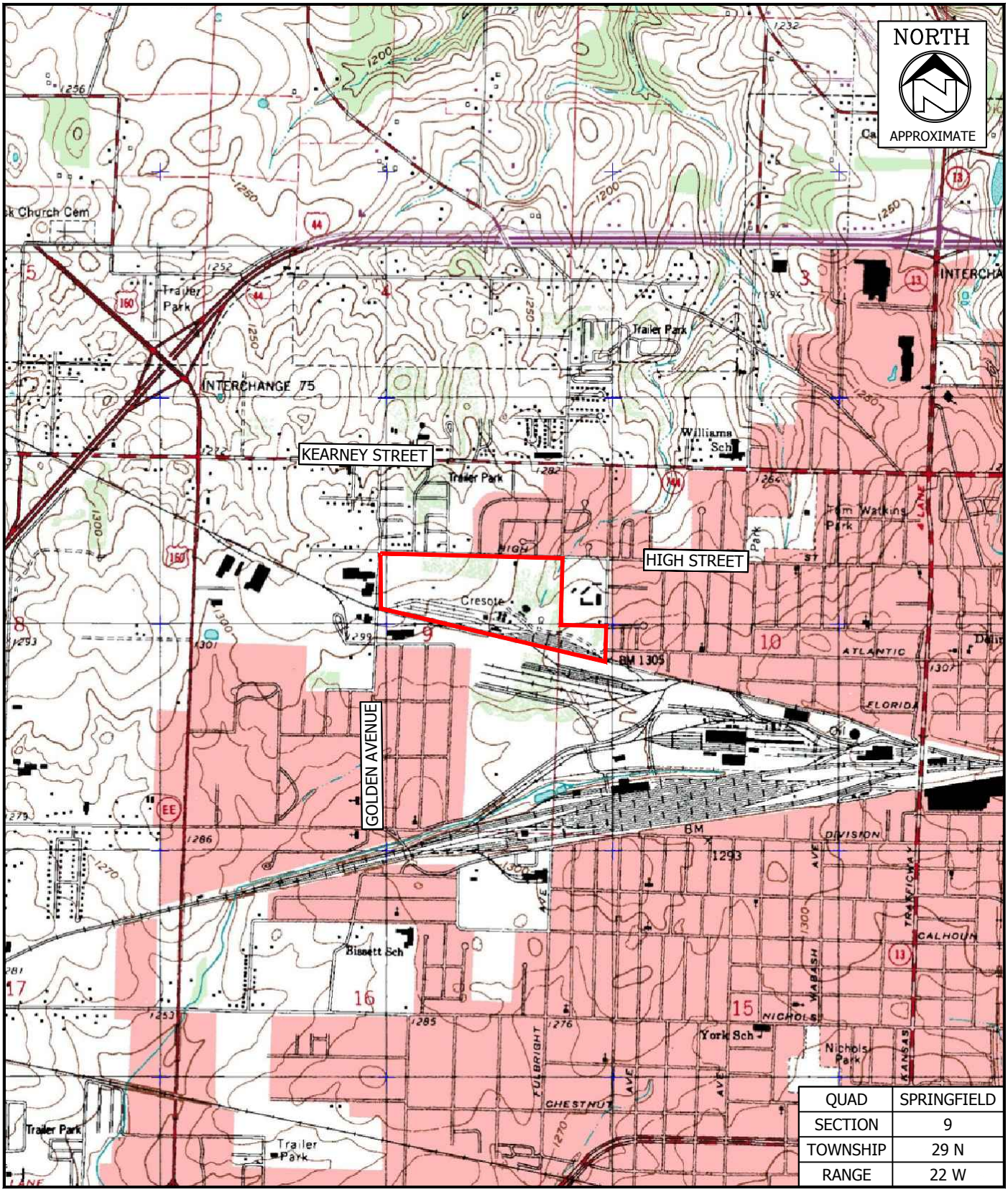
QUALITY ASSURANCE PROJECT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 High Street, Springfield, Missouri

Figure 1.0 - Project Organizational Chart





QUAD	SPRINGFIELD
SECTION	9
TOWNSHIP	29 N
RANGE	22 W

SOURCE: www.mapcard.com (2000)

SCALE (FEET)
0 1000 2000

EWI# 150683
DRAWN BY: CLM
Aug. 18, 2016

PREPARED FOR:
Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust

PREPARED BY:
ENVIRONMENTAL WORKS

FACILITY LOCATION - TOPOGRAPHIC MAP

FORMER TRONOX FACILITY
2800 WEST HIGH ST.
SPRINGFIELD, GREENE COUNTY, MISSOURI

FIGURE
2.0

APPENDIX 2

TABLES

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 High Street, Springfield, Missouri

TABLE 1.0
Data Quality Indicators
Former Tronox Facility
Springfield, MO

Data Quality Indicator (DQI)	Description
Precision	**Summary:** Precision will be evaluated by calculating the relative percent difference (RPD) for field duplicates and MS/MSD samples. RPD criteria outside of QC limits may result in qualification of data as estimated (J). Data will not be qualified solely based on RPD criteria not being met. Rather, outlying RPD data will be reviewed with other QC data to assess the overall impact to data quality.
	Definition: Precision is a measure of mutual agreement among individual measurements of the same property under identical, or substantially similar conditions, calculated as either the range or as the standard deviation.
	Field Objectives: Field precision is assessed through the collection and measurement of field duplicate samples at 10 percent of the sampling locations.
	Laboratory Objectives: Laboratory precision is assessed through the calculation of relative percent difference (RPD) for duplicate samples. RPD = [X1 - X2/(X1 + X2)/2]*100.
Bias	**Summary:** Bias will be assessed by evaluating laboratory reference materials and spiked matrix samples.
	Definition: Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction.
	Field Objectives: Minimize loss of VOCs to the atmosphere when collecting soil and groundwater samples; decontaminate equipment prior to sample collection; close all sample containers tightly and secure in cooler for shipping.
	Laboratory Objectives: Analyze trip blanks; compare reference standards or matrix spikes against sample results to determine bias.
Accuracy	**Summary:** Accuracy will be assessed by evaluating the results of spiked samples for percent recovery and blank samples for potential contamination of samples. Recovery results for spike samples (LCSs and MSs) will be used to assign qualifiers to analytical data. Percent recovery above QC limits suggests the possibility of high bias in the analytical results, and detections will be qualified as estimated (J) when this occurs. Percent recovery below QC limits suggests the possibility of low bias in the analytical results, and data will be qualified as estimated (J/UJ) or unusable (R) based on the magnitude of the deviance from the QC limits. Blank samples will be used to evaluate whether field samples have been cross contaminated during shipping or handling. Detections in blank samples will be used to qualify similar detections in associated field samples. If a field sample has a detection of a compound that is less than five times (10 times for common laboratory contaminants) the blank concentration, then the field sample result will be qualified as undetected (U).
	Definition: Accuracy is the degree of agreement of a measurement with an accepted reference or true value.
	Field Objectives: Accuracy in the field is assessed through the use of field rinsate blanks and adherence to all sample handling procedures, preservation requirements, and holding times.
	Laboratory Objectives: Laboratory accuracy is assessed through the analysis of matrix spike or standard reference materials and the determination of percent recoveries. An acceptable accuracy for this project is considered to be 75 to 125% recovery.
Completeness	**Definition:** Completeness is the amount of valid data obtained from a measurement system compared to the amount that was expected and needed to be obtained to meet the project data goals.
	Field and Laboratory Objectives: Completeness will be measured for each set of data received by dividing the number of valid measurements (all measurements except rejected data) actually obtained by the number of valid measurements that were planned. Completeness = (valid data points obtained/total data points planned)*100. To be complete, the data set must also contain all QC check analyses that verify the precision and accuracy of the results. The intent of this project is to attempt to achieve a goal of 100% completeness; however, realizing that under normal conditions this goal may not be achievable, the completeness goal for this project is 90%.
Representativeness	**Summary:** Representativeness expresses the degree to which sample data accurately and precisely represent environmental conditions and parameter variations at a sampling location. Representativeness is a qualitative parameter most concerned with the proper design of the sampling program. The representativeness criterion is best satisfied by assuring that sampling locations are properly selected and a sufficient number of samples are collected.
	Definition: Representativeness is the selection of analytical methods and sampling protocols and locations such that results are representative of the media being sampled and conditions being measured.
	Field Objectives: Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field sampling plan is followed and that proper sampling techniques are used.
	Laboratory Objectives: Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing field duplicate samples. The sampling network was designed to provide data representative of conditions at the Site. Analytical data for samples that are not analyzed within holding times will be qualified as estimated (J/UJ) or unusable (R) based upon the magnitude of the holding time exceedance.
Comparability	**Summary:** Comparability of the data collection activities must consider field conditions as well as sampling and analytical techniques. Comparability cannot be ensured through use of standard methods and protocols alone. In order to compare the data, various important elements will be considered. During this project, three elements (analytical methods, quality of data, and sampling design) will be evaluated for data comparability. If the data do not appear comparable after the initial evaluation, the contracted laboratory will attempt to identify other components possibly affecting comparability. Those components may include field conditions, sampling protocols, and the occurrence of true data anomalies.
	Definition: Comparability is an expression of the confidence with which one data set can be compared to another.
	Field Objectives: Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field sampling plan is followed, and that proper sampling techniques are used.
	Laboratory Objectives: Analytical data will be comparable when similar sampling and analytical methods are used and documented. Similar quality assurance objectives will be used throughout the project to ensure comparability.
Sensitivity	**Summary:** The sensitivity of laboratory instruments will be determined by performing method detection limit (MDL) studies. MDLs will be determined on instruments that will be used to report low-level results, under realistic conditions. Field instrument detection limits (IDLs) will be determined by review of the operating manuals and calibration procedures.
	Definition: Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.
	Field and Laboratory Objectives: Sensitivity is dependent on proper use and calibration of the analytical instruments; users of field equipment will refer to published documentation of IDLs or will determine IDLs via calibration procedures. Users of laboratory equipment will perform applicable MDL studies.

Table 2.0
Laboratory Performance Criteria

Former Tronox Facility
Springfield, MO

WATER CHEMICALS OF CONCERN

Compound	MDL	LOQ	Units	Hold Time	Precision	Bias
Benzene	0.2	1.0	ug/l	14 Days	20% RPD	80-120% Control Limit
Ethylbenzene	0.2	1.0	ug/l			
Toluene	0.2	1.0	ug/l			
Total Xylenes	0.2	1.0	ug/l			
2,4-Dimethylphenol	0.5	1	ug/l	7 Days	20% RPD	75-110%
2,4-Dinitrophenol	10	30	ug/l			36-138%
2-Chlorophenol	0.5	1	ug/l			61-114%
2-Methylnaphthalene	0.1	0.5	ug/l			69-103%
2-Picoline	2	5	ug/l			56-105%
Acenaphthene	0.1	0.5	ug/l			75-111%
Acenaphthylene	0.1	0.5	ug/l			78-117%
Anthracene	0.1	0.5	ug/l			82-116%
Benzo(a)anthracene	0.1	0.5	ug/l			76-122%
Benzo(a)pyrene	0.1	0.5	ug/l			73-115%
Benzo(b)fluoranthene	0.1	0.5	ug/l			75-123%
Benzo(k)fluoranthene	0.1	0.5	ug/l			74-119%
Chrysene	0.1	0.5	ug/l			77-126%
Dibenz(a,h)anthracene	0.1	0.5	ug/l			72-127%
Dibenzofuran	0.5	1	ug/l			75-109%
Fluoranthene	0.1	0.5	ug/l			76-117%
Fluorene	0.1	0.5	ug/l			80-117%
Indeno(1,2,3-cd)pyrene	0.1	0.5	ug/l			70-121%
Naphthalene	0.1	0.5	ug/l			69-109%
Phenanthrene	0.1	0.5	ug/l			75-110%
Phenol	0.5	1	ug/l			13-89%
Pyrene	0.1	0.5	ug/l			76-111%

Table 2.0
Laboratory Performance Criteria
Former Tronox Facility
Springfield, MO

SOIL CHEMICALS OF CONCERN

Compound	MDL	LOQ	Units	Hold Time	Precision	Bias
Benzene	2	5	ug/kg			80-120%
Ethylbenzene	2	5	ug/kg	14 Days	20% RPD	71-120%
Toluene	2	5	ug/kg			80-120%
Total Xylenes	5	15	ug/kg			72-120%
2,4-Dimethylphenol	17	33	ug/kg			83-120%
2,4-Dinitrophenol	300	1000	ug/kg			27-140%
2-Chlorophenol	17	33	ug/kg			85-123%
2-Methylnaphthalene	3	17	ug/kg			83-109%
2-Picoline	100	330	ug/kg			64-108%
Acenaphthene	3	17	ug/kg			83-116%
Acenaphthylene	3	17	ug/kg			83-127%
Anthracene	3	17	ug/kg			82-118%
Benzo(a)anthracene	3	17	ug/kg			76-119%
Benzo(a)pyrene	3	17	ug/kg			85-117%
Benzo(b)fluoranthene	3	17	ug/kg	7 Days	20% RPD	78-129%
Benzo(k)fluoranthene	3	17	ug/kg			79-120%
Chrysene	3	17	ug/kg			80-121%
Dibenz(a,h)anthracene	3	17	ug/kg			81-123%
Dibenzofuran	17	33	ug/kg			85-115%
Fluoranthene	3	17	ug/kg			81-117%
Fluorene	3	17	ug/kg			86-118%
Indeno(1,2,3-cd)pyrene	3	17	ug/kg			81-118%
Naphthalene	3	17	ug/kg			83-112%
Phenanthrene	3	17	ug/kg			80-114%
Phenol	17	33	ug/kg			73-122%
Pyrene	3	17	ug/kg			81-114%

Table 2.0
Laboratory Performance Criteria

Former Tronox Facility
Springfield, MO

VAPOR CHEMICALS OF CONCERN

Compound	MDL	LOQ	Units	Hold Time	Precision	LCS/LCSD Bias
Benzene	0.2	1.0	ppb(v)			70-130%
Ethylbenzene	0.2	1.0	ppb(v)			70-130%
Toluene	0.2	1.0	ppb(v)	3 days	25%	70-130%
Total Xylenes	0.2	1.0	ppb(v)			70-130%
Naphthalene	0.5	1.0	ppb(v)			35-153%
2-Methylnaphthalene	0.1	0.05	ppb(v)	3 days	30%	83-106%

Table 3.0

Sample Containers, Preservatives, and Methods

Former Tronox Facility

Springfield, MO

Matrix	Analysis	Sample Container	Preservative	Laboratory	Method
Soil	VOCs	1 bulk soil jar (60 mL) or	none	Eurofins Lancaster Laboratories Environmental (ELLE)	8021B
		1 encore sampler or	none		
		1 field preserved methanol vial	methanol		
Soil	SVOCs	1 bulk soil jar (500 mL)	none		8270C
Soil	Moisture	no additional container	none		SM 2540 G-1997
Vapor	VOCs	Tedlar Bag	none	H&P or ELLE	TO-15
Vapor	SVOCs	Two 250 mL round amber glass w/ plastic screw cap	none		TO-13
Groundwater	VOCs	Three 40 mL glass vial w/ Teflon lined septum screw cap	HCl	ELLE	8021B
Groundwater	SVOCs	Two 250 mL round amber glass w/ plastic screw cap	none		8270C

Table 4.0
Consumables and Supplies Summary
Former Tronox Facility
Springfield, MO

Activity	Critical Supplies/Consumables	Inspection Acceptance Criteria	Inspection Frequency	Responsible Individual	Handling/Storage Conditions
Soil Sampling	PID	Instrument clean, free of particulates, calibrate within acceptable range	daily during field work, before use	FM	Store in plastic case
	PID external particulate filters	Free of particulates, clean	upon receipt from supplier, before use	FM	Store in clean plastic bag
	Plastic bags	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Store in sample bag
	Sampling trowel	Free of particulates, clean	upon receipt from supplier, before use	FM	Store in sample bag
	Nitrile gloves	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Store in sample bag and stockroom
	Decontamination supplies	Compatible material (Alconox, etc.), brushes free of particulates, distilled water, buckets free of particulates, clean	upon receipt from supplier, before use	FM	Stored in equipment shed onsite
	Munsell color chart, grain size chart	Free of particulates, clean, all color representations present and undamaged	upon receipt from supplier, before use	FM	Stored in sample bag
	Sample table and polyethylene sheeting	Free of particulates, clean, table in good working condition, sheeting unused	upon receipt from supplier, before use	FM	Stored in equipment shed onsite
	Sample jars, labels, etc.	Free of particulates, clean, unused, appropriate containers	upon receipt from laboratory, before use	FM	Stored in coolers in office until use
Groundwater Sampling	Polyvinyl tubing	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Stored in clean area in stockroom
	Pump, controller, compressed air, and associated supplies	Free of particulates, clean, unused supplies (tubing, etc.), pump & controller in good working order	upon receipt from supplier (supplies), before use	FM	Stored in plastic case in office equipment room and designated clean area onsite during field activities
	Sample jars, labels, etc.	Free of particulates, clean, unused, appropriate containers	upon receipt from laboratory, before use	FM	Stored in coolers in office until use
	PID	Instrument clean, free of particulates, calibrate within acceptable range	daily during field work, before use	FM	Stored in plastic case
	PID external particulate filters	Free of particulates, clean	upon receipt from supplier, before use	FM	Stored in clean plastic bag
	Water level indicator	Free of particulates, clean, in good working order, good visual markings on tape	daily during field work, before use	FM	Stored in bag in equipment room until use
	Water quality meter and flow-through cell	Instrument clean, free of particulates, calibrate within acceptable range	daily during field work, before use	FM	Stored in plastic case in office equipment room until field activity use
	Nitrile gloves	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Stored in sample bag and equipment shed onsite
	Decontamination supplies	Compatible material (Alconox, etc.), brushes free of particulates, distilled water, buckets free of particulates, clean	upon receipt from supplier, before use	FM	Stored in equipment room
	Plastic bags	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Stored in sample bag
Soil Vapor Sampling	Tedlar bags	Free of particulates, clean, unused, appropriate containers	upon receipt from laboratory, before use	FM	Stored in coolers in office until use
	Tygon tubing	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Stored in clean area in stockroom
	Two-way valves	Free of particulates, clean, unused, appropriate containers	upon receipt from laboratory, before use	FM	Stored in office until use
	Nitrile gloves	Free of particulates, clean, unused	upon receipt from supplier, before use	FM	Stored in sample bag and equipment shed onsite

Notes:
This list is not intended to represent an exhaustive list of all materials/equipment that will be utilized. It is intended to represent the general level of detail and care EWI uses to inspect, maintain, and store supplies and consumables

APPENDIX 3

STANDARD OPERATING PROCEDURES

ENVIRONMENTAL WORKS, INC.

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 High Street, Springfield, Missouri

Skills Required:

1) Instruction in use of the type of PID to be used
2) Care in using sensitive equipment
3) Site-specific health & safety training

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to describe the proper procedure for screening headspace vapor for volatile organic compounds (VOCs) in soil samples with a photoionization detector (PID).

This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. These are standard operating procedures which may be varied as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and variances noted in field notes for inclusion in the final report.

2.0 SCOPE

A PID is a useful tool capable of detecting and measuring concentrations of most volatile and some semi-volatile organic vapors in air. PID screening is performed by a variety of EWI personnel to provide quantitative data for PPE health monitoring, and data used as a qualitative tool to choose soil samples which may contain VOCs and be submitted for laboratory analysis. The PID can also be used to monitor vapors in utility conduits, for monitoring VOCs in confined spaces, and during removal of underground storage tanks.

3.0 PID INSTRUMENT LIMITATIONS

- The PID cannot differentiate between gases if multiple VOCs are present (i.e., gasoline). The instrument reads the total concentration of all VOC gases present.
- The PID can only be a quantitative tool if the instrument is used in an environment with a single VOC present and the instrument is pre-calibrated for that VOC with a VOC-specific calibration gas.
- If the PID cannot be calibrated or loses calibration, it becomes a qualitative tool only and cannot be used for health and safety monitoring.
- The PID does not respond to certain low molecular weight hydrocarbons, such as methane and ethane.
- The PID does not detect a compound if the probe has a lower energy than the compound's ionization potential. The correct PID ionization lamp must be used.
- The PID does not detect certain toxic gases and vapors, such as carbon tetrachloride and hydrogen cyanide, which possess high ionization potentials.
- Electrical power lines or power transformers may cause interference with the instrument and thus cause measurement errors. Static voltage sources such as radio transmissions may also interfere with measurements.
- High winds affect measurement readings.

- The PID unit is not designed for operation under conditions of high moisture content in the air (high humidity).

A list of compounds detected by a PID is included as an Attachment.

4.0 EQUIPMENT

All equipment will be calibrated per manufacturer specifications. The following equipment is needed for the PID screening procedure:

a. PID unit
b. Operating manual
c. Battery charger for PID
d. Backup, charged battery
e. Tubing
f. Calibration gas
g. Regulator for calibration gas
h. Charcoal tubes for zero calibration
i. VOC conversion factor table (Technical note TN-106)
j. Jeweler's screwdriver for adjustments
k. Field data sheets / Site logbook
l. Plastic bags for soil sampling and/or protecting the PID from moisture and dirt
m. Logbook for the meter ("Calibration, Repair,& Problem History")

5.0 PROCEDURE

5.1 Pre-Operation

1) Gather all equipment needed and review the work plan/work request.
2) Check out equipment (initial and date the correct PID sign-out sheet) and make sure the PID is working properly by checking with calibration gas.
3) Conduct on-site safety meeting. Have all personnel sign the Tailgate Safety Meeting form (see Appendix B).
4) Allow five minutes for the PID to equilibrate to surrounding temperatures.
5) Ensure that the battery is fully charged. A standby charged battery is recommended for field use.
6) Listen for the fan to ensure fan is working properly.
7) Calibrate the PID using the applicable calibration procedure from the meter-specific owner's manual. For the MiniRae, use the "MiniRae Portable VOC Monitor Operation and Maintenance Manual" (available in the Library folder on the U:Drive). Calibration should be performed immediate prior to commencing on-site field work when possible, and be done away from contaminant sources.
8) Check the response of the PID with a known volatile organic source, such as a magic marker, or the calibration gas to verify proper functioning.

9) Once calibrated, the PID should not be turned off. Depending on the model, if turned off, the unit has to be re-calibrated for use. Record that you have calibrated the meter in the meter's log book with dates.

5.2 Operation

1) All readings should be recorded on appropriate data sheets (see Appendix B) or in the site log book. Readings should be recorded in parts per million (ppm). The instrument's ID number, date, time, and the name of the sampling technician should be recorded, as well as calibration data (date, time, calibration gas, concentration).
2) If performing soil sampling, screening for volatile organic chemicals can be performed in a number of ways. One way is to place a soil sample in a plastic bag allowing space for ambient air. Seal and gently shake the bag to expose the soil to the trapped air. Allow the sample to equilibrate for five minutes (ideal). Conduct PID screening by placing the probe into a small opening in the bag. Do not immerse the probe into the soil. **Be consistent** with the method of screening (size of test sample, time, whether placing samples in bags or another method) in order to get the most accurate comparative data. Note that if a lot of moisture is present in the sample, it can cause a false spike in the first reading, so allow the PID reading to stabilize prior to recording.
3) If soil is collected in a Geoprobe membrane, once cut open, the soil core can be slit with a decontaminated tool and the PID probe end carefully inserted to screen for VOCs along the length of the soil core.
4) Under no circumstances should the probe be immersed in fluid. If needed, during heavy rain, for example, wrap the PID in plastic to prevent water from entering the probe tip, but do not block the intake with plastic. Move screening into a controlled climate if possible (indoors, in a vehicle with A/C or heat).

5.3 Post-Operation

1) Turn the FUNCTION switch to OFF.
2) Return the PID to the Equipment room and sign it in.
3) Connect the PID to a charger and plug it in.
4) Check equipment for any damage. Tag malfunctioning equipment and notify the Operations Manager of any problems. Note problems in the meter's log book with dates and details.
5) Record all pertinent information in the site log book and return all paperwork and field notes to the Project Manager. Fill out a daily equipment log (DEL) and return to the Equipment Manager.

6.0 SAFETY

To reduce the risk of electrical shock, turn off the power before removing the sensor cap for service. Never operate the unit while the cap is removed. To reduce the risk of ignition in hazardous atmospheres, only recharge the battery in an area known to be non-hazardous.

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) for anticipated hazardous substances before the initiation of sampling.

Conduct an on-site safety meeting each day before the start of the project and as conditions change. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, required PPE, health monitoring, emergency procedures, alertness to heavy equipment). Have all personnel sign a Tailgate Safety Meeting form each day before the start of the project. Take appropriate action if personnel are injured on-site in accordance with EWI directives.

When working with potentially hazardous substances, follow the U.S. Environmental Protection Agency, Occupational Safety and Health Administration, the Environmental Works, Inc. "Corporate Health and Safety Plan" guidelines, and the Site-Specific Health and Safety Plan.

7.0 REFERENCES

To properly implement this procedure, please look to the following documents for further information related to this SOP.

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- "HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training." Safety Source, Inc.
- U.S. Code of Federal Regulations, 49 CFR Parts 100 to 177, Transportation, revised November 1, 1985.
- U.S. Environmental Protection Agency. 1984. "Characterization of Hazardous Waste Sites – A Methods Manual: Volume II, Available Sampling Methods, Second Edition", EPA-600/4-84-076, Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.
- US EPA PHOTOIONIZATION DETECTOR (PID) HNU SOP#: 2114, DATE: 10/06/94, REV. #0.0.

Environmental Works, Inc. SOP No. 1_

Field Headspace Photoionization Device (PID) Screening

ATTACHMENTS

Compounds Detected by a PID

PID Applications

- Confined Space Entry
- Aircraft Wingtank Entry
- HAZMAT
- Pulp and Paper
- Chemical Processing
- Sewer Entry
- Water and Wastewater Processing
- First Responders
- Petrochemical
- General Industry
- Arson Investigation
- Homeland Security
- Drug Labs
- Perimeter Monitoring
- VOC Leak Surveys
- Fire Service
- Food Packaging
- Leak Detection

VOCs and other gases detected by PID

Acetaldehyde
Acetic anhydride
Acetone
Acrolein
Acrylamide
Allyl alcohol
Allyl chloride
Allyl glycidyl ether
Allyl propyl disulfide
Amino pyridine
Ammonia
Amyl acetate
Aniline
Aromatic hydrocarbons
Benzene
Benzyl chloride
Biphenyl
Bromoform
Butadiene
2-Butanone (MEK)
Butoxyethanol
Butyl acetate
Butyl alcohol
Butyl mercaptan
Butyl amine
Butyl glycidyl ether
Butyl toluene
Camphor vapor
Carbon disulfide
Chloroacetophenone
Chlorobenzene
Chloronitropropane
Chloroprene
Chrysene
Cresol
Crotonaldehyde
Cumene (isopropyl benzene)
Cyclohexane
Cyclohexanol
Cyclohexanone
Cyclohexene
Cyclopentadiene
Cyclopropane
Diazomethane
Dibutylphthalate
Dichlorobenzene
Dichlorvos
Diesel
Diethyl amine
Diethyl ether
Diethyl ketone
Diethyl sulfide
Diisopropylanmine
Dimethyl amine
Dimethylaniline
Dimethylformamide
Dimethylphthalate
Dinitro analine
Dioxane
Diphenyl
Dipropyl amine
Epichlorohydrin
Ethanol
Ethyl acetate
Ethyl acrylate
Ethyl amine
Ethyl amyl ketone
Ethyl benzene
Ethyl bromide
Ethyl disulfide
Ethyl isothiocyanate
Ethyl ether
Ethyl mercaptan
Ethyl propionate
Ethyl silicate
Ethylene dibromide
Ethylene diamine
Ethyleneimine
Ethynylbenzene
Fluorotoluenes
Furfural
Furfuryl alcohol
Gasoline vapors
Glycidol
Heptane
Hexane
Hexanone
Hexone
Hexylacetate
Hydrogen sulfide
Hydroquinone
Iodine
Isoamyl acetate
Isobutyl acetate
Isobutyl alcohol
Isophorone
Isopropyl acetate
Isopropyl alcohol
Isopropyl amine
Isopropyl ether
Jet fuels
Kerosene
Ketene
Mesitylene
Mesityl oxide
Methyl acetate
Methyl acetylene
Methyl acrylate
Methyl amyl ketone
Methyl amine
Methyl bromide
Methyl butyl ketone
Methyl cellosolve
Methyl ethyl ketone
Methyl hydrazine
Methyl iodide
Methyl isobutyl ketone
Methyl mercaptan
Methyl methacrylate
Methyl styrene
Methylcyclohexane
Monomethyl aniline
Monomethyl hydrazine
Morpholine
Naphthalene
Naphthylamine
Nitroaniline
Nitrobenzene
Nitrogen dioxide
Nitrotoluene
Octane
Pentaborane
Pentane
Pentanone
Perchloroethylene
Phenol
Phenyl ether
Phenylene diamine
Phenyl hydrazine
Phosphine
Propioaldehyde
Propyl acetate
Propyl alcohol
Propyl amine
Propyl benzene
Propyl ether
Propyl formate
Propylene
Propylene imine
Propylene oxide
Pyridine
Quinone
Stibine
Solvent vapors, various
Styrene
Terphenyls
Tetrahydrofuran
Toluene
Toluidine
Trichloroethene
Trichloroethylene
Triethyl amine
Trimethyl amine
Turpentine vapor
Vinyl chloride
Vinyl methyl ether
Vinyl toluene
Xylenes

Many other hazardous VOCs can be detected by PID that are not found on this list. Please contact the BW Regional Sales Manager in your area for specific chemicals or concerns.

May 2005/5062-11

"INNOVATORS IN GAS DETECTION"
BW Technologies

Skills Required:

1) 40-hour HAZWOPER training (if drilling on hazardous waste sites)
2) On-site training with experienced person desirable
3) Understanding of, and ability to, make decisions regarding site-specific objectives
4) Knowledge of corporate Safety requirements and health and safety plan
5) Training in soils characterization and sampling (if duties involve sampling)

1. OBJECTIVE / APPLICABILITY

The Objective of this Standard Operating Procedure (SOP) is to provide procedures for planning and observing direct push and hollow-stem auger drilling with considerations for sample collection.

This SOP serves as a reference tool to facilitate consistency among Environmental Works, Inc. (EWI) personnel. These operating procedures may be varied as required, depending upon site conditions, equipment limitations or limitations imposed by the project or client. In all instances, the ultimate procedures employed should be documented and associated with the final report.

2. SCOPE AND PERSONNEL APPLICATION

During any drilling operation, the purpose and ultimate reason for drilling need to be kept in mind. Oversight of drilling for sampling is normally performed by technical personnel (commonly EWI scientists and associate scientists). Any personnel performing these functions should be trained in proper planning and field techniques. The person performing the function is responsible for ensuring that all equipment and materials necessary for drilling are on-hand for the job. If there is any question regarding the purpose of the drilling, the person should confer with the project manager prior to mobilization to the work site.

3. EQUIPMENT

Equipment and materials needed for oversight of drilling operations to include sampling may include but is not limited to the following (this list excludes items specifically used for sample collection; see Sample Collection SOP for those items):

a. A work plan outlining project drilling objectives and locations
b. Field notebook or field documentation sheets
c. Small tape measure
d. Paper towels
e. Nitrile or appropriate disposable gloves
f. PID and calibration gas for VOC sites (including diesel and gasoline sites)
g. Camera (digital best)
h. Fine-tipped Sharpie
i. Trash bags
j. PPE appropriate for the site and COCs; must include hardhat, safety glasses with side shields, ear protection, and steel-toed boots (lace up for BNSF sites)

k. Soil boring logs, Air Monitoring Logs
l. Project Sampling Plan, Quality Assurance Project Plan
m. Site Safety and Health Plan, Tailgate Safety Form

4. PROCEDURES

4.1. General Planning and Procedures PRIOR to Mobilizing to the Field

1) Plan out number of bores, depths, samples needed and sample collection desired, well completion types (screened or open bore bedrock, above or below ground completion) and intervals, size and depths of borings and wells needed, materials needed for well construction, etc. prior to contacting drilling subcontractor for bids.
2) Research, or verify with drilling contractor, the State regulations and requirements for borehole abandonments, annular spaces for well casings and screens, filter pack requirements for monitoring wells, and registrations or reporting requirements
3) If collecting soil samples, plan the type of sample desired and specify to driller for bid: 2-foot split spoons of varying diameters (2”-3” depending on auger size), Shelby tubes, and 5-foot continuous samplers of varying diameter (1.25”-4”)
4) If installing wells, plan large enough casing diameters to accommodate purpose of the well or bore (i.e., is a pump going to be installed?)
5) If installing wells, in general use PVC for metals sampling or non-corrosive environments. In corrosive environments (includes high concentrations of chlorinated solvents), use stainless steel casing and screen.
6) If installing PVC wells, use Schedule 40 for depths shallower than 100 feet, and Schedule 80 for depths exceeding 100 feet.
7) Arrange for utility clearances both above and below ground well in advance of the drilling. Even if the client performs the utility clearance, EWI personnel must obtain written verification – and preferably on-site inspection – of utility clearance prior to commencing drilling. Remember that WE are responsible for OUR subcontractor!
8) Arrange for needed equipment, sampling containers, and special items well prior to job startup (i.e., PID monitoring, plastic for berms, drums for cuttings or waste water, or other special tanks or contingency items such as absorbents and floor-dry for spill cleanup).
9) Plan out decontamination procedures and decon areas with driller and client prior to job startup. Who is responsible for materials must be clearly understood.
10) Plan out waste handling, sampling, and disposal responsibilities prior to job startup.
11) Ensure a <u>current</u> Site Safety and Health Plan (SSHP) is available; some drillers require a copy for their records.
12) Prepare SSHP Tailgate Safety Meeting form with pertinent data before the field event.

4.2. General Procedures in the Field and during Drilling Operations.

1) Use Daily Field Logs, Boring Logs, and Air Monitoring Logs to record all pertinent information and activities as the job progresses (example logs are in the Attachments). Examples of what to record:
   - Documentation that Utility Clearance was performed.
   - Documentation that initial SSHP was reviewed and daily Tailgate Safety briefings were performed.
   - Names of drillers, type and condition of drill rig (no leaks!) and serial/State registration number.
   - Other personnel working on the task with you.
   - Key events, start and end times, footages reached, unusual PID readings or observations
   - Any problems arising – causes, details of discussions and decisions with client or regulatory agencies.
2) Measure lengths, and inside and outside diameters of drilling rods, hollow stem augers, bits, samplers, well casing and screens – anything that will go in the hole – and record in field notes using pictures as needed. Sometimes drillers need to change the size of bits or augers – record changes in bit sizes and depths where changes occur on the boring log.
3) Set up "hot zone" Exclusion Zone and Contaminant Reduction Zone perimeters appropriate for the project work and per the SSHP prior to starting drilling. This is advisable even if contaminants are not present to minimize pedestrian encounters. If contaminants are present, appropriate PPE and decon stations must be set up prior to drilling.
4) Set up a plastic-covered plywood stand (use sawhorses or back of pickup truck) if sampling will be conducted. Use a fresh or well-cleaned piece of plastic for each borehole.
5) Distances and directions from known locations (building corners, etc.) to the boring shall be measured and written on the field boring log for each boring or well installed, in addition to collecting GPS latitude/longitude/elevation data (pending equipment availability).
6) When sampling for VOCs or SVOCs, measure and record PID background readings immediately prior to start of drilling, and record breathing zone and background readings every 5 feet of depth or at points of any discoloration or odors.
7) Take photographs of the wellhead, drill rig, and samples for each borehole, and for any unusual circumstance and document in field notes.
8) All separate borings, including step-outs due to refusal or relocated borings for any reason, will be given a unique boring name. Each boring shall have its own field boring log prepared with appropriate notes as to the reason for stepping out, the geographical distances and directions between borings, and other information to provide complete documentation on the field log as well as in the field notes. Normally borings are named "SB-XX"; step-out borings can be numbered and lettered SB-XX**A**, SB-XX**B**, etc.

10) Divide your time between watching drilling activities, taking PID breathing space readings, collecting samples, logging soil, and recording everything. Avoid getting fixated on any one task at the expense of others. Remember that safety (i.e., breathing zone monitoring and drilling operations) is the top priority, followed by sample collection.

4.3. Procedures and Issues Specific to Direct Push Drilling

1) See EWI SOP ___ for details on how a direct push drilling machine is operated.
2) A DPT rig will push through cover materials, such as asphalt. Commonly, concrete is cored first, unless the rig has a concrete bit. Do not collect samples of these covering materials for analysis.
3) Drilling for samples may be performed using a macrocore (2-inch diameter) or using "dual tube" drilling with a smaller 1.25-inch diameter sampler. In both cases, the samplers will be 4 or 5 feet long and contain an acetate liner to collect the core. The smaller dual-tube system is used for non-cohesive geologic conditions where core may fall out through the larger sampler, or where the hole will not stay open to avoid sloughing. Note that less sample is collected using the dual tube system, so there could be insufficient sample volume if several analytes are required.
4) The sampler acetate tube should be measured to verify length, to provide an accurate reference for determining recovery.
5) Decontamination of drill samplers and rods (or augers, if used) should be conducted between samples and wells. The extent and techniques for decontamination can vary between simply brushing to remove gross surficial material, to standard soap and rinse scrubbing with or without a hotsy-type steam pressure sprayer. The appropriate methodology depends on project and regulatory requirements, and specified in the project sampling plan and/or quality assurance project plan.
6) If monitoring wells are to be installed using direct push technology, the maximum diameter will be 1-inch, pending State regulations for monitoring well construction (a variance may be required). The direct push rig (such as EWI's Geoprobe), may be equipped with augers, which enable a larger diameter (2-inch diameter) monitoring well.
7) Groundwater samples may be collected at selected footage intervals without installation of a monitoring well. DPT rigs may be equipped with a temporary well screen that can be inserted through the drill rods and "opened" at the desired depth. Tubing and a pumping or vacuum apparatus is used to extract groundwater so that a sample can be collected for analysis. Note that this technique yields a sample of undeveloped and unpurged groundwater.
8) DPT drilling may also be used for installing soil vapor points. This involves constructing "mini-monitoring wells" in the vadose (unsaturated) zone.

4.4. Procedures and Issues Specific to Auger Drilling

1) Auger rig rigs are larger and more powerful than DPT rigs, and capable of drilling larger diameter and deeper boreholes. Auger rigs can drill bores with an outside diameter from 4 to larger than 12 inches.
2) Augers can be solid stem or hollow stem. Hollow stem augers allow for soil sampling during drilling (split spoon, Shelby tube, or continuous sampler), and offer a "clean" way to construct a monitoring well. Inside diameter of hollow stem augers is about 2 to 4 inches smaller than the OD.
3) If monitoring wells are to be installed, be sure to plan large enough hollow stem augers to allow well construction inside the augers (per "Monitoring Well Construction" requirements for your State).
4) Auger drilling produces large quantities of soil cuttings, so containment, management, and disposal of soil cuttings must be planned prior to drilling. Saturated soil commonly produces a soupy cuttings mixture that can easily flow away from the wellhead area.
5) A good management technique is to set up plastic or plywood (with a hole cut in the center) around the wellhead for dry to moist cuttings placement if contaminants are known or could be anticipated, or to keep the work area clean if no contaminants are anticipated. Soil cuttings can be shoveled onto plastic and covered, or place in 55-gallon open-top drums.
6) If wet, soupy cuttings are anticipated, insure that a berm with plastic sufficient to contain liquid runoff around the wellhead is constructed.
7) Auger flights are decontaminated between wells, and samplers are decontaminated between samples, if sampling is conducted. If full scale decontamination is to be used, plan for a bermed area to contain spray water, and drums to contain decontamination fluids and mud that will be produced.
8) Auger drilling involves large equipment and heavy components, which are lifted manually and by drill hoist. Part of your job as a safety observer is to watch for dangerous situations, particularly when auger flights are being lifted and hoisted.

4.5. Completion Procedures and Hole Abandonment

1) At the completion of all drilling and sampling, the boring log must be checked to verify that it contains specific bore location, start and completion times, driller names (company and individual), type of drill equipment, sampling methodology (i.e. "2-in. diam., 4-ft. acetate liner), PID detections (including "0"), soil and groundwater sample IDs and intervals, and total depth (noting "refusal" if the case). Measure the location of the borehole with a direction and a distance from a known stationary object, such as to an existing well or corner of a building that has been surveyed in the past.
2) If not converted into monitoring well, boreholes need to be abandoned and plugged per State regulations. These steps explain the general procedure:

a. If possible, determine the actual depth of the borehole in case the hole collapsed, to calculate the volume of bentonite needed to plug the hole. Record the depth of the open borehole.

b. Pour bentonite pellets into the borehole up to the zone of saturation (note that some States require use of a tremie pipe in the saturated zone). If possible, tamp the pellets to insure compaction and no bridging in the bore.

c. Above the zone of saturation, add bentonite chips or pellets in one-foot lifts and hydrate with potable water.

d. Tamp the hydrated bentonite to compact the bentonite and to prevent bridging.

e. Repeat until the borehole is plugged to land surface. If within a building, the bentonite should extend to the base of concrete, and a concrete plug poured in the opening with the top smoothed.

f. Record the abandonment procedure on the boring's field lithologic log with types and quanitities of fill material used.

3) Mark each bore at ground surface with a labeled wooden stake driven into the ground, or by permanent marker/paint if indoors.

4) The back of the drilling rig and all equipment that went downhole needs to be decontaminated before the drill rig leaves the site. All equipment rinsate will be collected and subsequently disposed of at the site treatment facility.

5) Drill cuttings, decon water, and all trash (including acetate liners and cores) need to be properly stored and protected until disposed.

5. SAFETY

Acute or chronic exposure to chemically-contaminated soil could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

6. REFERENCES

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- "HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training." Safety Source, Inc

Environmental Works, Inc. SOP No. 2

Soil Logging & Sampling for Direct Push and Hollow-Stem Auger Rotary Drilling

ATTACHMENTS

Soil Boring Log

Air Monitoring Log

DIRECT AIR MONITORING LOG

Page ____ of ____

LOCATION:_____ DATE:_____ DRILLER:_____ MONITOR:_____

WEATHER:_____ TEMP:_____ WIND:_____

MONITORING INST:_____ READINGS: PPM___ PPB___

TIME	DEPTH	BREATH ZONE	HOLE/ CASING	PIT/ TANK	BACK GROUND	BORING-- COMMENTS

SOIL BORING LOG

Page _____ of _____

BORING NO._____

Ground Elev _____

Sampler _____

Driller _____

Location _____

Date _____ Start Time _____ Finish Time _____

Drill Equipm't _____ Sample Method _____

BACKGROUND		PID HEADSPACE MONITORING - PID Instrument:									
Time	ppm	Time	ppm	Time	ppm	Time	ppm	Time	ppm	Time	ppm

Abandonment Method _____

Depth BLS	Recovery (ft/ft)		Sample Depth	Sample Ident	PID (ppm)	Description of Material Drilled	Unified Classif

Skills Required:

1) 40-hour HAZWOPER training (if sampling on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in soils characterization and sampling
4) Training and ability to use PID
5) Knowledge of corporate Safety requirements and health and safety plan

1.0 OBJECTIVE / APPLICABILITY

The Objective of this Standard Operating Procedure (SOP) is to provide the proper procedure for characterizing and logging soil during direct push and hollow-stem auger drilling.

This SOP serves as a reference tool to facilitate consistency among Environmental Works, Inc. (EWI) personnel. These operating procedures may be varied as required, depending upon site conditions, equipment limitations or limitations imposed by the project or client. In all instances, the ultimate procedures employed should be documented and associated with the final report.

2.0 SCOPE AND PERSONNEL APPLICATION

Soil characterization and logging is performed to provide qualitative information for evaluating site conditions, extent of contamination, and potential for contaminant transport. Soil sampling is done to provide quantitative analytical data for total amounts of chemicals of concern (COCs) in the soil at specified locations and depths. These analytical data are compared to federal and State regulatory levels (e.g., Missouri Risk-Based Corrective Action (MRBCA) target levels), to provide information for remediation decision-making.

Soil logging and sampling is normally performed by technical personnel (commonly EWI scientists and associate scientists). Any personnel performing these functions should be trained in proper identification and techniques. The person performing the function is responsible for ensuring that all equipment and materials necessary for logging and sampling are on-hand for the job. If there is any question regarding materials, the logger/sampler should confer with the project manager prior to mobilization to the work site.

3.0 EQUIPMENT

Equipment needed for soil logging and sampling may include but is not limited to:

a. A work plan outlining project soil sampling requirements
b. Field notebook or field documentation sheets
c. Plastic for logging table
d. Table for logging (portable table or plywood and sawhorses, 3'x5'
e. Small tape measure
f. Soil sampling spatula (or stainless steel spoon or butter knife)
g. Small spray bottle
h. Small plastic bucket for rinse/used gloves, etc.

i. Paper towels
j. Munsell color charts (in plastic baggies)
k. Soil characterization guide sheets
l. Appropriate tool for cutting acetate liners (with extra blades)
m. Sandwich size baggies (zip-lock type)
n. Quart size baggies (zip-lock type)
o. Nitrile or appropriate disposable gloves
p. Terra Core Soil Kits (includes 1 methanol 40ml vial, 2 sodium phosphate tribasic 40ml vials, 2 unpreserved 40ml vials, 1 unpreserved amber jar, and 1 disposable Terracore[RM] sampler) if required for sampling.
q. PID and calibration gas for VOC sites (including diesel and gasoline sites)
r. Camera (digital best)
s. Collection jars appropriate for analytes (provided by analytical laboratory)
t. Soil trip blank(s) (provided by analytical laboratory)
u. Temperature blank(s) (provided by analytical laboratory)
v. Sample labels
w. Chain of Custody (COC)
x. Cooler to store samples
y. Ice
z. Packing tape
aa. Duct tape
bb. Fine-tipped Sharpie
cc. UPS/Fed-Ex Shipping label(s)
dd. Custody Seal(s)
ee. Trash bags
ff. PPE appropriate for the site and COCs
gg. Soil boring logs, Air Monitoring Logs
hh. Site Safety and Health Plan, Tailgate Safety Form

4.0 PROCEDURES

4.1 General Procedures

1) Setup and organize logging area well before drilling starts. Have PID on and calibrated. Organize materials to be readily available within reach.

2) Know the type of soil sampling to be performed (Geoprobe 2" liners, 1" liners, 2-foot split spoons 2"-3" diameter, Shelby tube, 5-foot continuous samplers 3"-4" diameter, or grab samples from auger cuttings) and plan ahead how logging, sampling, PID readings will best be done. Procedures will vary whether operating alone or with another person.

3) The general procedure steps for logging and sampling are:
   - Note general geology, obvious areas of impact, recovery
   - Slit the core lengthwise, measure and record PID readings
   - Note water saturation level
   - Select horizons to sample and collect samples

- Collect small representative samples in baggies (labeled with depth)
- Perform detailed lithologic characterization of core
- Measure PID readings inside baggies, use for Munsell color determination
- Measure and record recovery (inches of core / inches sampler length)
- Take pictures of core

4) Stop driller if you get behind in logging and sampling a run. Don't just let sample tubes collect waiting for processing. Complete and accurate data are needed.
5) Divide your time between watching drilling activities, taking PID breathing space readings, collecting samples, logging soil, and recording everything. Avoid getting fixated on any one task at the expense of others.
6) Use Daily Field Logs, Boring Logs, and Air Monitoring Logs to record all pertinent information and activities as the job progresses. You do not have to record repetitive information. Example boring logs and air monitoring logs are attached.

4.2 Lithologic Characterization

Examine each different geologic material in the core, noting and recording the following properties for each type in the order presented. Different guide sheets in the attachments provide detailed explanations how to characterize each property, as well as an abbreviated list for use in the field.

- **MAIN TYPE OF MATERIAL** (fill, sand, clay, etc.)
  and **SUPPLEMENTAL** (sandy, silty, clayey, gravelly)

  (Usually written like Silty CLAY, or Clayey SAND, or Gravelly CLAY, or CLAY and GRAVEL (if 50/50). If mixture, note percentage of lesser (e.g., CLAY w/ 20% GRAVEL)
- **GRAIN SIZE** (if not clay) – fine, medium, coarse.

  For gravel also give size range in inches (e.g., 1/8" to pea size) and roundness (e.g., angular, subrounded, rounded)
- **SORTING AND GRADING** (if not clay):

  Poorly sorted (all different sizes) to well sorted (all same size)
  Poorly graded (different sizes all mixed up in position) to
  well graded (different sizes occur in sequential layers – coarse to fine)
- **COHESIVENESS**

  Very soft, soft, firm, stiff, v. stiff, hard *if cohesive*
  Very loose, loose, med dense, dense, extreme dense *if non-cohesive*
  Plasticity for clays (non-plastic, low, medium, or high plasticity)
- **COLOR**

  Note overall color. If two distinct colors, specify both. Note supplemental, like "mottled" or "brown laminations, etc". Specifically note areas of impact or

discoloration. Use Munsell color charts, comparing soil to color spots and recording the Munsell color code. Add text color later from Munsell code sheet. OK to note "multicolored" without Munsell codes if many colors. Recommend keeping Munsell charts in large plastic baggies to protect color spots. See example Munsell color spots and code sheets in the attachments.

- **SATURATION**

  Note & record dry, damp, slightly moist, moist, very moist, saturated (or wet)

  Saturation can be difficult to determine in clay. Clay may be saturated and not appear "wet" – attempt to squeeze a small amount of sample to see if water is released.

- **ODOR**

  State either "no odor" or any noted odor, e.g., "petroleum-like". Limit use of specifics, e.g., diesel or gasoline, and always use "-like".

- **ANY INDICATORS OF CONTAMINATION**

  Discoloration, free product, odors

Abbreviations on field sheets are OK if logical. Include a key if not. The following are examples of log entries:

CLAY, 20% pea gravel, subround, stiff, low plastic, olive brn (2.5Y 4/3) w/ orange mottling, moist, no odor or visual impact

Clayey SAND, fin-gr, well sort, soft, pale brn (10YR 6/3) w/ dk gray irreg patches to ½", saturated, petroleum-like odor, impact in dk discolored areas

5.5'-6': GRAVEL lens, poor sorted 1/8" – ½", well graded (coarse down), med dense, lt gray (5YR 7/1) and dk gray (5YR 4/1), v. moist, no odor or visual impact

While all of the above properties are needed to fully characterize geologic materials, the following are the key properties that must be recorded:

- Type of material including supplemental types
- Grain size if not clay
- Color by Munsell charts
- Saturation level
- Indications of impact

4.3 PID Measuring and Sampling Cores (liners, split spoons, Shelby tubes, continuous samplers)

1) Spoons/samplers/Shelby tubes should not be opened, or acetate liners cut open, until you are ready to begin logging.

2) As soon as the core is exposed, use a sampling spatula or other flat, dull-blade knife to slit the core lengthwise and measure PID readings. Carefully insert the

PID tip into the space made while "twisting" the spatula/knife - care must be taken to avoid plugging the PID tip. Measure every 6" and at areas of suspected impact. With a team of two persons, one person should measure starting depth and reading, while the 2nd person records the values – both the depth and reading should be noted on the boring log. If working alone, measure and record no more than 3 readings at a time to maintain accuracy.

3) Once core PID readings are recorded, and general lithology, saturation level, and potential areas of impact have been identified, samples must be collected.

4) Collect samples using a spatula/flat knife decontaminated between sampled horizons to fill sample jars. Collect samples as quickly as possible, remembering that samples for VOC analysis must be packed as tightly as possible in the sample container without over-pushing, squeezing samples. Label the sample container, insert in a baggie, and place in a cooler with ice. If time-constrained, write sample ID, depths, and time on lid and add labels later. If using a 5035 kit, see the 5035 SOP for proper procedures.

5) Samples should be given logical identifications to include the collection depth, e.g.: SB-4: 4.5-5 for a sample collected from SB-4 between 4.5'-5'.

6) Clearly depict sample horizons and ID on the boring log, noting depths.

7) After samples are collected, take depth baggies and measure headspace with PID after at least 5 minutes, and record. Beware of saturated samples, which can produce a temporary peak in PID readings. These baggies are also a good way to evaluate Munsell color of the interval when time allows

4.4 Logging and Sampling from Auger Cuttings

If hollow stem drilling is conducted without use of split spoons, Shelby tubes, or continuous samplers, grab soil samples for characterization and chemical analysis can still be collected from auger cuttings returned to the surface from the augers. The following are considerations and procedures related to soil sampling in these conditions.

1) There are limitations and potentially adverse effects from sampling auger cuttings that should be considered in collecting samples:

- Collecting samples while actively augering involves your movement close to the drill rig and moving parts, so this action requires keen attention to detail and situational awareness.
- The actual depth of the sample is uncertain, because there is a time delay in the sample reaching the surface while the augers continue downward.
- Detailed PID depth profiles cannot be discerned due to mixing of thinner horizons of soil by the augers; however, auger movement can release more volatiles and yield more readily detected elevated PID readings.
- If the chemicals of concern are highly volatile, it is likely that movement of the augers and the heat of friction will reduce the volatile content of samples, so results must be considered as minimal concentrations.

- Finer details of lithology (thin horizons, sorting, grading, coloration, contamination details) are not possible when logging auger cuttings.
- Moisture content can be difficult to accurately determine because of heat drying soils. However, saturated soil commonly produces a soupy return, making identification of true saturation easy to determine.

2) If samples are collected from auger cuttings, they must be collected using a sampling implement (not gloved hands) and placed rapidly into containers to minimize loss of volatiles. The freshest, most recently arrived sample should be selected. "Old" soil that has been stuck on augers should not be used.
3) Samples for lithologic description and color should be grabbed at regular intervals and set aside for logging and marked somehow with depth. Samples for PID headspace should be placed in baggies labeled with depth.
4) Actual depth of the augers immediately at the time of fresh sample collection should be recorded. Many variables (soil type, density, moisture content, power of the rig, etc.) result in unpredictable lag time of cutting reaching the surface.
5) Appropriate naming for grab samples from augers would be: SB-4: 6G for a grab sample collected at 6 ft depth. Depth cannot be determined accurately enough to provide a range over which a single grab sample was collected.
6) Use of auger cuttings for samples, technique of collection, and definition of depth assignment should be noted on the boring field log.

5.0 FIELD QA/QC SAMPLING PROCEDURES

Quality assurance/quality control sampling should be performed to assure quality of field analytical data. The following QA/QC sampling should be done as appropriate for regulatory or client requirements, or project constraints:

- Select 10% of total samples for duplicate sampling and analysis, with a minimum of one sample collected per event. Duplicate samples should be assigned a fictitious name, but one that can be recognized (e.g., add a "2" after the primary sample name: SB-32 as a duplicate of SB-3).
- Collect and analyze one field blank sample when collecting water samples.
- Utilize Trip Blanks sent from the laboratory when VOC sampling.
- Collect one equipment rinsate blank from geoprobe macrocores, split spoons, continuous samplers, or sampling utensils after being decontaminated.

Field duplicate samples are analyzed to check for sampling and analytical reproducibility.

Trip blanks will be used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. One laboratory-supplied trip blank will be forwarded with each cooler containing samples and analyzed for VOCs.

Field blanks will be collected to assess possible impact from external contaminant sources in the area of sampling. Blanks will be collected by filling sample bottles with dionized/distilled water at the logging/sampling table and submitted for analysis of VOCs.

Equipment rinsate blanks will be taken to assess the effectiveness of decontamination and any potential impact on cross-contamination between samples. Blanks will be prepared by routing deionized/distilled water through decontaminated sampling equipment and before field sample collection. Rinsate blanks can be submitted for VOC and/or other analytes, depending on what the analytes of concern are at the job site.

6.0 SAFETY

Acute or chronic exposure to chemically-contaminated soil could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

7.0 REFERENCES

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- "HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training." Safety Source, Inc

Environmental Works, Inc. SOP No. 3

Soil Logging & Sampling for Direct Push and Hollow-Stem Auger Rotary Drilling

ATTACHMENTS

Soil Boring Log

Air Monitoring Log

GEOLOGIC LOGGING – INFO AND ORDER TO RECORD

Visual Percent Estimation Charts (un-named)

Field Guide for Soil and Stratigraphic Analysis v.2

Unified Soil Classification System

Soil Classification System (Modified U.S.C.)
Conventional Soil Descriptions

Instructional Diagram for Determining Soil Texture by Feel

Munsell color chart (example pages)

Munsell Soil Color Names (example pages)

Environmental Works, Inc.

Soil Boring Log

Date/Time: _____

Sampler: _____

Boring ID: _____

Driller: _____

Site Name: _____

Drill Equipm't and Method: _____

Location: _____

Depth	Recovery	Sample Depth / ID	PID BZ	Sample PID	Description of Material	USCS

GEOLOGICAL LOGGING – INFO AND ORDER TO RECORD

MAIN TYPE OF MATERIAL (sand, clay, clay, etc.)
and **SUPPLEMENTAL** (sandy, silty, clayey with %)

GRAIN SIZE sand – fine, medium, coarse - and supplemental
gravel –size in inches, roundness, % if supplemental

SORTING AND GRADING (for sands and gravels)
Sorting (size): Poor to well
Grading (size mix): Poor to well

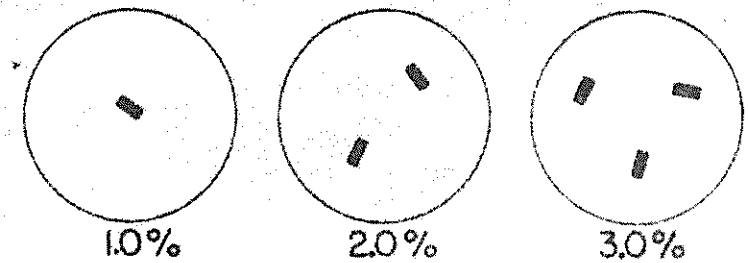
COHESIVENESS
Very soft….soft…firm…stiff… v. stiff… hard *(cohesive)*
Plasticity for clays
Very loose…loose…med dense…dense…extreme dense *(non-cohesive)*

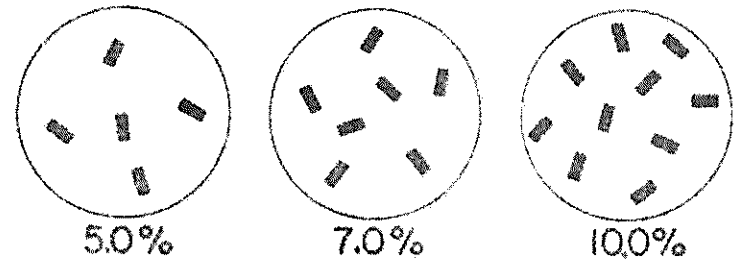
COLOR Name (Munsell number)

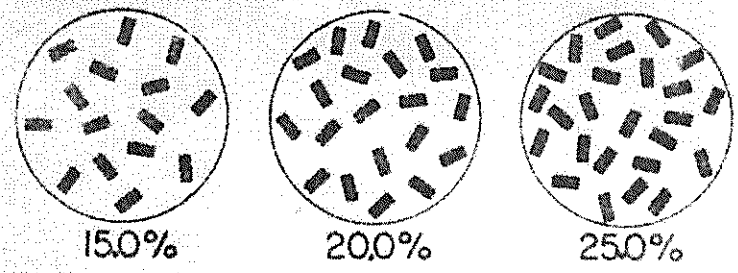
SATURATION
Dry…damp…slightly moist…moist…very moist…saturated

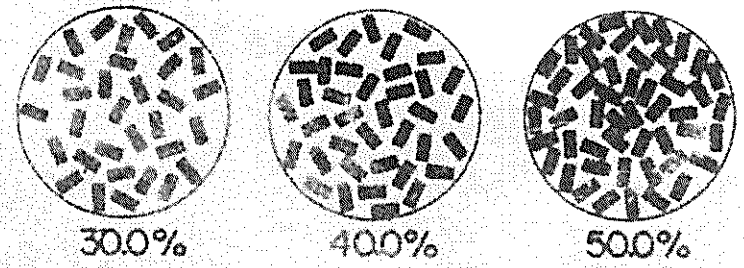
ODOR

ANY INDICATORS OF CONTAMINATION









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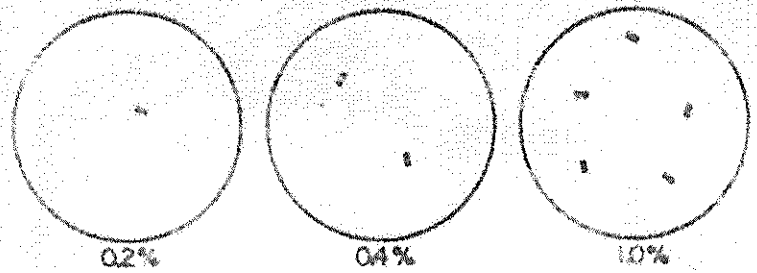
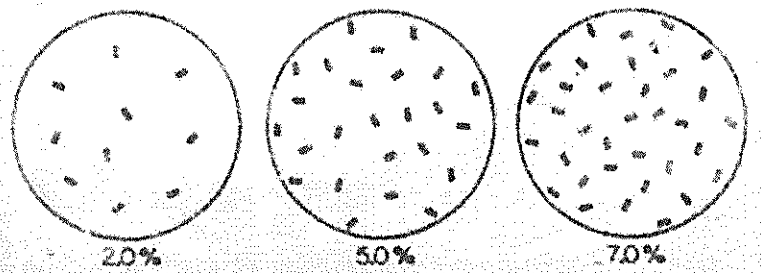
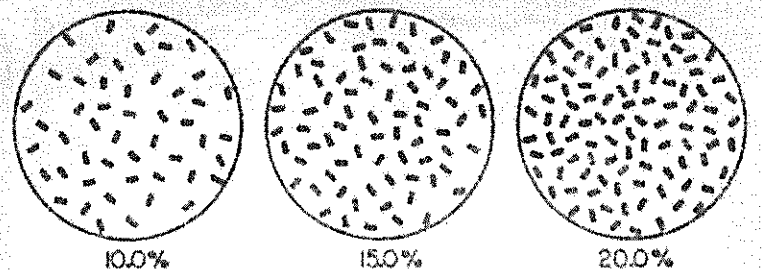
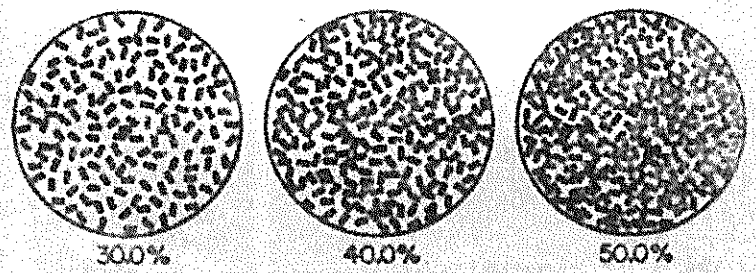


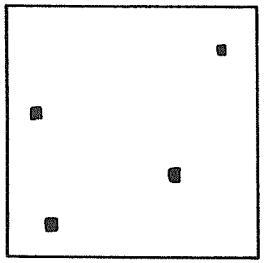






particle size 1.49mm x0.56mm

CHARTS FOR ESTIMATING PROPORTIONS OF MOTTLES AND COARSE FRAGMENTS



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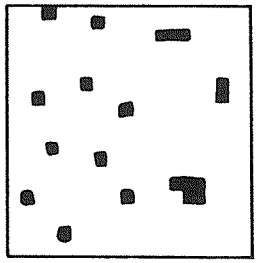

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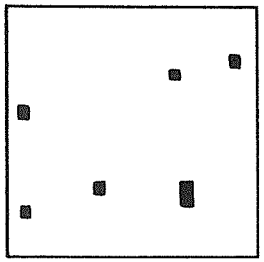

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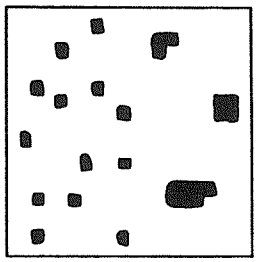

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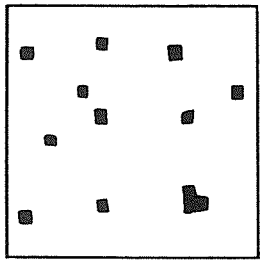

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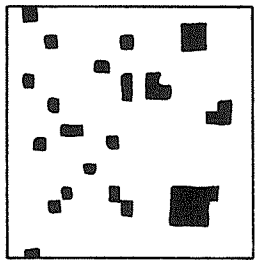

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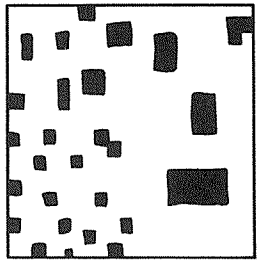

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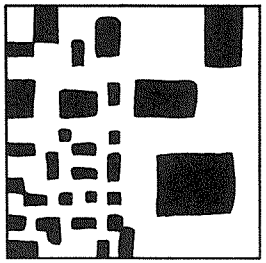

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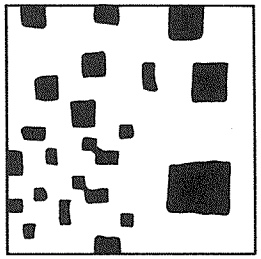

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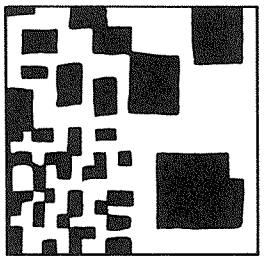

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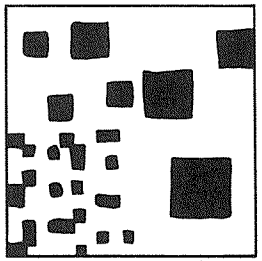

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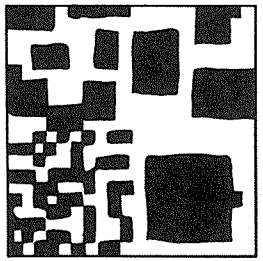

50%

Each fourth of any one square has the same amount of black

UNIFIED SOIL CLASSIFICATION SYSTEM

FOR COMMON INORGANIC AND ORGANIC SEDIMENTS

Modified from ASTM

STEP 1: IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS

(>50% coarse-grained, <50% fine sediments)

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

INCREASING GRAIN SIZE

SAND			GRAVEL		
FINE	MEDIUM	COARSE	FINE	COARSE	

0.075 MM — 0.425 MM — 2.0 MM — 4.75 MM — 19.0 MM — 75.0 MM

STEP 3: *CONTINUE WITH "SAND" OR "GRAVEL" AND FOLLOW FLOW CHART TO ASSIGN A **GROUP SYMBOL** AND A **GROUP NAME***

			GROUP SYMBOL		GROUP NAME
Gravel (gravel > sand)	< 5% fines	Well graded (non-uniform)	GW	<15% sand	WELL GRADED GRAVEL
				>15% sand	WELL GRADED GRAVEL WITH SAND
		Poorly graded (uniform)	GP	<15% sand	POORLY GRADED GRAVEL
				>15% sand	POORLY GRADED GRAVEL WITH SAND
	10% fines	Well graded (non-uniform)	GW-GM (non-plastic fines)	<15% sand	WELL GRADED GRAVEL WITH SILT
				>15% sand	WELL GRADED GRAVEL WITH SILT AND SAND
			GW-GC (plastic fines)	<15% sand	WELL GRADED GRAVEL WITH CLAY
				>15% sand	WELL GRADED GRAVEL WITH CLAY AND SAND
		Poorly graded (uniform)	GP-GM (non-plastic fines)	<15% sand	POORLY GRADED GRAVEL WITH SILT
				>15% sand	POORLY GRADED GRAVEL WITH SILT AND SAND
			GP-GC (plastic fines)	<15% sand	POORLY GRADED GRAVEL WITH CLAY
				>15% sand	POORLY GRADED GRAVEL WITH CLAY AND SAND
	> 15% fines		GM (non-plastic fines)	<15% sand	SILTY GRAVEL
				>15% sand	SILTY GRAVEL WITH SAND
			GC (plastic fines)	<15% sand	CLAYEY GRAVEL
				>15% sand	CLAYEY GRAVEL WITH SAND
Sand (sand > gravel)	< 5% fines	Well graded (non-uniform)	SW	<15% gravel	WELL GRADED SAND
				>15% gravel	WELL GRADED SAND WITH GRAVEL
		Poorly graded (uniform)	SP	<15% gravel	POORLY GRADED SAND
				>15% gravel	POORLY GRADED SAND WITH GRAVEL
	10% fines	Well graded (non-uniform)	SW-SM (non-plastic fines)	<15% gravel	WELL GRADED SAND WITH SILT
				>15% gravel	WELL GRADED SAND WITH SILT AND GRAVEL
			SW-SC (plastic fines)	<15% gravel	WELL GRADED SAND WITH CLAY
				>15% gravel	WELL GRADED SAND WITH CLAY AND GRAVEL
		Poorly graded (uniform)	SP-SM (non-plastic fines)	<15% gravel	POORLY GRADED SAND WITH SILT
				>15% gravel	POORLY GRADED SAND WITH SILT AND GRAVEL
			SP-SC (plastic fines)	<15% gravel	POORLY GRADED SAND WITH CLAY
				>15% gravel	POORLY GRADED SAND WITH CLAY AND GRAVEL
	>15% fines		SM (non-plastic fines)	<15% gravel	SILTY SAND
				>15% gravel	SILTY SAND WITH GRAVEL
			SC (plastic fines)	<15% gravel	CLAYEY SAND
				>15% gravel	CLAYEY SAND WITH GRAVEL

FINE-GRAINED DEPOSITS

(>50% fines, <50% coarse-grained sediments)

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

INCREASING PLASTICITY

NON PLASTIC	LOW PLASTICITY	MEDIUM PLASTICITY	HIGH PLASTICITY
ML	CL	CL	CH

STEP 3: *CONTINUE WITH **GROUP SYMBOL** AND FOLLOW FLOW CHART TO ASSIGN A **GROUP NAME***

STEP 4: DOES ORGANIC CONTENT INFLUENCE SOIL PROPERTIES?

				GROUP NAME
NO → ML	less than 30% Coarse Grained Sediments	< 15% Coarse-Grained Sediment		SILT
		15-25% Coarse-Grained Sediment	% sand > % gravel	SILT WITH SAND
			% sand < % gravel	SILT WITH GRAVEL
	more than 30% Coarse Grained Sediments	% sand > % of gravel	<15% gravel	SANDY SILT
			>15% gravel	SANDY SILT WITH GRAVEL
		% sand < % gravel	<15% sand	GRAVELLY SILT
			>15% sand	GRAVELLY SILT WITH SAND
CL	less than 30% Coarse Grained Sediments	< 15% Coarse-Grained Sediment		LEAN CLAY
		15-25% Coarse-Grained Sediment	% sand > % gravel	LEAN CLAY WITH SAND
			% sand < % gravel	LEAN CLAY WITH GRAVEL
	more than 30% Coarse Grained Sediments	% sand > % of gravel	<15% gravel	SANDY LEAN CLAY
			>15% gravel	SANDY LEAN CLAY WITH GRAVEL
		% sand < % gravel	<15% sand	GRAVELLY LEAN CLAY
			>15% sand	GRAVELLY LEAN CLAY WITH SAND
CH	less than 30% Coarse Grained Sediments	< 15% Coarse-Grained Sediment		FAT CLAY
		15-25% Coarse-Grained Sediment	% sand > % gravel	FAT CLAY WITH SAND
			% sand < % gravel	FAT CLAY WITH GRAVEL
	more than 30% Coarse Grained Sediments	% sand > % of gravel	<15% gravel	SANDY FAT CLAY
			>15% gravel	SANDY FAT CLAY WITH GRAVEL
		% sand < % gravel	<15% sand	GRAVELLY FAT CLAY
			>15% sand	GRAVELLY FAT CLAY WITH SAND
YES → OL / OH	less than 30% Coarse Grained Sediments	< 15% Coarse-Grained Sediment		ORGANIC SOIL
		15-25% Coarse-Grained Sediment	% sand ≥ % gravel	ORGANIC SOIL WITH SAND
			% sand < % gravel	ORGANIC SOIL WITH GRAVEL
	more than 30% Coarse Grained Sediments	% sand ≥ % of gravel	<15% gravel	SANDY ORGANIC SOIL
			≥15% gravel	SANDY ORGANIC SOIL WITH GRAVEL
		% sand < % gravel	<15% sand	GRAVELLY ORGANIC SOIL
			≥15% sand	GRAVELLY ORGANIC SOIL WITH SAND

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FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS v.2

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START HERE

DENSITY OR CONSISTENCY

COARSE GRAINED DEPOSITS

N-VALUE	
0-4	► VERY LOOSE
5-10	► LOOSE
11-29	► MEDIUM DENSE
30-49	► DENSE
>50	► VERY DENSE

FINE GRAINED DEPOSITS

N-VALUE	q_u (tsf)	
0-2	<0.25	► VERY SOFT
3-4	0.25-0.50	► SOFT
5-8	0.50-1.0	► MEDIUM
9-15	1.0-2.0	► STIFF
16-30	2.0-4.0	► VERY STIFF
>30	>4.0	► HARD

COLOR

Use Standard Munsell Color Notation

IS THE COLOR A MATRIX COLOR?

- YES → **MATRIX COLOR** List in sequence, dominant first
- NO → IS THE COLOR FROM A COATING OR CONCENTRATION?
  - YES → **COATING or CONCENTRATION** Note frequency, color, and size
  - NO → **MOTTLE** Note contrast, color, and size

CLASSIFICATION

Unified Soil Classification System - adopted ASTM D2488

STEP 1: IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS

>50% coarse-grained sediments, <50%fines

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

INCREASING GRAIN SIZE

SAND			GRAVEL	
FINE	MEDIUM	COARSE	SMALL	LARGE

STEP 3: *CONTINUE WITH SAND OR GRAVEL ON FLOW CHART (REVERSE)*

FINE-GRAINED DEPOSITS

(organic and inorganic)

>50% fines, <50% coarse-grained sediments

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

INCREASING PLASTICITY

NON PLASTIC	LOW PLASTICITY	MEDIUM PLASTICITY	HIGH PLASTICITY
ML	CL		CH

STEP 3: *CONTINUE WITH GROUP SYMBOL ON FLOW CHART (REVERSE)*

MOISTURE

MOISTURE ABSENT	► DRY
DAMP	► MOIST
VISIBLE WATER	► WET

FOR NON-PLASTIC FINES

WATER RISES TO SURFACE SLOWLY	► SLOW DILATENCY
WATER RISES TO SURFACE QUICKLY	► RAPID DILATENCY

PLASTICITY

(Use with CLASSIFICATION)

WILL NOT SUPPORT 6mm DIAMETER ROLL IF HELD ON END	► NON-PLASTIC	6mm
6mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 4mm DIA. ROLL DOES NOT	► LOW PLASTICITY	
4mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 2mm DIA. ROLL DOES NOT	► MEDIUM PLASTICITY	4
2mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF	► HIGH PLASTICITY	2

COHESIVENESS

6mm DIAMETER ROLL CANNOT BE FORMED	► NONCOHESIVE
6mm DIAMETER ROLL CAN BE FORMED	► COHESIVE

SEDIMENTARY STRUCTURE

UNIFORM	► MASSIVE
BEDS >30cm	► THICKLY BEDDED
BEDS 3cm to 30cm	► BEDDED
BEDS 0.5cm to 3cm	► THINLY BEDDED
BEDS <0.5cm	► LAMINATED

SECONDARY SOIL STRUCTURE (IN SOLUM ONLY)

Spheroidal peds or granules usually packed loosely	► GRANULAR
Irregular, roughly cubelike peds with planar faces (angular or subangular)	► BLOCKY
Flat and horizontal peds	► PLATY
Vertical, pillarlike peds with flat tops	► PRISMATIC
Vertical, pillarlike peds with curved tops (which are commonly "bleached")	► COLUMNAR

WEATHERING ZONE ABBREVIATION

MODIFIER SYMBOL (if present)		1st SYMBOL		2nd SYMBOL		LAST SYMBOL (if present)	
MOTTLED	► M	OXIDIZED	► O	LEACHED	► L	SECONDARY CARBONATE	► 2
JOINTED	► J	REDUCED	► R	UNLEACHED	► U		
		UNOXIDIZED	► U				

EXAMPLE

solum	
OJL	MRJU
MOJL	RJU
MOJL2	RU
MOJU	UU

SECONDARY GRAIN SIZE INFORMATION

< 5%	► TRACE
6% to 15%	► FEW
16% to 30%	► LITTLE
31% to 49%	► SOME

► UNIFORM (poorly graded)	► FINE SAND
	► MEDIUM-GRAINED SAND
	► COARSE-GRAINED SAND
► NON-UNIFORM (well graded)	► FINE GRAVEL
	► COARSE GRAVEL

FOR GLACIAL DIAMICTONS
- ► CLAST FRACTION
- ► CLAST LITHOLOGY

DEPOSITIONAL ENVIRONMENT

VARIOUS DEPOSITIONAL ENVIRONMENTS (Interpretation)
- ► EOLIAN (LOESS)
- ► FLUVIAL
- ► ALLUVIAL
- ► LACUSTRINE
- ► COASTAL
- ► RESEDIMENTED

GLACIAL DEPOSITIONAL PROCESSES
- ► SUBGLACIAL
- ► GLACIOFLUVIAL
- ► GLACIOLACUSTRINE
- ► RESEDIMENTED

GENERALIZED RESEDIMENTATION PROCESSES
- ► MASS SLUMP
- ► SEDIMENT FLOW
- ► COLLUVIUM

STRATIGRAPHIC NAME

USE FORMAL STATE GEOLOGICAL SURVEY NOMENCLATURE WHEN POSSIBLE;
IF NOT POSSIBLE, ASSIGN SITE-SPECIFIC UNIT NAME ACCORDING TO DEPOSITIONAL ENVIRONMENT / FACIES ASSEMBLAGE

STRATIGRAPHIC CONTACT

< 10 cm	► SHARP (or ABRUPT for pedogenic alternation)
> 10 cm (Note transition interval)	► GRADATIONAL (or TRANSITIONAL for weathering zone change)

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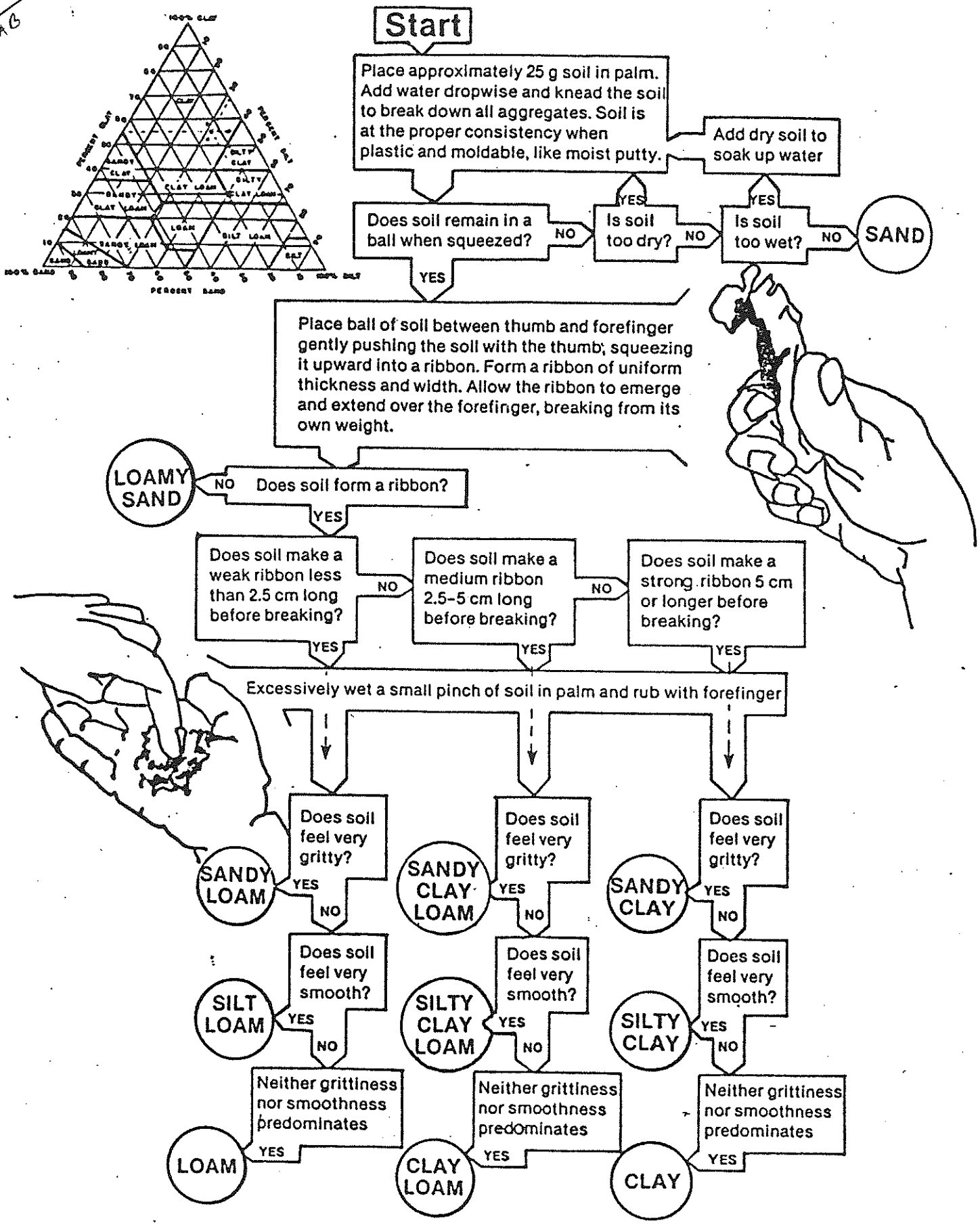

Fig. 1. Instructional diagram for determining soil texture by feel.

Skills Required:

1) Site-specific health & safety training.
2) Corporate procedures on field documentation methods and soil boring logging
3) Drilling operations.
4) Site-specific data quality objectives and corporate quality assurance.

1.0 OBJECTIVE / APPLICABILITY

The Objective of this Standard Operating Procedure (SOP) is to provide procedures for EWI personnel to employ Terra Core® Method 5035 when collecting soil samples of soil for volatiles analysis.

In June 1997, the United States Environmental Protection Agency (EPA) adopted Method 5035 for the sampling and analysis of total amounts of volatile organic compounds (VOCs) in solids. This method does not apply to samples collected for leachate analysis such as those for the Toxicity Characteristic Leachate Procedure (TCLP).

Method 5035 was adopted because of studies showing that sampling according to the previous methods resulted in significant losses of selected VOCs. Method 5035 incorporates chemical preservatives and sample storage techniques to limit volatilization and biodegradation of VOCs.

This is a standard operating procedure, which may be varied as required dependent of site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedure employed should be documented and associated with the final report.

2.0 SCOPE

This SOP describes the process of collecting soil samples using the 5035 method. The scope of this SOP is limited to retrieval of the soil to be sampled (using a push probe, excavator or hand auger) through packaging the sample for shipment to a laboratory.

3.0 EQUIPMENT

Equipment needed for Terra Core® Method 5035 Soil Sampling include:

a. A work plan outlining soil sampling requirements for the project
b. Terra Core Soil Kits (typical kit includes 1 methanol 40-ml vial, 2 sodium phosphate tribasic 40-ml vials, 2 unpreserved 40-ml vials, 1 unpreserved 2-oz or 4-oz jar, and 1 disposable Terra Core sampler).
c. Chain of Custody
d. Two gallon plastic bags
e. Cooler to store samples
f. Ice
g. Packing tape
h. Duct tape
i. Fine-tipped Sharpie

j. UPS/Fed-Ex Shipping label(s)
k. Custody Seal(s)
l. Disposable sampling gloves
m. Paper Towels
n. Trash bags

4.0 PROCEDURES

4.1 Pre-Operation

(1) Gather all equipment needed and review the work plan/work request.
(2) Review contents of the laboratory cooler. Ensure that all Terra Core® kits, trip blanks, temperature blanks, chain of custody, sample labels and shipping labels are present
(3) Conduct an on-site safety meeting each day before the start of the project. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment). Have all personnel sign the Tailgate Safety Meeting Form (see Appendix A) each day before the start of the project.
(4) Have the driller/excavator collect the soil to be sampled. Assess qualitative characteristics of soil (i.e. soil type, odor, presence of chert, color, etc) and record observations on soil boring log. Collect soil sample for PID reading according to SOP #4.

4.2 Operation

(5) Identify the zone in the soil core that is to be sampled. In a typical soil core, approximately six inches of soil will need to be present to collect a sample using this method. Avoid soil zones that contain excessive amounts of gravel or chert fragments.
(6) Insert the Terra Core sampler into the soil to the base of the plunger as shown in the first photo below. **Always wear disposable gloves when handling the vials, the Terra Core and the sample**.
(7) Wipe soil or debris from the outside of the Terra Core® sampler. The soil plug should be flush with the mouth of the sampler as shown in the second photo.
(8) Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the 40ml VOA vial containing the appropriate preservative and extrude the sample by pushing the plunger down (see third photo). Quickly place the lid back on the 40ml VOA vial.

(9) Repeat Steps #5 - #8 until all 40-mL vials are filled with approximately five grams of soil. For each sample, most laboratories provide five 40-mL vials: two preserved with sodium phosphate tribasic (TSP), two unpreserved and one preserved with methanol.

(10) Fill the 2 or 4 oz glass jar with soil from the same zone as where the sample was collected from. You do not need to use the Terra Core to fill this jar.

(11) Dispose of the Terra Core sampler.

(12) Write sample ID, date, time, and sampler name on each pre-labeled vial and glass jar. **Note: The sample kits are pre-labeled and pre-weighed. Do NOT attach a new label to any of the jars as this will alter the net weight of the jar or vial.**

(13) Place soil sample kit in a two gallon plastic bag, seal the bag, and then place the bag in the cooler on ice.

(14) Repeat steps 5-13 until all soil samples are collected.

(15) Make sure coolers are packed with plenty of ice to keep the samples at 4°C. Include one trip blank and one temperature blank per cooler or as required by the site-specific work plan.

(16) Keep the copy of chain of custody and place the completed original chain of custody in a plastic bag. Tape the plastic bag with the chain of custody securely to the inside of the cooler lid.

(17) Tape up cooler(s) with packing tape. Make sure to tape over drain valves on the coolers, if applicable.

(18) Sign and date the custody seal(s).

(19) Place the custody seal over the cooler opening and secure with a piece of packing tape.

(20) Complete the Shipping Label. Keep shipper's copy and attach original to the cooler(s).

(21) Ship coolers for next day delivery. NOTE: For the laboratory to analyze the samples using the unpreserved sample containers, the samples must be received by the laboratory no later than 48 hours after sample collection.

5.0 REFERENCES

(1) SW-846 EPA publication "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm

(2) En Novative Technologies, Inc. *Recommended Use Of The Terra Core®*

Skills Required:

1) Instruction in how to fill out a COC
2) Understanding of sampling containers, preservatives and their use
3) Knowledge of project sampling plan and quality assurance project plan

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to describe the proper procedure for transferring environmental samples to another person or analytical laboratory using a Chain of Custody document (see Attachment A).

This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. These are standard operating procedures which may be varied as required, depending upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented in field notes and included in project documentation.

2.0 SCOPE

Due to the evidentiary nature of environmental samples collected during investigations, the possession of samples must be documented from the time of collection until they disposed following analytical analyses. After collecting and properly labeling sample containers, all samples must be maintained under Chain of Custody procedures.

3.0 EQUIPMENT

The following equipment is needed for the Chain of Custody procedure:

a. Site log book or field notes
b. Chain of Custody form
c. Sample and shipping labels (if mailing samples)
d. Zip-lock® plastic bags and tape (if taping to a cooler)
e. Cooler for securing samples and ice (unless low temperature preservation is not required)

4.0 PROCEDURE

4.1 Pre-Operation (sample collection)

1) Collect each sample and place it in an appropriate sample container.
2) Cap the container and fill out a label for the sample, using waterproof ink, including the name of sampler, date, time, unique sample ID, and desired analysis. Place the label around the sample container, partially over the cap, creating a custody seal.
3) If sampling for soil or groundwater, place all samples in zip-lock® plastic bags with cushioning wrap for glass containers, and put them in a cooler with ice.
4) Record all important information in the Site log book or field notes.

4.2 Operation

1) Once the samples have been collected and properly stored in a cooler, fill out the Chain of Custody form. Form entry may vary with laboratories, but should include these minimum items:

- Project name, number, and location
- Name of sampler
- Chemical analyses and methods to be used
- Requested due date (turn around time)
- Each sample's unique sample ID, date, and time it was collected
- The correct matrix code (e.g., soil, water, or sludge)
- Type and number of containers
- Type of preservative
- Place a diagonal line through unused sample entry rows and write "no others"
- Page numbers
- Additional instructions to the laboratory. For BNSF projects, note the cost/accounting code
- Signature of sampler at bottom of page along with date signed
- Relinquished by signature along with date and time

Note that erroneous information cannot be erased on the Chain of Custody. Errors must be lined out and initialed.

2) Tear out the appropriate copy for EWI records prior to shipping.

4.3 Post-Operation

1) If sampling soil or groundwater, place the Chain of Custody in a zip-lock® plastic bag and tape it to the inside lid of the cooler.
2) Pack the cooler with samples and sufficient cushioning/packing material with double-bagged ice.
3) Tape the cooler and place signed custody seals and shipping labels on the outside of the cooler.
4) Fill out field notes and the daily equipment log (see Appendix B) and return paperwork to the Project Manager.

5.0 SAFETY

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) for anticipated hazardous substances before the initiation of sampling soil, groundwater, or another medium.

Conduct an on-site safety meeting each day before the start of the project. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, required PPE, health monitoring,

emergency procedures, alertness to heavy equipment). Have all personnel sign a Tailgate Safety Meeting form each day before the start of the project. Take appropriate action if personnel are injured on-site in accordance with EWI directives.

When working with potentially hazardous substances, follow the U.S. Environmental Protection Agency, Occupational Safety and Health Administration, the Environmental Works, Inc. "Corporate Health and Safety Plan" guidelines, and the Site-Specific Health and Safety Plan.

6.0 REFERENCES

To properly implement this procedure, please look to the following documents for further information related to this SOP.

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- "HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training." Safety Source, Inc.
- US Environmental Protection Agency CHAIN OF CUSTODY PROCEDURES, SOP file:G:\EIA\SOPs\chainofcustody_SOP.wpd, DATE: 3/25/02, REV. #1.

ATTACHMENTS

Chain of Custody Form
(different examples)

Chain of Custody/Order Form

Page _____ of _____

ENVIRONMENTAL WORKS INC.
1016 W. Battlefield • Springfield, Missouri 65807
(417) 890-9500 • FAX (417) 823-9659

Report To:

Purchase Order #:

Project Name:

Project Location: City/State:

Date Due: Sampled By:

Lab#	Client Sample ID	Matrix	Date/Time	Preservative
	1.			
	2.			
	3.			
	4.			
	5.			
	6.			
	7.			
	8.			
	9.			
	10.			

Analysis/Method

Relinquished By	Date	Time	Received By	Date	Time

Sample Receipt Notes

Temperature

Preserved Properly

Method of Shipment

Special Handling:

Submission #

TestAmerica Anchorage
2000 W. International Airport Road
Suite A10
Anchorage, AK 99502
phone 907.563.9200 fax 907.563.9210

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_____ of _____ COCs
Address	**Analysis Turnaround Time**			Job No.
City/State/Zip	Calendar (C) or Work Days (W) _____			
(xxx) xxx-xxxx Phone	TAT if different from Below _____			
(xxx) xxx-xxxx FAX	☐ 2 weeks			SDG No.
Project Name:	☐ 1 week			
Site:	☐ 2 days			
P O #	☐ 1 day			

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For _____ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

CHAIN OF CUSTODY

ACCUTEST Laboratories

10165 Harwin Drive, Ste. 150, Houston, TX 77036
TEL. 713-271-4700 FAX: 713-271-4770
www.accutest.com

FED-EX Tracking #	Bottle Order Control #
Accutest Quote #	Accutest Job #

Client / Reporting Information

Company Name
Address
City State Zip
Project Contact E-mail
Phone #
Sampler's Name

Project Information

Project Name
Street
City State
Project #
Fax #
Client Purchase Order #

Requested Analysis

Matrix Codes

DW - Drinking Water
GW - Ground Water
WW - Water
SW - Surface Water
SO - Soil
SL - Sludge
OI - Oil
LIQ - Other Liquid
AIR - Air
SOL - Other Solid
WP - Wipe

LAB USE ONLY

Accutest Sample #	Field ID / Point of Collection	SUMMA # / MEOH Vial #	Collection Date	Collection Time	Sampled By	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	NONE	NaHSO4	MEOH	ENCORE

Turnaround Time (Business Days)

- ☐ 10 Day *STANDARD*
- ☐ 5 Day *RUSH*
- ☐ 3 Day *EMERGENCY*
- ☐ 2 Day *EMERGENCY*
- ☐ 1 Day *EMERGENCY*
- ☐ Other

Approved By: / Date:

Emergency & Rush T/A data available VIA LabLink

Data Deliverable Information

- ☐ Commercial "A"
- ☐ Commercial "B"
- ☐ Reduced Tier 1
- ☐ Full Tier 1
- ☐ TRRP13
- ☐ EDD Format _____

Commercial "A" = Results Only

Comments / Remarks

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received by:	Relinquished by	Date Time:	Received by:
1		1	2		2
Relinquished by:	Date Time:	Received by:	Relinquished by:	Date Time:	Received by:
3		3	4		4
Relinquished by:	Date Time:	Received by:	Custody Seal #	Preserved where applicable ☐	On Ice ☐	Cooler Temp.
5		5				

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Pace Analytical™ www.pacelabs.com

Page: of

Section A **Required** Client Information:	**Section B** **Required** Project Information:	**Section C** Invoice Information:
Company:	Report To:	Attention:
Address:	Copy To:	Company Name:
		Address:
Email To:	Purchase Order No.:	Pace Quote Reference:
Phone: Fax:	Project Name:	Pace Project Manager:
Requested Due Date/TAT:	Project Number:	Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER_____

SITE LOCATION ☐ GA ☐ IL ☐ IN ☐ MI ☐ NC ☐ OH ☐ SC ☐ WI ☐ OTHER____

Filtered (Y/N)

Requested Analysis:

Section D **Required** Client Information

SAMPLE ID

One Character per box.
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

ITEM #	SAMPLE ID	MATRIX CODE	SAMPLE TYPE G=GRAB C=COMP	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Residual Chlorine (Y/N)	Pace Project No. Lab I.D.
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

Additional Comments:

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME

SAMPLE CONDITIONS

Temp in °C	Received on Ice	Custody Sealed Cooler	Samples Intact
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM / DD / YY)

Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in soils characterization and recognizing saturation (SOP #3)
4) Knowledge and training in types of wells and well materials
5) Knowledge of corporate Safety requirements and health and safety plan

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to provide general and specific procedures, methods and considerations to be used and observed when designing and installing permanent and temporary groundwater monitoring wells to be used for collection of groundwater samples and or measurement of water levels.

This SOP serves as a reference tool to facilitate consistency among Environmental Works, Inc. (EWI) personnel. These operating procedures may be varied as required, depending upon site conditions, equipment limitations or limitations imposed by the project or client. Exceptions are requirements by federal or state environmental regulatory agencies; monitoring well installation requirements specified by these agencies must be followed or an official variance obtained prior to field work. It is the responsibility of EWI personnel to research, understand, and follow such regulations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

2.0 SCOPE AND PERSONNEL APPLICATION

Monitoring wells must be appropriately and correctly installed to enable collection of reliable and accurate data for evaluating site conditions, and extent and changes in contamination. Improperly constructed wells will yield non-representative data and lead to erroneous decisions leading to potentially adverse environmental and/or fiscal liabilities for the client and EWI.

Supervision of well installation should normally be performed by technical personnel (commonly EWI scientists and associate scientists). Personnel performing these functions should be trained in proper decision-making and techniques. If there is any question regarding specific circumstances of well installation, the project manager should be consulted.

Most states, including Missouri, require certification for drillers and supervisory personnel for installation of monitoring wells.

3.0 GENERAL PLANNING CONSIDERATIONS

The design and installation of monitoring wells requires an understanding of varying subsurface materials and conditions. There are several different drilling methods and installation procedures that can be deployed, depending on the geologic and hydrologic conditions, contaminants, and objective and desired length of time for monitoring. The selection of drilling method and installation procedures should be based on field data and/or search of existing data. Each monitoring well should be designed and installed to achieve the project objective and function properly throughout the duration of the monitoring program. When planning and designing monitoring wells, the following should be considered prior to starting field activities:

(1) Short and long-term objectives – temporary or permanent well;
(2) Purpose of the well (hydraulic or chemical monitoring, or both);
(3) Probable duration of the monitoring program;
(4) Contaminants likely to be encountered;
(5) Surface and subsurface geologic conditions – unconsolidated or bedrock well?
(6) Properties of the aquifer(s) to be monitored;
(7) Type of drilling method most appropriate to use;
(8) Type of well materials to use;
(9) Length, slot size, and placement of well screen;
(10) Type of surface completion (above ground pedestal, or flush-mount);
(11) Control and management of solid and liquid drilling wastes;
(12) Regulatory requirements; and
(13) Potential site health and safety hazards.

The following sections discuss aspects of these considerations and provide procedural guidelines for installing a well.

4.0 WELL CONSTRUCTION MATERIALS

4.1 Well Screen and Casing ("Riser Pipe") Materials:

- Must not contribute foreign constituents
- Must not remove contaminants of concern from the groundwater
- Durable for length of monitoring
- 2" minimum diameter for monitoring, less allowed for piezometers
  - Want large enough to accommodate well use (sampling? pump? data logger?)
- PVC Schedule 40 minimum (Sched 80 if over 100 ft deep)
- Mechanical, waterproof joints (threaded or welded, not glued if plastic)
- If metal, same type must be used
- Compatibility with contaminants - see Attachments for compatibility table (EPA document EPA/540/S-95/503, *Nonaqueous Phase Liquids Compatibility with Materials Used in Well Construction, Sampling, and Remediation*)
- Types of casing and screen materials for checking compatibility:
  - Metal: stainless steel (304 and 316) (preferred on RCRA and Superfund sites) (carbon steel, low-carbon steel, galvanized steel not recommended)
  - Thermoplastics: polyvinyl chloride (PVC) and acrylonitrile-butadiene-styrene (ABS)
  - Fluoropolymers: polytetrafluoroethylene (PTFE), tetrafluoroethylene (TFE), fluorinated ethylenepropylene (FEP), perfluoroalkoxy (PFA) and polyvinylidene fluoride (PVDF)

4.2 Filter Pack Materials

- Clean, rounded, hard, insoluble siliceous particles (quartz sand)
- Base filter pack particle size on sieve analysis of aquifer material if possible.

- Filter pack size may be based on knowledge of expected geology.
- "Pre-pack" screens are available, which have an inner and outer screen with sandpack already placed inside. Good for small diameter well applications, wells that cannot be built within augers, or application in heaving sands.

4.3 Seal and Grout Materials

- Bentonite as chips or pellets is used for a seal above the filter pack (chips are cheaper and hydrate better than pellets)
- Grout above the seal may be pure ("neat") cement (may shrink), a cement-bentonite mixture (5-20% bentonite, reduces shrinkage), or a bentonite slurry (check State regulations for requirements). Some states may not allow plain dry, powdered bentonite as a grout seal, so regulations must be checked. The Attachments contain a table showing amounts of cement, bentonite, and water for various percentage mixtures.
- Grout in deeper wells should be emplaced with a tremie tube, filling from the bottom up.

5.0 GENERAL MONITORING WELL INSTALLATION PROCEDURES

5.1 Unconsolidated Zone Wells

- Unconsolidated zone wells will always need a well screen and filter pack, and are normally constructed with the hollow stem augers in place to keep things centered in the hole and produce "cleaner" well conditions. Considerations:
  - Insure large enough hollow stem augers to allow proper well construction. Check State regulations for size requirements of the annular space between the boring walls and the casing diameter. 2" annular space is a common requirement.
  - If the bore is drilled with soil sampling and minimum or very little water is produced, the well can be constructed after removing the centerline drill rods and bit, pending size of the augers and casing/screen.
  - If very little water is produced, an option is to remove the augers and install the well materials using centralizers to insure the screen and casing are positioned mid-hole. Be careful of centralizer placement so as not to cause clumping of filter pack material with void space below ("bridging") when it is added.
  - If water is produced during boring, remove the augers once total depth (TD) is reached and sampling is completed, install a wooden (or other inert material) plug in the lead auger, and drill down to TD. The well can then be constructed inside the augers by pushing out the plug by holding the casing in place as the augers are removed while the filter sand is introduced. This is a longer process, but is necessary to avoid infilling of soil into the augers and the sand pack getting impacted by muddy water (which makes the well very difficult to develop).
  - If the bore is to be drilled without sampling and material is fairly soft, it may be possible to install the plug in the lead auger bit before starting. The plug can then be pushed out once TD is reached, and the well constructed inside the augers.
- Once TD is reached, sketch out the well on paper (in your field notes) and check your depths before giving directions to the driller. For guidelines in planning wells:

- Identification of the saturated or water-producing zone is critical to proper well construction. The saturated zone is normally determined by soil logging and/or information from the driller (depth where hole is "making water"). A drop in blow counts (if samplers advanced by pounding) may indicate saturated conditions. Selecting well screen depths for follow-up wells should utilize saturated zone and water level data from existing wells in the area.
- Screen length must be long enough to effectively monitor the zone of interest, normally not less than 5 ft in length. Maximum length may be restricted by geology.
- Normally a 0.01-inch slot size screen is used. A finer slot size may be needed if finer sand filter pack is required. This needs planned in advance and the driller alerted.
- Screen placement should have top of screen above the water table sufficient to keep fluctuations in water table within the screen interval. Placing the bottom 2/3 of the screen below the water table is a good general guide.
- If depth to saturation is questionable, it is better to use a longer well screen and install it deeper to insure the screen will encounter the water table.
- If the boring TD is deeper than the desired monitoring interval, the excess depth can be filled in with sand prior to placement of the screen, or a blank casing can be installed on the bottom of the screen to create a "sump". A sump may be desirable if fine-grained aquifer material may cause sedimentation in the well.
- Plan on installing filter pack (sand pack) to at least 2 feet above top of screen (check State regulations)
- Sand pack size should be matched to lithology. Sand normally comes in the size grades 8-14 (very coarse), 10-20 (coarse), 20-40 (medium), and 40-60 (fine). For most mixtures of silt and sand matrices, Medium Sand is commonly used; this should be adjusted for known or measured sediment grain size.
- Plan on installing a minimum 3-foot bentonite seal (check State regulations). Chips are commonly used versus pellets. They are just as effective and cheaper. Bentonite must be hydrated with water if installation of the seal is above the water table. Note that if bentonite slurry grout is planned, a thinner layer (or none) of bentonite chips may be used (check State regulations).
- Use Well Construction Tables (if available) or calculations to estimate the volumes of filter pack, bentonite seal, and upper grout that will be needed to fill the annular space between the casing/screen and the boring wall.

- Measure all components of the well string – end cap, screen, and casing and record on the field well completion log (see Attachments).
- Drill crew actions when installing a well inside augers should be the following:
  - Emplace the casing and screen with end cap to TD. The top of casing should be capped or covered with tape to prevent materials from entering the casing during well construction activities.
  - Brace the casing appropriately while the augers are lifted slightly to "pop" out the wood plug (if used).
  - Begin slowly pouring in sand filter material as the depth is measured. For deep wells it may be necessary to use a tremie pipe to avoid "bridging" of the sand.

- Slowly pull out augers as sand is added. The idea is to have enough sand inside the augers as they are pulled to avoid native soil and water from entering the augers, yet not so much sand as to "sand lock" the augers and prevent their removal.
- Insure the driller progressively measures the depth of filter pack material and seal materials during installation using a weighted tape measure as the augers are removed; depth checks should be made circumferally around the casing.

- Note and record the number and weight of bags, manufacturer, and type of filter pack and bentonite seal material emplaced.
  - Compare actual volumes installed to the calculated quantities needed.
  - Note that bentonite seals must be hydrated in "lifts" if groundwater is lacking.
- If a cement seal is used above the bentonite seal, note and record the manufacturer and number and weight of neat cement bags. If powdered bentonite is added to the cement, note the quantity added. Record the quantity of water used in mixing the cement. Compare calculated volumes to those actually installed.
- Note the depth of the bentonite or cement grout from surface. Cement grout should be allowed sufficient time to set prior to the final surface completion.

5.2 Bedrock Wells

- Several bedrock drilling techniques are available, unlike unconsolidated wells:
  - Diamond core drilling: Desirable, since yields core samples for logging and testing, but requires constant water source, recirculation tank or pit, and is expensive.
  - Water (mud) rotary: Used for deeper wells, requires water source and water recirculation pit. Geology logged from cuttings.
  - Air rotary: Commonly used for unconsolidated and bedrock sockets and larger diameter bores. Produces lot of dust. Geology logged from cuttings.
  - Air hammer: Commonly used for bottom hole completions – fastest drilling, straightest holes. Also produces a lot of dust. Geology logged from cuttings.
- Wells in bedrock may complete as an open bore without screen and filter pack.
  - Need bedrock geology to support open bore without collapsing or caving in.
  - Will result in vertically extensive monitored interval, good if water entry horizons are not known.
  - Desirable if downhole geophysics or downhole videography is planned.
  - If extensive fractures or solution cavities are encountered, may need screen to keep out sediment (plan ahead).
  - May require a variance from state regulations (e.g., Missouri).
- Bedrock wells may have multiple casings (check State regulations for size requirements).
  - A surface casing will normally be needed regardless of type of bedrock completion.
  - The surface casing is grouted in a bedrock "socket" to insure the unconsolidated zone is sealed out.
  - If a casing and screen are used, the well will have dual casings.

- Deep wells may have multiple casings-within-casings if needed to properly seal certain zones.

- For open bore bedrock wells, a surface casing must be securely in place and grouted prior to drilling the open borehole. Measure and record type of material, diameter, and length.
  - Depending on conditions, a "shale basket" (cone-shaped heavy rubber collar) can be placed at the bottom of the casing prior to installation to help hold annular seal and grouting materials in place.
- For wells using casing riser pipe and screen, planning and placement of screen, filter pack, seals, and grout is the same as for unconsolidated wells, but some procedures are different:
  - Centralizers will normally be required to insure central placement of the drill string
  - Filter pack and bentonite seal materials will commonly have to be emplaced using a tremie due to well depths (check State regulations)
- Drilling waste can be an issue with bedrock wells using air techniques, and management of wastes must be planned and coordinated with the driller prior to mobilization.
  - Wellhead diverters can be used to control wastes and channel wastes into tanks, bins, or other containers.
  - Water producing zones can produce a lot of water. Diverters and berms around the wellhead must be employed if water-producing zones could be present.

5.3 Surface Completions

- Two types: Flush (below ground) or Pedestal (above ground). Check State regulations for size, length, depth, placement hole, type of sealant, etc. requirements.
- Surface completion pads (whether above or below ground) should be installed using a 2-ft by 2-ft wood-framed square of concrete, or a circular pad using a mold. The surface should be elevated above the ground and should slope downward in all directions from the pedestal or vault lid.
  - Note the depth of the hole for the surface completion.
  - Note the type and quantity of seal (normally concrete or "quickrete") and water volume used to construct the pad area
  - Note the dimensions and type of pedestal or vault used for the installation.
- Proper procedures for cutting top of casing to final height:
  - Insure shavings from the casing cutting do not enter the well (bundled paper, etc. can be placed inside the casing with string to aid in its removal following cutting).
  - Top of casing should be a few inches minimum above the base of the vault or inside pedestal concrete to prevent build up of water that could seep inside the well.
  - A "J-Plug" expandable well cap should be placed on the casing and tightened to prevent easy removal of the well cap or seepage of water into the well.
  - Measure and record on the field log the final top of casing height above/below land surface
- Pedestal mount completions must be completed per State regulations.

- Some states require drilling of a "weep hole" to drain water from inside the pedestal.
- Pedestals should have 2 to 3 bumper guards ("bollards") installed to prevent damage to the pedestal and contained well riser.

- The well ID should be painted or stenciled on the inside and outside of vault or pedestal lids.

6.0 TEMPORARY MONITORING WELL INSTALLATION

- Normally used for short-term delineation of contaminants or for site screening purposes. May be installed, purged, sampled, removed, and backfilled in a matter of hours. Must not be used to replace permanent monitoring wells, and may be subject to State regulations for installation and the duration of time that temporary wells are allowed to remain in place; check State regulations.
- Construction and materials use are varied to meet objectives of the well. Sand pack materials may or may not be used, but typically there is no bentonite seal, grout, surface completion, or extensive development.
- Types of temporary wells:
  - **No Filter Pack** – Casing and screen are inserted in a bore without filter pack or development. Least expensive and fastest application, but is extremely sensitive to turbidity fluctuations.
  - **Traditional Filter Pack** – Casing and screen are inserted into the borehole, and sand is quickly poured into the annular space. Collapse of the bore may result in incomplete sand coverage, and the filter will be compromised by muddy water.
  - **Double Filter Pack** – The well screen is filled with filter pack material and the well screen and casing inserted until the top of the filter pack is at least 6 inches below the water table. Filter pack material is poured into the annular space around the well screen. May be effective in aquifers where fine silts or clays predominate.
  - **Well-in-a-Well** – A 1-inch well screen and riser are inserted into a 2-inch well screen with riser, and centered. Filter pack material is placed into the annular space surrounding the 1-inch well screen, to approximately 6 inches above the screen. The well is then inserted into the borehole. This is basically creating a "pre-pack" screen in the field.
- Temporary well boreholes must be decommissioned after sampling by removing the screen and riser, and backfilling the bore with bentonite chips to saturation.

7.0 VARIANCE, CERTIFICATION, AND REGISTRATION FOR MONITORING WELLS

State well regulations must be researched prior to planning and drilling monitoring wells. If site conditions and objections require installation of a well that will not comply with state regulations, a variance might be obtained by written request to that state's regulating entity; note that such requests need to be made and approved prior to initiating drilling. Most states require some form of formal certification or registration for installed monitoring wells, sometimes including temporary wells. Well logs are commonly required, and fees may be charged. Formal registration report forms may also be required for monitoring wells or soil borings that have been

abandoned, with or without a fee. State regulations must be researched prior to installing or abandoning wells to insure compliance with requirements.

8.0 SAFETY

8.1 General Safety Precautions

Acute or chronic exposure to chemically-contaminated soil or water could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

8.2 Safety Procedures Specific to Drilling Activities

- Utility clearances must be conducted and documented prior to start of drilling.
- Drill crews and others working near the rig should wear safety hats, safety glasses, and steel toed boots. Ear plugs are required and provided by the site safety officer or driller.
- Work gloves (cotton, leather, etc.) should be worn when handling drilling equipment.
- All personnel directly involved with the drilling rig should know where the “kill switch” is located in case of emergencies.
- All personnel should stay clear of the drill rods or augers while in motion. Rod wipers, rather than gloved or bare hands, should be used to remove mud or other material from the drill stem as it is withdrawn from the borehole.
- Do not hold drill rods or any part of the safety hammer assembly while taking standard penetration tests or while the hammer is being operated.
- Watch for slip/trip/fall hazards due to tools or drilling equipment on the ground.
- Only the driller and drill crew will conduct all drilling activities. The EWI supervisor will make decisions regarding bore locations, sampling, and well installations, and should act as a safety observer.
- Air monitoring of the breathing zone and wellhead must be conducted if volatile organic compounds are suspected to be present.
- A first-aid kit and fire extinguisher located in the drill rig trailer will be quickly accessible for emergencies. All personnel will be familiarized with their location.
- Be aware of loose clothing, jewelry, or long hair that could be caught up in moving parts.

- The drill rig should not be operated within a minimum distance of 10 feet of overhead electrical power lines and/or buried utilities. Drilling operations will cease if an electrical storm or lightening moves into the area, and the mast should be lowered.

9.0 REFERENCES

(1) U.S. EPA Region 4 Science and Ecosystem Support Division Guidance "*Design and Installation of Monitoring Wells*." February 2008.

(2) U.S. EPA Office of Research and Development and Office of Solid Waste and Emergency Response. "*Ground Water Issue: Nonaqueous Phase Liquids Compatibility with Materials used in Well Construction, Sampling, and Remediation*." July 1995.

(3) The American Society for Testing and Materials (ASTM). Standard D5092, *Design and Installation of Ground Water Monitoring Wells in Aquifers.*

(4) "*Corporate Health and Safety Plan*" Environmental Works, Incorporated.

(5) "*HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training*." Safety Source, Inc.

(6) State regulations for well installations, e.g., Missouri Code of State Regulations 10 CSR 23-4.0 "*Rules of the Department of Natural Resources Division 23 – Division of Geology and Land Survey Chapter 4 – Monitoring Well Construction Code*." May 1996.

Environmental Works, Inc. SOP No. 6

Monitoring Well Installation

ATTACHMENTS

Chemical – Material Compatibility Chart

Table 1 – Cement, Bentonite, Water Mixtures

Well Construction Form

CHEMICAL COMPATIBILITY TABLE

For All Non- Metals

R = Resistant
A = Excellent - No effect
B = Good - Minor effect
C = Fair - Moderate effect
U = Unsatisfactory
X = Conflicting Data
- = No Data Available

For Metals

E < 2 mils Penetration/Year
G < 20 mils Penetration/Year
S < 50 mils Penetration/Year
U > 50 mils Penetration/Year
(1 mil = .001 inch)
A = Excellent - No effect*
B = Good - Minor effect*
C = Fair - Moderate effect*
* No corrision rate reported

	Plastics											Elastopolymers										Metals						
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypropylene	PTFE (Teflon)	PVC Type I	PVC Type II	PVDF (Kynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Acetaldehyde	U	A	U	R	U	U	A	A	U	U	X	A	A	C	U	U	A	U	U	-	R	E	E	G	E	G	U	U
Acetamide	-	A	-	R	R	R	A	A	U	-	C	A	A	B	A	U	B	U	B	-	-	G	G	-	-	G	-	-
Acetate Solvent	U	-	U	R	R	R	B	A	U	U	A	A	A	C	U	-	A	U	U	-	-	E	E	G	E	E	S	G
Acetic Acid 10%	X	X	C	R	U	R	B	A	U	-	C	A	A	C	C	-	C	U	R	A	R	E	E	U	E	G	U	G
Acetic Acid, Glacial	U	U	U	R	U	R	A	A	U	U	B	U	A	X	X	U	B	U	U	A	R	E	E	U	E	E	U	U
Acetone	U	A	U	R	R	R	A	A	U	U	U	A	A	U	U	U	B	U	U	A	R	E	E	G	E	E	G	E
Acetonitrile	U	-	-	R	R	-	R	R	-	-	R	R	-	-	-	-	-	-	-	-	-	G	G	G	-	E	G	G
Acetophenone	U	-	-	R	R	U	R	R	U	U	R	R	-	U	U	-	-	-	U	-	-	G	G	G	G	G	G	G
Acetyl Chloride	U	-	U	R	U	U	U	A	U	U	R	U	-	U	U	U	-	-	R	-	R	G	G	G	-	U	U	U
Acetylene	R	-	R	R	R	-	R	R	R	R	R	R	-	R	R	-	-	-	R	-	-	E	E	G	G	E	U	U
Acrylonitrile	U	-	X	R	R	R	A	A	X	U	A	X	-	C	U	-	U	-	U	-	-	G	G	G	G	E	G	G
Adipic Acid	R	-	A	R	-	R	B	A	R	R	A	A	A	B	X	-	U	-	X	-	-	G	G	G	E	G	-	G
Aldrin (1 oz/gal)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	E	E	G	-	E	-	-
Allyl Alcohol	U	-	R	R	R	R	R	R	R	R	R	R	-	R	R	-	-	-	R	-	-	E	E	G	G	G	G	E
Allyl Chloride	U	-	U	R	-	R	R	R	U	U	R	U	-	U	U	-	-	-	-	-	R	G	E	U	-	U	-	-
Ammonium Acetate	-	-	A	R	A	-	A	A	R	R	R	A	-	A	B	-	-	A	A	-	-	G	G	-	-	G	U	U
Ammonium Oxalate 10%	-	-	-	R	-	-	R	R	R	-	-	R	-	-	-	-	-	-	-	-	-	G	G	U	E	E	-	U
Amyl Acetate	U	B	U	R	R	R	X	A	U	U	A	A	A	U	U	U	U	U	U	A	R	E	E	G	E	E	E	G
Amyl Alcohol	R	A	A	R	A	R	B	A	R	U	A	A	A	A	B	U	U	A	B	A	R	G	G	G	G	G	G	G
Amyl Chloride	U	-	U	R	U	U	U	R	U	U	U	R	-	U	U	-	-	-	R	-	-	G	G	U	E	U	G	G
Aniline	U	A	X	R	X	R	X	A	U	U	A	X	A	U	U	U	U	C	B	A	R	E	E	G	G	G	U	U
Aniline Hydrochloride	U	-	U	R	U	U	X	A	X	U	A	B	-	U	U	-	U	U	A	-	R	U	U	U	U	U	U	G
Antifreeze	B	U	A	-	U	-	U	-	A	-	-	A	-	C	A	-	C	B	A	-	-	-	A	-	-	A	-	-
Aroclor 1248	-	-	-	R	A	U	U	A	-	-	-	B	A	U	X	-	B	-	A	-	-	G	G	G	E	E	E	E
Asphalt	-	B	X	R	A	R	B	A	A	-	A	U	A	U	X	-	U	-	A	-	-	G	G	G	-	E	E	E
Benzaldehyde	X	A	U	R	A	U	X	A	U	U	A	A	A	U	U	U	U	U	U	A	R	G	G	U	G	G	G	G
Benzene	U	A	U	R	A	U	X	A	U	U	A	U	B	U	U	U	U	C	A	A	R	G	G	G	G	E	G	G
Benzo Sulfonic Acid 10%	R	-	R	R	U	R	R	R	R	R	R	U	-	R	U	U	-	-	R	-	R	G	G	U	G	U	G	-
Benzyl Alcohol	U	A	X	R	B	U	A	A	U	U	A	B	A	X	X	U	-	U	A	A	R	E	E	G	G	G	G	E
Benzoic Acid	R	B	A	R	X	B	R	A	R	R	A	U	A	B	U	U	B	A	A	A	R	G	G	U	E	G	G	G
Benzol	U	A	U	R	X	U	U	A	U	U	A	U	A	U	U	U	U	C	A	A	R	G	G	G	G	E	G	G
Benzonitrile	-	-	-	R	R	A	-	A	-	-	-	-	A	-	-	-	A	-	-	-	-	U	U	-	C	-	-	-
Benzyl Chloride	U	A	U	R	R	-	C	R	R	-	R	U	-	U	U	-	U	-	A	-	-	G	G	U	-	U	U	U
Bromobenzene	-	-	-	R	-	-	U	R	-	-	R	U	-	U	U	-	-	-	R	-	-	-	-	-	-	-	-	-
Butadiene	U	A	A	R	R	U	U	A	R	U	A	X	A	B	X	U	U	-	B	-	-	G	G	G	G	G	G	G
Butane	B	A	C	R	R	U	U	A	R	R	A	U	A	A	A	R	U	C	A	-	-	G	G	E	G	G	G	G
Butyl Alcohol	U	A	A	R	B	B	R	A	R	U	A	A	A	A	X	-	B	B	A	-	R	E	E	G	G	E	G	G
n-Butyl Amine	-	X	U	R	R	U	U	A	U	U	X	-	U	U	R	-	B	U	U	-	-	-	G	G	G	G	-	-
Butyl Ether	-	U	U	R	A	-	-	A	R	-	A	U	A	U	B	-	U	A	U	-	-	-	E	E	-	E	-	-
Butyl Phenol	U	-	U	R	-	-	U	R	U	U	R	-	-	U	-	-	-	-	U	-	-	G	E	-	G	G	-	-
Butyl Phthalate	-	-	U	R	R	-	R	R	R	-	R	B	A	D	U	-	A	-	C	-	-	G	G	-	G	U	G	G

	Plastics											Elastopolymers										Metals						
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypropylene	PTFE (Teflon)	PVC Type I	PVC Type II	PVDF (Kynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Butylacetate	U	A	X	R	A	R	X	A	U	U	B	B	A	X	U	-	U	U	U	-	R	G	G	G	G	E	G	G
Butyric Acid	U	A	U	R	U	U	R	R	U	U	A	B	A	U	U	-	U	U	B	-	R	G	G	U	E	G	G	G
Carbon Tetrachloride	U	B	U	R	X	U	U	R	U	U	R	U	A	U	U	U	U	B	A	A	R	E	E	G	E	U	G	E
Carbonic Acid	R	B	A	R	R	R	A	A	R	R	A	B	A	X	X	R	A	-	A	A	-	G	G	G	E	E	G	G
Chloroacetic Acid	U	U	U	R	U	U	C	A	R	R	A	B	A	U	U	U	U	A	U	-	-	U	U	U	E	U	U	U
Chlorobenzene	U	X	U	R	R	U	U	B	U	U	A	U	A	U	U	-	U	A	A	A	R	G	G	G	E	G	G	G
Chlorobromomethane	-	-	-	-	C	-	A	A	U	-	-	B	-	U	U	-	U	-	A	A	-	-	-	-	-	-	B	-
Chlordane (1/4 lb/gal)	U	-	-	-	-	-	-	R	-	-	-	U	-	C	B	-	U	-	A	-	-	G	G	G	-	-	-	-
Chloroethane	U	A	U	R	R	R	X	A	U	U	A	X	A	U	U	-	U	-	B	-	-	G	G	G	-	-	-	G
Chloroform	U	A	U	R	R	U	X	A	U	U	A	U	B	U	U	U	U	B	A	A	R	E	E	U	G	G	G	G
Chloronaphthalene	U	-	-	-	-	-	-	-	R	-	-	-	-	U	U	-	-	-	-	-	-	-	G	-	E	U	-	-
Chlorophenol 5% (aq.)	-	R	U	R	U	-	-	R	U	U	R	-	-	-	-	-	-	-	-	-	-	G	G	S	E	-	-	-
Citric Acid	U	B	B	R	R	A	A	A	R	-	A	A	A	A	A	-	A	-	A	A	R	E	E	U	E	E	-	E
Cresol	U	U	U	R	U	U	U	R	X	U	R	U	A	U	U	U	U	U	X	-	R	E	G	G	G	G	-	-
Cresylic Acid 50%	U	U	U	R	U	R	X	R	R	R	R	X	-	U	U	U	U	-	A	-	-	G	G	G	G	G	-	-
Crude Oil	R	R	R	R	R	U	R	U	U	U	U	U	-	U	R	R	-	-	R	-	-	E	E	G	E	E	G	G
Cyclohexane	R	A	U	R	R	R	U	A	X	-	R	U	A	U	B	R	U	U	A	-	-	G	G	G	G	G	G	G
Cyclohexanone	U	A	U	R	R	U	U	A	U	U	R	B	U	U	U	-	U	U	U	A	-	G	G	U	G	G	G	G
DDT 5%	-	-	U	-	-	-	-	-	U	U	-	-	-	-	-	-	-	-	-	-	-	E	E	G	-	E	-	-
Detergents (general)	B	A	A	R	R	R	A	A	R	R	A	A	A	B	A	-	A	A	A	A	-	E	G	G	E	G	G	E
Diacetone Alcohol	-	A	U	R	R	R	R	A	R	-	A	A	B	U	U	-	U	B	U	-	-	G	G	G	E	E	E	E
Dibutyl Phthalate	U	-	U	R	R	U	R	R	U	U	U	R	-	U	U	U	-	-	U	-	-	G	G	G	G	G	G	G
Dichlorobenzene	U	-	U	R	X	U	C	A	U	U	A	U	-	U	U	-	U	-	C	-	-	-	G	-	E	G	-	-
Dichloroethane	U	A	U	R	R	R	X	A	U	U	A	U	A	U	U	-	-	U	C	A	R	G	G	G	G	G	G	-
Dichloroethylene	U	-	-	R	R	-	R	R	U	U	R	U	-	U	U	-	-	-	R	-	-	G	G	-	G	G	-	-
Dichlorofluoromethane	-	-	-	R	-	-	-	R	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diesel Fuel	-	A	A	R	R	R	A	A	R	-	A	U	A	B	A	-	U	-	A	-	-	E	E	G	G	E	E	-
Diethanolamine	-	-	-	R	R	-	R	R	U	U	U	-	-	R	-	-	-	-	-	-	-	E	E	E	E	E	-	G
Diethyl Amine	U	B	U	R	R	U	A	X	U	-	X	B	A	A	C	-	B	C	A	-	-	G	G	U	-	G	-	-
Diethyl Ether	U	R	U	R	R	U	R	A	U	U	R	U	C	U	U	-	U	-	U	-	-	G	G	G	G	G	G	G
Diethyl Phthalate	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diethylene Glycol	B	A	A	R	R	R	A	A	X	-	A	A	-	A	A	-	B	C	A	-	-	E	E	E	G	G	-	G
Dimethyl Aniline	U	U	U	R	R	-	X	A	U	U	A	B	A	U	U	-	U	U	U	-	-	B	B	-	B	A	-	-
Dimethyl Ether	-	-	-	R	-	-	-	R	-	-	-	-	-	U	R	-	-	-	-	-	-	G	G	-	G	-	G	G
Dimethyl Formamide	U	X	U	R	R	R	A	X	U	U	U	X	A	X	U	-	C	U	X	-	-	-	G	U	-	E	-	-
Dimethyl Phthalate	U	-	-	R	R	-	R	R	U	U	R	-	-	U	U	-	-	-	R	-	-	E	E	E	-	E	-	-
Dimethyl Sulfoxide	-	R	U	R	R	R	R	R	U	-	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene	-	-	-	-	-	-	-	R	-	-	-	U	-	U	U	-	U	-	X	-	-	G	G	-	-	-	-	-
Dioctyl Phthalate	U	-	U	R	R	U	U	R	U	U	R	R	-	U	U	U	-	-	R	-	-	G	G	G	-	E	-	-
Dioxane	U	R	-	R	R	U	R	R	U	-	U	U	-	U	U	-	-	-	U	-	-	G	G	G	G	G	G	G
Diphenyl	-	-	-	R	R	-	U	A	U	-	-	U	-	B	U	R	U	-	A	-	-	G	G	G	G	G	G	G
Diphenyl Oxide	-	U	-	-	-	-	U	A	U	-	B	U	-	U	A	-	C	U	A	-	-	B	A	-	B	B	-	A
Esters (general)	-	-	U	R	R	-	-	R	U	U	R	-	-	-	-	-	-	-	-	-	-	-	G	-	-	-	-	-
Ethane	-	A	A	-	U	-	U	A	A	-	A	U	-	B	A	-	U	A	A	-	-	A	A	-	-	-	-	A
Ethanolamine	-	U	U	R	R	-	X	A	U	-	X	B	U	B	B	-	B	-	U	A	-	E	E	G	G	G	-	-
Ethers (general)	U	A	U	-	R	U	U	A	U	U	R	C	B	U	X	-	U	C	X	-	R	E	E	G	G	G	G	G
Ethyl Acetate	U	A	U	R	R	R	A	A	U	U	X	B	A	U	U	U	B	U	U	A	R	G	G	G	G	-	G	G
Ethyl Alcohol	B	A	B	R	R	R	A	A	R	R	R	A	B	A	C	U	B	C	A	A	R	G	G	G	E	E	G	G
Ethyl Benzene	-	R	-	R	-	U	U	R	U	U	R	U	-	U	U	-	-	-	R	-	-	S	G	U	E	G	-	-
Ethyl Benzoate	U	-	U	-	-	U	B	A	U	-	U	-	-	U	U	-	U	U	A	-	-	-	-	-	-	-	-	-
Ethyl Chloride	U	R	U	R	R	U	U	R	U	U	R	R	-	U	R	U	-	-	B	-	R	E	E	G	G	-	-	G
Ethyl Ether	U	A	U	R	R	U	U	A	U	U	R	U	A	U	X	U	U	-	U	-	R	G	G	G	G	G	G	G

	Plastics											Elastopolymers										Metals						
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypropylene	PTFE (Teflon)	PVC Type I	PVC Type II	PVDF (Kynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Ethyl Sulfate	-	-	-	-	-	-	-	A	-	-	-	-	A	-	A	-	-	-	A	-	-	U	U	-	-	-	-	B
Ethylene Bromide	U	-	U	R	R	U	U	A	U	U	A	X	B	X	U	-	U	U	A	-	-	E	E	-	E	-	-	-
Ethylene Chloride	U	A	U	R	R	R	X	A	U	U	A	X	A	U	U	-	U	-	B	-	-	G	G	G	-	-	-	G
Ethylene Chlorohydrin	U	U	U	R	U	U	X	A	U	U	A	B	-	X	U	U	C	U	A	-	-	G	G	G	G	G	G	G
Ethylene Diamine	U	X	U	R	U	-	R	A	U	U	B	A	U	X	A	-	A	-	B	-	-	G	G	G	U	G	U	U
Ethylene Dibromide	-	-	-	R	-	-	R	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	G	-	G	-	G	-
Ethylene Glycol	A	B	A	R	R	R	A	A	R	R	A	A	A	A	A	R	A	B	R	A	-	G	G	G	E	E	G	G
Ethylene Oxide	U	U	X	R	R	R	U	A	U	U	A	X	C	U	U	U	U	-	U	-	R	G	G	G	E	E	U	-
Formaldehyde 100%	B	A	A	-	U	-	C	A	A	-	A	A	A	C	C	-	B	B	U	-	-	C	A	-	A	A	-	A
Formaldehyde 37%	A	A	A	R	R	R	A	A	R	R	A	A	A	B	X	U	-	-	R	-	R	E	E	U	G	G	E	G
Formic Acid 5%	-	U	R	R	U	R	R	R	R	-	R	R	-	R	U	-	-	-	R	-	-	G	E	-	E	U	S	E
Fuel oils	U	A	-	R	R	R	A	B	R	R	B	U	A	B	X	R	U	A	A	-	-	G	G	G	G	G	G	G
Gasoline (high-aromatic)	U	B	A	-	-	-	A	B	A	-	A	U	A	A	A	-	U	A	A	A	-	A	A	-	A	U	-	-
Gasoline (leaded)	U	A	U	R	R	U	X	A	R	-	A	U	A	B	A	R	U	C	A	A	-	G	G	G	E	G	G	G
Gasoline (unleaded)	U	A	X	R	R	U	X	A	R	-	A	U	A	B	A	R	U	C	A	-	-	G	G	G	E	G	G	G
Glycolic Acid	B	A	A	R	-	R	A	A	R	R	B	A	B	A	A	-	A	A	A	-	-	G	G	U	G	G	-	-
Heptane	X	A	A	R	R	R	C	A	R	R	A	U	A	B	A	U	U	B	A	-	-	G	G	G	E	G	G	G
Hexachloroethane	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	G	G	-	G	G	S	G
Hexamine	-	-	-	R	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	E	E	-	E	E	G	-
Hexane	U	A	B	R	R	U	B	A	R	R	A	U	A	B	A	R	U	U	A	-	-	E	E	G	E	G	G	-
Hexyl Alcohol	-	A	-	-	A	-	-	A	A	-	-	C	-	A	A	-	B	A	C	-	-	A	A	-	A	A	-	-
Hydraulic Oil (petro.)	-	B	-	-	A	-	U	A	A	-	A	U	-	A	A	-	B	A	A	-	-	A	A	-	A	A	A	A
Hydraulic Oil (synthetic)	-	-	-	-	A	-	U	A	A	-	A	A	-	A	U	-	B	A	A	-	-	A	A	-	A	A	A	A
Hydrazine	-	B	U	-	-	U	C	C	-	-	A	A	-	B	B	-	B	-	A	-	-	A	A	-	-	-	-	A
Hydrogen Peroxide (dilute)	R	R	U	R	R	R	R	R	R	-	R	R	-	U	R	-	-	-	R	-	-	G	G	U	E	E	U	U
Hydroquinone	X	A	A	R	U	-	A	A	R	R	R	U	-	A	X	-	-	-	B	-	-	G	G	G	G	G	G	-
Hydroxyacetic Acid 70%	-	A	A	-	-	-	-	A	U	-	A	A	-	A	A	-	-	-	A	-	-	-	-	-	-	-	-	-
Iodoform	-	-	-	R	-	-	R	C	-	-	C	A	-	A	U	-	-	C	R	-	R	E	E	U	U	G	-	G
Isobutyl Alcohol	B	A	-	-	A	-	A	A	A	-	-	A	-	A	B	-	A	A	A	-	-	-	-	-	-	-	-	-
Isooctane	-	-	-	-	A	B	A	A	A	-	A	U	A	B	A	-	U	A	A	-	-	A	A	-	-	A	A	-
Isopropyl Acetate	U	U	U	R	R	R	B	A	U	U	X	B	-	U	U	-	U	-	U	-	-	E	G	E	G	G	-	-
Isopropyl Alcohol	R	A	C	R	U	R	A	A	R	R	R	A	-	B	B	U	A	A	A	A	-	G	G	G	G	G	G	G
Isopropyl Ether	-	U	R	R	R	-	X	A	R	R	X	U	A	U	B	R	U	A	U	-	-	E	G	-	-	-	G	G
Isotane	-	-	-	-	U	-	U	-	A	-	A	-	-	U	A	-	-	-	-	A	-	-	-	-	-	U	-	-
Jet Fuel JP-4, JP-5	-	A	R	R	R	-	A	A	R	R	A	U	A	U	A	U	U	A	A	-	-	G	G	G	E	G	E	-
Kerosene	X	A	R	R	R	R	R	A	R	R	A	U	A	A	A	U	U	U	A	A	-	G	G	G	G	G	G	G
Lacquer thinners	A	U	-	-	A	-	U	A	U	-	-	U	-	U	U	-	U	U	U	-	-	-	G	-	-	G	-	-
Lacquers	A	U	-	-	A	-	U	A	U	-	U	U	-	U	U	-	U	A	U	-	-	E	E	-	-	-	-	-
Lactic Acid	U	B	A	R	R	-	B	A	R	R	B	A	A	A	X	-	A	A	A	A	-	G	G	U	G	G	G	G
Lead Acetate	B	B	A	R	R	R	A	A	R	R	A	A	A	A	B	-	A	B	U	A	-	G	G	U	G	U	U	G
Linoleic Acid	A	B	A	R	U	U	B	A	R	R	A	U	-	U	B	-	B	A	B	-	-	G	G	U	G	G	U	U
Maleic Acid	R	A	A	R	X	R	R	A	R	R	A	X	-	U	U	-	-	C	A	-	R	G	G	U	G	-	G	-
Malic Acid	R	A	R	R	X	R	A	A	R	R	A	U	-	X	A	-	B	A	A	-	-	E	E	U	G	G	-	U
Melamine	-	A	A	-	A	-	A	A	U	-	-	A	-	U	C	-	C	U	A	-	-	-	U	-	-	-	-	-
Methane	-	A	-	R	R	-	A	A	R	R	A	X	-	B	A	-	U	-	A	-	-	E	E	G	E	E	E	G
Methyl Acetate	U	X	U	R	R	R	X	A	U	U	B	X	A	X	U	-	U	A	U	-	-	G	G	S	E	G	-	-
Methyl Acetone	-	U	-	-	A	-	-	A	U	-	U	A	-	U	U	-	-	A	U	-	-	A	A	-	-	A	A	-
Methyl Acylate	-	B	-	-	-	-	U	-	-	-	B	B	-	B	U	-	U	-	U	-	-	A	-	-	-	-	-	-
Methyl Alcohol	U	A	A	R	R	R	A	A	R	R	A	A	A	A	A	U	A	A	U	A	R	G	G	G	E	G	G	G
Methyl Alcohol 10%	U	A	A	-	B	B	A	A	-	-	A	A	A	A	A	-	A	A	A	A	-	-	-	-	-	-	-	-
Methyl Amide	U	U	-	-	-	-	A	A	U	-	C	A	A	-	B	-	-	U	U	-	-	A	A	-	-	A	U*	-
Methyl Bromide	U	U	U	R	U	R	X	A	U	U	A	U	-	U	B	-	-	-	A	-	-	G	G	G	-	U	-	-
Methyl Butyl Ketone	-	U	-	-	U	U	U	-	-	-	U	A	-	U	U	-	U	-	U	-	-	A	A	-	-	-	-	-

	Plastics											Elastopolymers										Metals						
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypropylene	PTFE (Teflon)	PVC Type I	PVC Type II	PVDF (Kynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Methyl Chloride	U	B	U	R	R	U	U	A	U	U	A	U	A	U	U	U	U	U	A	-	-	E	E	U	G	U	E	G
Methyl Chloroform	U	-	U	R	-	-	U	R	U	U	R	U	-	U	U	-	-	-	R	-	-	-	-	-	-	-	-	-
Methyl Dichloride	-	U	-	-	C	-	U	-	-	-	U	U	-	-	U	-	-	-	A	-	-	-	-	-	-	-	-	-
Methyl Ethyl Ketone	U	U	U	R	R	U	B	A	U	U	U	A	A	U	U	U	U	U	U	A	-	G	G	G	G	G	G	G
Methyl Isopropyl Ketone	-	-	-	-	A	-	-	A	U	-	-	C	-	U	U	-	C	-	U	-	-	A	A	-	-	A	-	A
Methyl Methacrylate	-	U	R	R	-	-	X	R	R	U	B	U	-	U	U	-	C	-	U	-	-	G	G	U	-	G	-	-
Methyl Pentanone	U	-	U	R	R	R	R	A	U	U	X	B	A	U	U	-	U	-	U	-	-	G	G	G	G	G	G	G
Methylene Chloride	U	B	U	R	U	U	B	A	U	U	B	X	A	U	U	U	-	U	B	-	R	G	G	G	E	E	G	G
Monochloroacetic acid	-	U	-	-	U	U	-	A	-	-	B	C	B	A	U	-	-	-	C	-	-	A	A	-	A	U*	B	
U*																												
Monoethanolamine	-	U	-	R	R	-	B	A	U	U	U	B	-	X	B	-	B	-	X	-	-	E	E	G	G	G	G	G
Motor Oil	C	B	A	R	R	U	U	A	R	R	B	U	A	B	A	-	-	A	R	A	-	G	G	G	-	-	G	G
Napthalene	U	X	U	R	R	U	R	A	U	U	A	U	A	U	U	R	U	C	A	A	-	E	E	G	G	G	G	G
Nitrobenzene	U	X	U	R	R	U	B	A	U	U	A	U	A	U	U	U	U	U	B	-	R	G	G	G	G	E	G	G
Nitromethane	U	A	U	R	U	-	R	A	R	R	A	B	A	U	U	-	U	B	U	-	-	G	G	G	-	G	-	-
Nitrophenol	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	G	G	-	-	G	-	G
Octane	-	-	-	R	-	R	R	R	U	U	R	U	-	R	R	-	-	-	R	-	-	-	G	G	-	G	G	G
Octyl Alcohol	A	A	B	-	A	-	-	-	-	-	-	B	-	B	B	-	B	-	B	-	-	A	A	-	C	A	-	A
Oleic Acid	X	A	A	R	R	U	B	A	R	R	A	B	B	X	B	R	U	C	B	A	-	E	E	G	G	G	S	G
Oxalic Acid 5%	R	U	R	R	U	R	R	R	R	R	R	R	-	R	U	-	-	-	R	-	-	U	G	U	G	G	S	G
Palmitic Acid 10%	A	A	A	R	R	R	B	A	R	R	A	B	-	U	A	R	U	B	A	-	-	-	G	-	-	G	G	G
Pentachlorophenol	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	E	-	-	-	-
Pentane	-	B	-	-	A	-	U	A	A	-	A	U	-	B	A	-	U	A	A	-	-	C	C	-	A	B	-	-
Petroleum	B	B	A	R	-	U	B	A	R	-	A	U	-	B	A	-	U	-	A	-	-	G	G	-	-	G	G	G
Phenol 10%	U	X	A	R	U	R	B	A	U	U	A	B	B	U	U	U	U	C	A	A	-	G	G	G	G	E	G	G
Phthalic Acid	B	C	X	R	R	-	A	A	U	U	A	A	-	A	U	-	B	-	A	-	-	G	E	S	G	G	G	G
Phthalic Anhydride	B	C	U	R	-	-	U	A	U	-	A	A	-	A	U	-	-	B	A	-	-	E	E	G	E	E	G	-
Picric Acid	X	A	U	R	U	U	A	A	U	U	A	A	-	A	X	-	B	-	A	-	R	G	G	U	G	E	U	U
Propyl Alcohol	X	A	A	R	U	R	A	A	R	R	A	A	A	A	A	-	A	A	A	A	-	E	E	G	E	G	G	G
Propylene	B	-	-	-	-	-	-	A	B	-	-	U	-	U	U	-	U	B	A	-	-	B	A	-	-	A	-	A
Propylene Glycol	B	B	X	R	R	R	A	A	U	U	A	A	-	C	A	-	A	-	A	A	-	G	G	G	G	G	G	G
Propylene Oxide	-	-	-	R	-	R	R	R	U	U	U	R	-	U	U	-	-	-	U	-	-	E	E	-	-	-	-	-
Pyridine	-	B	U	R	R	R	A	A	U	U	U	X	A	U	U	-	U	U	U	A	-	G	G	G	E	G	G	G
Sodium Acetate	B	B	A	R	R	R	A	A	R	R	A	A	A	B	B	-	U	-	U	A	-	G	G	U	G	E	G	G
Sodium Benzoate	A	-	A	R	R	R	A	A	R	R	A	A	-	A	B	-	-	B	A	-	-	-	-	-	G	G	-	E
Sodium Hypochlorite 20%	R	U	R	R	U	R	R	R	R	R	R	R	A	U	U	-	B	C	A	-	U	U	U	U	U	G	G	S
Stearic Acid	U	A	B	R	R	R	A	A	R	R	A	X	-	B	B	R	B	B	A	-	R	G	E	S	E	G	S	G
Styrene	-	A	U	-	A	U	-	A	U	-	-	U	-	U	U	-	U	-	B	-	-	A	A	-	U*	A	A	B
Tartaric Acid	-	B	A	-	B	-	A	A	A	-	B	B	A	A	A	-	A	B	A	A	-	C	C	-	B	B	U*	A
Tetrachloroacetic Acid	R	-	R	R	R	R	R	R	R	R	R	U	-	R	R	R	-	-	R	-	-	E	E	-	G	G	S	U
Tetrachloroethane	-	A	X	R	R	-	C	A	U	U	A	U	A	U	U	-	U	-	A	-	R	E	E	E	E	G	-	S
Tetrachloroethylene	U	A	U	R	R	U	U	A	U	U	R	U	A	U	U	U	U	-	A	-	-	E	E	G	G	G	G	G
Tetrachlorophenol	-	-	-	-	-	-	R	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetraethyl Lead	U	-	R	R	-	U	R	R	R	R	R	U	-	-	U	-	-	-	R	-	-	G	G	G	-	G	G	-
Tetrahydrofuran	U	A	U	R	R	U	C	A	U	U	B	U	A	U	U	-	U	-	X	A	-	E	G	E	E	U	-	-
Toluene	U	X	U	R	R	U	C	A	U	U	A	U	B	U	X	U	U	U	C	A	-	E	E	E	E	E	E	E
Toxaphene-Xylene 10-90%	-	-	U	R	-	-	R	R	U	-	-	-	-	-	-	-	-	-	-	-	-	G	G	S	-	S	-	-
Trichloroacetic Acid	-	-	R	R	U	R	A	A	R	-	B	B	A	U	R	-	U	C	C	A	-	U	U	U	G	U	G	G
Trichlorobenzene	-	-	-	-	-	-	-	R	U	-	-	-	-	U	U	U	-	-	R	-	-	-	-	E	-	-	-	-
Trichloroethane	-	A	-	-	-	-	C	A	C	-	A	U	A	U	U	-	U	-	A	-	-	-	-	-	-	-	-	-
Trichloroethylene	U	U	U	R	R	U	C	A	U	U	B	U	A	U	U	U	U	-	X	A	-	G	G	G	E	E	G	G
Trichlorofluoromethane	-	-	-	-	-	-	-	-	U	-	-	-	-	U	U	-	-	-	-	-	-	-	G	-	-	G	-	-
Trichloropropane	U	A	-	-	-	-	-	A	-	-	-	-	A	A	U	-	-	U	A	-	-	A	A	-	A	U*	-	A

	Plastics											Elastopolymers										Metals						
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypropylene	PTFE (Teflon)	PVC Type I	PVC Type II	PVDF (Kynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Triethanolamine	R	U	R	R	R	U	R	R	U	U	R	R	-	R	U	U	-	-	R	-	-	G	G	G	G	G	U	E
Triethylamine	U	U	A	R	R	-	U	A	R	R	A	A	A	A	C	-	-	A	X	B	-	G	G	-	-	-	-	-
Trimethylpropane	U	-	R	R	-	-	U	R	R	R	R	-	-	-	R	R	-	-	-	-	-	-	-	-	-	-	-	-
Turpentine	U	A	A	R	R	U	X	A	X	U	A	U	A	U	R	U	U	B	A	A	-	E	E	G	G	G	S	G
Vinyl Acetate	U	-	U	R	-	U	B	A	U	U	A	B	-	X	X	-	U	U	A	B	-	E	E	G	E	E	G	-
Vinyl Chloride	U	-	U	-	A	-	-	A	U	-	B	C	-	U	U	-	-	U	A	A	-	B	A	-	A	B	-	B
White liquor (Pulp mill)	X	U	R	R	R	-	R	R	R	R	R	R	-	R	R	-	-	-	R	-	-	G	G	S	G	G	-	-
White Water (Paper mill)	R	B	-	-	R	-	R	-	R	-	-	-	-	A	-	-	-	-	A	-	-	A	A	-	-	-	-	-
Xylene	U	A	U	R	R	U	B	A	U	U	A	U	A	U	U	U	U	U	X	A	-	G	G	G	E	G	G	G

This table should only be used as a guide since it is difficult to duplicate operating conditions. To fully guarantee the suitability of a particular material, chemical resistance tests should be conducted under actual operating conditions.

No data was found on the following environmentally important chemicals:

Acenaphthene [(1)]
Acenapthalene [(1)]
Acrolein
Anthracene [(1)]
Benzidine
Benzo(a)athracene [(1)]
Benzo(b)fluoranthene [(1)]
Benzo(g,h,i)perylene [(1)]
Benzo(a)pyrene [(1)]
Bromophenylphenylether
Butylbenzylphthalate
Chlorodibromomethane
Chloroethoxymethane
Chloroethylether
Chloroethylvinylether
Chloroisopropylether
Chloromethylether
Chlorophenylphenylether
Chrysene [(1)]
DDD [(2)]
DDE [(2)]
Dichlorobenzidine
Dichlorobromomethane
Dichlorophenol
Dichlorophenoxyacetic acid
Dichloropropane
Dichloropropylene
Dieldrin [(2)]
Dinitrophenol
Diphenylhydrazine
Endosulfan
Endrin [(2)]
Fluoranthene [(1)]
Fluorene [(1)]
Heptachlor [(2)]
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclohexane
Indeno(1,2,3-c,d)pyrene [(1)]
Isophorone
2-Methylnapthalene
Parachlorometa cresol
Phenanthrene [(1)]
Phenylenepyrene
Pyrene [(1)]
Trichlorophenol
Trichlorophenoxyacetic acid

[(1)] *Component of cresotoe and coal tar. At room temperature and below, these compounds are solid in pure form.*
[(2)] *Pesticides*

TABLE 1.0
CEMENT/BENTONITE SLURRY CALCULATIONS

Product	% Bentonite added/sk cement	Total water requirements (gallons)
Type I Portland (1 sack = 94 lbs)	0	5.2 to 6
	1% bentonite - 0.94 lbs bentonite/sk of cement	5.8 to 6.6
	2% bentonite = 1.9 lbs bentonite/sk of cement	6.4 to 7.2
	3% bentonite = 2.8 lbs bentonite/sk of cement	7 to 7.8
	4% bentonite = 3.8 lbs bentonite/sk of cement	7.6 to 8.4
	5% bentonite = 4.7 lbs bentonite/sk of cement	8.2 to 9
	6% bentonite = 5.7 lbs bentonite/sk of cement	8.8 to 9.6

Boring ID: _____ **Logged By:** _____

Drilled By: _____

Aboveground:
Casing height agl _____

Protective Casing: Aboveground or Flush Mount (circle one)

Flush Mount: Traffic Rated Y or N
Diameter:_____

Surface Pad Diameter:_____

Land Surface

Cement Pad Depth:_____bls

Well Cap: Lockable Y or N

Top of Bentonite Cement Grout:_____bls

Grout Seal: Neat Cement or
Bentonite Cement or Bentonite Slurry (circle one)
_____ # Bags cement (wt/bag _____)
_____ % Bentonite by dry weight

Blank Casing: _____
Diameter: _____
Type: Sch 40 PVC or Stainless Steel (circle one)

Top of Bentonite Seal:_____bls

Bentonite Seal: Pellets or Chips or Slurry (circle one)
_____ # Bags (wt/bag: _____)

Top of Filter Pack:_____bls

Filter Pack:
Type: _____
Size: _____
_____ # Bags (wt/bag:_____)

Top of Screen:_____bls

Screen Casing: _____
Slot Size: _____
Diameter: _____
Type: Sch 40 PVC or Stainless Steel (circle one)

Bottom Cap (length _____)

Bottom of Screen:_____bls

Total Boring Depth:_____bls

Borehole Diameter_____

NOT TO SCALE

Well Construction Details Form

DRAWN	CHECKED	APPROVED	DATE
FILENAME			

ENVIRONMENTAL WORKS

Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in pump and water quality instrument calibration and use
4) Knowledge and understanding of monitoring well construction
5) Knowledge of EWI quality standards
6) Knowledge of corporate Safety requirements and health and safety plan

1.0 OBJECTIVE / SCOPE / APPLICABILITY

This Standard Operating Procedure (SOP) is intended to provide an overview of monitoring well development and establish recommended procedures and documentation for EWI personnel to properly develop a monitoring well.

The purpose of monitoring well development is threefold:

1) To remove fine sediment from the well and screen/filter pack (if installed) that may have been generated during drilling activities;
2) To diminish any smear zone that may be in the well bore as a result of drilling activities; and,
3) To re-establish the normal flow of groundwater through the formation, well screen (if installed), and well bore.

Monitoring wells should be developed within the first 48 hours following well construction. Development is commonly done through the use of a bailer (shallow wells or slow recharge) and/or pump (deeper wells or rapid recharge) to rapidly remove water from the well and allow recharge to occur. Whatever method is employed, it should be repeated until sediment free water is produced. A surge block or jetting may also be used to help loosen and mobilize sediment in a well or filter pack. In the case of open borehole bedrock wells, potable water may be flushed, pumped, or blown into and out of the well to clean out sediment.

Surging involves use of a piston-like device either manually or affixed to the end of a rod. The up-and-down plunging action alternately forces water to flow into and out of the well, similar to a piston in a cylinder. Periods of surging should be alternated with periods of water extraction from the well so that sediment, brought into the well, is removed. Surging should initially be gentle to assure that water can come into the well and that the surge block is not so tight as to damage the well casing or screen.

Development of a monitoring well is considered done when any of the following criteria are met:

1) The water being removed from the well has cleared of suspended sediment;
2) A minimum of 10 well volumes of water have been removed from the well; or,
3) The well is dry and potable water is added, surged, and removed with no inflow of groundwater.

Note: The number of volumes removed during development is **less important** than sediment removal and aquifer restoration.

2.0 EQUIPMENT

Specific equipment needed for monitoring well development/purging include:

a. A work plan outlining development/purging specifications for the project
b. Bailer(s) if using bailing method
c. Water pump if using pumping method
d. Power source (generator or 12 volt battery)
e. Fishing line
f. 5-gallon bucket(s)
g. Polytank or 55-gallon drum(s)
h. Calculator
i. Interface Probe w/ extra batteries
j. Monitoring Well Development Form (see Attachments)
k. Disposable gloves
l. Plastic to place around wellhead if contaminated water is present
m. Decontamination buckets, water, soap, etc.
n. Source of potable water
o. Trash bags
p. Fish hooks and other supplies as contingency for equipment lost in well.

3.0 PROCEDURES

The following should be done in preparation for well development

- Determine appropriate type of purge: (1) bailer for shallow, smaller diameter wells with slow recharge; (2) bailer or pump for shallow, smaller diameter wells with good recharge; (3) pump for deeper wells.
- Plan logistics for setup at wellhead, and for pumping option estimate tubing lengths and order as needed.
- Estimate volumes to be purged for each well and arrange appropriate purge water management (drums, tanks, disposal, etc.). Consider non-hazardous vs. hazardous status and any storage and sampling of purge water that might be required.
- Gather all equipment, materials, and forms needed and verify operational status.

Field Procedures for Bailer-Type Monitoring Well Development

- Conduct on-site safety meeting and organize equipment and materials. Place plastic on ground around wellhead to catch spills and keep in-well equipment clean. Measure initial water level in well and record all information on development form (see attachment).
- Calculate well volume of water based on well diameter and depth, water level, and conversion factors on the well development form.
- Measure appropriate length of fishing line (if used) and securely attach bailer. If using wire reel, attach bailer.
- Drop bailer to the water surface and allow to sink a few feet. Rapidly raise and lower the bailer to create a surge wave that loosens trapped sediment, and raise bailer. Empty in 5-gallon bucket. Repeat action.

- Note time bailing begins, and record the time every gallon of water is removed. The color, visual turbidity, and other physical features should be recorded as well.
- Continue development and data recording until a minimum of 10 well volumes have been removedl, the well goes dry, or water removed from the well has cleared of sediment.

Procedures for use of a surge block to aid in development:

- Surge blocks are sometimes used to supplement well development, and may be a closed, weighted cylinder, or disk or plunger device on a rod. The surge block is built so that it has an outside diameter that is only slightly less than the inside diameter of the well.
- Lower the surge block on cable, rope, or rods to below the level of the screen.
- Gently plunge up and down to mobilize particulates around the well screen.
- Surging should be alternated with bailing or pumping to remove groundwater and sediment brought into the well.
- Repeat several iterations of surging and water removal that cover the entire length of the screen.

Procedures for use of a pump vs bailer for development

For larger diameter or deeper wells, a development pump is normally used to remove water. Specific procedures may vary depending on the type of pump used, but the following procedures will generally apply.

- Plan the pump depth to be able to lower it to the bottom of the screen interval. Measure out a sufficient length of clean discharge tubing and attach to the pump.
- Tubing should be long enough to come out of the well and discharge into a bucket with gallon marks to accurately track volume pumped. Multiple buckets are useful to prevent delays in pumping operation. Drums or a poly tank should be in place to transfer pumped water from buckets.
- Lower pump to near bottom of well, and attach electrical leads from the pump to an appropriate electrical source, or attach to an air compressor if using an air-operated pump. Be sure discharge line is in the first bucket and begin pumping. Note time.
- If pumping rate is adjustable, set to allow constant pumping without running the well dry. Water level should be visually checked or gauged during pumping, and periodically recorded. Record the time each gallon (or more if rapidly pumping) is removed. Note color and turbidity of effluent after each gallon(s) are removed. Record all information.
- If little change in water level occurs, the pump string should be raised and lowered incrementally to cover the length of the wells screen. Depending on the size of the pump and well, the pump can be used as a surging device while pumping.
- Continue development and data recording until a minimum of 10 well volumes have been removed from the well, or water removed from the well has cleared of sediment. If the well is being pumped dry and pumping rates cannot be adjusted, turn off pump and allow the well to recharge between pumping intervals. In this case the well should be surged between pumping intervals. Consider adding potable water to the well to aid in development with surging (will normally require regulatory approval). If potable water is used, the well should be allowed to recharge following the last pumping cycle, and the recharged water pumped out. If time permits, to this at least twice.

Procedures for developing open bore bedrock wells generally involve the following:

- Open bore bedrock wells require very little development; this normally only involves removal of drilling cuttings and dust from the well.
- If the well recharges rapidly, the groundwater can be blown out by using compressed air applied through the drill rods. Alternatively, most drill rigs are equipped with a pump that can remove the water. Two to three well recharge volumes removed normally result in fairly clear return. If not clear, repeat recharge and removal.
- More commonly, bedrock wells recharge very slowly. In this case, potable water can be added to the well bore and blown or pumped out by the drill rig (may require regulatory approval).
- In either case, coordination with the driller is needed prior to mobilization to insure appropriate control, collection, and management of development water. If potable water may be needed, this also needs planned with the driller and a source of potable water identified prior to start of work.

Regardless of the method used for well development, all data should be accurately recorded on an appropriate form. This includes times for known volumes of water removed by bailing, start and stop times for pumping and surging, water levels, water quality changes as development continues, and times and volumes of potable water used, plus final recharged volumes removed. The ending water quality condition and total volumes removed must be recorded.

4.0 SAFETY

Acute or chronic exposure to chemically-contaminated soil or water could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

5.0 REFERENCES

(1) U.S. EPA Environmental Response Team Standard Operating Procedures "*Monitoring Well Development*", October 2001.

(2) "*Corporate Health and Safety Plan*" Environmental Works, Incorporated and Site-specific HASP.

(3) "*HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training*." Safety Source, Inc.

Environmental Works, Inc. SOP No. 7

Monitoring Well Development and Purging

ATTACHMENTS

Well Development Form

ENVIRONMENTAL WORKS

WELL DEVELOPMENT FORM

Well No: _____

Project Name: _____ Date: _____ Time: _____

Project No: _____ Well Type: Monitor Extraction Other: _____

Recorded By: _____ Sampled By: _____

WELL PURGING

PURGE VOLUME:

Casing Diameter (inches): _____

2-inch 4-inch 6-inch Other: _____

Total Depth of Well (TD in feet BTOC): _____

Water Level Depth (WL in feet BTOC): _____

Number of Well Volumes to be Purged (# Vols)

3 4 5 10 Other: _____

PURGE METHOD:

Bailer -Type: _____

Submersible Centrifugal Bladder; Pump No: _____

Other - Type: _____

PUMP INTAKE SETTING:

Near Bottom Near Top Other: _____

Depth in feet (BTOC): _____

Screen Interval in Feet (BTOC) from _____ to _____

PURGE VOLUME CALCULATION:

(_____ - _____) X _____ ^{2} X _____ X 0.0408 = _____ gallons

TD (feet) WL (feet) D (inches) # Vols Cal. Purge Volume

PURGE TIME:

_____ Start _____ Stop _____ Elapsed

PURGE RATE:

Initial _____ gpm Final _____ gpm

ACTUAL PURGE VOL:

_____ gallons

FIELD PARAMETER MEASUREMENTS

Minutes Since Purging Began	pH	Cond. (µmhos/cm)	Temp. C F	Description: well condition, turbidity, color, odor, etc.

Discharge Water Disposal: Sanitary Sewer Storm Sewer Drummed/Retained Onsite

Other (describe): _____

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | April 1992

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EPA

Ground Water Forum

MONITORING WELL DEVELOPMENT GUIDELINES FOR SUPERFUND PROJECT MANAGERS

Ruth Izraeli* Doug Yeskis, Mark Collins, Kathy Davies, Bernard Zavala

The Ground Water and Engineering Forums were established by EPA professionals in the ten EPA Regional Offices. The Forums are committed to the identification and resolution of scientific, technical and engineering issues impacting the remediation of Superfund and RCRA sites. The Forums are supported by and advise OSWER's Technical Support Project, which has established Technical Support Centers in laboratories operated by the Office of Research and Development, Office of Radiation Programs, and the Environmental Response Team. The Centers work closely with the Forums in providing state-of-the-science technical assistance to EPA project managers.

This document provides well development guidelines and recommended additional sources of information. It was developed by the Superfund Ground Water Forum and draws upon U.S. Army Corps of Engineers and draft RCRA SW-846 field protocols. Comments from ORD and Regional Superfund hydrogeologists have been incorporated. These guidelines are applicable to the great majority of sites. However, unusual, site-specific circumstances may require alternative approaches. In these instances, the appropriate Regional hydrogeologist should be contacted to establish alternative development protocols.

Introduction

The goal of ground-water sampling is to obtain water samples that best represent natural undisturbed hydrogeological conditions. Adequate well development is critical to minimize the introduction of biases into the sampling effort. Well development is necessary because every drilling method disturbs the geologic materials around the well bore to some extent. Development processes are used to try to ensure proper hydraulic connection between the well and the geologic materials in the vicinity of the well. This is done by stressing the formation around the screen so that mobile, artifact particulates are removed. This process is necessary to obtain a ground water sample which is as similar as possible to *in situ* conditions.

One of the major goals of well development is to produce a well capable of yielding ground-water samples of acceptably low turbidity. Excess turbidity may alter water quality and result in erroneous chemical analysis (particularly for unfiltered metals samples which require acid preservation).

Turbidity in ground-water samples is minimized by well development. Proper well development creates a graded filter pack around the well screen. When pumping is first initiated, natural materials in a wide range of grain sizes are drawn into the well, producing very turbid water. However, as pumping continues, the natural materials are drawn into the filter, producing an effective filter pack through a sorting process. This sorting process begins when the largest particles of natural materials are retained by the filter pack, resulting in a layer of coarse particles against the well screen. With continued development, this process produces progressively finer layers until an effective graded filter is produced, which then minimizes turbidity. Development is also necessary to remove any foreign materials introduced during drilling, such as drilling water and mud.

These guidelines are directed toward the development of relatively permeable (i.e., $K>10^{-6}$ cm/sec) aquifers. However, it is sometimes necessary to screen wells in water-bearing zones containing significant quantities of silt and clay, which would not normally be considered producing aquifers. Low-yielding wells located in marginal aquifers often cannot be developed using standard methods. For a discussion of the construction and development of wells in low-yielding forma-

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tions, see Aller et al. (1989), Gass (1989), and Paul et al. (1988).

Wells constructed in bedrock may require special protocols. For example, wells constructed as open boreholes (cased to monitored zone) generally should not be developed using a surge block due to the potential for damaging the borehole walls. Bedrock wells constructed with screens may be developed in two stages, before and after the screen is installed. Since bedrock wells may require special development protocols other than those described here for wells in unconsolidated aquifers, Regional hydrogeologists should be consulted when designing bedrock well development procedures.

Finally, it is important to note that there are some hydrogeologic environments, such as fine-grained "marginal" aquifers and karst terraines, where excess turbidity may still exist even after optimizing well construction (e.g., filter pack size and thickness, screen size, drilling technique) and development.

Development Methods

The common methods for developing wells are described by Aller et al. (1989) and Driscoll (1986) and include:

- Overpumping
- Backwashing
- Surging
- Bailing
- Jetting
- Airlift pumping
- Air surging

Well development procedures that have the potential to alter ground-water quality should not be used. Therefore, methods which involve adding water or other fluids to the well, or use air to accomplish development, are not recommended. Generally unsuitable methods for monitoring well development include jetting, airlift pumping, and air surging. However, air development techniques may be used if they offer site-specific advantages over other methods, and extreme care is taken to prevent air from contacting the screened interval. Air development techniques must only be implemented by an experienced operator.

Recommended monitoring well development methods include pumping, overpumping, bailing and backwashing, in combination with some form of surging. The most effective combination and timing of these methods must be determined through field testing, or from experience developing wells in similar hydrogeologic regimes.

Movement of ground water into the well in one direction generally results in bridging of the particles, and a means of inducing flow reversal is necessary to break down the bridging and produce a stable filter. Aller et al. (1989) state that one of the most effective and efficient methods to induce flow reversal is through careful use of a properly-constructed surge block. For a more detailed description of proper usage of a surge block and other methods of achieving flow reversal, see Aller et al.

One example of a well development field protocol is described below:

1. Record static water level and total well depth.

2. Set the pump and record pumping rate and turbidity. Pump until turbidity (as measured by a nephelometer) reaches desired level or stabilizes.

3. Discontinue pumping and surge the well.

4. Measure depth to the bottom of the well. If more than 10% of the screen is occluded by sediments, remove excess sediment by bailing.

5. Reset the pump, recording pumping rate and turbidity. Pump until turbidity reaches desired level or stabilizes. If the well has been properly designed, the amount of pumping required to achieve the desired turbidity level will be substantially less than required in the first pumping cycle.

6. Repeat surging and pumping until the well yields water of acceptable turbidity at the beginning of a pumping cycle. A good way to ensure that development is complete is to shut the pump off during the last anticipated pumping cycle, leaving the pump in place, and restart it some time later. The turbidity of the discharge water should remain low.

The pumping rate used during development must be greater than the highest rate expected to be used during subsequent purging and sampling. In fact, recent field experience suggests that extremely low (i.e., 100 to 500 ml/min) purging and sampling pumping rates may significantly reduce the turbidity of ground-water samples (Puls et al., 1990). The pump intake should be placed close to, or within, the well screen interval.

The development techniques listed above are most efficient in wells with screens having the greatest area open to the aquifer. Therefore, continuous slot, or wire wrapped screens are recommended for use in formations where adequate development is expected

to be difficult. The additional cost of continuous slot screen is typically more than compensated for by significantly less cost in development time and subsequent well purging times.

Development Criteria

Development should continue until clear, artifact-free, formation water is produced. Water quality parameters such as specific conductance, pH, temperature, and turbidity should be measured during development, and should stabilize before development is stopped. Turbidity measurements are the most critical development criteria. Other parameters should be used to provide supplemental information regarding aquifer conditions, and stabilization of these parameters is indicative of the presence of formation water. If water was added during well construction or development, two to three times the volume of water added must be removed. Finally, the well should be producing visually clear water before development is stopped.

Experience has shown that development may take from less than an hour to several days, depending on the formation, development procedures, and well characteristics or construction. In some marginal aquifers such as glacial tills and interbedded sands and clays, it may not be possible to attain the 5 NTUs turbidity target level used as guidance in RCRA. However, poor well construction practices, failure to emplace an adequate filter pack, poor selection of screen slot size and sand pack materials, as well as inadequate development may result in high turbidity levels. In these situations, the PRP or contractor must demonstrate that the well has been constructed properly and all reasonable efforts have been expended to develop the well. The determination of whether to abandon the well or address the turbidity problem during sampling and analysis should be made by the project manager in consultation with a Regional hydrogeologist.

After development is completed, wells should be allowed to stabilize and re-equilibrate before sampling. The time necessary for stabilization depends on the characteristics of the aquifer and the geochemistry of the parameters to be monitored. Generally, high permeability formations require less time (i.e., several days) than low permeability formations (i.e., several weeks).

Development Documentation

Monitoring well development must be thoroughly documented to verify that foreign materials have been removed, formation water is being sampled, and turbidity has reached acceptable levels or stabilized.

The following data should be recorded before and during well development:

1. Date and duration of development

2. Water level from the marked measuring point on the top of casing before and 24 hours after well development.

3. Depth from top of well casing to the top of any sediment present in the well, before, during, and after development.

4. Types and quantity of drilling fluids introduced during drilling and development.

5. Field measurements (e.g., turbidity, specific conductance, pH, dissolved oxygen, temperature) taken before, during, and after well development.

6. Volume and physical characteristics of developed water (e.g., odor, color, clarity, particulate matter).

7. Type and capacity of pump and/or bailer used and pumping rates.

8. Detailed description of all development methods used.

Glossary

Backwashing The surging effect or reversal of water flow in a well that removes fine-grained material from the formation surrounding the borehole. Only formation water is used during this process.

Jetting Bursts of high-velocity water injected into the well.

Overpumping Pumping at rates generally greater than those used during sampling or well purging. Commonly combined with surging of the well.

Surge Block A plunger-like tool, consisting of leather or rubber discs sandwiched between steel or wooden disks that may be soild or valved, that is used in well development.

Surging A well development technique where the surge block is alternately lifted and dropped within the borehole above or adjacent to the screen to create a strong inward and outward movement of the water through the well intake.

Turbidity Solids and organic matter suspended in water.

References

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, D.M. Nielsen, and J.E. Denne, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-water Monitoring Wells: Technology Support Center, Environmental Monitoring Systems Laboratory, EPA600/4-89/034, United States Environmental Protection Agency, 398pp.

Driscoll, Fletcher G., 1986. Ground Water and Wells; Johnson Division, St. Paul, Minnesota, 1089pp.

Gass, T.E., 1989. Monitoring Wells in Non-aquifer Formations, Water Well Journal, v. XXXXII, no. 2, pp. 27-28.

Paul, D., C. Palmer, and D. Cherkauer, 1988. The Effect of Construction, Installation and Development on the Turbidity of Monitoring Wells in Fine-grained Glacial Till. Ground Water Monitoring Review, v. 8, no. 1, pp. 73-82.

Puls, R.W., J.H. Eychaner and R.M. Powell, Colloidal-Facilitated Transport of Inorganic Contaminants in Ground Water: Part I. Sampling Considerations, Environmental Research Brief, USEPA, EPA/600/M-90/023, December 1990.

U.S. Army Corps of Engineers, Missouri River Division, 1990. Installation of Ground-water monitoring wells and exploratory borings at hazardous waste sites, Chapter 6: Well development, pp. 38-44.

Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in operation of pumps, use of bailers, and collecting water samples
4) Knowledge of EWI quality control standards
5) Knowledge of corporate Safety requirements and health and safety plan

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to provide the proper procedure for purging and sampling monitoring wells. Groundwater samples are often tainted with trace quantities of contaminants. When dealing with trace quantities, it is relatively easy to bias a sample through cross contamination, absorption, agitation, etc. The goal of this procedure is to reduce or eliminate sampling bias and collect a representative groundwater sample.

This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. These are standard operating procedures which may be varied as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. This SOP should generally be used only for the sampling of shallow wells installed within the unconsolidated zone. Certain site-specific sampling may require additional data collection or alternate purging/sampling techniques. This procedure does not apply to low flow sampling (see SOP #9). In all instances, the ultimate procedures employed should be documented in field notes and included in the final report.

2.0 SCOPE

Many site inspections and remedial investigations require groundwater sampling within a defined criterion of data confidence or data quality. This necessitates that the personnel collecting the samples are trained and aware of proper sample collection procedures.

Purging, which must be conducted prior to initiating groundwater sampling, is the process of removing standing water in the well, which may not be representative of formation groundwater, and bringing fresh water from the aquifer into the well casing. This is due to standing water being in contact with the atmosphere, which allows the influx of atmospheric oxygen, changing the reduction/oxidation (redox) potential of groundwater, and hence, the solubility of certain dissolved species.

3.0 EQUIPMENT

Some or all of the following equipment is needed for purging and sampling based on project conditions:

a. Submersible pump
b. Tubing
c. Bailers
d. Photo-ionization device (PID)
e. YSI or Hydac meter (if necessary)
f. Power source for pump
g. Fishing line, Teflon coated wire (reel), or appropriate weight cotton string

h. 5-gallon buckets
i. 55-gallon drums or poly tanks
j. Interface probe or water level meter
k. Filtration equipment (if needed)
l. Sample containers and labels
m. Disposable gloves
n. Decontamination supplies
o. Trip blanks & Temperature blanks
p. Chain of custody
q. Cooler and ice
r. Shipping labels
s. Trash bags and Tape
t. Field notes and forms

4.0 PROCEDURE

4.1 Pre-Purge Operation

- Gather all equipment needed, ensure it is working properly, and review well and sampling requirements (well diameter, well depth, screened interval, anticipated contaminants, required analyte parameters, sample container requirements).
- Review and verify correct sample containers and preservatives are available. Check minimum holding times for set of parameter.
- Conduct an on-site safety meeting, documenting on Tailgate Safety Meeting form.
- For below ground vaults, remove any standing water with sponge or bailer prior to removing the casing plug. Containerize the water in a 5-gallon bucket.
- Open all wells and take PID readings, if required, when VOCs with low permissible exposure levels (PELs) are expected. Note if the well was pressurized, and let it stabilize for 15-30 minutes prior to gauging.
- Gauge total depth and depth to water/free product and record on a Water Level Record form. Contact the Project Manager for further instruction if free product is present and contingency procedures have not been established.

4.2 Purging Operations

- Calculate the amount of water to purge from each well. A single well volume equals the water level subtracted from the total depth, multiplied by a casing volume per foot factor for the appropriate diameter well (see Attachment). Normally, a minimum of 3 well volumes should be purged.
- If purging with a submersible pump, decontaminate the pump and tubing per EWI standard procedures.
- Slowly lower the pump and attached tubing into the top of the standing water column and not deep into the column. This is done so that the purging will pull water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed.

- Attach the pump to a power source and allow purge water to drain into a bucket or 55-gallon drum. Measure the water level (and record with time noted) while pumping, and lower the pump as the water level decreases.
- If purging with a bailer, securely fasten the bailer to the line/wire/string. When removing the bailer, keep the line/wire/string over plastic (if used) and prevent it from touching the ground. Using coated wire on a reel simplifies this procedure.
- Whether using a pump or bailer, remove three well volumes before sampling – there are two exceptions that may apply to certain project-specific requirements:
    - If specified by the workplan, an adequate purge may be achieved when the pH, specific conductance or ORP, temperature, and turbidity of the groundwater have stabilized. This can be determined by using a YSI or Hydac meter when using a pumping method of purging. Connect the pump input to the YSI unit. Once a steady flow is achieved, begin writing down the readings for the parameters above. Continue to write down readings once every 2-3 minutes noting the time, until the values are within 10% of the previous values. When this occurs, an adequate purge has been achieved even if three well volumes have not been removed.
    - Wells with slow recovery might be purged to dryness. If this occurs, all water should be removed from the well. Once done, sample as soon as there is sufficient volume in the well for the parameters to be analyzed. If the well does not sufficiently recover within the same day as purged, it should be checked and sampled the following day. Record all times and water levels measured during this procedure.
- In all cases regardless of technique, incremental volumes purged and times should be accurately recorded. The final, total purge volume removed should be noted. See example forms in the Attachments.
- Following purging activities at each well, decontaminate all reusable equipment and discard disposable equipment.
- Procedures used to sample temporary wells will differ from permanent wells if temporary wells are installed for immediate sample acquisition. As such, water is not stagnant, but will normally have a high level of turbidity. Temporary wells should be developed sufficiently to remove sediment-laden water and water disturbed by drilling. As such, this development can serve as a purge for sampling. However, the longer a temporary well is in place and not sampled, the more stagnant the water column becomes and the more appropriate it is to apply standard well purging criteria to achieve representative aquifer conditions.
- Purging generates quantities of purge water classified as investigation derived waste (IDW), the disposition of which must be considered. Disposal of this waste must be in accordance with EWI standard procedures.

4.2 Sampling Operations

- Groundwater sampling should be conducted immediately following the purging activities described above. Clean disposable gloves should be utilized for each well.

- Measure and record the water level and time just prior to sampling. Use a new bailer to collect samples, and sample wells from least to most contaminated. Decontaminate all equipment after each well sampled. New gloves, a new bailer, and fresh string or line should be used for each well.
- When sampling with a disposable bailer, slowly immerse the bailer into the top of the water column. This is particularly important in order to minimize turbidity and disturbance of volatile organic constituents. Improper use may result in an unrepresentative sample
- When sampling volatile constituents, do not open the sample container until immediately prior to sampling. Do not touch the inside of the sample container. Slowly fill sample containers, using slow, laminar flow (not turbulent) from the bailer to avoid aeration. Fill sample containers with just enough water to form a meniscus. Do not overfill to spillage, as this depletes preservative in the container.
- If sampling for dissolved metals analysis, filter the water before sampling using a 0.45 µm filter and pump mechanism. Filtering is performed by collecting approximately 500 mL in a clean, unpreserved plastic bottle and using a hand pump to pump the sample from this container through the in-line filter into a new 500-mL sample container. Approximately 1/10 Liter (100 mL, or slightly less than 3 VOA containers) of water should be pumped through the filter and disposed of before sample collection.
- If specified, collect a "duplicate sample": an extra sample collected from a well. The duplicate and original should be virtually the same water, collected at the same time and location, using the same sampling techniques. Duplicate samples are used to evaluate the precision of the overall sample collection and analysis process. The location and sample ID of the duplicate should be noted in the field notes and sample log, and it should be labeled with a coded sample identity on the chain of custody.
- Cap the container and fill out a label for the sample, using waterproof ink, including the name of sampler, date, time, unique sample ID, and analysis desired. Place the label around the sample container, partially over the cap, creating a custody seal.
- Place all samples, including trip blanks and temperature blanks, in zip lock plastic bags and put them in a cooler with ice. Use cushioned packs/sleeves for glass sample bottles (supplied by the lab if requested).
- Fill out sampling information on an appropriate sample form (see Attachments), to include: Sample ID, time collected, color, odor, method of collection, water level, PID reading (if applicable), and any measured parameters (pH, temperature, conductivity).

4.3 Post-Operation

- Close all wells, replace locks, and secure lids.
- Fill out chain of custody per EWI SOP and place in a Ziploc bag (taped to the inside lid of the cooler). Ensure that each cooler contains sufficient ice for proper temperature and enough packing material to prohibit breakage of containers.
- Tape the cooler and place signed custody seals and shipping labels on the outside of the cooler. If present, tape the drain valve shut.

- Record all pertinent information in the Sampling Form (see Appendix A) and Field Notes. This should include purge volumes, observations made during sampling, water quality parameters, any needed well repairs, and the fate of purge water. Complete all other paperwork as required for the project.

5.0 SAFETY

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) for anticipated hazardous substances before the initiation of well purging and sampling.

Conduct an on-site safety meeting each day before the start of the project. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, PPE required, health monitoring and action levels, emergency procedures, other physical or chemical hazards) using a Tailgate Safety Meeting form and have all personnel sign it each day before the start of the project. Take appropriate action if personnel are injured on-site in accordance with EWI directives.
When working with potentially hazardous substances, follow the U.S. Environmental Protection Agency, Occupational Safety and Health Administration, the Environmental Works, Inc. "Corporate Health and Safety Plan" guidelines, and the Site-Specific Health and Safety Plan.

6.0 REFERENCES

To properly implement this procedure, please look to the following documents for further information related to this SOP.

- "*Corporate Health and Safety Plan*" Environmental Works, Incorporated.
- U.S. Environmental Protection Agency Science and Ecosystem Support Division, "*Groundwater Sampling*", November 2007.

Environmental Works, Inc. SOP No. 8

Groundwater Sampling – Pump or Bailer Purge

ATTACHMENTS

Calculating Well Volumes

Calculating Well Volume

Prior to the development or purging of a groundwater monitoring well, the volume of water in either the well casing or well annulus (if it is an uncased or partially cased well) must be determined. A construction diagram of a typical monitoring well illustrating the well casing and other components is shown on the following page.

To calculate the volume of water in a well, the following information is required:

(1) Total Depth of the well (to the nearest 0.10 foot)
(2) Depth to the water (to the nearest 0.10 foot)
(3) Inside diameter of well casing or annulus (in inches)

Once the above information has been obtained, calculate the volume of water by subtracting the depth to water (DW) from the total depth (TD), then multiply the number with the appropriate casing/annulus conversion number (see below). The formula is:

(TD – DW) X Conversion Number = Volume of water in a well

Conversion numbers express the gallons of water that can occupy one foot of schedule40 PVC pipe (gallons per linear foot).

Common Well Conversion Numbers

Well Diameter (inches)	Gallons per Foot
1.25 inches	0.08
2 inches	0.17
3 inches	0.38
4 inches	0.66
6 inches	1.5
8 inches	2.6
12 inches	5.81

Once you have calculated the volume of water in each well, multiply the volume of water by however many well volumes you need to purge from the well (10 for development and 3 for purging).

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Springfield, Missouri 65802
Office: 417-890-9500
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GROUNDWATER SAMPLING LOG

PROJECT NAME: _____

PROJECT NO: _____ **EVENT:** _____

DATE: _____ **TIME:** _____ **PERSONNEL:** _____

WELL ID: _____ **WELL DIAMETER:** _____ **SAMPLE ID:** _____

PURGING DATA

WATER LEVEL: _____ **WELL TD:** _____ **FT WATER IN WELL:** _____ X FACTOR* = _____ **GALLONS**

EVACUATION METHOD: _____ **TOTAL GAL PURGED:** _____

***FACTOR: 2" diam well = 0.2 3.5" diam well = 0.5 4" diam well = 0.7 6" diam well = 1.5 8" diam well = 2.6**

PURGING PARAMETER MEASUREMENTS

TIME	VOLUME	COLOR	ODOR	TEMP	pH	DO%	COND	

SAMPLING DATA

(fill in blanks or circle as appropriate)

SAMPLING METHOD: _____ **DATE:** _____ **TIME:** _____

ANALYTES: VOC TPH-DRO TPH-GRO TPH-ORO Oxygenates METALS Other _____

CONTAINER: 40 ml VOA (#____) 1 L Amber Glass (#____) 250 ml Poly (#____) 500 ml Poly (#____)

PRESERV. None Hydrocloric Acid Sulfuric Acid Nitric Acid Na Thiosulfate

APPEARANCE: _____ **COLOR:** _____ **ODOR:** _____

DUPLICATE COLLECTED? ____ **ID:** _____ **SPLIT SAMPLE?** ____ **FOR WHO?** _____

SAMPLING NOTES:

Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in operation of pumps and collecting water samples (see SOP #8)
4) Knowledge of EWI quality control standards
5) Knowledge of corporate Safety requirements and health and safety plan

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to provide a framework for collecting groundwater samples using a low flow purging and sampling procedure in order to collect samples representative of the formation water from the aquifer's identified zone of interest with minimum stress on the aquifer. The technique minimizes chemical changes that can occur as a result of traditional "purge and sample" techniques, and greatly reduces the amount of purge water to be managed. See the attached article by Kaminski for further information.

This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. Low flow sampling procedures allow little departure from procedural standards. If site conditions or equipment issues limit adherence to the procedures, any variance needs to be discussed with the project manager and recorded in field notes. The ultimate procedures employed should be documented in field notes and in related reports.

2.0 SCOPE

This SOP outlines the procedure needed to provide samples indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The low flow method minimizes aquifer stress by using reduced pumping rates at or below groundwater recharge rates to minimize alteration of water chemistry. This SOP is aimed primarily at 2" or larger diameter monitoring wells that have either a short (less than 10 feet) screen length or monitoring interval (if open bore), or have identified target horizons to be monitored. This procedure can be used in a variety of well construction situations. As with all groundwater sampling, this procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs).

3.0 EQUIPMENT

All equipment will be calibrated per manufacturer specifications. Specialized equipment is needed for the Low Flow procedures (see below and attached Low Flow Equipment sheet). The following specifies the QED "Sample Pro" pump and MP-10 controller currently used by EWI:

a. QED Sample Pro Low Flow Sampling pump kit including wellhead support plate
b. QED MP-10 Controller kit (3 AA batteries), blue & red air lines with fittings
c. Disposable bladders (one per sample) and push grab plate (one per sample)
d. Double ¼" air/discharge tubing (enough length for wells)
e. Single ¼" or ½" tubing for discharge from YSI
f. Cable or 50-lb test fishing line backup to hang pump (sufficient length for wells)
g. 5-gallon buckets (one graduated in gallons)
h. 55-gallon drum(s) (enough to hold expected purge water) and large funnel

i. Interface probe (capable of measuring to 0.01 foot accuracy)
j. YSI meter (or equivalent) for measuring pH, Eh, dissolved oxygen, specific conductance, ORP, and temperature, calibration fluids (4 C-cell batteries if YSI)
k. Turbidity meter (4 AA batteries), bottles in kit, & calibration fluid
l. Photoionization detector (PID), calibrated and charged battery
m. Wheelbarrow compressor or bottled nitrogen tank & regulator, and hose
n. Decontamination supplies (non-phosphate detergent, distilled water)
o. Tool kit (basic tools, incl knife to cut tubing) & tools to open well covers
p. Plastic sheeting and knife
q. Folding plastic table
r. Key for well locks
s. Nitrile gloves
t. Sample bottles, labels, baggies, tape
u. Cooler, Chain of Custody (COC) forms, Shipping labels
v. Low Flow sampling field forms and field notes

5.0 PROCEDURE

5.1 Pre-Operation

1. Review project objectives and desired analytes, and order appropriate bottles, coolers, COCs, and shipping materials from the laboratory at least one week prior to the field event.
2. Utilized the attached "LoFlowPlanCalc" Excel sheet to plan out tubing lengths needed for each well and total purge volumes to expect. Tubing for each well = pump depth plus 4-5 ft.
3. QED bladders, push fitting grab plate, and tubing need to be ordered a minimum of one week prior to the field event. Gather and check all equipment needed. Insure you have spare batteries for the QED controller, YSI, and flowmeter.

5.2 Field Procedures

1. Mobilize to site, and conduct and record an on-site safety meeting (do each morning). Review planned sampling well order for the day.
2. Visit all wells, remove well J-plug and immediately take PID readings, and record on field sampling sheet (see attachment).
3. Measure water level after stabilization (minimum of 15 minutes) and record on field sample sheet. Check water level against sample plan (LoFlowPlanCalc sheet) to verify appropriate pump placement.
4. Note: If NAPL present, contact the project manager for direction on handling that well.
5. Utilize the attached "LowFlowSampling-OnePage" sheet to aid in setting up for sampling. Cut appropriate size plastic and position around wellhead. Set up folding table and organize equipment; set up YSI in shade area (block with cardboard, etc.) to avoid solar heating.

6. Calibrate YSI and flowmeter. Install bladder and grab plate inside pump. Cut dual ¼" tubing to length for that well and affix to pump by pushing into grab plate (note "A" for air and "D" for discharge tubing).
7. Tie off 50-lb fishing line to pump and lower pump to pre-determined depth. Lower gently to minimize disturbances in the well.
8. Thread tubing through wellhead support plate and tie off fishing line as backup for pump loss.
9. Connect ¼" air tube from pump to blue airline fitting. Hook up blue airline to controller and red airline to air source (compressor or nitrogen tank).
10. Connect ¼" discharge tube from pump to bottom YSI fitting, using ½" tubing as adapter if necessary. Connect single discharge line from upper YSI fitting to flow into graduated 5-gallon bucket.
11. Thread interface probe through wellhead support plate and verify water level. Raise to just above water level and turn off to conserve battery.
12. Calculate submergence (pump depth minus water level) and set MP-10 controller to no more than 10-15 psi above the submergence amount (If submergence <5 ft, do not exceed 18-20 psi on MP-10 controller).
13. Set MP-10 controller to 4 cpm (cylces per minute) and record ID (103). Start air compressor or open regulator on nitrogen tank.
14. Start the pump by selecting CYCLE on the MP-10. Watch for water to enter discharge tubing and fill YSI.
15. Check water level once discharge begins. If water level drop approaches 0.33 ft, use DOWN arrow to lower flow rate or change the CPM to 3 or 2 CPM. Note: anytime you change the flow rate, record the ID on the sample field form. Note flow rate by recording volume in calibrated 5-gallon bucket and times one gallon, etc. are reached.
16. If drawdown exceed 0.33 ft, stop pump and allow time for well to recover. Then restart pump at lower rate. If adjustments result in a minimal discharge that still results in drawdown exceeding 0.33 feet, but remains stable, continue purging but record detailed information in field notes. Measure and record water levels between YSI readings to verify minimal drawdown.
17. Once YSI cell fills with water, start monitoring indicator field parameters: temperature, specific conductivity, ORP, pH, and dissolved oxygen. Record every 5 minutes until parameters begin to stabilize, then record every 3 minutes.
18. Use cuvette vial for flowmeter to collect water from YSI discharge, clean outside of vial with alcohol solution (in flowmeter kit), place in flowmeter, and measure and record reading with every YSI reading set.
19. Purging is considered complete and sampling may begin when indicator field parameters have stabilized. Stabilization is achieved when three consecutive readings, taken at three to five minute intervals, are with the following limits:

- Turbidity = 10% for values greater than 1 NTU
- Dissolved oxygen = 10%
- Specific conductivity or ORP = 3%
- Temperature = 3%
- pH = ± 0.1 unit

20. Collect water samples after stabilization is verified. Collect samples at the same low flow rate. On the MP-10 controller, use the PAUSE function, and collect samples from the discharge tubing PRIOR to entry into the YSI cell. Fill appropriate bottles, beginning with VOCs. Measure and record water level during sampling to verify drawdown criterion is maintained.
21. Label all samples, using waterproof ink, including the sample ID, date, time, sampler name, and analysis desired. Place inside plastic baggie and put in cooler with ice. Record all information on sample field form.
22. Stop compressor/turn off air and allow air lines to purge (check pressure gauge). Decontaminate equipment between wells. Disassemble pump and dispose of bladder, tubing, and grab plate. Wash pump decontaminating solutions from buckets.
23. Collect rinsate blank, if part of sampling QA/QC, near end of sampling event. Collect field blanks, if part of sampling QA/QC, during sampling event.

5.3 Post-Operation

1. After each well is sampled record total purge volume and place purge water into a 55-gallon drum for disposal per project planning.
2. When ready to ship samples, fill out the COC, place it in a zip lock plastic bag, and tape it to the lid of the cooler (see EWI SOP#5). Tape the cooler and place signed custody seal and shipping labels on the outside of the cooler.
3. Return equipment to the Equipment Room, noting any malfunctions or issues.
4. Verify all field sample sheets and progress notes are complete, fill out a Daily Equipment Log, and return all paperwork to the Project Manager.

6.0 SAFETY

Acute or chronic exposure to chemically-contaminated soil or water could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

7.0 REFERENCES

The following documents may be reviewed for further information appropriate to this SOP.

- U.S. Environmental Protection Agency Region I, "*Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*", SOP # GW 0001, DATE: 7/30/1996, REV. #2.
- U.S. Environmental Protection Agency, Ground Water Issue, "*LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES*," EPA/540/S-95/504, April 1996.
- ASTM Standard D6771
- Kaminski, David, "*Low Flow Ground Water Sampling: What does the sample represent?*"
- Richey, Joe, 2002, "*Low Flow Purging and Sampling Groundwater*", ASTM Standard News
- Technology Overview of Passive Sampler Technologies (Section 2), ITRC, March 2006. With pp. 35-36 from 2007 ITRC document on *Protocol for Use of Five Passive Samplers*
- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- Site Specific Health and Safety Plan

ATTACHMENTS

Low Flow Planning Spreadsheet

Low Flow Equipment List – Single Page

Low Flow Procedure – Single Page

Low Flow Groundwater Sampling Form

Article: "Low Flow Groundwater Sampling:
What Does the Sample Represent?"

LOW FLOW SAMPLING SETUPS
MONITORING WELLS
_____ Site

Monitor Well ID	TD (Ft BTOC)	Water Level (Ft BTOC)	2" Casing Volume (gal)	Top Screen (FtBTOC)	Pump Depth BTOC	Tubing Length (ft)
Example	11.98	3.1	1.5	4.0	7.0	11
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
			0.0			
	Total Volume		1.5	**Total tubing needed**		**11**

Pump depth is 1/3 submergence

Tubing Length includes 4 ft TOC to YSI

Low Flow Sampling Volume Calculation

Time to Purge (min)	Volume @0.2 l/min	Volume @0.4 l/min
15	0.7 gal	1.3 gal
25	1.1 gal	2.2 gal
35	1.5 gal	3.1 gal
45	2.0 gal	4.0 gal
55	2.4 gal	4.8 gal

Low Flow Sampling Equipment List

Equipment	Quantity	Comment
Low Flow Sampling pump kit (extra bladders and parts)	1 kit	
MP-10 Controller kit (3 AA batteries)	1 kit	
Double ¼" air/discharge tubing (enough length for wells)	roll	Need new tubing for each well
Single ¼" or ½" tubing for discharge from YSI (sm spool)	3-5 ft	Can re-use between wells
Pump wellhead support bracket	Set	Modified as needed for size of casing
Tool kit (basic tools, incl knife to cut tubing)	1 kit	
Blue air line with fittings	set	
Red air line with fittings	set	
50-lb test fishing line (sufficient length for wells)		Backup to hang pump
YSI meter/case/calibration fluids (4 C-cell batteries)	set	
YSI pH 4, 7, 10 and conductivity calibration fluids; Confidence Solution if available	set	
Turbidity meter & calibration fluid (4 AA batteries)	set	
"Y" connection for ¼" discharge line (split YSI / turbidity)	1	Optional – can just use flow cell discharge
Interface probe	1	
Wheelbarrow compressor	1	
5-gallon buckets, one marked in gallons	2	
Plastic sheeting / knife	roll	
55-gallon drums / funnel	1-2	
Decon buckets & soap	set	
Nitrile gloves	3	
Sample bottles, Coolers, ice	As req'd	
Logging – sampling forms	set	
Folding table (optional)	1	

Low Flow Sampling Procedure

1. Divide preparation and setup tasks. For first well of the day:
   - Person #1measure and record water levels; prepare pump, tubing, etc. and organize equipment around wellhead (see picture for set-up). Set up with YSI flow through cell location in shade. Set compressor close to well in downwind location and start up to build air pressure in tank. Set up MP-10 controller with red air line from compressor to AIR IN port on MP-10 controller. Install blue air line in AIR OUT port on MP-10.
   - Person #2 calibrate YSI (daily) and Turbidty Meter (monthly). Install pH probe from separate vial. Save YSI probe storage fluid and pH probe vial fluid (use poly bottles in case). If available, use YSI confidence solution to check previous day's YSI calibration and calibrate only needed parameters. Calibrate % DO first, then Conductivity, then pH.
2. Assemble Lo-Flow pump with new bladder and tubing grab plate, verify O-ring placements. Verify tubing length for well (pump depth + 4 to 5 ft), and measure and cut if not previously prepared. Insert tubing into pump, noting which tube is in "A" (airline) and "D" (discharge) openings on pump, and verify secure. Tie off pump with 50-lb test fishing line and lower into well to desired depth. Cut fishing line and tie off on wellhead support plate. Separate dual air/discharge tubing and thread through wellhead support plate. Place wellhead plate on casing. Connect ¼" air line from pump into blue air line fitting. Connect ¼" pump discharge line to bottom port on YSI flow-through cell using clear plastic adapter tubing. Connect YSI discharge tubing from top port on YSI to discharge to 5-gallon bucket.
3. Thread interface probe through plate opening verify water level; record on log. Raise probe to just above water level and turn off to conserve battery.
4. Check pump submergence (pump depth minus water level) and set MP-10 controller no more than 10-15 psi above the pump's submergence on MP-10 gauge. Note: If submergence < 5 ft, do not exceed 18-20 psi on MP-10 gauge.
5. Set MP-10 controller to 4 CPM (ID 103) and record ID setting (e.g., "103") under FLOW RATE on log. Record the ID number anytime you change the CFM or UP/DOWN arrows.
6. Hit CYCLE on MP-10 controller to begin pumping. Watch for water movement in tubing, and for YSI to fill. Do not begin recording YSI parameters until cell has been full for 3 min.

   Note: for Amory, MS, initially set the controller on CPM 6 & max flow. It's OK to get a drop in water level for the first 5-10 minutes since at least one well casing volume must be removed. Carefully monitor water level but YSI parameters need not be monitored. After 5-10 min, reduce CPM to 3 or 4, and record low flow parameters with stable water level
7. Check water level once pumping begins to insure drop is < 0.33 ft. If approaches 0.33 ft drop, use DOWN arrow to lower flow rate, or use CPM ◄► to change MP-10 CPM to 3 or 2.
8. Record YSI readings every 5 minutes initially, checking water level. Note if any bubbles occur in YSI flow through cell. After first 15-20 minutes, or when values appear to be stabilizing, record every 3 minutes. Record TEMP, pH, DO%, COND.
9. Use cuvette vial from Turbidity Meter and collect sample from YSI discharge at each recording. Wipe outside of cuvette, check in Turbidity Meter, and record with YSI readings.
10. Measure water levels between reading events to insure stable (less than 0.33 ft drop).
11. Carefully check stabilization criteria on Log. When ALL parameters are within criteria for three consecutive readings, sampling can be done.
12. Sample at the same low flow pump rate - use PAUSE function on MP-10. Sample from discharge tubing before YSI flow thorough cell. Verify stable water levels during sampling activities.
13. Disassemble pump, decon wash/rinse, and install new bladder between wells.

Low Flow Sampling Procedure

1. Divide preparation and setup tasks. For first well of the day:
   - Person #1measure and record water levels; prepare pump, tubing, etc. and organize equipment around wellhead (see picture for set-up). Set up with YSI flow through cell location in shade. Set compressor close to well in downwind location and start up to build air pressure in tank. Set up MP-10 controller with red air line from compressor to AIR IN port on MP-10 controller. Install blue air line in AIR OUT port on MP-10.
   - Person #2 calibrate YSI (daily) and Turbidty Meter (monthly). Install pH probe from separate vial. Save YSI probe storage fluid and pH probe vial fluid (use poly bottles in case). If available, use YSI confidence solution to check previous day's YSI calibration and calibrate only needed parameters. Calibrate % DO first, then Conductivity, then pH.
2. Assemble Lo-Flow pump with new bladder and tubing grab plate, verify O-ring placements. Verify tubing length for well (pump depth + 4 to 5 ft), and measure and cut if not previously prepared. Insert tubing into pump, noting which tube is in "A" (airline) and "D" (discharge) openings on pump, and verify secure. Tie off pump with 50-lb test fishing line and lower into well to desired depth. Cut fishing line and tie off on wellhead support plate. Separate dual air/discharge tubing and thread through wellhead support plate. Place wellhead plate on casing. Connect ¼" air line from pump into blue air line fitting. Connect ¼" pump discharge line to bottom port on YSI flow-through cell using clear plastic adapter tubing. Connect YSI discharge tubing from top port on YSI to discharge to 5-gallon bucket.
3. Thread interface probe through plate opening verify water level; record on log. Raise probe to just above water level and turn off to conserve battery.
4. Check pump submergence (pump depth minus water level) and set MP-10 controller no more than 10-15 psi above the pump's submergence on MP-10 gauge. Note: If submergence < 5 ft, do not exceed 18-20 psi on MP-10 gauge.
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6. Hit CYCLE on MP-10 controller to begin pumping. Watch for water movement in tubing, and for YSI to fill. Do not begin recording YSI parameters until cell has been full for 3 min.

   Note: for Amory, MS, initially set the controller on CPM 6 & max flow. It's OK to get a drop in water level for the first 5-10 minutes since at least one well casing volume must be removed. Carefully monitor water level but YSI parameters need not be monitored. After 5-10 min, reduce CPM to 3 or 4, and record low flow parameters with stable water level
7. Check water level once pumping begins to insure drop is < 0.33 ft. If approaches 0.33 ft drop, use DOWN arrow to lower flow rate, or use CPM ◄► to change MP-10 CPM to 3 or 2.
8. Record YSI readings every 5 minutes initially, checking water level. Note if any bubbles occur in YSI flow through cell. After first 15-20 minutes, or when values appear to be stabilizing, record every 3 minutes. Record TEMP, pH, DO%, COND.
9. Use cuvette vial from Turbidity Meter and collect sample from YSI discharge at each recording. Wipe outside of cuvette, check in Turbidity Meter, and record with YSI readings.
10. Measure water levels between reading events to insure stable (less than 0.33 ft drop).
11. Carefully check stabilization criteria on Log. When ALL parameters are within criteria for three consecutive readings, sampling can be done.
12. Sample at the same low flow pump rate - use PAUSE function on MP-10. Sample from discharge tubing before YSI flow thorough cell. Verify stable water levels during sampling activities.
13. Disassemble pump, decon wash/rinse, and install new bladder between wells.

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LOW FLOW WELL SAMPLING LOG

WELL: _____

PROJ. NAME/NO.: _____

DATE: _____ **TIME:** _____ **PERSONNEL:** _____

WATER LEVEL: _____ **WELL TD:** _____ **PUMP DEPTH:** _____ **MODEL:** _____

LOW FLOW PURGING DATA

TIME	FLOW RATE	COLOR	ODOR	W. LEVEL	TEMP	pH	DO%	ORP	COND	TURBID
TARGET CRITERIA FOR STABLIZATION				**0.33' diff**	**10%**	**0.1**	**10%**	**10%**	**3%**	**10%**

SAMPLING DATA

(fill in blanks or circle as appropriate)

VOLUME PURGED: _____ **DATE/TIME COLLECTED:** _____/_____ **SAMPLE ID**: _____

ANALYTES: VOC TPH-DRO TPH-GRO TPH-ORO Oxygenates PAH METALS Other _____

CONTAINER: 40 ml VOA (#____) 1 L Amber Glass (#____) 250 ml Poly (#____) 500 ml Poly (#____)

PRESERV. None Hydrocloric Acid Sulfuric Acid Nitric Acid TSP

APPEARANCE: _____ **COLOR:** _____ **ODOR:** _____

DUPLICATE COLLECTED? ____ **ID:** _____ **SPLIT SAMPLE?** ____ **FOR WHO?** _____

SAMPLING NOTES:

Low-Flow Ground Water Sampling: What does the sample represent?

David Kaminski
QED Environmental Systems Inc.
Ann Arbor, MI / Oakland, CA

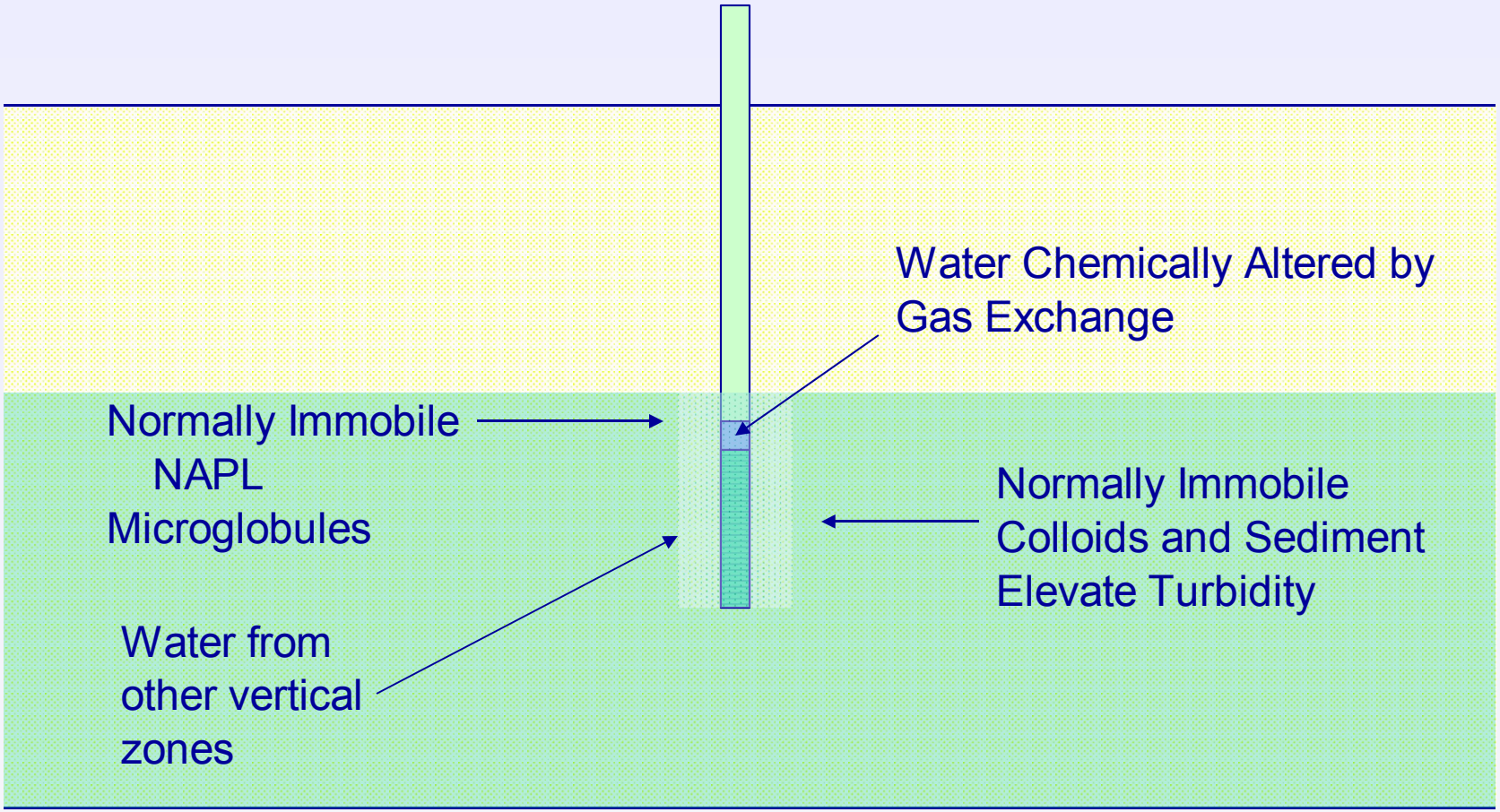
QED
Environmental Systems

Early research into purging resulted in guidelines to purge wells to remove “stagnant” water

- Where wells would produce sufficient water, the “rule of thumb became “3 to 5 well volumes” prior to sampling.
- Where wells would not yield sufficient water, they were evacuated and sampled upon recovery, typically within 24 hours.
- In practice, little concern was given to how purging methods and devices (e.g., bailers) affected the chemistry of subsequent ground water samples.

QED Environmental Systems

What does the sample represent with traditional purging methods?



QED Environmental Systems

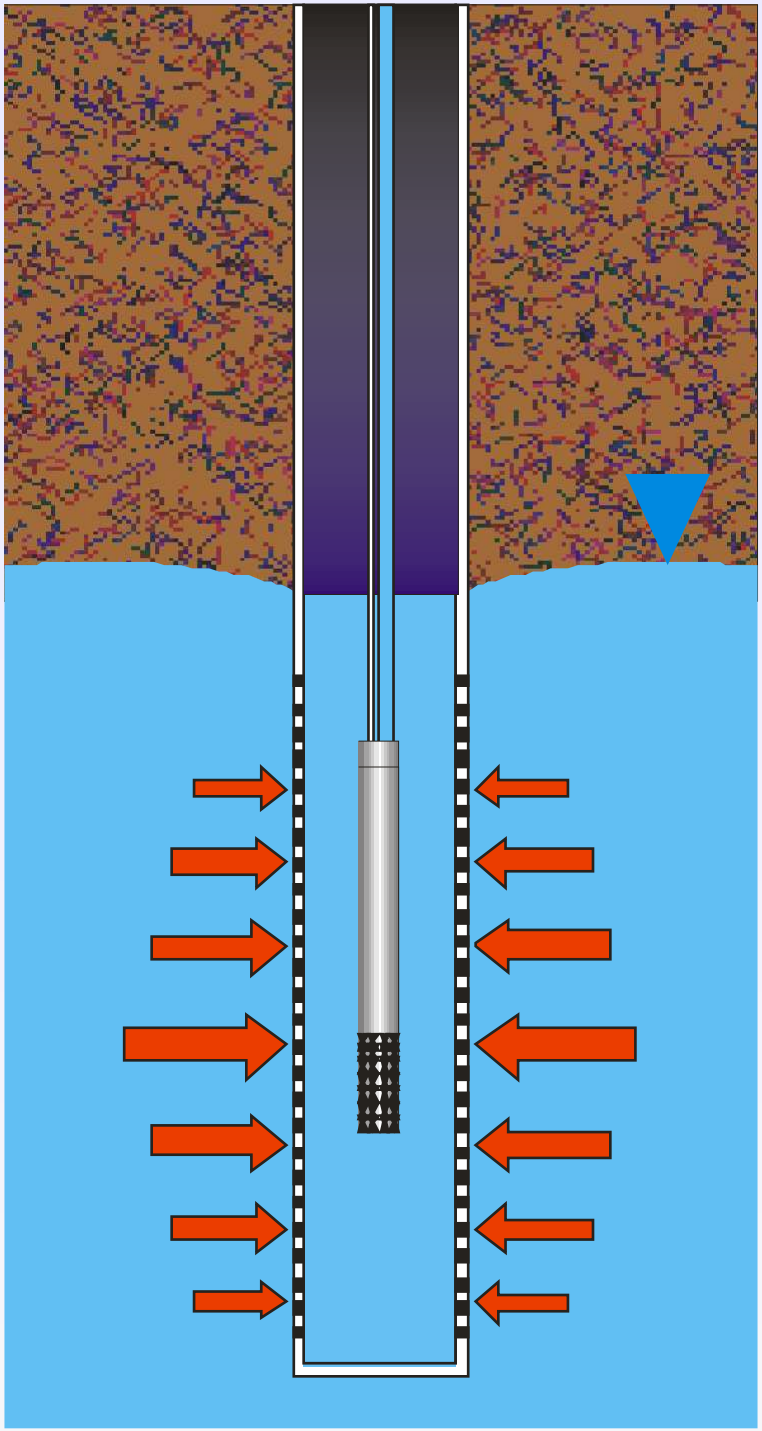
Limitations in traditional purging methods led to the evolution of low-flow purging

- Low-flow purging and sampling is a methodology that reduces disturbance to the well and aquifer typically caused by bailing or over-pumping.
- Contrary to popular belief, the development of the low-flow purging approach was based on a need to control artifactual turbidity, not to reduce purge water volumes.
- Low-flow pumping from the well screen controls turbidity that could affect analytical results.
- Because turbidity is low, unfiltered samples can be used to get a better estimation of the true mobile contaminant load.
- Purge volume is based on indicator parameter stabilization or evacuation of the sampling system.

QED Environmental Systems

Low-Flow Sampling

- Low pumping rate minimizes drawdown, mixing and formation stress, isolates stagnant water.
- Low stress = low turbidity, improved sample accuracy, reduced purge volumes.
- Samples represent formation water and naturally mobile contaminants, not stagnant water in the well or mobilized contaminants.



What Does a Low-Flow Sample Represent?

- While low-flow sampling is recognized as a solution for improving sample quality and reducing purge water volume, defining what the sample represents, in terms of the zone within the well screen that is sampled, is still often questioned.
- Pump placement can be an issue when changing to LFS from traditional purging; the concern is that samples will come from a narrow zone within the well screen, possibly “missing” contamination above or below the pump intake.
- Field experiments, laboratory simulations and numerical modeling support the position that samples are derived from the entire screen zone under low-flow pumping conditions.

QED Environmental Systems

Vertical Concentration Profiles from Puls and Paul, 1998

- In a field study, Puls and Paul found that well bore concentrations were averaged throughout the well screen zone under very low flow pumping conditions (0.25 lpm) where analyte concentrations were known to be measurably stratified within the surrounding formation.
- The concentrations from low-flow samples were virtually identical to the mean concentration of the multi-level and direct-push samples taken.
- Bailed sample concentrations were biased lower than the low-flow pumped sample results.

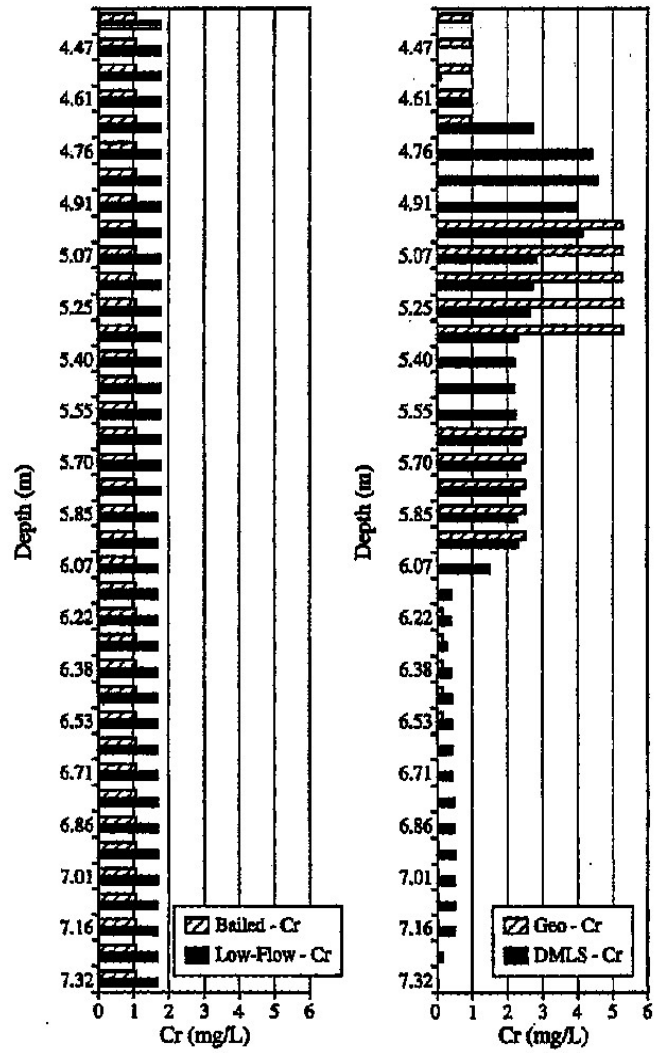


FIG. 6. Chromium Data for Samples Collected Using DMLS, Low-Flo, and Bailed Sampling Approaches for Well 45 in September 1995

MODFLOW Simulations

- MODFLOW computer simulations with high vertical definition by Varljen, et al. (GWMR, Winter 2006) show that flow across a well screen, regardless of pump placement, captured water from the entire well screen zone.
- The objectives of the modeling experiment were to demonstrate the actual monitoring zone achieved during low flow purging and sampling and assess the effects of:
  - screen length
  - pumping rate
  - pump position in screen
  - sand pack configuration
  - formation heterogeneity and anisotropy
  - full vs. partial screen penetration

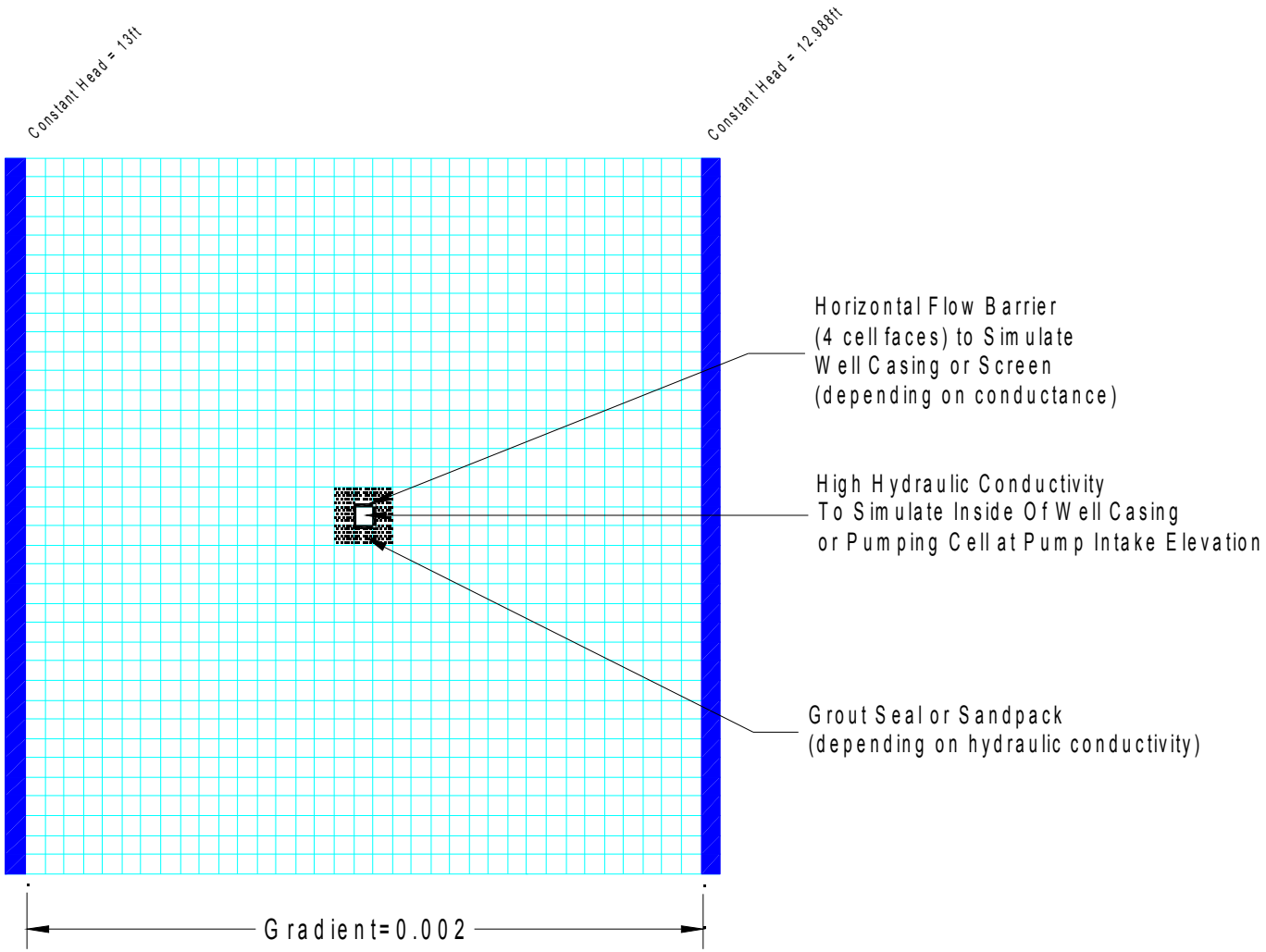
QED Environmental Systems

Varljen et al. Model Configuration

- 106,782 node finite-difference simulation using MODFLOW
- 78 layers (2-, 4-, or 8-inch thickness depending on screen length)
- 2-inch horizontal grid spacing
- Pumping rates of 250 and 500 ml/min @ steady state

QED Environmental Systems

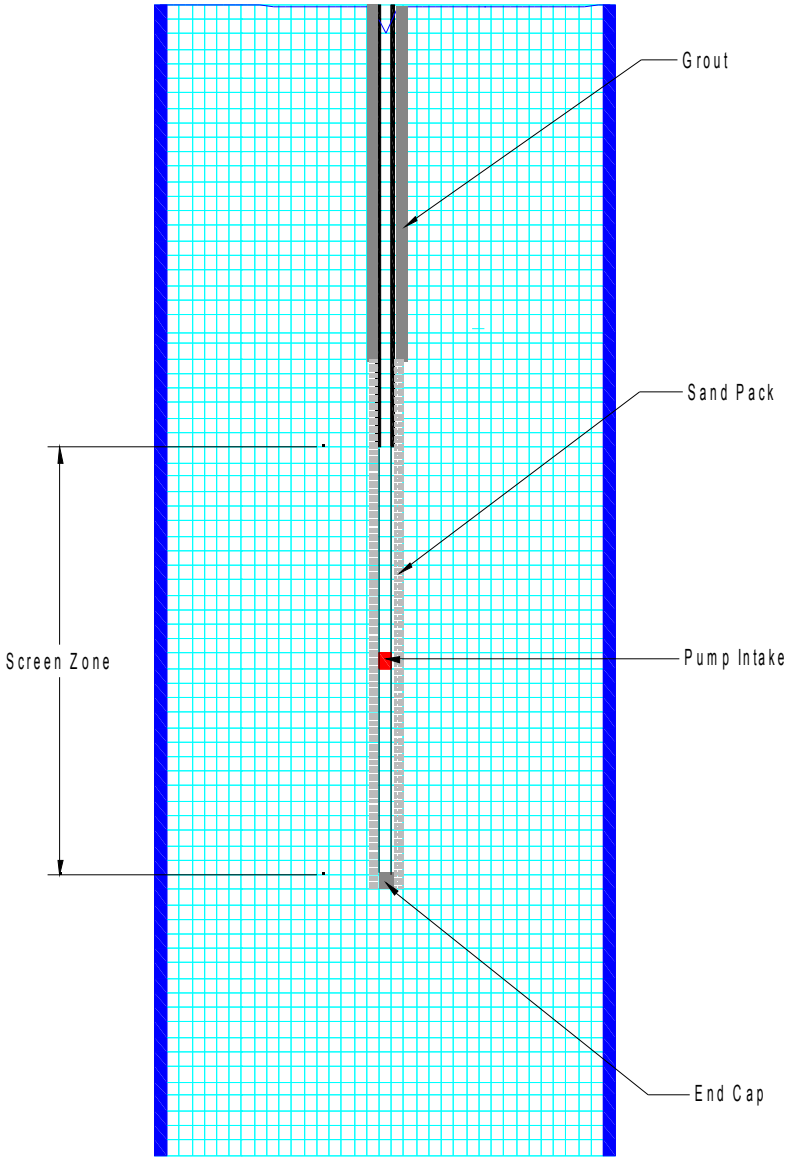
Plan View of MODFLOW Simulation



Varljen, et al. 2006

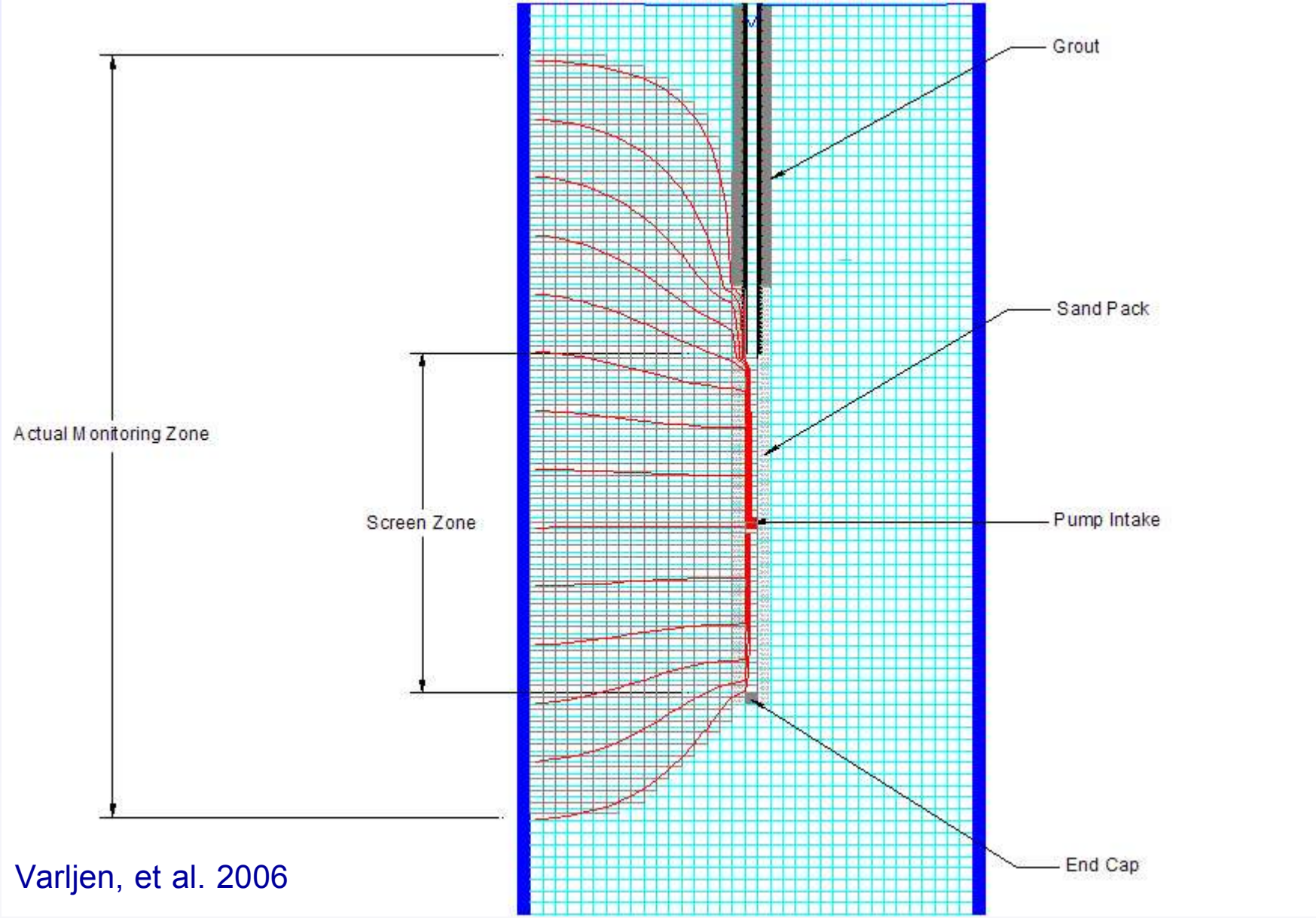
QED Environmental Systems

Horizontal View of MODFLOW Simulation



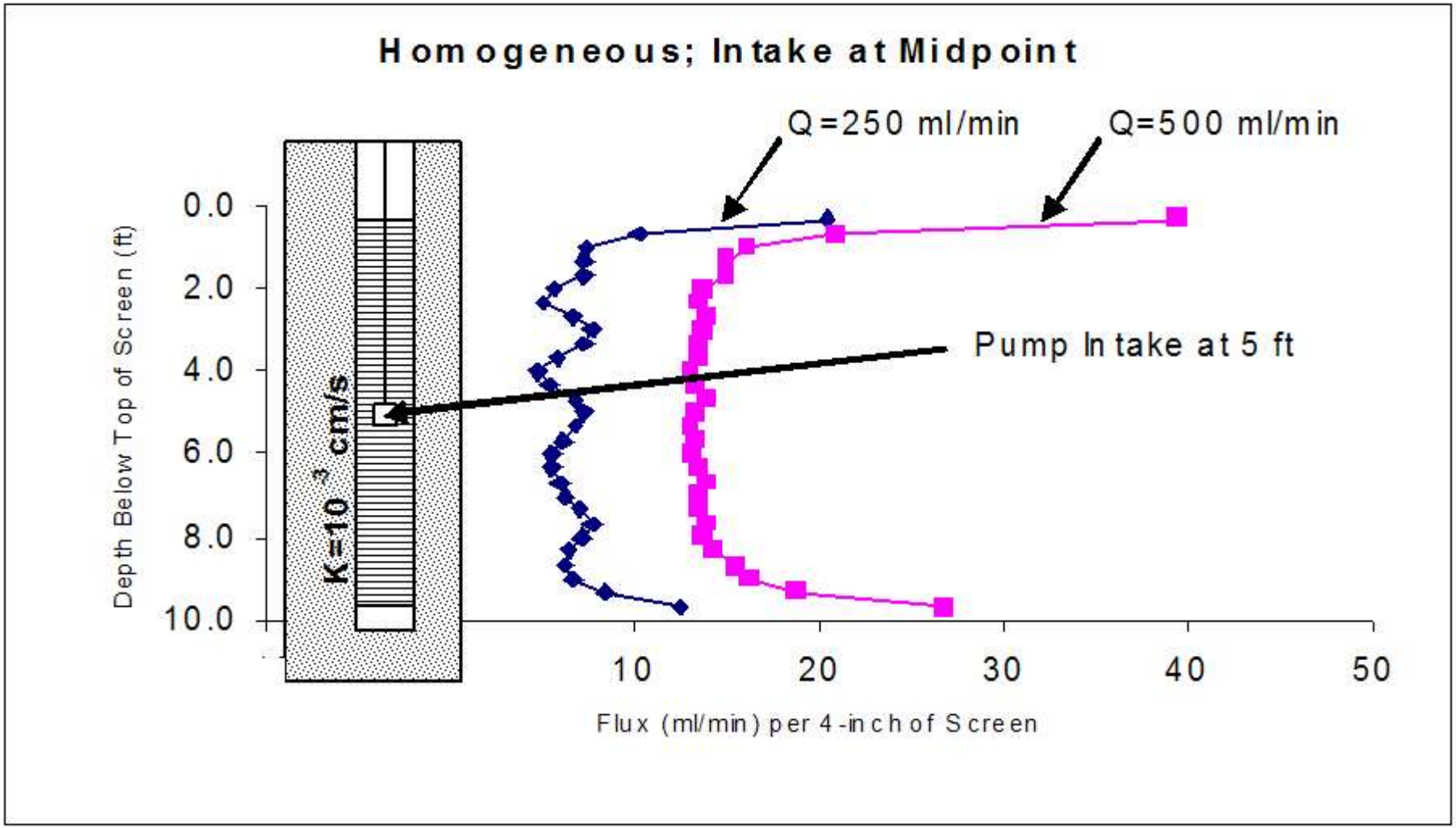
Varljen, et al. 2006

Model Output at 0.25 L/min Steady State Flow



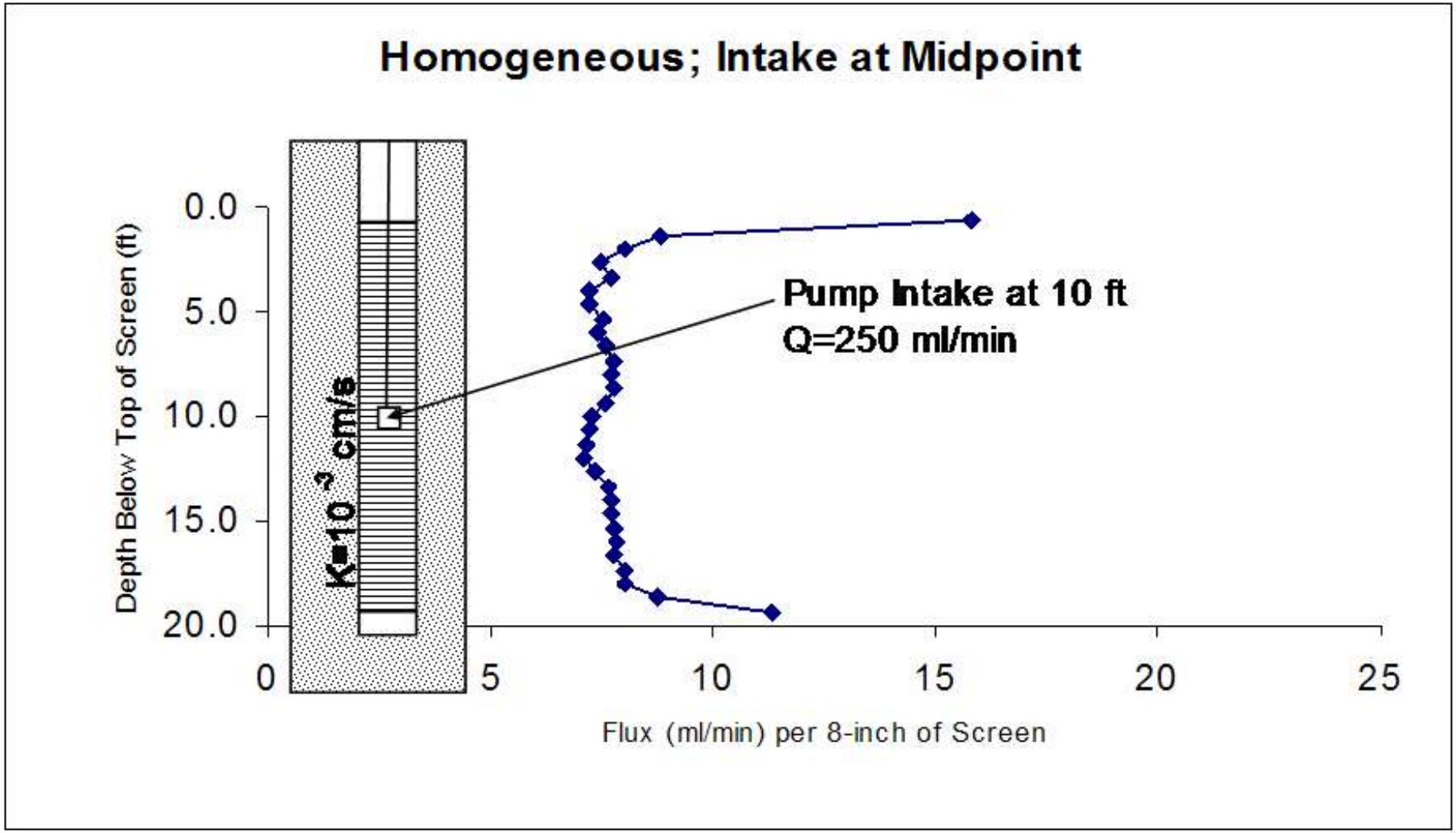
Varljen, et al. 2006

Vertical Distribution of Flux into a 10-foot Well Screen and Effect of Changes in Pumping Rate



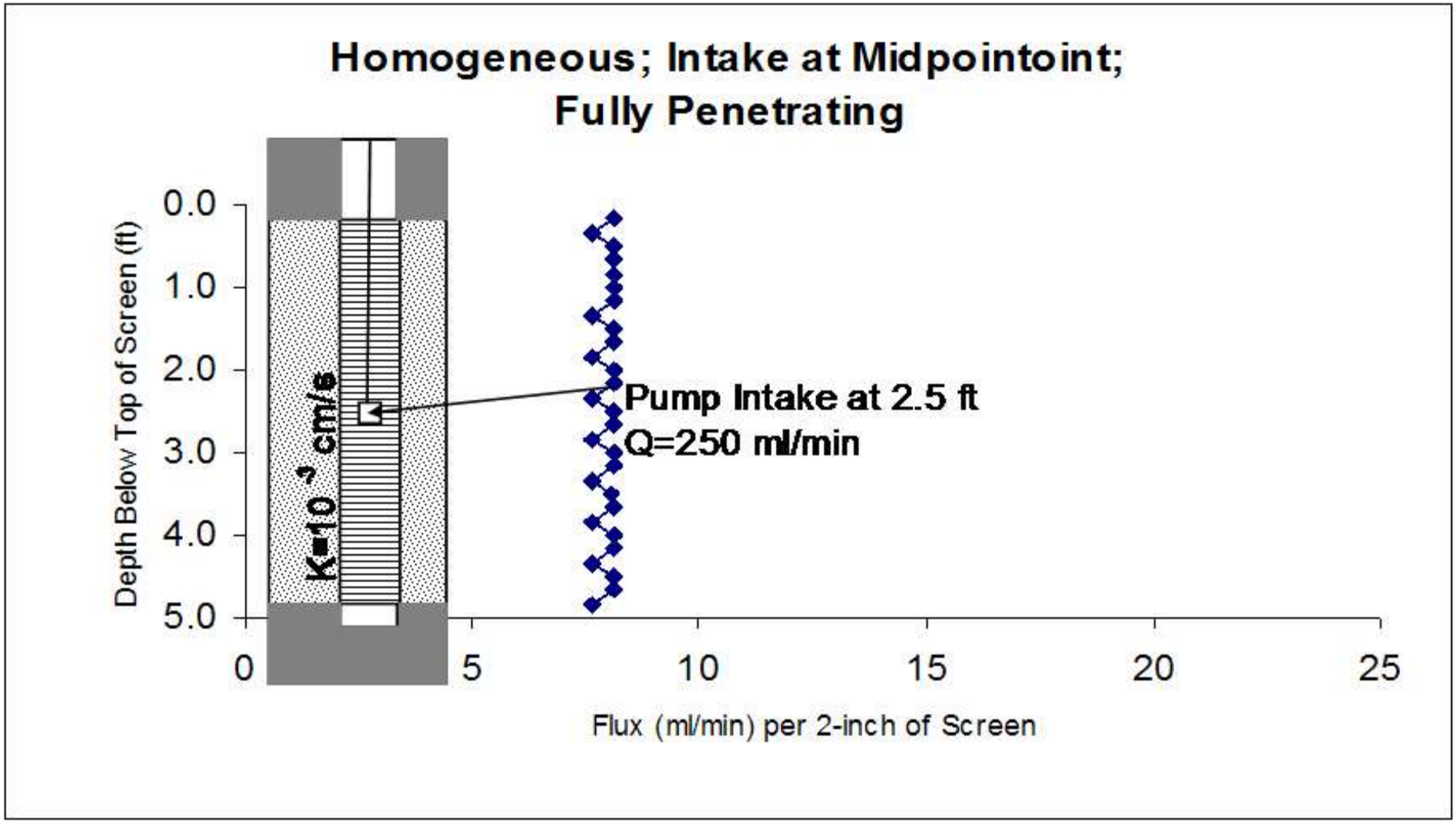
Varljen, et al. 2006

Vertical Distribution of Flux into 20-foot Well Screen



Varljen, et al. 2006

Effect of Removing Sand Pack Extensions on Flux Distribution Pattern



Varljen, et al. 2006

CONCLUSIONS:

- Water is drawn from the entire length of the well screen during low-flow purging and sampling.
- More water comes from the top and bottom of the screen in partially penetrating wells due to capture from above and below the screen.
- The flow pattern remains the same with changes in flow rate and in screens from five feet to 20 feet long.

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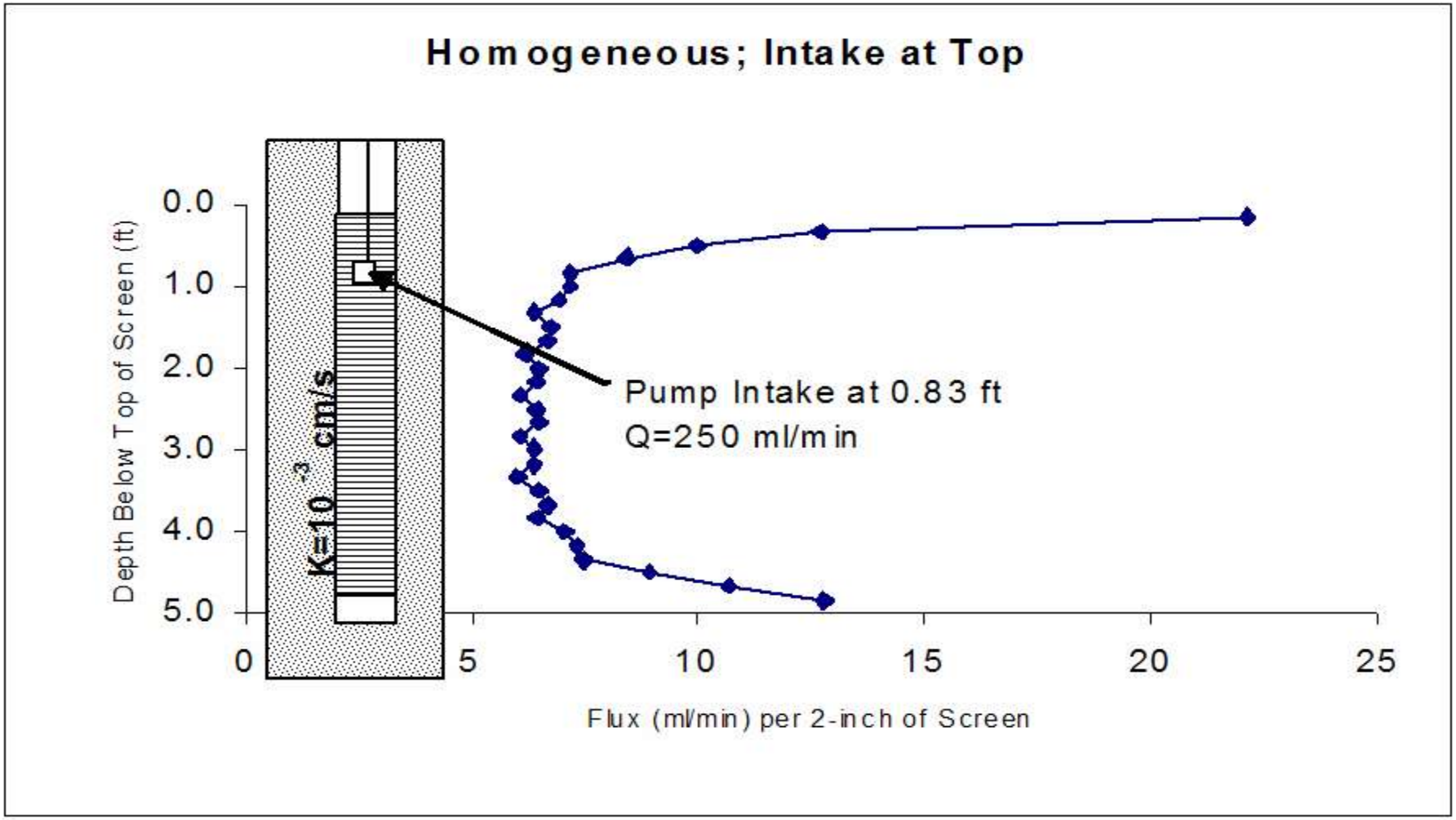
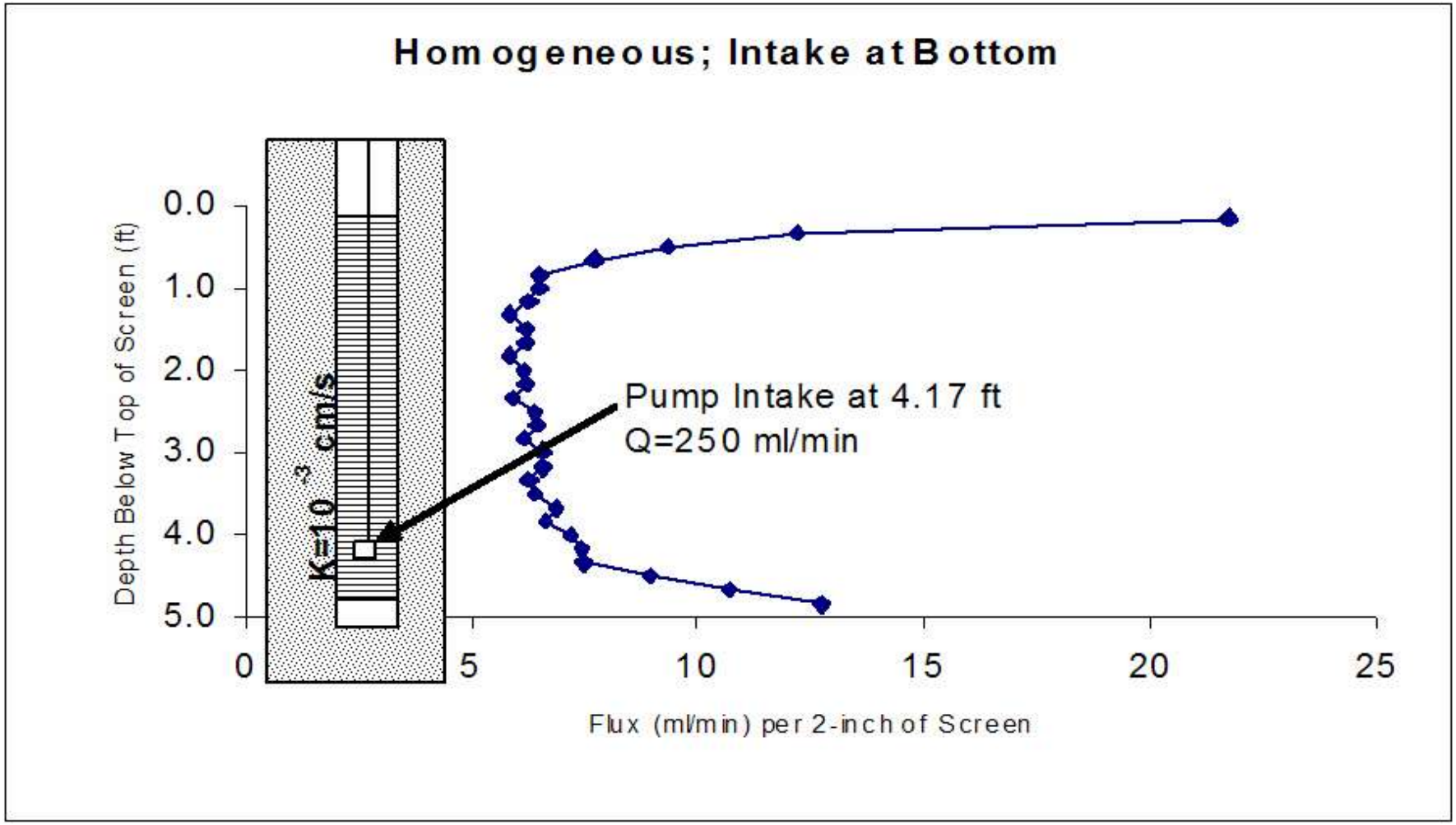
Effect of Pump Placement on Vertical Flux Distribution



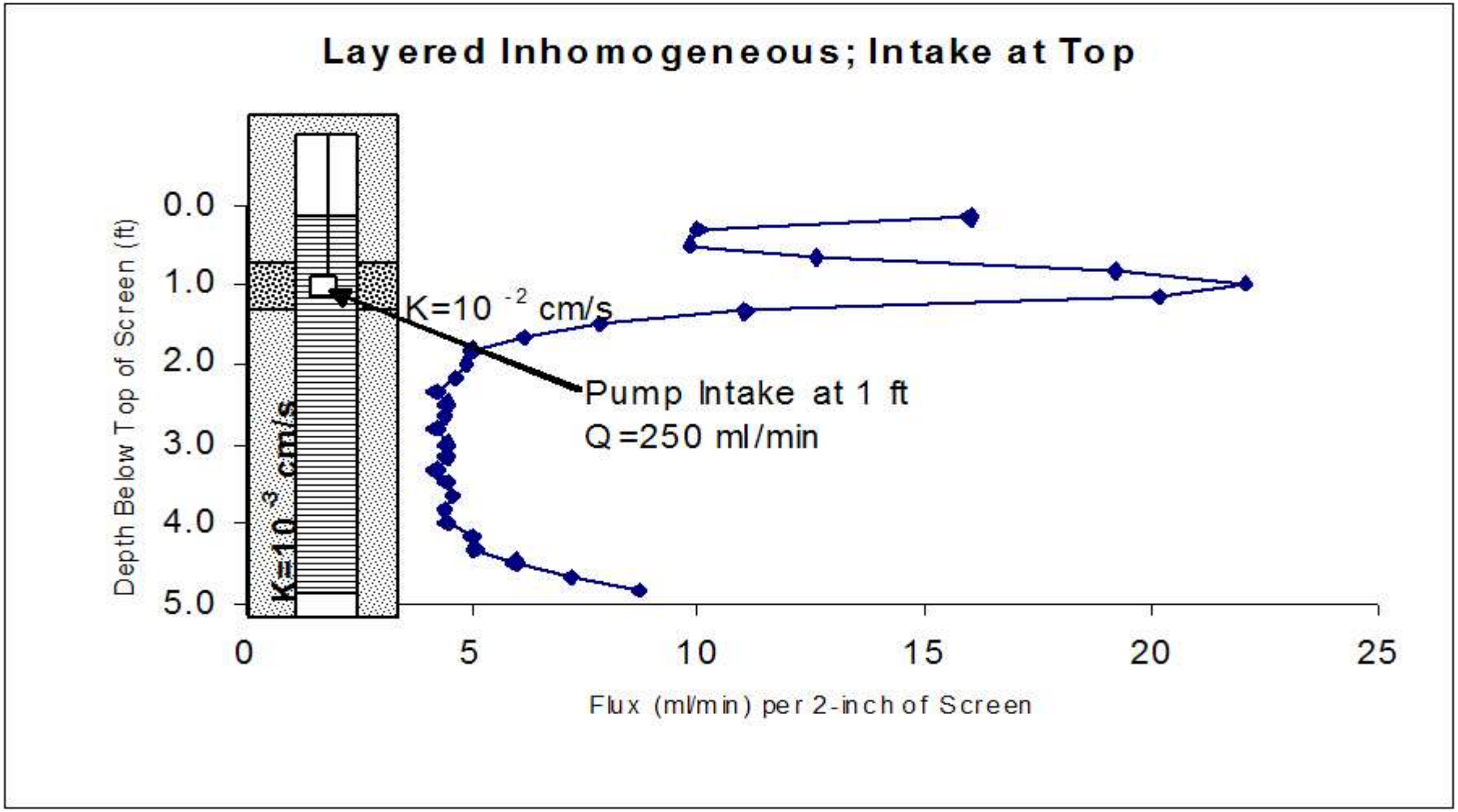
Varljen, et al. 2006

Effect of Pump Placement on Vertical Flux Distribution



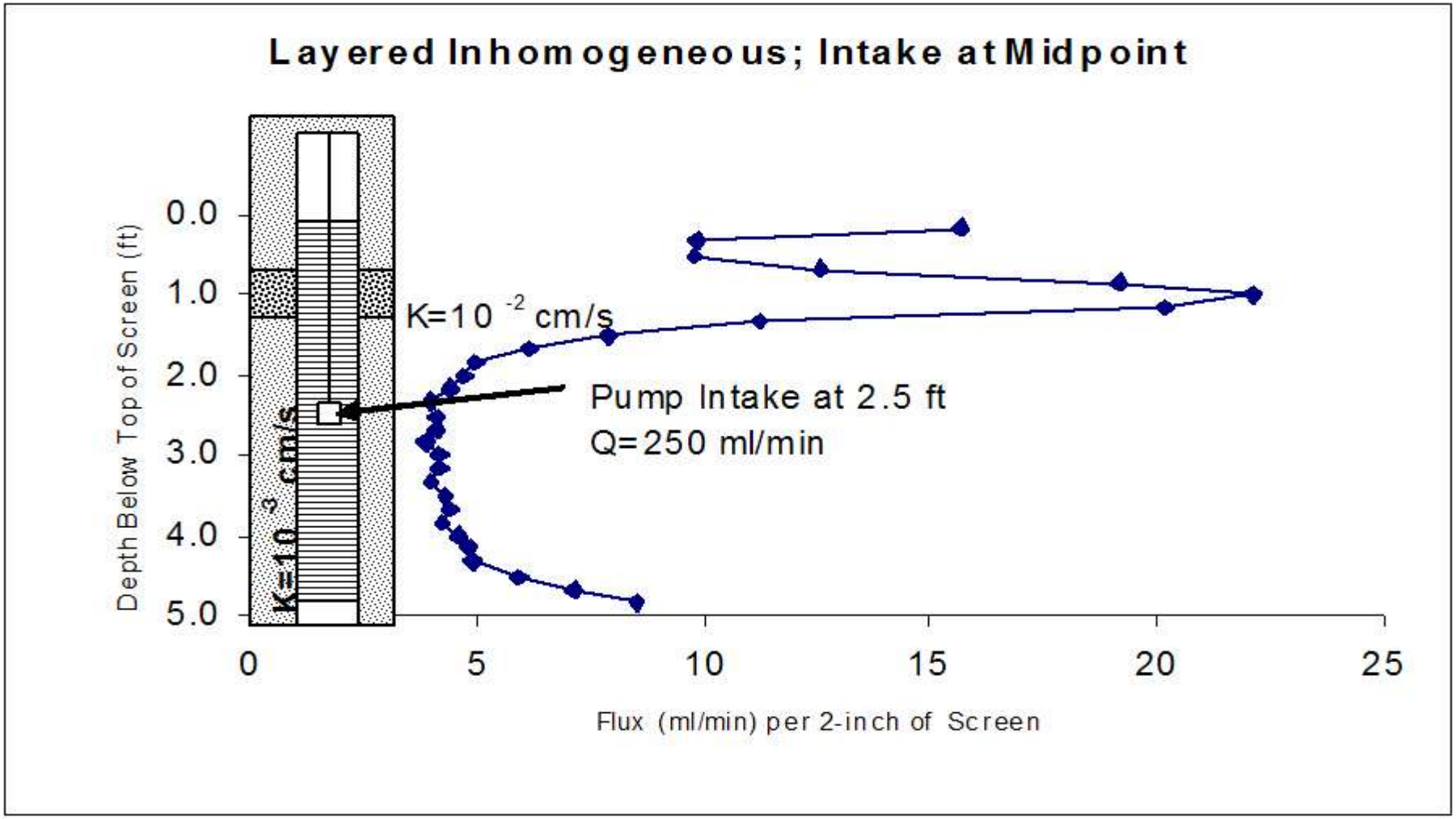
Varljen, et al. 2006

Effect of Heterogeneities on Flux Distribution Pattern



Varljen, et al. 2006

Effect of Heterogeneities on Flux Distribution Pattern



Varljen, et al. 2006

CONCLUSIONS:

- Pump placement has no significant effect on where the water comes from.
- While more water comes from the most permeable zones near the well screen, the flow pattern remains the same regardless of pump position.

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Passive and No-Purge Sampling: The next evolutionary step?

- Over the past 10-12 years, research and developers have studied the potential to sample wells without purging.
- The methodology is based on the concept of ambient horizontal flow through the well screen that would maintain an approximation of the formation water chemistry within the well screen zone.
- Samples taken represent the discrete interval within the screen where the samplers are placed or activated, rather than a flow-weighted average of the screen zone.
- Several passive or no-purge samplers can be deployed in a single well in order to identify any contaminant stratification within the water column.

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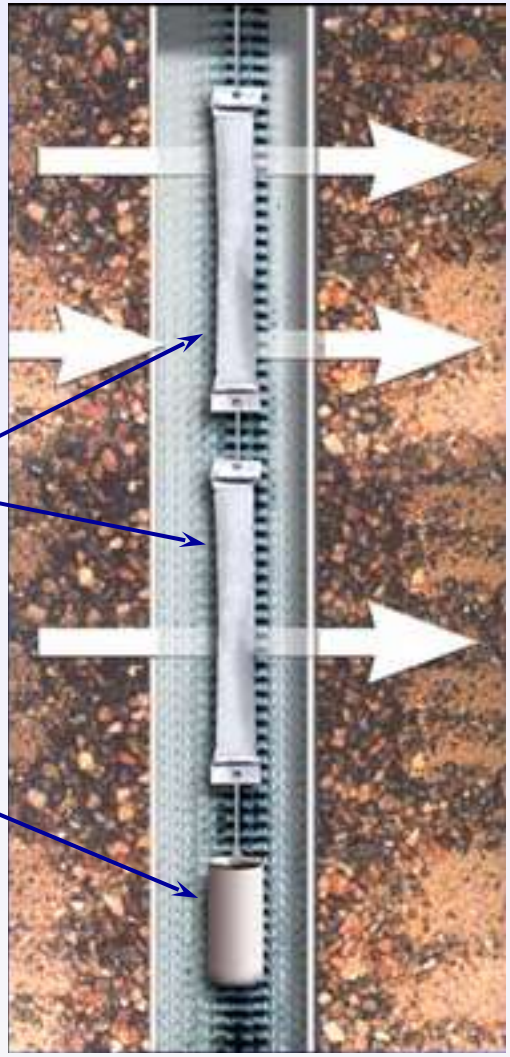
Polyethylene Diffusion Samplers



Diffusion Samplers

Weight

Cross Sectional View

Typical PDB sampler is 1-2 feet in length

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No-Purge Sampling can be performed with grab samplers

HydraSleeve

Snap Sampler™

Kemmerer Sampler

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No-Purge/Passive Sampling Advantages

- Eliminate or greatly reduce purge water volume.
- Samplers are inexpensive to make or buy – low capital cost.
- Easy to deploy and recover samplers, except in very deep wells.
- Some samplers are disposable, so no decontamination is needed between wells.
- Minimal amount of field equipment is required.
- Can provide information on contaminant stratification within the well.
- Samplers are not subject to interference from turbidity.

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No-Purge/Passive Sampling Limitations

- Must identify sufficient ambient flow in the screen zone through use of borehole flow meters or other methods. As an alternative, developers suggest trying passive/no-purge methods and comparing results to historical methods, or to traditional purge-and-sample methods if no historical data.
- Target monitoring zone is determined through analysis of multiple samplers or flow meter studies; improper placement can result in significant concentration differences. The cost of these initial studies can often be as much as the cost of traditional dedicated sampling pumps.
- Collecting background water chemistry parameters (pH, DO, etc.) requires a separate sampling step.
- Resampling to verify questionable data requires redeployment and waiting a minimum of days or weeks.

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How do low-flow sampling and no-purge/passive sampling compare?

- Studies comparing LFS and no-purge/passive sampling show good correlation in some wells but often result in significant differences for some analytes in others. This may be the effect of ambient vertical flow and mixing or the limitations of some passive sampling devices.
- Cost comparisons showing no-purge/passive savings are typically based on a single sampling point. If significant contaminant stratification exists within a well that would warrant multiple samplers, sampling cost savings are quickly offset by increased analytical costs.
- The biggest difference is the sample itself. LFS represents a flow-weighted average of the well screen, while a no-purge/passive sample may represent either a depth-discrete sample, or may be influenced by ambient vertical flow.

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The bigger question is…

What is the well really telling us?

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CAUTION
THIS SIGN HAS
SHARP EDGES
DO NOT TOUCH THE EDGES OF THIS SIGN
ALSO, THE BRIDGE IS OUT AHEAD

Monitoring Well Biases

- Results depend on screen position and length relative to contaminant pathways. *What you screen is what you get!*
- Pumped samples are averaged values of the screen zone and beyond, depending on pumping rate. This averaging effect may underestimate maximum concentrations by an order of magnitude.
- Wells often redistribute contaminant mass in the aquifer when vertical gradients are present, making correlation with contaminant distribution within the aquifer a guessing game.
- In effect, there is little point in trying to determine anything from depth-discrete samples taken within the screen. The only solutions for obtaining spatial resolution are discrete, short wells screens or multi-level sampling systems.

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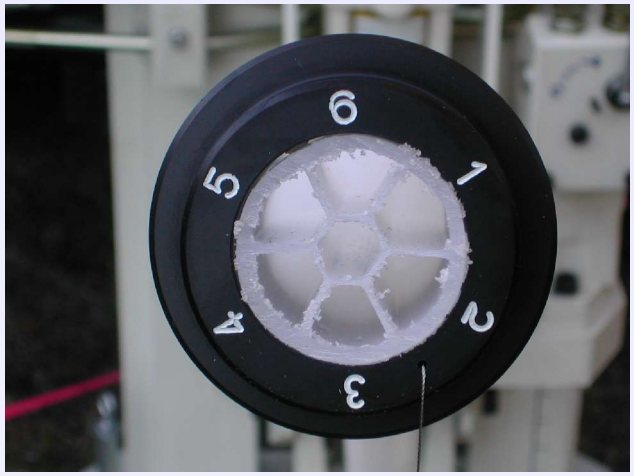
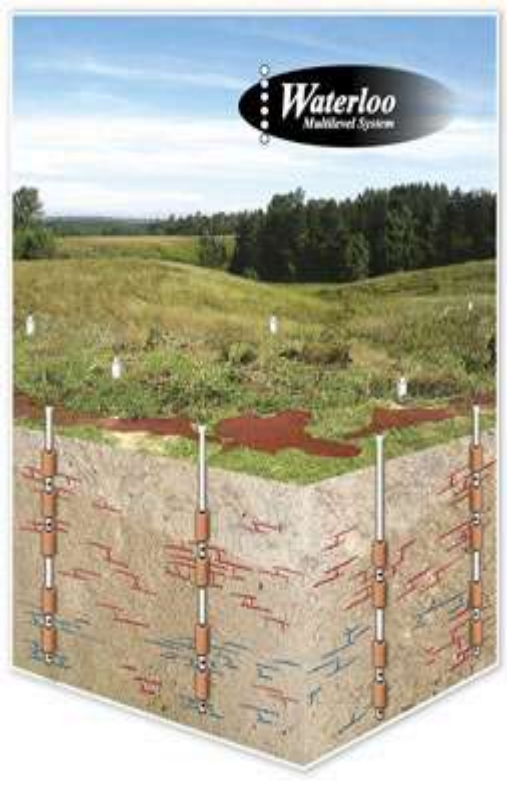
Multi-Level Samplers

FLUTe™ Liner/Sampler



Solinst CMT System

WestBay® System



Waterloo Multi-Level System

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Advantages of Multilevel Sampling Systems

- Samples represent a very small slice of the formation relative to the total saturated thickness
- Opportunity for much better spatial resolution than wells, even those with very short screens
- Accurately identify high-concentration zones
- Insensitive to shifts in the plume position
- Provides date to calculate the *rate* at which contaminants are moving in the aquifer (mass discharge)

API Groundwater Remediation Strategies Tool

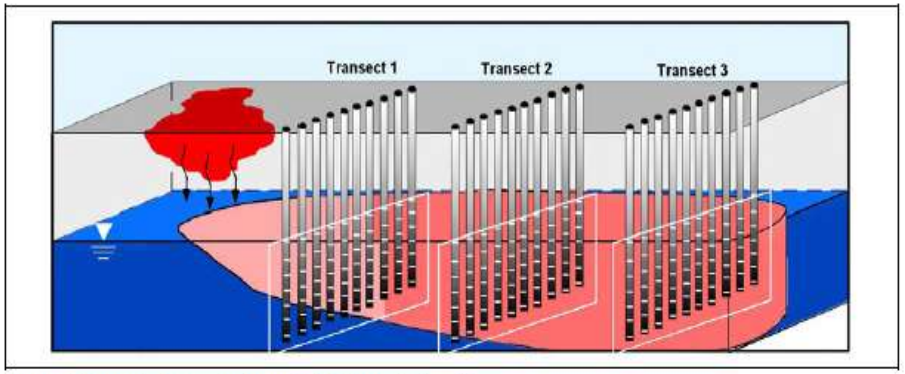

Figure 4. Example Transects through 3-D Plume Delineation

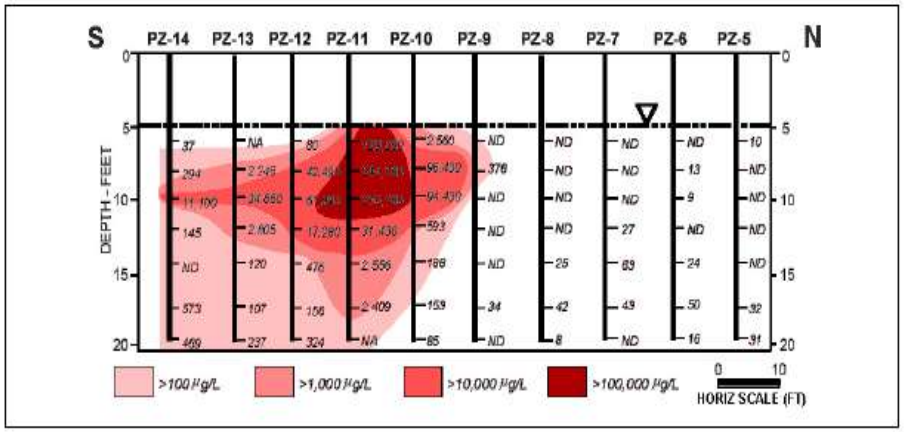

Figure 5. MTBE Concentration Profile for 3-D Transect No. 1 Shown in Figure 4
(Adapted from: Einarson, 2001)

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Summary

- Low-flow sampling provides flow-weighted average concentrations from the entire screen zone, while multi-level sampling systems can provide depth-discrete samples with much greater spatial resolution.
- The issue of well screen length is one of monitoring program objectives and is not a sampling method issue.
- The screen length should relate to the saturated thickness of interest and identifiable flow paths and should not be based on an arbitrary design or guideline.
- The sampling system design and sampling method used should be based on the type of monitoring program (e.g., compliance or detection monitoring, site characterization, remedial performance).
- Sampling methods are like tools in a toolbox – each has an appropriate use based on the task at hand. In many cases, averaged samples from wells are more appropriate and economical than high spatial resolution sampling with multi-level systems.

QED Environmental Systems

Thank you!

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Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in assembly and proper use of sampling equipment
4) Knowledge of EWI and the state of Missouri quality control standards
5) Knowledge of corporate safety requirements and health and safety plan

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to provide a framework for active purging and sampling techniques for soil vapor (SV) wells. The methodology described below utilizes a sampling train that consists of Tygon tubing, vacuum gauge with the sample containerized in a 500 mL Tedlar bag. See the attached MRBCA article for additional information on the proper installation considerations for soil gas monitoring wells.

This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. Soil vapor sampling procedures allow little departure from procedural standards. If site conditions or equipment issues limit adherence to the procedures, any variance needs to be discussed with the project manager and recorded in field notes. The ultimate procedures employed should be documented in field notes and in related reports. Also, use of Summa Canisters is another common method for collection of soil-gas samples that may be required for specific projects or under certain regulatory programs. This SOP does not cover sampling using Summa Canisters.

2.0 SCOPE

This SOP outlines the procedure needed to provide representative soil gas samples that can be used to evaluate vapor intrusion associated with volatile contaminants. This procedure can be applied to various constructions of soil vapor wells with the modified connections to the well employed as needed.

3.0 EQUIPMENT

The following equipment is needed for the proper purging, collecting and shipment of soil vapor samples. It is important to understand the construction of the wells to be sampled to ensure all necessary supplies are available.

a. Tedlar bags: one per SV well to be sampled, plus duplicate, if applicable
b. Tygon tubing: 6-8" of 1/4" ID tubing per set up AND 12-18" of 1/8" ID tubing per set-up
c. Disposable syringe (one per sample)
d. One-way and two-way valves (one each per sample)
e. Vacuum gauge (range 0-15 in Hg), with 1/8" OD and 1/4" OD fittings
f. 3-4" zip-ties (minimum of 9 ties per assembly)
g. Isopropyl alcohol
h. Paper towels
i. Tool kit (basic tools, including needle nose pliers, box cutter, wrenches, etc.)
j. Soil vapor sampling kit w/ proprietary wrench, additional brass fittings, spare gauge,

Teflon tape, etc.
k. Cardboard boxes with bubble wrap
l. Packing tape
m. Interface probe (for nearby water wells, if applicable)
n. Nitrile gloves
o. Chain of Custody (COC) forms, Soil Vapor Sampling SOP, Shipping labels
p. Soil vapor sampling field forms and field notes

5.0 PROCEDURE

5.1 Pre-Operation

1. Review project objectives and desired analytes. Confirm soil vapor well depths and construction details to insure proper purging volume is calculated.

2. Order appropriate number of Tedlar bags and valves from the laboratory. Order supplies at least one week prior to the field event.

3. Gather and check all equipment needed.

5.2 Field Procedures

1. Mobilize to site, and conduct and record an on-site safety meeting.
2. Review planned sampling well order for the day. If nested wells are present, it may be useful to set up at the shallow wells first: if the water table intersects this shallow well, a modified set-up can be used to check for water in the deeper well. See Modified Set-Up below.
3. If nearby water wells will be gauged to determine depth to water level, open wells and allow for stabilization (minimum of 15 minutes). Record on field sample sheet.
4. At each well head, remove lid and well plug (or open valve). Note the presence of water in well vault and the overall condition of the soil vapor well.
5. Construct the sampling train as directed on the H&P guidelines (attached). From the well head to the syringe, the sampling train should consist of 1/4" ID tubing, a one-way valve, ~18" length of 1/8" ID tubing, vacuum gauge, 3-4" length of 1/4" ID tubing, two way valve and the syringe. All connections need to be zip-tied securely. Note that is preferable to double zip-tie the connection at the well head.
6. Test the vacuum pressure of the train:
   - Before attaching sample train to well position the one-way valve to the OFF position, the discharge direction of the two-way valve in the OFF position and NO TEDLAR BAG ATTACHED, pull 10-15 in Hg with the syringe.
   - Turn the two-way valve 90° such that the sampling train has been closed at this connection.

- Verify that the train holds the original vacuum pressure for 30 seconds. Document this on the sampling form.
- If the train does not hold, check each zip-tied connection, re-securing as needed.
- If the sampling train continues to lose vacuum pressure, disassemble and check gauge connections and reassemble with replacement components. SAMPLING SHOULD NOT BE CONTINUED IF THE LEAK CHECK FAILS.

7. Release the vacuum from the train. Open the one-way valve and purge the ambient air from the sampling train/well/filter pack. Use the formula provided on the SV sampling form to determine the correct purge volume.

PURGING

8. Purging and sampling need to be conducted under controlled flow conditions: pull 3-4 mL/s or a 50 mL syringe in approximately 15 seconds.
9. Monitor the vacuum gauge and tubing during purging. The vacuum should not exceed 8 in Hg and water should not be present in the tubing. If one or both of these conditions occur, please refer to the modified purging setup and modified sampling protocol in sections 5.3 and 5.4. IMPORTANT: DO NOT allow water in the well to be pulled into the sampling train near the gauge.
10. Once the syringe is full or the purging volume has been met, turn the two-way valve such that the sampling train and well are shut off. Discharge the syringe.

SAMPLING

11. Connect the Tedlar bag to the discharge port of the two-way valve using 1/8" ID tygon tubing. Zip-tie these connections. Open the Tedlar bag, take care to open according to the designation on the bag: 1 full rotation only is standard.
12. Away from the well head, apply Isopropanol (IPA) to a paper towel/rag. Place this rag over the well head and sampling train up to and including the first connection of the one-way valve. CHANGE GLOVES immediately.
13. With the discharge direction on the two-way valve in the OFF position, begin sampling at 3-4 mL/s. Continue to monitor the pressure gauge and the well head for signs of water.
14. With a full syringe, rotate the two-way valve 90° to turn off the sampling train (clockwise). Discharge the contents of the syringe into the Tedlar bag.
15. To continue to sample, rotate the two-way valve counterclockwise to close off the discharge port. The Tedlar bag can remain 'open' for the duration of the sampling. Repeat steps 14 and 15 until the required volume of sample is achieved. In general, a minimum of 85 mL of air is needed to process a sample. If shipping by air, do not fill Tedlar bag with more than 300 mL.
16. Once the designated sample volume has been collected, close and disconnect the Tedlar bag. Label the sample, including the sample ID, date, time, sampler name, sample volume and analysis desired. Record all information on sample field form.
17. If a duplicate sample is to be collected, attach the next Tedlar bag and begin sampling.

18. Remove the IPA soaked rag from the vicinity of the well and equipment. Change nitrile gloves before continuing the disassembly and decon of the rest of the sampling train.
19. With syringe still attached to gauge, pull 200-300 mL of ambient air through the gauge to purge thoroughly.
20. Dispose of all tubing that comes into contact with Tedlar bag, syringe and two-way valve. Keep tubing attached to gauge for further sampling. Close the valve at the wellhead or replace the plug. Secure the lid to the well.

5.3 Modified Set-Up: Shallow Groundwater

If there is reason to suspect that the water table may be shallow in the vicinity of the soil vapor well (whether from nearby monitoring wells, previous site conditions or high vacuum pressure observed during purging using the normal set-up), a modified set-up can be used to prevent the accidental drawing of water into the vacuum gauge.

1. Connect the 1/4" ID tubing to the one-way valve as described above. Connect the one-way valve directly to the three-way valve and syringe. **Omit the gauge from the sampling train.**
2. Open one-way valve and close discharge port on three-way valve. Purge calculated volume.
3. If water is pulled into the syringe, continue momentarily to extract air/water to ensure that the water in the line is not just a remnant of moisture in the line. Record the total air and water extracted. Disconnect the syringe and three-way valve and set up at a different well. Record procedure and findings.
4. If no water is pulled into the amended train/syringe, close the one-way valve and connect and check the sampling train as directed in section 5.3. Additional purging is not warranted.
5. In some cases, high vacuum pressure is not associated with water in the line. Some very low permeability soils require a purging and sampling approach that allows for the considerably restricted flow of soil vapors through pore spaces. If this is the case, follow the Modified Sampling Protocol below.

5.4 Modified Sampling Protocol: Low Permeability Soils

In the case that high vacuum pressure are observed and the modified set up produces no water drawn into the line, a project manager might require the sampler to use a modified sampling protocol for low permeability soil. Note that use of this procedure may bias the soil vapor sample high, and should therefore be discussed with the project manager prior to being implemented.

1. Connect and check the sampling train as directed in section 5.3. Decrease the extraction flow rate to accommodate the low permeability soils. This might include pulling 50 mL at the previous rate and then closing the sampling train to allow for the influx of soil gas and the decrease in vacuum pressure. If you cannot purge or sample without consistently exceeding 8 in Hg, discontinue sampling.

5.5 Post-Operation

Most soil vapor samples are shipped overnight by air due to the very short hold time of the samples. Soil vapor samples do not need to be kept cold during shipping.

1. The lab may ask that the samples be placed in a small cardboard box with no other packing material. This box should then be packed by securing in a larger box along with the chain of custody. Return equipment to the Equipment Room, noting any malfunctions or issues.
2. Verify all field sample sheets and progress notes are complete, fill out a Daily Equipment Log, and return all paperwork to the Project Manager.

6.0 SAFETY

Acute or chronic exposure to chemically-contaminated soil or water could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, severe weather conditions and emergency procedures). Soil vapor wells can be located within a parking lot or drive of an active commercial facility: remember to make yourself as visible as possible by donning all appropriate PPE and using cone/barricades to segregate yourself from potential traffic hazards. Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

7.0 REFERENCES

The following documents may be reviewed for further information appropriate to this SOP.

- Hartman, B., 2006, How to Collect Reliable Soil-Gas Data for Risk-Based Applications-Specifically Vapor Intrusion, Part 4: Updates on Soil-Gas Collection and Analytical Procedures*, LUSTLine Bulletin* 53, September, 2006.
- H & P Mobile Geochemistry Inc., Instructions for Soil Gas collection in Tedlar Bags: Fulfilling Missouri DNR Guidelines, Procedural Outline/Supplemental Info provided with sampling supplies.
- Missouri Department of Natural Resources, Soil Gas Sampling Protocol, *Missouri Risk-Based Corrective Action for Petroleum Storage Tanks*, April 2005.

- U.S. Environmental Protection Agency, 2002, Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 2002.
- Environmental Works, Incorporated, Corporate Health and Safety Plan
- Site Specific Health and Safety Plan

ATTACHMENTS

Soil Vapor Sampling Log

Example Chain of Custody

H & P Instructions for Soil Gas Collection in Tedlar Bags

Article: "How to Collect Reliable Soil-Gas Data for Risk-Based Applications-Specifically Vapor Intrusion, Part 4" by Blayne Hartman

H&P Mobile Geochemistry Inc.

Purge Volume Calculation Worksheet

H&P Project: _____

Probe ID: _____

Soil Vapor Probe Construction Specifications

Sand Pack Height		inches
Sand Pack Diameter	1.250	inches
Dry Bentonite Zone Height		inches
Dry Bentonite Zone Diameter		inches
Tubing Length		feet
Tubing Inner Diameter*	0.177	inches

Tubing Chart (Nylaflow)	
Outer Diameter	Inner Diameter
1/4"	0.177"
1/8"	0.078"

	1PV	3PV	10PV
Volume of Tubing:	0	0	0
Volume of Sand Pack (40% porosity):	0	0	0
Volume of assumed Dry Bentonite Zone (50% porosity):	0	0	0
Total System Volume (tubing + sand + bentonite):	**0**	**0**	**0**

Purge Time Calculations (for using a pump)

Collection Volume	0	cc
Pump Flow Rate	0	mL/min

Pump Time Calculations

	Min	Sec
1PV	#DIV/0!	#DIV/0!
3PV	#DIV/0!	#DIV/0!
10PV	#DIV/0!	#DIV/0!

Pump Time For Difference of Volumes

	Volume Diff.	Min	Sec
1PV	N/A	#DIV/0!	#DIV/0!
3PV-1PV Collection Vol.	0	#DIV/0!	#DIV/0!
10PV-3PV Collection Vol.	0	#DIV/0!	#DIV/0!

H&P Mobile Geochemistry Inc.

INSTRUCTIONS FOR SOIL GAS COLLECTION IN TEDLAR BAGS
FULFILLING MISSOURI DNR GUIDELINES

Collecting Samples into Tedlar Bags

1. Connect a 2-way valve on to the soil gas probe using flex tubing. Connect the vacuum gauge to the 2-way valve and to a 3-way valve on 60 cc syringe as shown in Figure 1. BEWARE, STEM ON 3-WAY VALVE POINTS TO THE OFF DIRECTION.

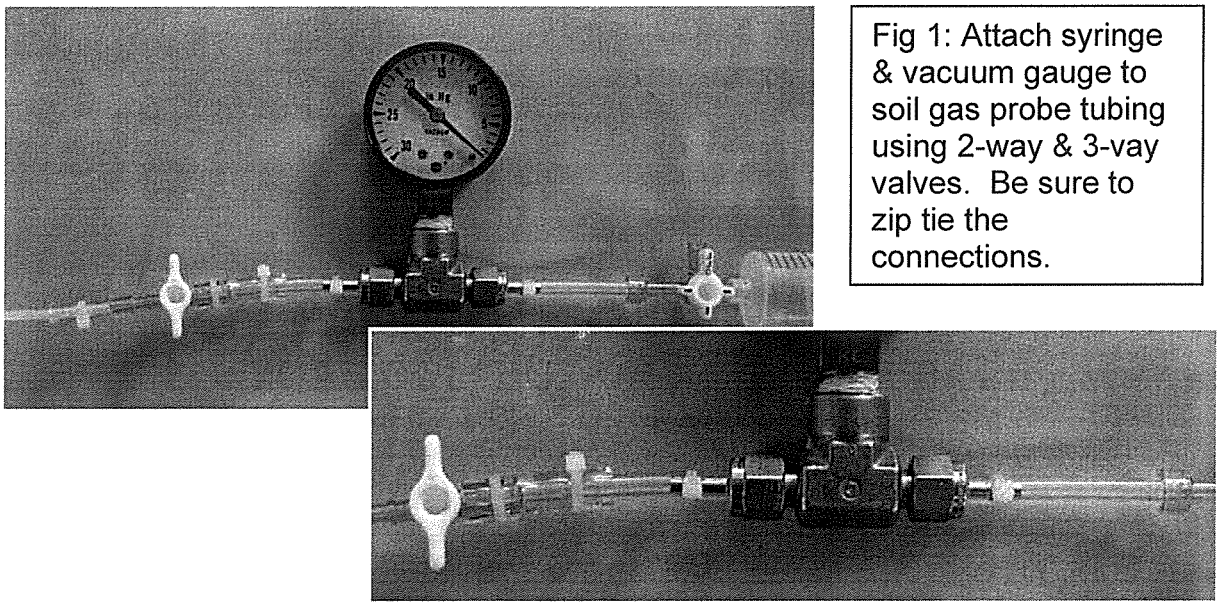

Fig 1: Attach syringe & vacuum gauge to soil gas probe tubing using 2-way & 3-vay valves. Be sure to zip tie the connections.

2. Leak test the sampling train by pulling on the syringe with the 2-way valve on the soil gas probe in off position. The vacuum gauge should deflect to ~10" to 15" of Hg.

3. Turn the 3-way valve on the syringe so that the flow-path to the vacuum gauge is off. Watch the vacuum gauge. If vacuum remains steady for 30 seconds, sampling train is leak-tight. If the vacuum does not remain steady, find the leak, correct, and repeat leak test.

4. Open the 3-way and 2-way valves so that the soil gas probe is open to the syringe and purge appropriate volume from probe using 60 cc syringe. Purge 3 internal dead-volumes unless otherwise instructed to do so. Dead volume of 1/8" nylaflow is 1 cc per foot. Dead volume of 1/4" tubing is 5 cc/foot.

H&P Mobile Geochemistry Inc.

5. After purging, leave the syringe connected to the vapor gauge & vapor probe and connect a tedlar bag to the side port of the 3-way valve using flex tubing (Figure 2).

Fig 2: Connect tedlar to the side port of the 3-way valve and fill bag with 300-450 cc vapor sample *(see notes in step #7 regarding sample volume)*.

6. If a leak/tracer compound is required, place tracer compound around base of probe where it enters the ground. An easy way to do this is to dampen a paper towel with isopropyl alcohol (rubbing alcohol) or difluoroethane (duster spray) and place around the base of probe.

   Note: For gaseous tracer compounds such as helium, place the shroud over the probe and extend the probe tubing out of the shroud and connect to the vacuum gauge (Figure 3).

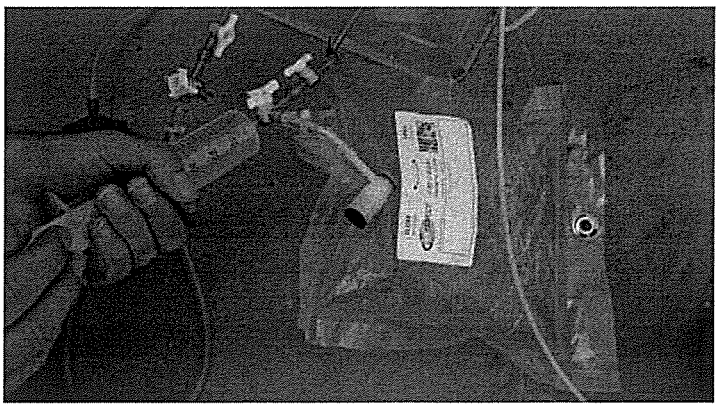

Fig 3. Sampling probe from under a shroud with a syringe into a tedlar bag. *For MO, a vacuum gauge shown in figure 1 would be in-line between the syringe & the probe valve.*

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7. Open the valve on the tedlar bag. Fill tedlar bag with 300 cc to 450 cc using the syringe and switching the position of the 3-way valve from the probe to the tedlar bag. Withdraw the plunger on the syringe to ensure flow is less than 200 ml/min (15 seconds to fill the syringe to 50 cc). Monitor the vacuum gauge to ensure measured vacuum < 8 inches of Hg).
   Notes regarding sample volume:
   - If tedlar bags are to be shipped by air, only fill them with 300 cc.
   - If the sample in the tedlar will be transferred to a summa on-site, put 450 cc into the tedlar (see steps beginning on page 4).
   - If a gaseous tracer is used, fill the tedlar bag with ~700 cc to allow measurement of the tracer compound from the bag with a portable meter.

8. Once filled, close valve on tedlar bag and remove from 3-way valve. If the gaseous tracer is to be measured, connect the tedlar bag up to the measuring device.

9. If the vacuum gauge is to be reused, flush with a syringe using clean or outside air between samples.

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Transferring Samples From Tedlar Bags to Summa Canisters

1. Connect transfer piece to the side port of tedlar bag using flex tubing (Figure 4).

Fig 4: Connect transfer piece to tedlar bag.

2. Open valve on tedlar bag. Then connect summa to transfer piece at the quick-connect fitting (Figure 5). Some summas have their own on/off valve, while some have just the quick connect. If summa has an on/off valve, turn valve to open now. Be sure to close valve before disconnecting from transfer piece.

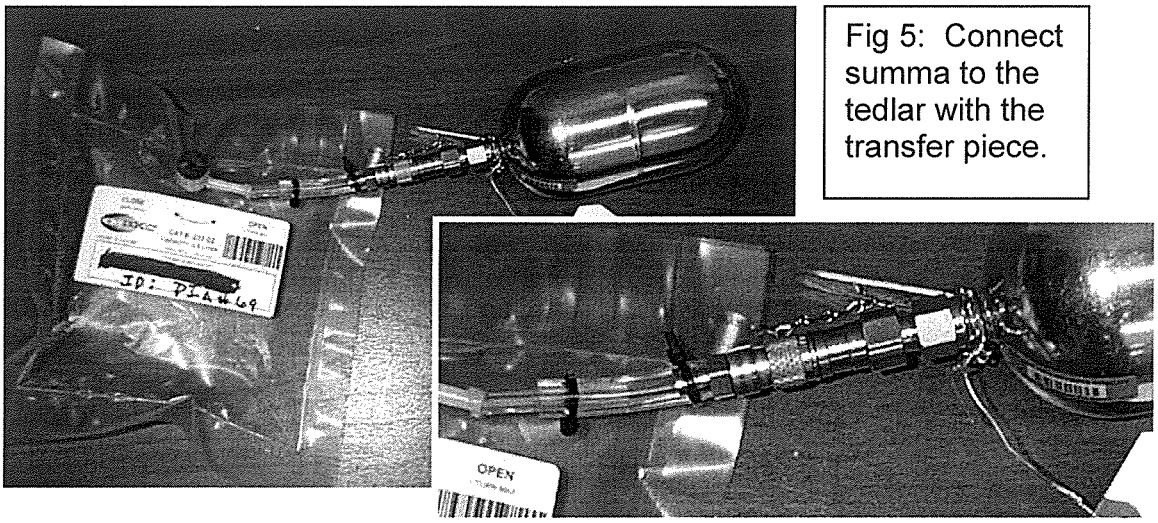

Fig 5: Connect summa to the tedlar with the transfer piece.

3. Summa can will fill within 15 seconds. There should be some residual soil gas left in tedlar as the mini-can volume is less than 450 cc. Disconnect summa from transfer piece.

4. Clean transfer piece between samples by connecting male quick-connect to female quick-connect and flushing with ambient air using the syringe (Figure 6).

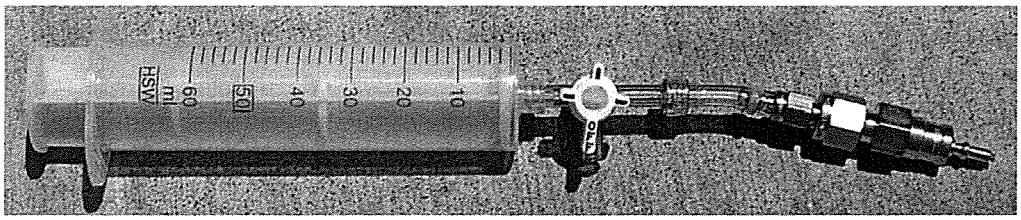

Fig 6: Flushing transfer piece

5. Keep canisters out of sun and do not chill.

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SOP F: Instructions for Collecting a Tedlar Bag Sample while monitoring Probe Vacuum

Recommended Tools/Supplies

- Scissors/Snips to cut tubing
- Nitrile Gloves
- Ball Point Pen
- Leak Check Compound (i.e. 1,1 Diflouroethane "duster spray" or Isopropyl Alcohol)
- Cloth Towel(s)
- Resealable plastic bag

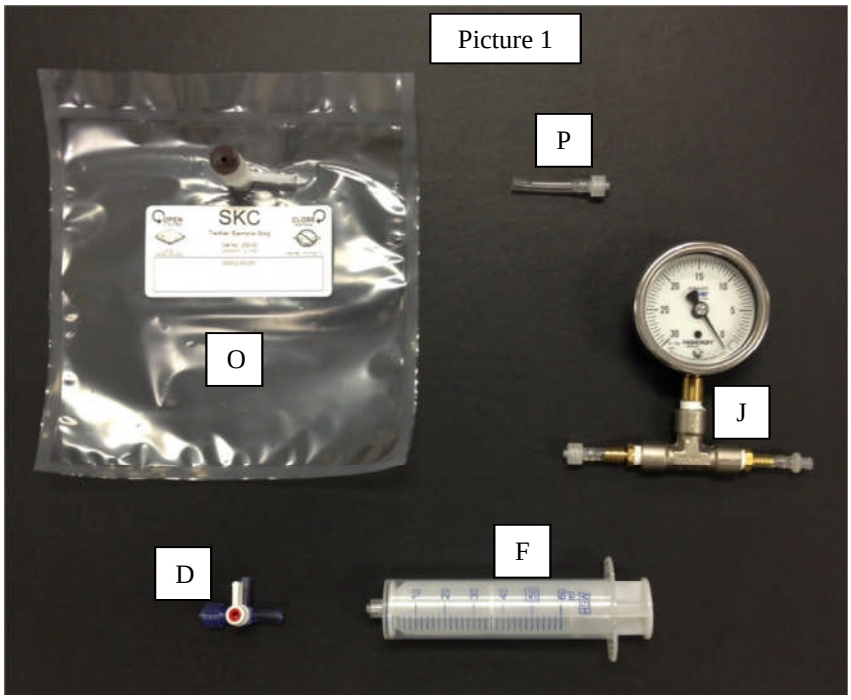
Sample Parts/Supplies Provided (Pic 1)

These Items are sent 1 per sample:

- D – 3-way valve
- F – 60 mL plastic syringe
- O – Tedlar Bag (500 mL, or 1 Liter upon request)
- P – Male luer fitting with 1/4" Tygon tubing connector piece

This Item sent 1 per project:

- J - In-line vacuum gauge with luer connections



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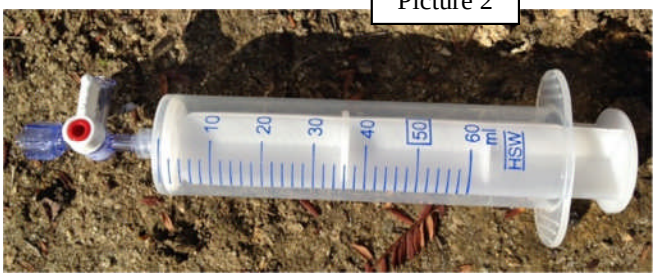
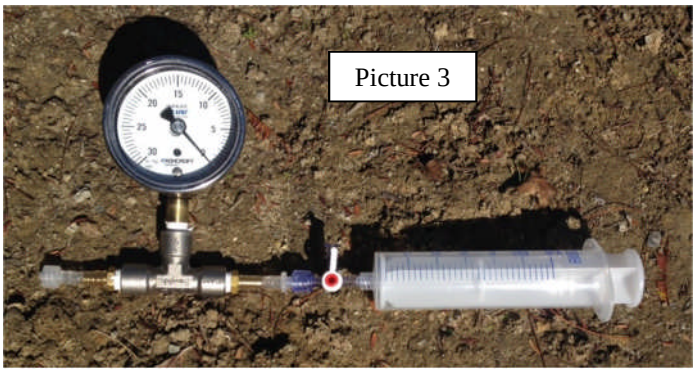
Connections for Sampling

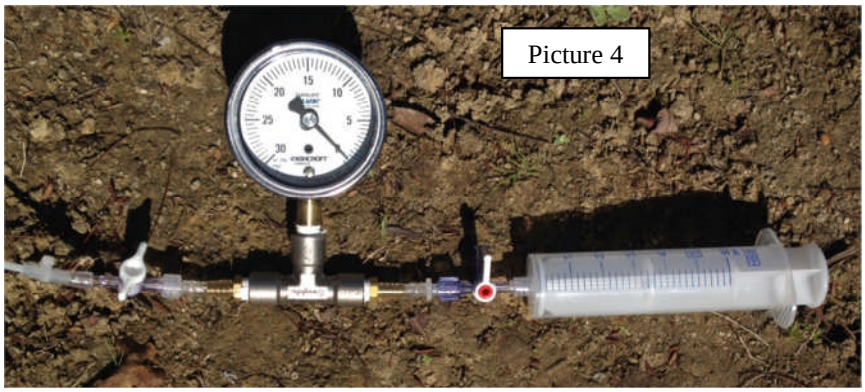
1. Attach the 3-way valve onto the syringe by carefully twisting the syringe male luer into the valve female luer. (See Pic 2)
2. Attach the male luer end of the 3-way valve on the syringe into the female luer fitting on in-line gauge. (See Pic 3)
3. Connect the leading end of the In-line vacuum gauge onto the probe valve.
    - If connecting to a soil vapor probe with a luer valve, twist syringe into valve. (See pic 4)
    - If connecting to a soil vapor probe, or a subslab port with something other than a luer valve, you will need to use flex tubing to connect syringe to probe.

Picture 2





Picture 3



Picture 4

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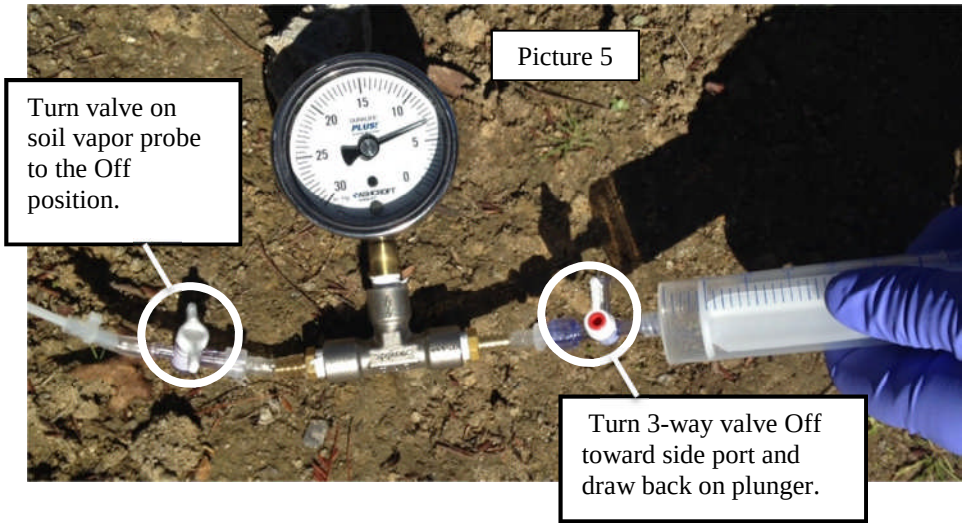
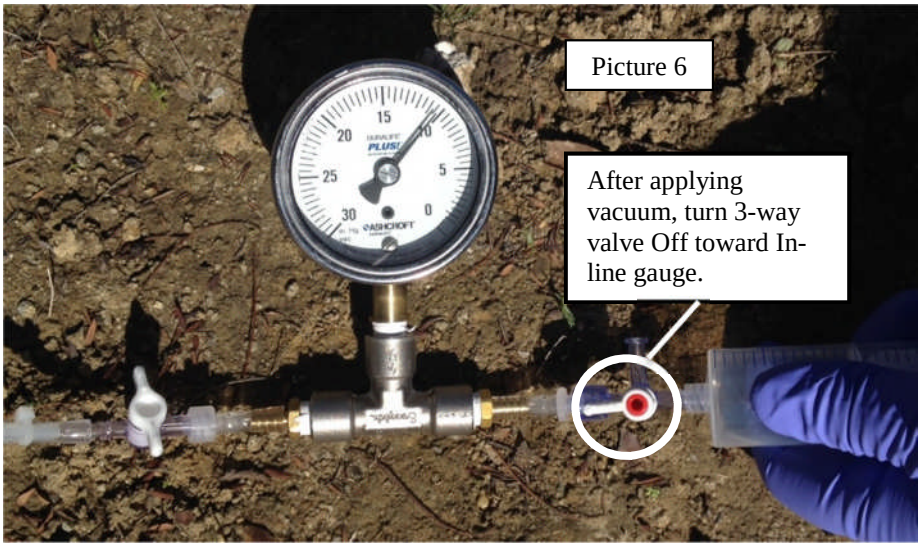
Conducting a Shut In Test

1. The one-way valve attached to the soil vapor probe should be in the off position.
2. With the 3-way valve on the syringe turned so that the side port is in the off position, slowly pull back on the plunger so that you draw a vacuum on the sample train. (See Pic 5).
3. Once the needle on the vacuum gauge rises to approximately 10" Hg, immediately turn the 3-way valve attached to the syringe so that it is off towards the in-line gauge. (See Pic 6)
4. Observe the vacuum gauge for at least 1 minute to determine if there is any vacuum loss.
5. If the needle drops, indicating a leak in the sample train, retighten all fittings and conduct shut-in test again.

   Note: The vacuum gauge reads in inches of Mercury. 7.4" Hg is equal to 100" H2O. You should maintain a vacuum of at least 100" H20 (or 7 – 8" Hg) when conducting the shut-in test.





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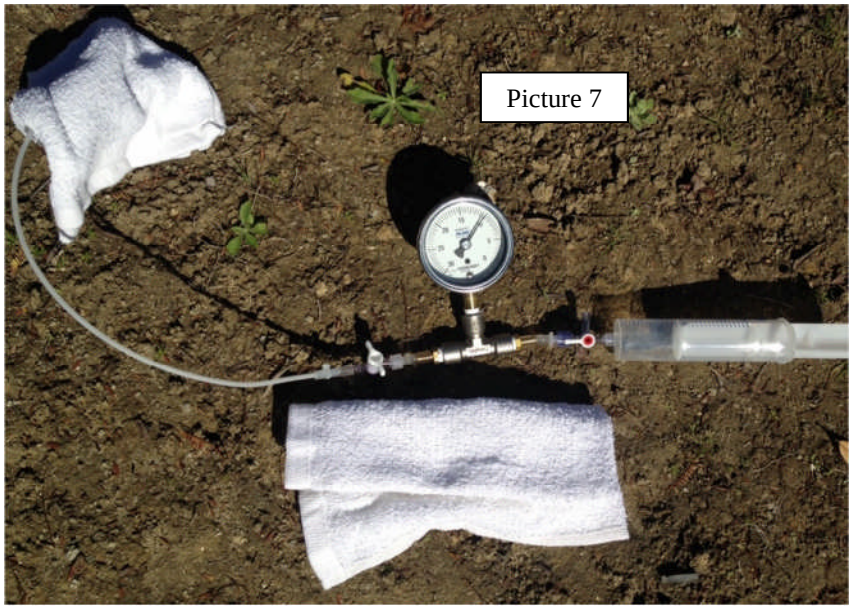
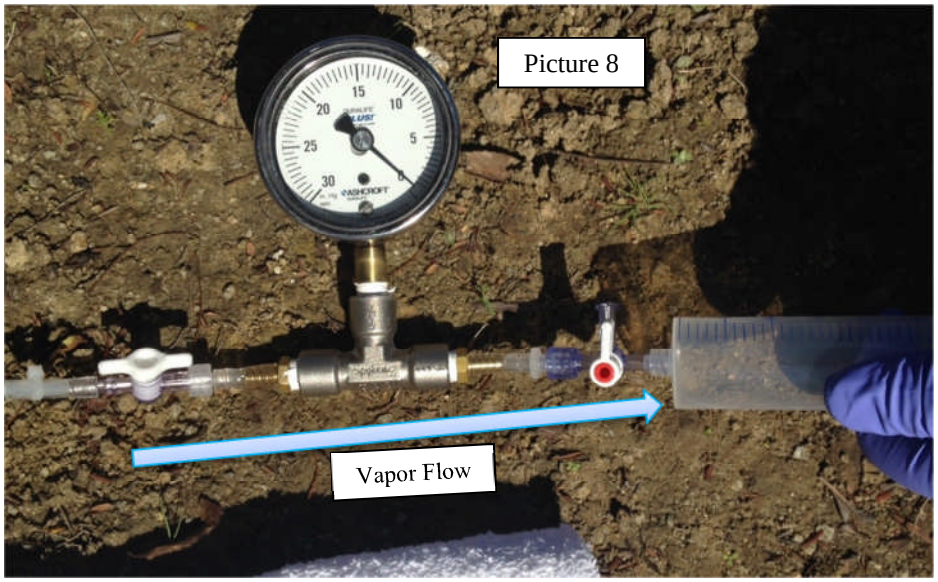
Applying a Liquid Leak Check Compound



1. Be sure to have on Nitrile gloves
2. Place towels in resealable plastic bag
3. Carefully spray or pour liquid leak check compound onto towel in bag. Do not oversaturate towel with compound. Note: liquid leak compounds typically used are 1,1 diflouroethane (duster spray), or Isopropyl alcohol.
4. Seal up plastic bag
5. Just prior to purging and sampling of the probe, gently place one saturated towel at the base of the soil vapor probe where the tubing enters the subsurface. Lay another towel near all of the sample train connections. Do not lay towel directly on fittings. (See Pic 7)
6. Discard nitrile gloves, as compounds can be quite strong, and put on a new pair prior to purging and sampling to prevent any cross contamination.

Purging the Soil Vapor Probe

1. Determine the proper purge volume to be evacuated from the soil vapor probe (eg. 3 dead volumes).
2. Open the On/Off valve on the vapor probe.
3. Using the syringe to purge, slowly draw out the vapor by pulling back on the plunger to fill syringe. Then expel the purge air by turning the 3-way valve so it is off towards the probe, and pushing the plunger in. Repeat this process until the desired purge volume is evacuated from the probe. (See pic 8)
4. To maintain a flow rate of under 200 mL/min, it should take approximately 20 seconds to pull back the plunger a full 60 mL.
5. Record any observed vacuum on the probe while purging and sampling.
   Note: You should not exceed 7-8"Hg (100" H2O) on the probe while purging or sampling.



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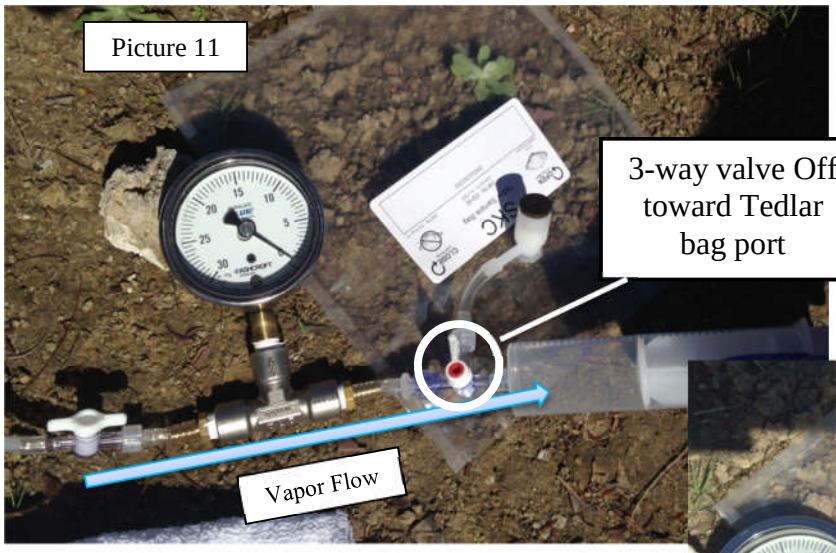
Collecting the Sample in the Tedlar Bag

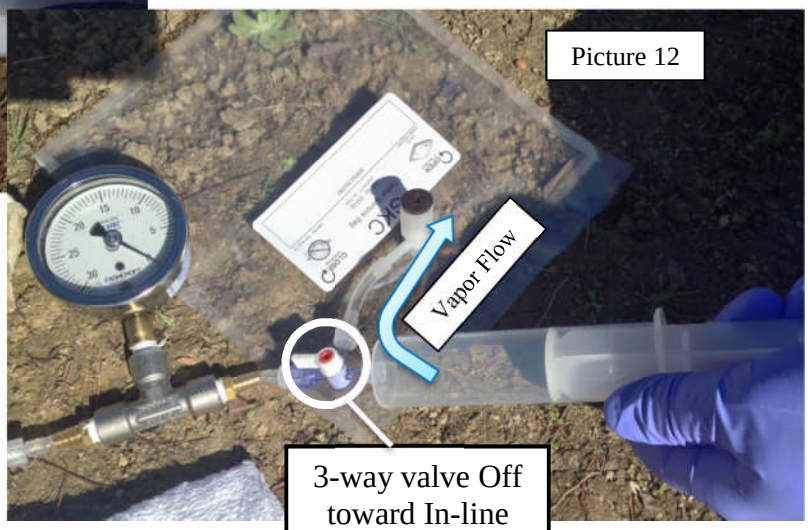
Picture 9

1. Attach the male luer fitting with the 1/4" connector tubing to the Tedlar bag. (See Pic 9)
2. Attach the Tedlar to the syringe by twisting the male luer fitting into the side port on the 3-way valve attached to syringe. (See Pic 10)
3. Open the round valve on the Tedlar bag at least one rotation. *Note: Be sure to turn entire valve and not just the brown "disk" on the head of the valve.*
4. Slowly draw the vapor from the soil vapor probe, or ambient air sample, into the syringe. (See Pic 11) Then turn the 3-way valve so it is off towards the probe, and push the plunger in. This will result in the sample vapor being pushed into the Tedlar bag. (See Pic 12)
5. Continue to this process until there is approximately 300 – 400 mL of sample air in the Tedlar. *Note: If the Tedlars are to be shipped back to the lab by air, only fill them with 300 mL.*
6. Once filled, close the valve on the Tedlar bag until it is snug. Remove the Tedlar bag from the syringe and prepare for shipment back to lab.

Picture 10



Picture 11



Picture 12

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Collection Notes

- If the vacuum gauge is to be reused, flush with a syringe using clean or outside air between samples.
- Twist luer fittings into each other so that all valves and gauges are facing up. This may take some practice.
- Label Tedlars with a ballpoint pen. DO NOT USE SHARPIE!
- Keep Tedlar bags out of sun and do not chill. Keep at room temperature.

Shipping Notes

- In order to meet Tedlar bag hold times, sample should be sent back to the lab immediately following sampling.
- Tedlar bags should be shipped back to the lab in a separate cardboard box within the shipping box. This will help protect them during shipping.
- You do not need to return any of the consumable items (ie. Syringes, valves, luer fittings).

Skills Required:

1) 40-hour HAZWOPER training
2) On-site training with an experienced person desirable
3) Ability to make careful measurements, accurately record time and events
4) Knowledge of corporate Safety requirements and health and safety plan
5) Knowledge in use of interface probes, product measuring devices (PMDs), and bailers

1. OBJECTIVE / APPLICABILITY

The Objective of this Standard Operating Procedure (SOP) is to provide procedures for performing a light non-aqueous phase liquid (LNAPL) bail-down test, such that accurate, useable data is collected. The test data can be used to quantitatively evaluate the mobility of the LNAPL in the formation through the calculation of the LNAPL transmissivity. LNAPL transmissivity is related to LNAPL recoverability, so it can be used to predict LNAPL recovery rates for a product recovery program. Transmissivity can also been used as a performance metric in determining when LNAPL has been recovered to the maximum extent practicable.

This SOP serves as a reference tool to facilitate consistency among Environmental Works, Inc. (EWI) personnel. These operating procedures should not be varied, as adherence to details are necessary to yield usable data. If site conditions, equipment limitations or limitations imposed by the project or client exist, the procedure should be delayed until conditions are conducive to conducting the testing per the protocol.

2. SCOPE AND PERSONNEL APPLICATION

During this operation, the purpose for performing a LNAPL bail-down test needs to be kept in mind. The procedure is essentially a "slug-out" test for LNAPL in a well, which requires the removal of product as quickly as possible and then gauging the product recovery over a period of time. Results of the testing are used to design appropriate product removal systems and operations; therefore, obtaining accurate data is essential. This testing should be performed by a minimum of two technical personnel (an EWI scientist or associate scientist is recommended as one person of the team). Any personnel performing these functions should be trained in proper bailing and water/product measurement field techniques. The lead person performing the function is responsible for ensuring that all equipment and materials necessary are on-hand for the job. If there is any question regarding this procedure, the lead person should confer with the project manager prior to mobilization to the work site.

3. EQUIPMENT

Equipment and materials needed to complete a LNAPL bail-down test include, but are not limited to, the following:

a. A work plan outlining project bail-down objectives and locations;
b. Field bail-down documentation log (see Attachment) and clipboard;
c. Clear bailers of appropriate size for the well to be bailed, graduated if possible;

d. Bailer reel, wire, and attaching clips for bailer;
e. Duct tape or other tape that can be marked;
f. Water-product interface probe with fresh batteries;
g. Small tape measure;
h. Product Measuring Device (PMD), or 5-gallon bucket marked with volume levels;
i. Large funnel;
j. 55-gallon drum or appropriate storage vessel, with secondary containment if feasible;
k. Proper drum labels for the type of LNAPL being recovered;
l. Stopwatch or accurate minute and second hand watch;
m. Plastic sheeting;
n. Absorbent pads for spills;
o. PID (calibrated) if VOC emissions are anticipated to pose a health hazard;
p. Camera (if third person available for documentation);
q. Fine-tipped permanent marker;
r. Paper towels;
s. Trash bags;
t. PPE appropriate for the site and LNAPL being recovered - including hardhat, safety glasses with side shields, steel-toed boots (lace up for BNSF sites), and chemical resistant gloves;
u. Site Safety and Health Plan, Tailgate Safety Form

4. PROCEDURES

4.1. General Planning and Considerations PRIOR to Mobilizing to the Field

1) Review procedures and plan coordination of how bail-down will progress.
2) Assign duties to team members, e.g., person "A" does the bailing and emptying, person "B" measures, tracks time, and records.
3) The following are key quality issues that must be maintained:
   - Remove most of the product from the test well as quickly as possible.
   - Removal of groundwater **must be minimized** – as groundwater is recovered, error is introduced into the test results. Analytical methods assume that groundwater levels are undisturbed, so initiate measures to assist with managing how deep to lower the bailer to avoid contact with groundwater.
   - Expect groundwater levels to <u>rise</u> as product is removed. Observe whether this is happening as analytical methods will be determined by whether a static potentiometric surface elevation is maintained.
   - Careful, consistent measurements must be made of product volumes, and product and water depths.
   - Time must be recorded for every measurement recorded.
4) Plan out liquid storage, transport, and disposal prior to job startup. Proper labeling is required on storage containers. Use security measures appropriate for the site location.
5) Ensure a <u>current</u> Site Safety and Health Plan (SSHP) is available and reviewed. Utilize a SSHP Tailgate Safety Meeting form with pertinent data for the record.

4.2. Procedures in the Field for LNAPL Bail-down Testing Operations

1) Plan the test for a period of fair weather, as rapid changes in barometric pressure produced by fronts can cause groundwater levels to change.
2) Measure and record water & product levels in wells under consideration for testing with an interface probe.
3) **WELL SELECTION**. Only wells with product thicknesses exceeding 1-foot should be considered for testing to limit the possibility of recovering groundwater. The LNAPL should be located within the screened interval of the test well for the best results. Wells under two-inches in diameter should only be tested if larger wells are unavailable, and special considerations may apply to testing small diameter wells.
4) Layout plastic and arrange absorbent pads, PMD or other graduated container, bailer, interface probe, funnel, gloves, etc. near wellhead to be tested.
5) Use interface probe to verify static product and groundwater levels in the well to be tested.
6) Select a bailer sized to fit the well being tested (a 1.5" bailer for a 2" well; a 3.5" bailer for a 4" well). This will allow for the most efficient recovery of LNAPL.
7) Measure the bailer line, with bailer attached, to mark the location on line with tape that coincides with the depth to LNAPL from the measuring point (top of riser). The tape will help judge the proper depth to lower the bailer to minimize the recovery of groundwater.
8) Note the time and begin bailing product, taking care to **avoid removing groundwater**. **If groundwater is accidently recovered**, decant the water from the bottom of bailer back into the well using a funnel at the wellhead. This procedure should be worked out before initiating the test. ***The goal is not to remove all the LNAPL, so groundwater recovery can be minimized if care is exercised.***
9) Place the recovered product into a PMD or other graduated container. If a non graduated container, like a 5 gallon bucket, is all that is available – record the dimensions of the container so that the LNAPL volume can be calculated.
10) Remember that the groundwater depth will rise as product is removed, so the depth that the bailer is lowered into the well will decrease as the test continues to avoid capturing water.
11) **Continue bailing product until the product thickness has been diminished by approximately 90% of the original thickness, or until the thickness of the LNAPL being recovered is no longer appreciably declining (equilibrium state).** The amount of bailing required to reach this level will vary between wells; even between wells at the same release site.
12) Coordinate team actions so that monitoring begins immediately after the last bailer of LNAPL is removed. One team member will use an interface probe to measure product and water levels, while the other person records the levels and the time on a LNAPL Bail-Down Test Log (see attachment). The first measurement will be at time = 0 minutes.

13) Continue to record product and water levels at regular time intervals, with the time between intervals increasing appropriately for the observed rate of product recharge. The faster the rate of recovery, the more frequent the time between measurements are required. As a rule, start by measuring levels every 30 seconds for about five minutes, then every minute for another 5 minute period, then every 5 minutes from the 10 minute to 30 minute portion of the test. At the 30 minute mark look at the data to determine the frequency of further measurements, as the rate of product recovery will likely have slowed or even stabilized. Plan for a minimum test time of 2 hours. **Ideally, measurements should continue until the LNAPL has returned to within 75% of the original product thickness**.

14) For very slowly recharging wells, it may be necessary to perform other site duties if product and water level measurements indicate little change over long periods of time. It may be necessary, if practical, to return to the site later in the day or the next day to finalize readings. Project budget and site conditions will dictate the duration of the test. Please consult with the project manager or a senior staff member for assistance if unusual conditions are observed.

15) Note the amount of LNAPL that was recovered and placed into the PMD at the start of the test. Make sure that the units of measurement (feet or gallons) used to measure the LNAPL are recorded and identify the PMD device utilized; these notes will ensure that the proper volume is calculated. If a non-graduated container was used to hold the LNAPL, please provide the dimensions of the container.

16) When the test is completed, secure the wellhead and arrange for the proper disposal of recovered product and solid waste (gloves and pads). If a 55-gallon drum is to be left on-site, find a secure area away from traffic for drum storage. Seek a storage area sheltered from the weather (if possible), but where pick-up can be easily completed when the drum is full. Arrange for secondary containment, if possible. Make sure that the drum is properly labeled.

4.3. Procedures to Process Collected Data from Bail-down Testing

1) Transfer your field data to the Excel processing spreadsheet created for bail down test results (see attachment). The spreadsheet will calculate groundwater and product level elevations, and product displacement for each time interval. The last two columns of the spreadsheet (time & displacement) will be imported into an AQTESOLV program to run the hydraulic calculations.

2) See EWI SOP #12 for processing of slug test data using AQTESOLV, or seek assistance from a staff member with experience using this software. If the groundwater elevation, corrected for LNAPL thickness, remained fairly constant throughout the test, then select the Unconfined Bouwer-Rice solution for a slug test on the AQTESOLV software screen. If the corrected groundwater elevation did not remain fairly consistent, then the modified Jacob & Lohman solution is recommended; which is not available in AQTESOLV. Seek help at this point from a senior staff member. .

3) When evaluating LNAPL bail-down test data using AQTESOLV software for a slug test, please be aware of some notable input changes. The software requests an aquifer saturated thickness value, which is replaced by the LNAPL saturated

thickness for a LNAPL bail-down test. The LNAPL saturated thickness is NOT the initial measured LNAPL thickness observed in the well, as LNAPL saturation can occur below the groundwater table (recall the "shark fin" saturation curve). Since this value cannot be measured, please seek assistance with estimating this value by using PID measurements or other data. The LNAPL saturated thickness value will also be substituted in as the *static water column height* and the *total well penetration depth* in the AQTESOLV software.

4) **Other AQTESOLV suggestions.** Use an effective porosity value for the filter pack of n = 0.2 (or 20%). When fitting a slope line to your curve on the displacement versus time graph, use the visual match option to fit lines at both ends of the curve (early & late). Though an early fit is the accepted practice, it is good to look at the transmissivity range resulting from evaluating different parts of the curve.

5) When a transmissivity value is obtained using the AQTESOLV Bouwer-Rice solution, a factor must be applied to compensate for the density difference between water and the LNAPL. As presented on page 49 of the Huntley article (see references / attachment), the factor is defined as $1 / (1 - \rho_r)$, where ρ_r is the relative density of the LNAPL.

Note: The corrected groundwater potentiometric surface elevation is determined by adding the product of the density of the LNAPL (ρ_r) times the product thickness, to the difference between the measuring point elevation and the depth to groundwater. This is the same correction applied to normal EWI water elevation tables for any LNAPL site. See the example plots in the Attachments that demonstrate the potentiometric surface vs. the water/product interface. In these plots the "corrected water level" is the potentiometric surface.

5. SAFETY

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult a material safety data sheet (MSDS) or other chemical reference materials for information on selecting the appropriate personal protective equipment (PPE) for the anticipated hazardous substances to be encountered during the product bail-down test.

Conduct an on-site safety meeting each day before the start of the project to go over safety concerns. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, PPE required, health monitoring and action levels, emergency procedures, other physical or chemical hazards) using a Tailgate Safety Meeting form and have all personnel sign it each day before the start of the project. Take appropriate action if personnel are injured on-site in accordance with EWI directives. When working with potentially hazardous substances, follow the U.S. Environmental Protection Agency, Occupational Safety and Health Administration, the Environmental Works, Inc. "Corporate Health and Safety Plan" guidelines, and the Site-Specific Health and Safety Plan.

6. REFERENCES

- "Analytical Determination of Hydrocarbon Transmissivity from Baildown Tests", David Huntley, GROUNDWATER, Vol. 38, No. 1, January-February 2000, pp. 46-52
- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- "HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training." Safety Source, Inc

Environmental Works, Inc. SOP No. 11

LNAPL Bail-down Testing

ATTACHMENTS

Analytical Determination of Hydrocarbon Transmissivity from Baildown Tests
(David Huntley article from GROUND WATER)

LNAPL Bail-down Testing Log

Example Excel Processing Spreadsheet

Example Product-Water Hydrograph Plot

Analytic Determination of Hydrocarbon Transmissivity from Baildown Tests

by David Huntley[a]

Abstract

Hydrocarbon baildown tests involve the rapid removal of floating hydrocarbon from an observation or production well, followed by monitoring the rate of recovery of both the oil/air and oil/water interfaces. This test has been used erroneously for several years to calculate the "true thickness" of hydrocarbon in the adjacent formation. More recent analysis of hydrocarbon distribution by Farr et al. (1990), Lenhard and Parker (1990), Huntley et al. (1994), and others have shown that, under vertical equilibrium conditions, there is no thickness exaggeration of hydrocarbon in a monitoring well, though there is a significant volume exaggeration. This body of work can be used to demonstrate that the calculation of a "true hydrocarbon thickness" using a baildown test has no basis in theory. The same body of work, however, also demonstrates that hydrocarbon saturations are typically much less than one, and are often below 0.5. Because the relative permeability decreases as hydrocarbon saturation decreases, the effective conductivity and mobility of the hydrocarbon is much less than that of water, even ignoring the effects of increased viscosity and decreased density.

It is important to evaluate this decreased mobility of hydrocarbon due to partial pore saturation, as it has substantial impacts on both risk and remediation. This paper presents two analytic approaches to the analysis of hydrocarbon baildown test results to determine hydrocarbon transmissivity. The first approach is based on a modification of the Bouwer and Rice (1976) analysis of slug withdrawal test data. The second approach is based on a modification of Jacob and Lohman's (1952) constant drawdown—variable discharge aquifer test approach. The first approach can be applied only when the effective water transmissivity across the screened interval to water is much greater than the effective hydrocarbon transmissivity. When this condition is met, the two approaches give effectively identical results.

Introduction

The hydrocarbon baildown test consists of (1) rapid removal of as much of the hydrocarbon in a well as is practical, followed by (2) monitoring of the elevations of the hydrocarbon/air and hydrocarbon/water interfaces (which for expediency will hereafter be referred to as oil/air and oil/water interfaces) in the monitoring well. This test is applicable only to wells with light nonaqueous phase liquids (LNAPL) filling a portion of the well casing, and was first proposed by Gruszczenski (1987) as a method to evaluate the "true" hydrocarbon (LNAPL) thickness in the formation adjacent to a monitoring well. Gruszczenski observed that, after bailing hydrocarbon from a monitoring well, the oil/water interface frequently rose to an inflection point before declining as hydrocarbon discharged from the formation to the well. He speculated that the thickness of hydrocarbon in the monitoring well at this point of inflection was the "true' hydrocarbon thickness in the formation. Testa and Paczkowski (1989) later referenced the approach of Gruszczenski (1987), and the use of the baildown test to measure "true" hydrocarbon thickness in formations became a common investigative practice.

In point of fact, this application of baildown testing is without theoretical or physical basis. More recent analysis of hydrocarbon distribution by Farr et al. (1990) and Lenhard and Parker (1990) have shown that there is no thickness exaggeration of hydrocarbon in a monitoring well, though there is a significant volume exaggeration. Under vertical equilibrium conditions, hydrocarbon saturations are zero at the oil/water interface, increasing between the oil/water and oil/air interface, and decreasing starting some distance above the oil/air interface (Figure 1). The degree to which hydrocarbon saturations increase above the oil/water interface is a function of the capillary characteristics of the soil, the relative density of the hydrocarbon, and the oil/water interfacial tension. With the same hydrocarbon thickness in the monitoring well, coarse soils will have greater hydrocarbon saturations than fine-grained soils (Figure 1). This theoretical hydrocarbon distribution predicted by Farr et al. (1990) and Lenhard and Parker (1990) has been verified by field measurements presented by Huntley et al. (1994), Lundegard and Mudford (1998), and others, and is demonstrated well by the comparison between measured and predicted hydrocarbon saturations in Figure 2.

This more recent and physically based body of work can be used to demonstrate that the thickness of the soil impacted by hydrocarbon (the "true" thickness) is actually somewhat greater than the thickness of hydrocarbon in the adjacent monitoring well due to the presence of hydrocarbon above the oil/air interface. There is no exaggeration of thickness by the monitoring well and, therefore, the baildown test cannot measure a degree of hydrocarbon exaggeration. The same body of work, however, also demonstrates that hydrocarbon saturations (percentage of pore space filled with hydrocarbon) are typically much less than one, and are often below 0.5, resulting in a significant volume exaggeration. This also has an

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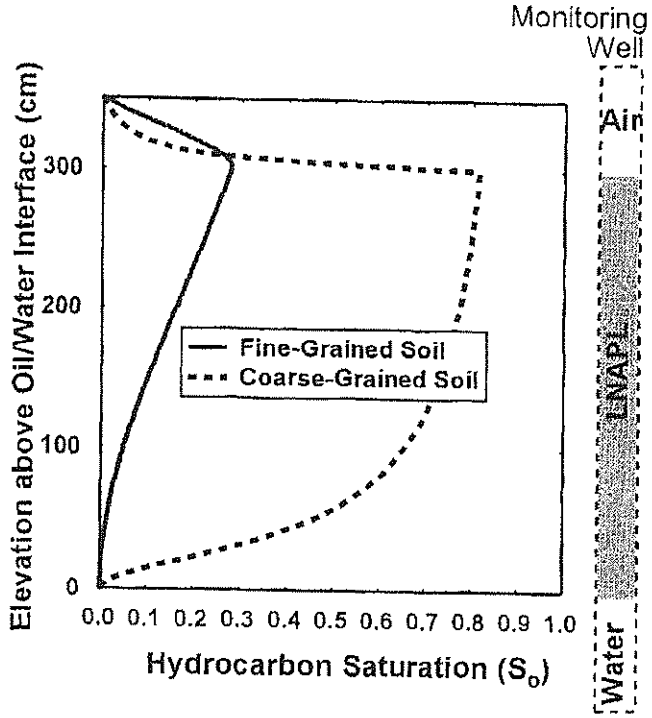

Figure 1. LNAPL saturation profile for coarse- and fine-grained soils with 300 cm of LNAPL in a monitoring well.

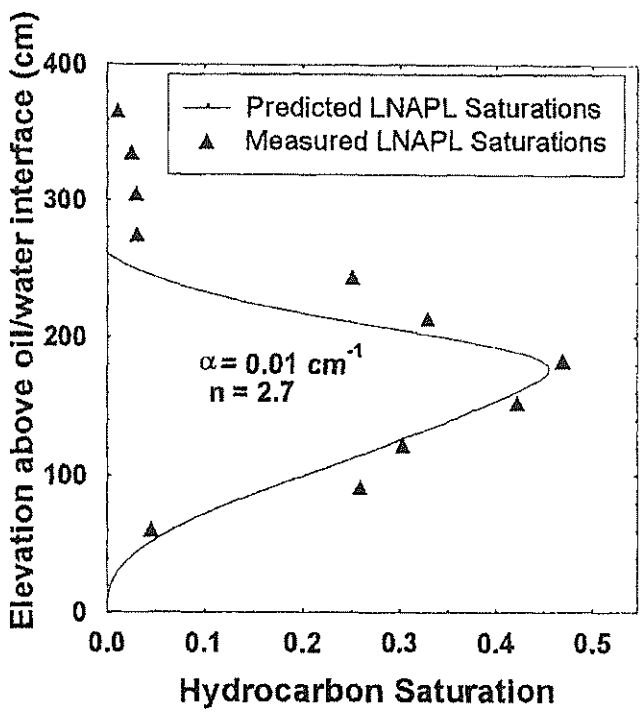

Figure 2. Comparison of predicted and measured hydrocarbon saturations, fine-grained homogeneous soil.

important implication with respect to mobility and recoverability of hydrocarbon. In a two-phase system, the flux of hydrocarbon is given by a modified form of Darcy's law:

$$q = k_{rn} k_i \frac{\rho_n g}{\mu_n} i \qquad (1)$$

where k_{rn} is the relative permeability of the nonwetting fluid (the hydrocarbon), k_i is the intrinsic permeability of the soil, ρ_n is the density of the hydrocarbon, g is the acceleration due to gravity, μ_n is the viscosity of the hydrocarbon, and i is the gradient. The relative permeability of the nonwetting phase (k_{rn}) decreases markedly as hydrocarbon saturation decreases, as given by Mualem (1976):

$$k_{rn} = (1 - S_e)^{1/2} (1 - S_e^{1/m})^{2m} \qquad (2)$$

where $S_e = (S_w - S_{rw})/(S_m - S_{rw})$, S_w is the water saturation, S_{rw} is the residual water saturation, S_m is the maximum water saturation (equal to one for the initial displacement of water by NAPL and equal to $1 - S_{rnw}$ for displacement of NAPL by water), S_{rnw} is the residual NAPL saturation, and m is a capillary parameter used to fit the measured saturation data to the closed-form van Genuchten expression (van Genuchten 1980). It is clear from this expression that as hydrocarbon saturation decreases (increasing S_w and S_e) the relative permeability of the hydrocarbon phase decreases exponentially. This, together with decreased density and generally increased viscosity, markedly decreases the mobility of hydrocarbon in the subsurface, both under ambient conditions and under conditions of recovery.

The hydrocarbon baildown test, though not providing any information about "true" or exaggerated thicknesses, does provide useful information about the mobility of hydrocarbon in the formation under prevailing hydraulic conditions. It is apparent that increased hydrocarbon mobility will result in increased rates of recovery following removal of hydrocarbon from a monitoring well. Quantitatively, the rate of recovery of hydrocarbon in the monitoring well will be a function of the hydrocarbon transmissivity (T_n), defined as

$$T_n = \int_{z_w}^{z_o} k_{rn} k_i \frac{\rho_n g}{\mu_n} dz \qquad (3)$$

where z_o is the elevation of the oil/air interface and z_w is the elevation of the oil/water interface.

This hydrocarbon transmissivity can be used to assess area-specific recovery rates and lateral rates of mass flux of hydrocarbon. Note that lateral plume movement is usually impeded by the low effective conductivity of hydrocarbon at the plume boundaries, where product thicknesses and saturations are often small. Therefore, discrete areas of high effective conductivity should not be misinterpreted as indicating mobility of the entire free-product plume.

Zhu et al. (1994) used a coupled numerical model and a nonlinear parameter estimator to iteratively match the measured response to a hydrocarbon baildown test to that predicted by the model, resulting in estimates of the capillary parameters and permeability of the soil. This approach requires access to multiphase numerical codes and frequently long execution times. The objective of the current paper is to provide analytic solutions that can be used to analyze baildown tests to derive the effective hydrocarbon transmissivity, rather than relying on numerical codes.

Theory and Results

The purpose of the baildown test is to empirically and quantitatively evaluate the mobility of hydrocarbon in the formation, through an in situ test. The hydrocarbon baildown test affects both the hydrocarbon and the ground water in the vicinity of the well. If

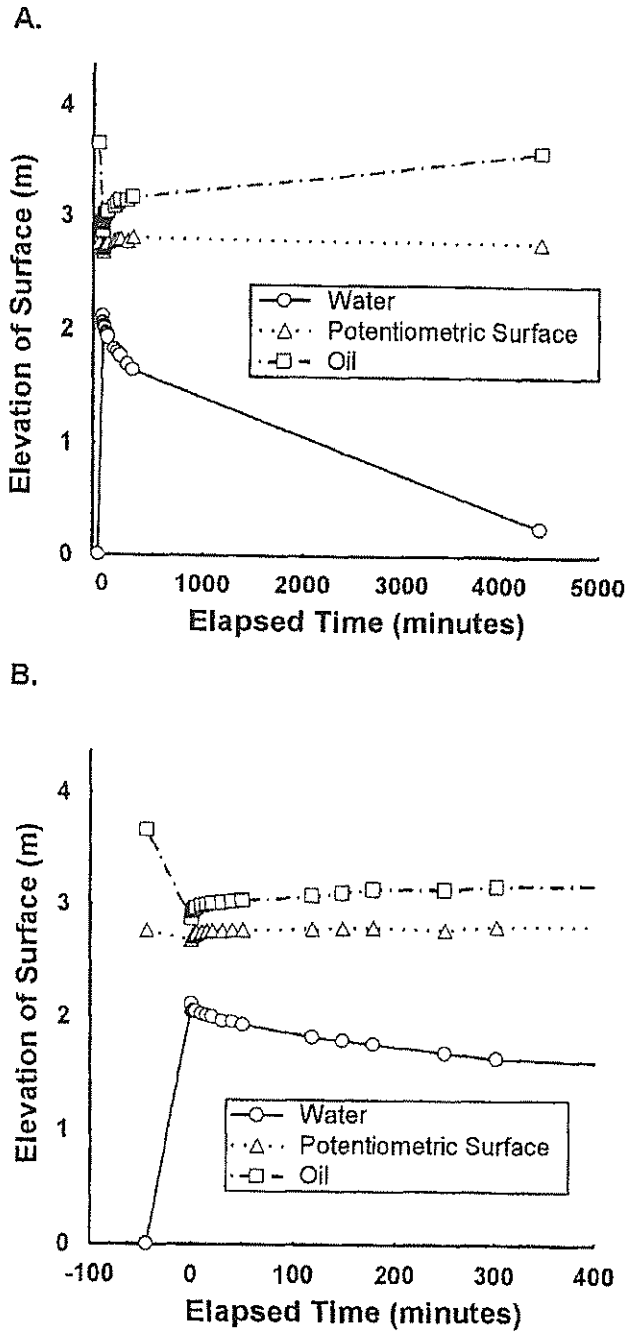

Figure 3. Fluid elevation changes, well MW-56. (a) zero to 5000 minutes, (b) expansion of first 400 minutes of response.

done carefully, extraction of hydrocarbon from the monitoring well removes little ground water, so ground water pressures in the formation are minimally affected by the test. As hydrocarbon is removed from the well, however, the ground water level in the well rises in response to the decrease in fluid pressure in the well relative to that of the ground water in the aquifer. Because the mobility of water is typically greater than that of hydrocarbon in the formation near the well, in most cases the potentiometric surface in the well (often called the corrected water table) recovers rapidly, and thereafter remains constant in the well. This potentiometric surface can be calculated as

$$Z_p = Z_w + \rho_r (Z_o - Z_w) \tag{4}$$

where z_p is the elevation of the potentiometric surface, z_o is the elevation of the oil/air interface, z_w is the elevation of the oil/water interface, and ρ_r is the relative density of the hydrocarbon. Therefore, as hydrocarbon enters the well during recovery, the oil/water interface declines to maintain that constant potentiometric surface. This can be seen in the fluid level plots for well MW-56, a 10 cm diameter monitoring well at a Southern California refinery (Figure 3). The oil/air interface was about 3.6 m above the oil/water interface prior to bailing. Through bailing, the hydrocarbon thickness decreased to about 0.6 m. Before bailing, the potentiometric surface was about 2.75 m above the datum. Immediately after bailing, the calculated potentiometric surface is within several centimeters of the original surface, and it remains constant thereafter. As hydrocarbon enters the well, the elevation of hydrocarbon (oil/air interface) rises from about 2.9 m gradually to about 3.4 m, while the corresponding elevation of the oil/water interface declines to about 0.3 m. This is consistent with the fact, that, if the potentiometric surface (z_p) remains constant, then

$$\Delta z_p = O = \Delta z_w + \rho_r (\Delta z_o - \Delta z_w) \tag{5}$$

or

$$\Delta z_w = \frac{-\rho_r}{1 - \rho_r} \Delta z_o \tag{6}$$

For example, if the hydrocarbon has a relative density of 0.75, then $\Delta z_w = -3\Delta z_o$, meaning that a 1 m rise in the oil/air interface elevation will produce a 3 m drop in the oil/water interface elevation.

Modification of Bouwer-Rice Slug Test Analysis

A hydrocarbon baildown test cannot be analyzed like a simple slug test, because the volume of hydrocarbon entering the borehole is not simply $\pi r_c^2 \partial h$, it is, $\pi r_c^2 (\partial z_o - \partial z_w)$ where r_c is the radius of the casing and ∂h is the change in head. In the case where ground water mobility is sufficiently high that the potentiometric surface recovers rapidly, such as that seen in Figure 3, Equation 6 can be used to relate the change in the oil/water interface elevation to that of the oil/air interface elevation.

Following the approach that Bouwer and Rice used to derive analytic expressions for the analysis of slug tests, the relation between drawdown (s) and discharge (Q) at any point in time can be approximated by the Thiem equation:

$$s = \frac{Q}{2\pi T} \ln\left(\frac{r_0}{r_w}\right) \tag{7}$$

where T is the aquifer transmissivity, r_0 is the radius of influence, and r_w is the radius of the well. In a simple water system, $Q = \pi r_c^2 \frac{\partial s}{\partial t}$. In an oil/water system, though, we have stated that

$$Q = \pi r_c^2 \left(\frac{\partial z_0}{\partial t} - \frac{\partial z_w}{\partial t}\right) \tag{8}$$

To solve this, we need a simplifying assumption. If ground water mobility is high relative to water, the potentiometric surface remains

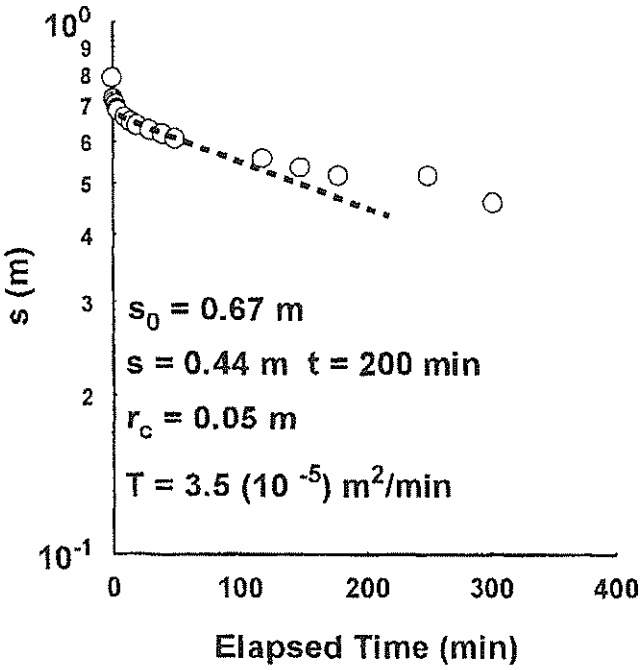

Figure 4. Analysis of the response of MW-56 using modified Bouwer-Rice approach.

relatively constant during the test. Therefore, we can substitute Equation 6 into Equation 8, resulting in

$$Q = \pi r_c^2 \left(\frac{1}{1-\rho_r}\right)\left(\frac{\partial z_o}{\partial t}\right) \tag{9}$$

The drawdown for the hydrocarbon baildown test is simply the difference between the original hydrocarbon elevation and the hydrocarbon elevation during the recovery period. Therefore $\partial z_o = -\partial s$, and Equation 9 can be substituted into Equation 7 to produce

$$s = -\frac{r_c^2\left(\frac{1}{1-\rho_r}\right)}{2T}\left(\frac{\partial s}{\partial t}\right)\ln\left(\frac{r_0}{r_w}\right) \tag{10}$$

rearranging:

$$T\int_0^t \partial t = -\frac{r_c^2\left(\frac{1}{1-\rho_r}\right)}{2}\ln\left(\frac{r_0}{r_w}\right)\int_{s_0}^{s}\left(\frac{\partial s}{s}\right) \tag{11}$$

after integrating from t = 0 to t = t and from $s = s_0$ to s = s, we have

$$T = \frac{2.3 r_c^2\left(\frac{1}{1-\rho_r}\right)}{2t}\ln\left(\frac{r_0}{r_w}\right)\mathrm{Log}\left(\frac{s_0}{s}\right) \tag{12}$$

This, of course, is the same equation as that derived by Bouwer and Rice (1976) for slug test analysis, except for the additional term $(1/(1-\rho_r))$. This implies that a plot of Log (s) versus t will yield a straight line (Figure 4). As in the traditional Bouwer and Rice analysis of slug test data, s_0, the drawdown at t = 0, is taken from the graph as the intercept of the straight line fit through the data, and t and s are the coordinates of a second point on the straight line. Transmissivity is calculated using those selected values and Equation 12. In other words, the approach is the same as the analysis of Bouwer and Rice, except the transmissivity calculated using the Bouwer and Rice equations is multiplied by $1/(1-\rho_r)$ to arrive at the transmissivity of the hydrocarbon system. This implies that existing aquifer test analysis approaches and software can be used to analyze the data from hydrocarbon baildown tests, with the simple correction of multiplying the resulting transmissivity by $1/(1-\rho_r)$.

It is important to point out that the described approach assumes that the potentiometric surface equilibrates nearly instantly, such that changes in z_w in the monitoring well are related to changes in z_o by Equation 6. If this assumption is not met, substantial error will result.

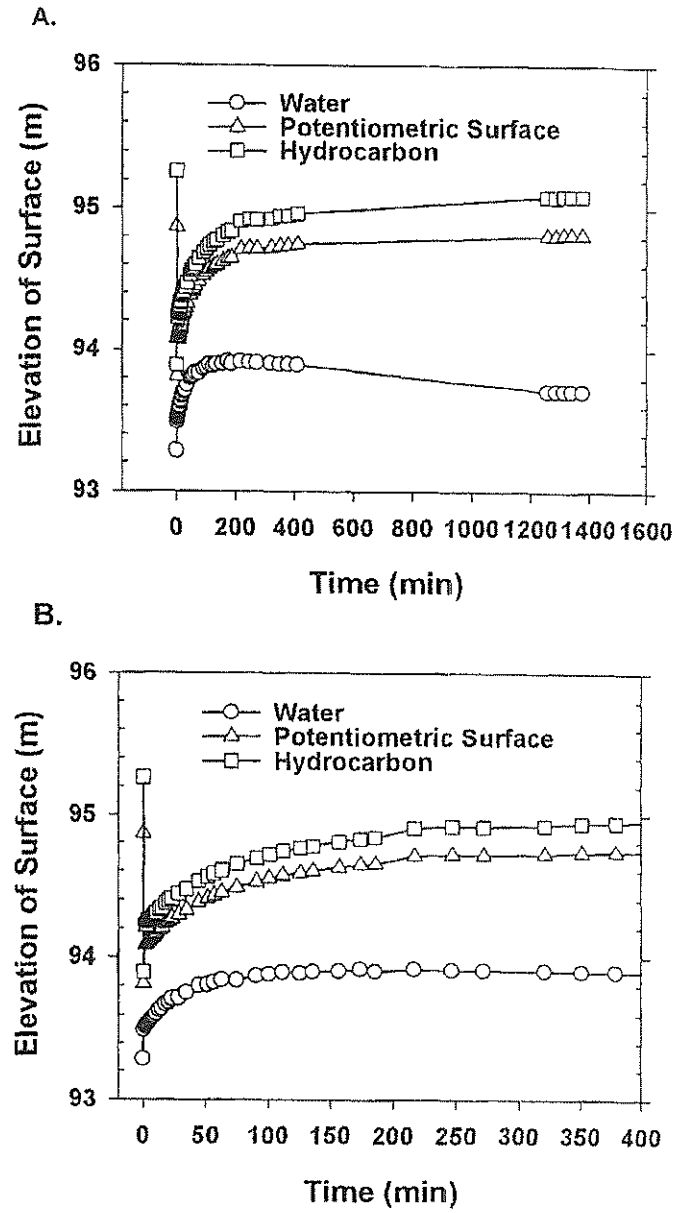

Figure 5. Fluid elevation changes, well MW-23, (a) zero to 1400 minutes, (b) expansion of first 400 minutes of response.

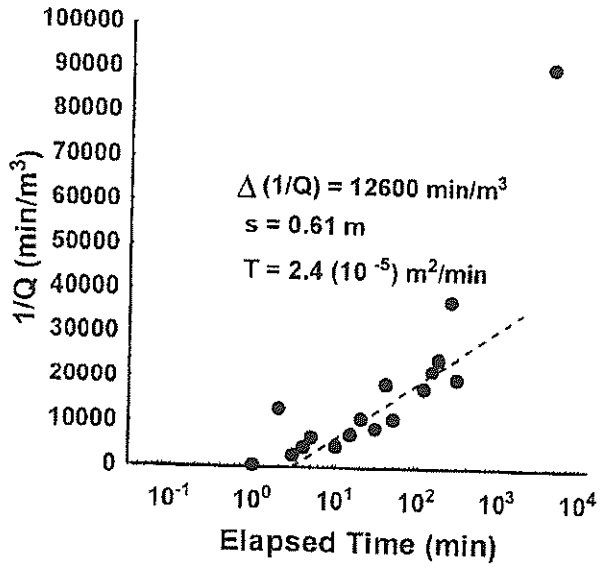

Figure 6. Analysis of MW-56 baildown test as a variable discharge, constant drawdown aquifer test.

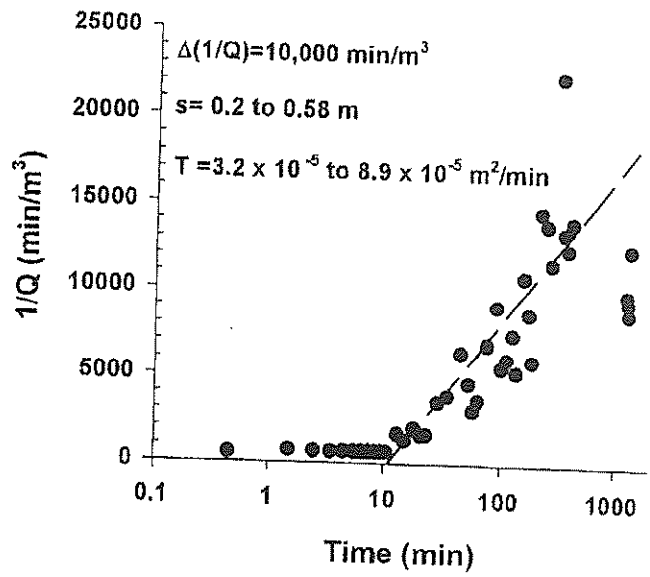

Figure 7. Analysis of MW-23 baildown test as a variable discharge, constant drawdown aquifer test.

Approaches Based on Cooper-Jacob Equation

In some cases, either because of limited permeability or a limited length of the well screen below the oil/water interface, the potentiometric surface may not equilibrate rapidly, such as is seen in the response of MW-23, a second monitoring well from the same Southern California refinery as MW-56 (Figure 5). In this well, the potentiometric surface is rising (recovering) throughout the entire test, such that Equation 6 cannot be applied. As a result, the modification of the slug test analysis previously derived cannot be used to analyze the data of MW-23. An alternate approach is based on Jacob and Lohman's (1952) modification of the Cooper-Jacob method for constant drawdown, variable discharge conditions. Jacob and Lohman (1952) noted that, except for very early times, the relationship between decreasing discharge and time under constant drawdown conditions is given by

$$\frac{1}{Q} = \frac{2.3}{4\pi Ts} \text{Log} \frac{2.25Tt}{r^2S} \tag{13}$$

where Q is the discharge from the well, s is the drawdown (assumed constant over the period used for the analysis), t is time, r is the distance to the monitoring well (or well radius for a single-well test), and S is the aquifer storage coefficient. Equation 13 implies that a plot of 1/Q versus Log t should be linear, and the slope can be used to calculate the transmissivity by

$$T = \frac{2.3}{4\pi s\, \Delta(1/Q)} \tag{14}$$

where $\Delta(1/Q)$ is the change in 1/Q per log cycle. Because, during the recovery from a baildown test, the well is not really being pumped but is recovering from a rapid removal of hydrocarbon from the well, the discharge (Q) must be calculated from the change in volume of hydrocarbon in the well. That is,

$$Q = \frac{\pi r_c^2 (\Delta z_0 - \Delta z_w)}{\Delta t} \tag{15}$$

This approach is shown for data from both well MW-56 (Figure 6) and well MW-23 (Figure 7). The method assumes that drawdown (s) is constant during the recovery period and is known. In the case of MW-56, the drawdown varies only slightly, from 0.58 to 0.64 m, so the assumption of constant drawdown introduces little error. In the case of MW-23, however, the drawdown varies from 0.2 to 0.58 m between 100 minutes and the end of the test, violating the assumption of constant drawdown and introducing unknown error in the analysis.

A variation on this approach, useful when drawdown is varying substantially during recovery, is to further modify the Cooper-Jacob equation to

$$\frac{s}{Q} = \frac{2.3}{4\pi T} \text{Log} \frac{2.25Tt}{r^2S} \tag{16}$$

allowing us to plot s/Q versus t. This approach compensates somewhat for time varying drawdown during the test, and allows us to calculate the transmissivity as

$$T = \frac{2.3}{4\pi\, \Delta(s/Q)} \tag{17}$$

where $\Delta(s/Q)$ is the change in s/Q per Log cycle.

An example of this analysis is again shown for MW-56 (Figure 8) and MW-23 (Figure 9). It should be noted that the Theis equation, on which the Cooper-Jacob approximation is based, assumes either constant drawdown or constant discharge. As the discharge of hydrocarbon into a well is not only dependent on the drawdown at time t but also on the drawdown at earlier times, the approach given by Equation 17 is an approximation, with increasing error introduced by an increasing variation in drawdown during the test. Further, although this approach allows one to take into account variable drawdown during the recovery, it frequently introduces additional scatter in the data. This scatter is produced by the fact that the thickness of hydrocarbon in the well ($z_o - z_w$) is changing slowly, and small errors in measurement can markedly affect the answer,

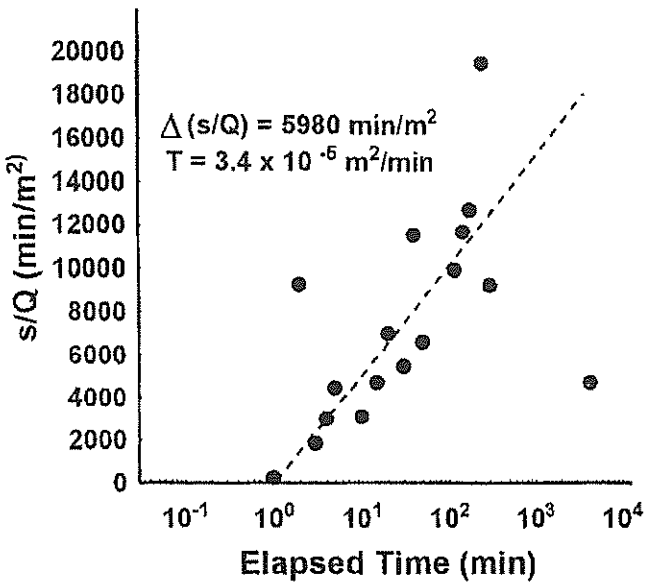

Figure 8. Analysis of MW-56 baildown test as s/Q vs. log time.

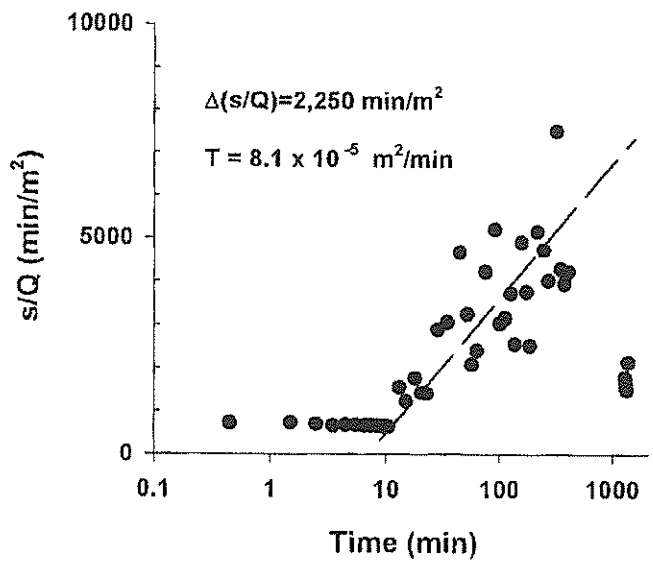

Figure 9. Analysis of MW-23 baildown test as s/Q vs. log time.

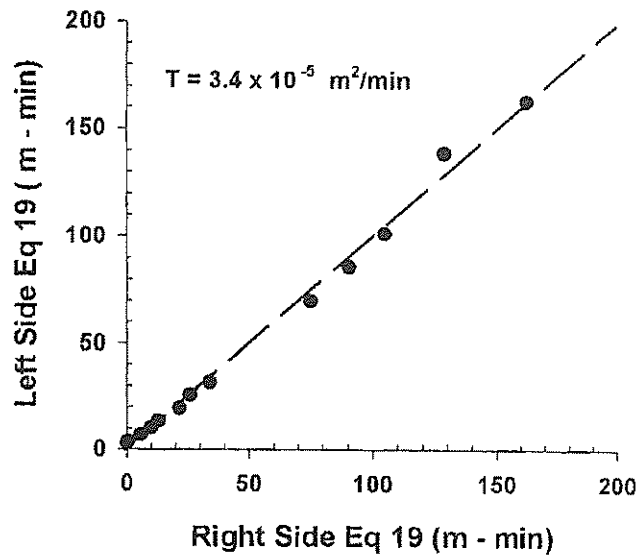

Figure 10. Plot of Equation 19, right-hand side vs. left-hand side for MW-56 baildown test response. Points are measured data from test, using calculated transmissivity; dashed line represents zero residual.

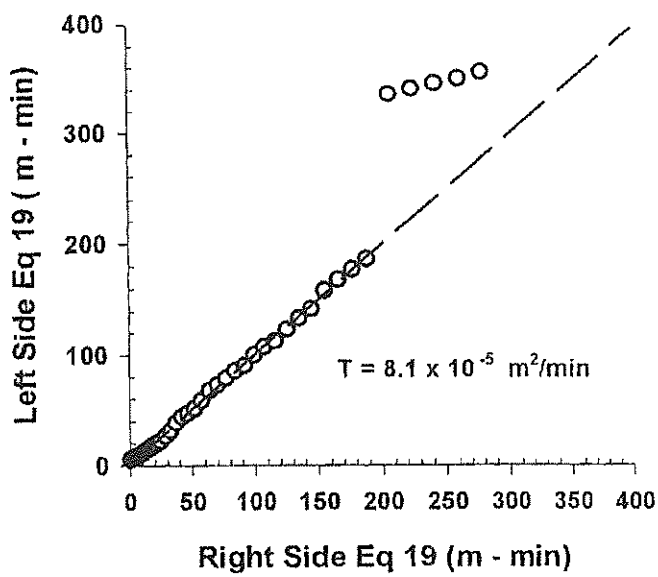

Figure 11. Plot of Equation 19, right-hand side vs. left-hand side for MW-23 baildown test response. Points are measured data from test, using calculated transmissivity; dashed line represents zero residual.

particularly if measurements are taken close together (small Δt). Real-world data sets sometimes show an apparent decrease in thickness due to errors in measurement.

To minimize the effect of this scatter, we can look at the cumulative change in volume of hydrocarbon in the well at any time. If we multiply both sides of the Cooper-Jacob expression by the interval between time steps (Δt),

$$(s\,\Delta t) = \frac{2.3(Q\Delta t)}{4\pi T}\,\mathrm{Log}\,\frac{2.25Tt}{r^2S} \qquad (18)$$

The term $Q\Delta t$ is simply the change in the volume of hydrocarbon in the borehole over the time step interval. Summing both the left- and right-hand side of the equation between time step 1 and time step n, we arrive at

$$\sum_{i=1}^{n}(s_i\,\Delta t_i) = \frac{2.3}{4\pi T}\sum_{i=1}^{n}\left(Q_i\,\Delta t_i\,\mathrm{Log}\,\frac{2.25Tt_i}{r^2S}\right) \qquad (19)$$

Solution of Equation 19 cannot be done graphically, but can be done iteratively or by using a tool such as Solver within an Excel™ spreadsheet. The approach is to calculate both the left- and right-hand sides of Equation 19 using an assumed (first guess) value of the two unknowns, T and r^2S. The squared residual can be calculated for each time step as

$$\left(\sum_{i=1}^{n}(s_i\,\Delta t_i) - \frac{2.3}{4\pi T}\sum_{i=1}^{n}\left(Q_i\,\Delta t_i\,\mathrm{Log}\,\frac{2.25Tt_i}{r^2S}\right)\right)^2 \qquad (20)$$

The sum of squared residual (SSR) is simply calculated as the sum of Equation 20 over all time steps. Values of T and r^2S are then iteratively adjusted to minimize the SSR. Visual confirmation of a

solution can be produced by plotting the left-hand side of Equation 19 versus the right-hand side (Figures 10 and 11), or by plotting the residual versus time.

Plotting the left-hand side of Equation 19 versus the right-hand side of Equation 19 shown for MW-56 (Figure 10) and MW-23 (Figure 11), allows the user to assess the degree to which the calculated value of transmissivity minimizes the residual (makes the left side and right side of Equation 19 equal, as indicated by the dashed line in Figures 10 and 11). The resulting transmissivity calculated for MW-56 (3.4×10^{-5} m^2/min) is effectively the same as that calculated using the modification to the slug test analysis approach derived earlier (3.5×10^{-5} m^2/min), much closer than the result using Equation 13, and the same as using Equation 16. The results are similar for MW-23 (Figure 11). Using previous approaches, data were scattered and calculated transmissivities range from 3.2×10^{-5} to 8.9×10^{-5} m^2/min. Using Equation 19, the resulting transmissivity is 8.1×10^{-5} m^2/min.

Discussion and Conclusions

Hydrocarbon production rates associated with liquid-phase extraction are directly proportional to the effective hydrocarbon transmissivity. Corapcioglu et al. (1994), Charbeneau et al. (1997), and Waddill and Parker (1997) present a series of semianalytic expressions that relate LNAPL production rates to the effective hydrocarbon transmissivity or to the product of the average effective hydrocarbon conductivity and the thickness of the hydrocarbon impacted interval. This effective hydrocarbon transmissivity can be calculated by detailed measurements of the LNAPL saturation distribution, combined with laboratory measurements of the capillary characteristics and intrinsic permeability of the soil and interfacial tensions, viscosity, and density of the LNAPL. Alternatively, it can be measured directly in the field through the use of the hydrocarbon baildown test.

Two independent approaches have been derived that allow us to determine hydrocarbon transmissivity from the response of monitoring wells to a hydrocarbon baildown test. In many wells, in our experience, ground water mobility is sufficiently greater than hydrocarbon mobility that the ground water potentiometric surface recovers to its original value rapidly compared to the recovery of the hydrocarbon elevation in the well. In this case, a modification of the Bouwer and Rice (1976) slug test analysis procedure can be applied to the data. However, in those cases where the potentiometric surface does not recover rapidly, this approach will lead to erroneous values of hydrocarbon transmissivity. Under these circumstances, a modification of the Jacob and Lohman (1952) analysis of transient aquifer test data is recommended. Three approaches were described: Plotting 1/Q versus log t is the simplest approach and invokes the fewest assumptions, but it is problematic when drawdown (s) varies significantly during the recovery analysis period. Plotting s/Q versus log t allows the user to take into account varying s, but frequently increases the scatter in the data and violates the assumption of either constant Q or constant s inherent in the use of the Cooper-Jacob equation. To reduce the effect of measurement errors, a third approach (still based on the Cooper-Jacob equation) was introduced using summation of terms over the duration of the test. Solution of the resulting Equation 19 requires iterative updating of the calculated transmissivity to minimize the sum of squares residual, rather than a graphical approach. The result, however, does minimize the effect of errors in individual measurements. For those cases where the calculated transmissivity has been (and can be) compared to that calculated using slug test analysis, the results are very close. This approach is particularly useful when the potentiometric surface does not remain constant with time and there is significant measurement error.

Acknowledgments

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Environmental Works, Inc.
1455 East Chestnut Expressway
Springfield, Missouri 65802
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LNAPL BAIL-DOWN TEST LOG

PROJECT NAME: _____ **NUMBER:** _____

DATE: _____ **PERSONNEL:** _____

INITIAL MEASUREMENTS - STATIC CONDITIONS

TEST WELL ID: _____

MEASURING POINT ELEVATION: _____

DEPTH TO LNAPL (feet below measuring point): _____

DEPTH TO GROUNDWATER (feet below measuring point): _____

PRODUCT THICKNESS (feet): _____ (verify the LNAPL thickness during the initial bail)

PRODUCT VOLUME: (gallons): _____

VOLUME FACTORS (gallons per foot): 2" diam well = 0.17 3" diam well = 0.38 4" diam well = 0.66 6" diam well = 1.5 8" diam well = 2.6

LNAPL BAIL-DOWN DATA

Record the amount of LNAPL removed from the well to lower the product thickness. Indicate the Product Measuring Device (PMD) used to measure the product, the product thickness and the units of measurement. If an in-house PMD was not used; please indicate the dimensions of the container and the LNAPL thickness observed or volume observed in the container.

PMD TYPE (in-house):

If other, please provide dimensions of the container:

Product thickness observed in the container (feet):

Product volume in the container (gallons): **Observed or Calculated?**

LNAPL RECOVERY DATA

Record the actual time the recovery monitoring starts (time @ test duration = 0):

TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)	TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)
0							
0.5							
1							
1.5							
2							
2.5							
3							
3.5							
4							
4.5							
5							
6							
7							
8							
9							
10							
15							
20							
25							
30							

LNAPL BAIL-DOWN TEST - WELL _____ PROJECT: _____ DATE: _____

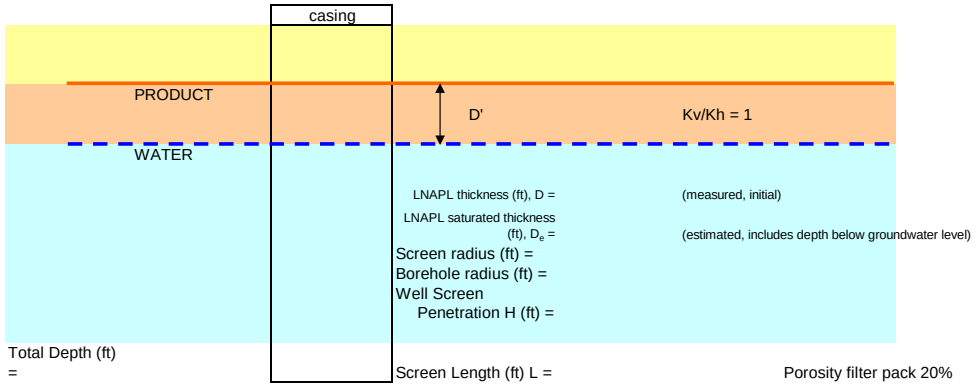
TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)	TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)

NOTES:

LNAPL BAIL-DOWN TEST, PROCESSING SPREADSHEET

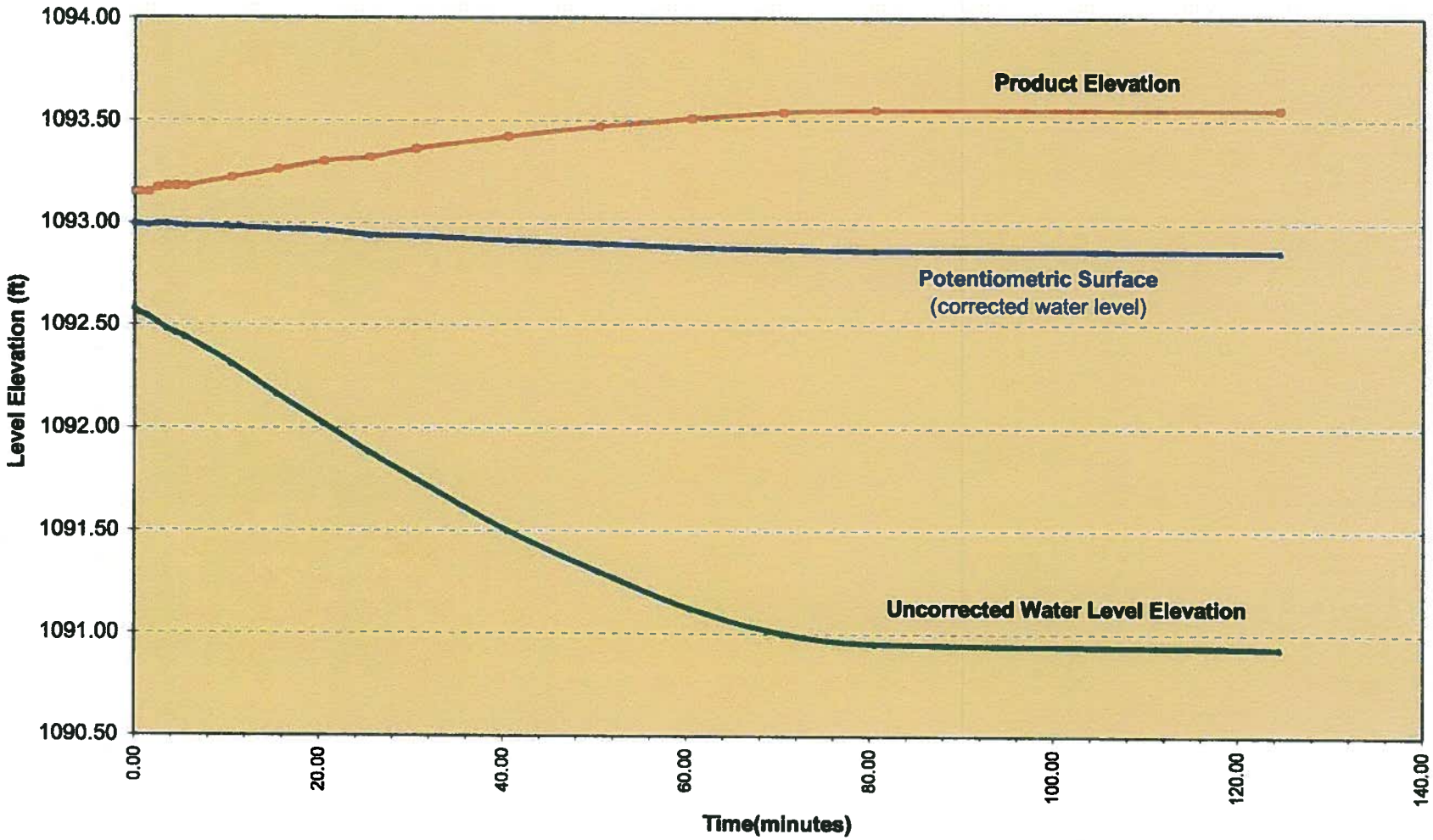
Date:
Site Name / Project Info:
Personnel:
Test Well I.D.: **Test Well Measuring Point Elevation (ft):**
Depth to Static Groundwater Level (ft): **Static Groundwater Elevation (ft):**
Initial (static) LNAPL Thickness (ft): **Initial LNAPL Elevation (ft):**
Initial LNAPL Drawdown (ft): **0.00** **Product Density (g/ml):**

TEST DURATION (minutes)	DEPTH TO LNAPL (feet)	DEPTH TO GROUNDWATER (feet)	PRODUCT THICKNESS (feet)	GROUNDWATER ELEVATION - CORRECTED (feet)	PRODUCT ELEVATION (feet)			AQTESOLV DATA Time (minutes)	AQTESOLV DATA LNAPL Displacement (feet)
0.00			0.00	0.00	0.00			0.00	0.00
0.50			0.00	0.00	0.00			0.50	0.00
1.00			0.00	0.00	0.00			1.00	0.00
1.50			0.00	0.00	0.00			1.50	0.00
2.00			0.00	0.00	0.00			2.00	0.00
2.50			0.00	0.00	0.00			2.50	0.00
3.00			0.00	0.00	0.00			3.00	0.00
3.50			0.00	0.00	0.00			3.50	0.00
4.00			0.00	0.00	0.00			4.00	0.00
4.50			0.00	0.00	0.00			4.50	0.00
5.00			0.00	0.00	0.00			5.00	0.00
6.00			0.00	0.00	0.00			6.00	0.00
7.00			0.00	0.00	0.00			7.00	0.00
8.00			0.00	0.00	0.00			8.00	0.00
9.00			0.00	0.00	0.00			9.00	0.00
10.00			0.00	0.00	0.00			10.00	0.00
15.00			0.00	0.00	0.00			15.00	0.00
20.00			0.00	0.00	0.00			20.00	0.00
25.00			0.00	0.00	0.00			25.00	0.00
30.00			0.00	0.00	0.00			30.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00
			0.00	0.00	0.00			0.00	0.00



Example Hydrograph Plot

Graph 1.0
MW-1B Bail Down Test (7/28/09)
Explorer Pipeline, Walnut Grove, MO



Well_____ Site_____

Baildown/Slug Test Field Form

Project #:		Site Name:	
Well:		Samplers:	
Evacuation Method:		Weather:	

Borehole Diameter (INCHES):
Filter Pack Specific Yield (LNAPL)
0.175

Well Information		LNAPL Information	
Casing Diameter (INCHES):		Fluid Type:	
Total Depth (FT):		Volume Removed:	
Depth to Top of Screen (FT):		Evacuation Method:	
Screen Length (FT):		LNAPL Well Volume:	

Length and volumetric units need to be specified

Length Units: **Volume Units:**

Effective Well Radius (FT)	
	LNAPL Well Volume
ft^3	
gal	
ml	

Period	Date	Time HH:MM	Elapsed Time (min)	DTP (feet)	DTW (feet)	Comments
Initial						
Removal Start						Test Start
Removal Stop						LNAPL/Slug Volume Removed (gal): Water Volume Removed (gal):

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Well_____ Site_____

Period	Date	Time HH:MM	Elapsed Time (min)	DTP (feet)	DTW (feet)	Comments

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Well_____ Site_____

Skimming Recovery Field Form

Project #:		**Site Name:**	
Well:		**Field Staff:**	
		Weather:	

Well Information		**Recovery System Information**	
Casing Diameter:		**Pump Type:**	
Total Well Depth:		**Recovered Volume Measurement Method:** (Tank Volume, Totalizer, Instantaneous)	
Depth to Top of Screen:			
Screen Length:			

Length and volumetric units need to be specified

Length Units: **Volume Units:**

Operational (Y/N)	Date	Time HH:MM	LNAPL Volume Recovered	Water Volume Recovered	Depth to LNAPL	Depth to Water	Pump Depth	Comments

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FAX: 417.823.9659

LNAPL BAIL-DOWN TEST LOG

PROJECT NAME: _____ **NUMBER:** _____

DATE: _____ **PERSONNEL:** _____

INITIAL MEASUREMENTS - STATIC CONDITIONS

TEST WELL ID: _____

MEASURING POINT ELEVATION: _____

DEPTH TO LNAPL (feet below measuring point): _____

DEPTH TO GROUNDWATER (feet below measuring point): _____

PRODUCT THICKNESS (feet): _____ (verify the LNAPL thickness during the initial bail)

PRODUCT VOLUME: (gallons): _____

VOLUME FACTORS (gallons per foot): 2" diam well = 0.17 3" diam well = 0.38 4" diam well = 0.66 6" diam well = 1.5 8" diam well = 2.6

LNAPL BAIL-DOWN DATA

Record the amount of LNAPL removed from the well to lower the product thickness. Indicate the Product Measuring Device (PMD) used to measure the product, the product thickness and the units of measurement. If an in-house PMD was not used; please indicate the dimensions of the container and the LNAPL thickness observed or volume observed in the container.

PMD TYPE (in-house):

If other, please provide dimensions of the container:

Product thickness observed in the container (feet):

Product volume in the container (gallons): **Observed or Calculated?**

LNAPL RECOVERY DATA

Record the actual time the recovery monitoring starts (time @ test duration = 0):

TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)	TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)
0							
0.5							
1							
1.5							
2							
2.5							
3							
3.5							
4							
4.5							
5							
6							
7							
8							
9							
10							
15							
20							
25							
30							

LNAPL BAIL-DOWN TEST - WELL _____ PROJECT: _____ DATE: _____

TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)	TEST DURATION (minutes)	DEPTH TO LNAPL (ft)	DEPTH TO GROUNDWATER (ft)	PRODUCT THICKNESS (ft)

NOTES:

Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in working with monitoring wells and measuring water levels
4) Knowledge of using Excel spreadsheets and AQTESOLV software
5) Knowledge of EWI safety requirements, site health and safety plan, and quality control standards

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to provide a procedure for conducting a slug test, collecting necessary field data, and determine hydraulic conductivity by processing the results in AQTESOLV software. This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. If well conditions or equipment issues limit adherence to the procedures, any variance needs to be discussed with the project manager and recorded in field notes. The ultimate procedures employed should be documented in field notes and in related reports.

2.0 SCOPE

This SOP outlines the procedure needed to collect field data from a slug test in a monitoring well, and to determine the hydraulic conductivity of the subsurface materials in the immediate vicinity of the well. Hydraulic conductivity (K) is an important parameter for modeling the flow of groundwater in an aquifer, and is also used to determine if a water-bearing unit is an aquifer, per Appendix G of the MRBCA guidance document:

http://www.dnr.mo.gov/env/hwp/mrbca/docs/mrbcaappendg.pdf

Slug tests are useful in small diameter wells (2" to 4" wells) where hydraulic conductivity and recharge occur slowly. If groundwater recharge is rapid or the well is larger diameter, use of a "hydraulic slug" or pumping tests may be more appropriate for determining hydraulic conductivity; should this be the case, staff should consult with a Senior Geologist or Principal for further guidance on conducting a pumping test.

3.0 CONSIDERATIONS

A slug test measures the rate of water level recovery in a well over time in response to the instantaneous injection or withdrawal of a mass (slug) from/to the groundwater surface. The slug can be a quantity of water or a solid of known volume. The hydraulic conductivity in the immediate vicinity of the well can be determined by measuring water level versus time data after the slug is added or removed. The primary advantages of using a slug test are listed below.

- Estimates can be made in-situ, thereby avoiding errors incurred in the laboratory testing of disturbed soil samples.
- Tests can be performed quickly at relatively low costs because pumping and observation wells are not required.
- The hydraulic conductivity of small discrete portions of an aquifer can be estimated (e.g. sand layers in a clay)
- No treatment, collection, or disposal of pumped water is necessary.

Slug tests also have certain limitations, listed below.

- Only the hydraulic conductivity of the area immediately surrounding the well is estimated which may not be representative of the average hydraulic conductivity of the area.
- Certain assumptions are made in the analysis process (i.e. if assumptions are inappropriate for the geologic conditions at the site, the slug test data are invalid).
- The storage coefficient, S, usually cannot be determined.
- Poor data quality will likely result if the well recharges rapidly, e.g., produces more than one gallon per minute water.

Rising-head slug tests are performed when a slug is removed from the well or water is bailed out, lowering the head and causing water to rise as water from the surrounding aquifer enters the well. Falling-head slug tests are performed when a slug is lowered into the well, causing the head to rise and water to enter into the surrounding aquifer. "Head" in this case refers to the pressure exerted by the water column in the well casing. Commonly, both types of tests are performed, and multiple tests on the same well are desirable. Unless site specific conditions require the use of a falling-head slug test, a rising-head slug test should always be performed. This is because the water displaced during the rising-head slug test must come from the aquifer whereas the falling-head slug test causes water to be pushed out into the aquifer.

It's desirable to have a significant change in the water level during the test, so the volume of the slug should be appropriate for the length of the water column and diameter of the well. The diameter of the slug should be only a little less than the diameter of the well. If there is a tall water column, then the length of the slug needs to be longer than would be used for a shallow well. For 2-inch diameter wells, a practical approach is to use a standard bailer to rapidly remove a "slug" of water for a "slug out" test, and then, after equilibration and measurements are completed, to rapidly lower the still-filled bailer into the well to perform a "slug in" test. Pre-fabricated, solid slugs can also be used.

Only conduct slug tests on relatively undisturbed wells, and the well should be developed prior to testing; at least one week should elapse between the drilling of a well and the performance of a slug test. Water level must be stable before conducting a slug test. A test should not be conducted on a well that has recently been pumped for water sampling purposes unless the well recharges to the static water level measured prior to the beginning of the test. Slug tests are not recommended for wells containing free product, as changing water levels in the well may induce product movement into the well, which alters the hydraulic potentiometric surface of water in the well. Do not attempt slug testing in a dry well by adding water to it.

"Pneumatic slugs" use air pressure (positive or negative) applied into the well casing on which a special air-tight fitting has been attached. This technique requires specialized equipment and will not be presented in this SOP.

Regardless of the method, allow sufficient time for performance of a slug test. Ideally, the test should be run until the water level equilibrates to within a minimum of 80% of the starting water level. The interval at which data needs to be collected also depends on whether the aquifer has slow or rapid recharge – more readings at closer intervals are needed for rapidly recharging wells. In all cases, more frequent readings are needed in the early portion of the test.

Ideally, an automatic data recorder should be used to collect water levels during the test; however, manual measurements can be taken if an automatic recorder is not available. Barometric pressure should be checked before and after, as well as hourly during the slug test (if necessary) to ensure major changes in pressure do not affect the results of the test.

4.0 EQUIPMENT

The following equipment is needed for the procedure depending on specific project conditions. All equipment will be calibrated per manufacturer specifications:

a. Pressure transducer (PTX), cable, and electronic data-logger (if available)
b. Manual water level (WL) meter or Interface probe
c. Tape measure
d. Watch with second hand or Stopwatch
e. Slug Test Record (STR) recording forms (see Appendix)
f. 5-gallon buckets or 55-gallon drum (if necessary for water containment)
g. New/decontaminated bailer or pre-fabricated slug, or potable water
h. Fishing line or appropriate line for raising and lowering slug
i. Field laptop with software to download automatic data recorder, if used
j. Computer with AQTESOLV software installed (at office)

5.0 PROCEDURE

5.1 Pre-Operation

1. Obtain information on each well to be tested: date drilled, diameter, well depth, screened interval, WL ranges, geology of screened interval, anticipated recharge speed, confined/unconfined conditions, screen fully or partially penetrate aquifer, and known contaminants. For each well, design size of slug and depth to be inserted, remembering an inserted slug has to remain submerged the entire time, and there must be room in well bore for slug, WL meter to reach water level, and PTX (if used).
2. Gather all equipment needed; check, calibrate, and decontaminate equipment.
3. At site, conduct health and safety review, complete Tailgate Safety form.
4. Remove well cap(s) and allow well(s) to stabilize for 30 minutes. Set up equipment at first well. If doing multiple tests, begin with least contaminated well.
5. Measure the WL and record time and depth to water on the STR form (see Appendix). Wait 5 minutes and re-measure the water level to ensure equilibrium.

5.2 Operation

<u>If using the transducer-automatic recorder method</u>:

1. Activate data logger program and enter well number, date, time, etc. Set data recording interval of at least one minute for slowly recharging wells, and 15 seconds for more rapidly recharging wells.
   <u>Note</u>: some loggers allow setting a logarithmic scale settings for measurements where more rapid readings are taken early and the frequency increases with time

2. Activate logging and place PTX into well (depth below slug depth or max drawdown); secure cable so that PTX will maintain constant, undisturbed depth.
3. Wait 5-10 minutes to record stabilized WL data. Meanwhile prepare slug.
4. If doing "slug out" with bailer, introduce bailer to well, submerged below WL, and wait 5 minutes for stabilization.
5. Quickly but carefully completely remove bailer from well and set aside to use for "slug-in" test. Take an immediate manual water level reading and record as backup. Record the exact time the bailer slug is taken out, and the volume of water removed.

   If doing a "slug-in" test, quickly but carefully insert the slug into the well to below the water level, secure it, and minimize movement thereafter. Take an immediate manual water level reading as backup. Record the exact time the slug is inserted.
6. Continue recording depth-time measurements until the water level returns to a minimum of 80% of equilibrium (pre-test) conditions. The duration of the test will vary depending on recharge, and could range from several minutes to hours.
7. Retrieve slug and stop the logging sequence. Repeat for multiple tests.

If using a water level indicator for manual measurements (slow recharge wells only):

1. Layout equipment around wellhead. Have WL meter reading for immediate use.
2. If doing "slug out" with bailer, introduce bailer to well, submerged below water level, and wait 5 minutes for stabilization, taking & recording a manual WL reading every minute.
3. One person quickly but carefully completely removes bailer from well and set aside to use for "slug-in" test. 2nd person immediately take a manual water level reading and record; record the exact time the bailer slug is taken out. Keep WL meter in the well above water. One person should take continual WL readings, and a 2nd person note the times and record associated depths.

   If doing a "slug-in" test, one person quickly but carefully insert the slug into the well to below the water level, secure it, and minimize movement thereafter. 2nd person immediately take a manual water level reading and record; record the exact time the slug is inserted. Keep WL meter in well.
4. Continue taking & recording depth-time measurements every 15 seconds for the first 1-2 minutes, then 30 seconds for 2-3 minutes, then every minute for another 5-7 minutes, then every two minutes for another 6-10 minutes, then every 5 minutes for 4 readings, then every 10 minutes until WL returns to within a minimum of 80% of equilibrium (pre-test) conditions. If WL is recharging rapidly, take more 30-second readings and more 1-minute readings than stated. It is critical to take accurate time readings matching the WL depth readings.
5. If also performing the opposite type slug test (In vs. Out, etc.), verify that equilibrium conditions are established prior to initiating the test. Follow the same procedures for readings and recording.
6. If using the manual WL method, unless recharge is exceedingly slow try to do at least three separate tests. More to include both slug-IN and slug-OUT are desired.

7. Ensure all data are recorded on the slug test record form(s) (see Appendix A), and all related information is documented on the form(s) and in field notes. In addition to the water level measurements, the volume of the slug introduced or removed should be noted.

5.3 Post-Operation

1. Decontaminate all down-well equipment, dry and pack.
2. Properly containerize and dispose of decontamination water in accordance with the approved site-specific work plan.
3. Complete all field documentation, DELS, etc. and return to EWI.
4. Download automated recorder (if used) and transfer data to online project file.
5. Check barometric pressure data for length of testing period, as changes in air pressure will affect water level in the well.

6.0 AQTESOLV PROCESSING

6.1 Data and Files Preparation

1. Manual Measurement: enter data into Excel Spreadsheet with columns showing Time and Water Level, and a row for each measurement

   Automatic Data Recorder: Download data if not done; export to Excel file and process with barometric pressure as required.
2. Make following columns in spreadsheet (see example in Attachment):

   Date/Time Elapsed Minutes Water Level Test Min Ft Diff
3. Set Test Min at "0" for row of WL change from slug IN or OUT. Add incremental minutes of readings for subsequent rows of elapsed minutes
4. At Test Min time=0 row, enter Ft Diff for WL change. Calculate the change for subsequent rows from this Time=0 row.
5. Draw simple diagram in Excel showing basic geology, top & bottom of aquifer, confining layer (if any), initial water level, well screen position. Color portions as desired, label entities with depth numbers (see example).
6. Below diagram, list following entries:

   S(0) = ___ = initial displacement in feet
   H = _____ = depth of well screen penetration (Screen Base – SWL)
   D = _____ = saturated aquifer thickness
   UNCONFINED = Aquifer base depth – SWL
   CONFINED = Aquifer base depth – Confine layer base depth
   Screen L =_____ = total screen length (note top & bottom depths on figure)
   r(c) = _____ = radius of well casing, in FEET
   r(w) = _____ = radius of well bore, in FEET
   Anisotropy Kv/Kh = _____ ratio of vertical to horiz hydr conductivity
   (typically 0.1 for clays to 0.85 for sands)
   Note if Screen is fully or partially penetrating the aquifer
   Note if Aquifer is Unconfined or Confined

6.2 AQTESOLV Setup and Operation

1. Open AQTESOLV. Select File→ New, or Open an existing file to Save-As & modify.
2. Select Edit → Units. Enter desired units (e.g. Feet and Minutes) & "consistent"
3. Select Edit → Annotations. Enter Title, Project Info, and Notes.
4. Select Edit → Aquifer Data and note tabs:
   Under General, enter Aquifer Sat thickness D & Kv/Kh ratio
   Under Aquitard, enter aquitard thickness (if have leaky aquitard situation)
   Skip Double Porosity & Single Fracture unless in bedrock with fractures
   Skip Wedge and Trench unless you have those unique conditions with defining data
5. Select Edit → Wells, and note tabs:
   Under General, enter Well Name, initial displacement H(0), and water col Height H
   Under Aquifer, values should be as entered previously
   Under Screen, enter Screen Length L & Depth to top of Well Screen
   Under Radius, enter r(c) casing and r(w) well bore radii. Make Well Skin = r(w). Ignore other entries.
   Under Corrections, leave unchecked unless know of needed corrections.
   Under Observations, enter the Test Min and Ft Difference data from Excel.
   NOTE: Do NOT enter Time=0 entry; start at row after T=0. If using SAVEAS file, you can Delete all existing entries. You can Add Rows as needed. I recommend copy and paste data from Excel.
   Ignore the Symbols, Curves, and Options tabs
6. Select View → select "Displacement-Time"
7. Select Match → Solution. Select "Unconfined Bouwer-Rice (1976)" to start. You can select different solutions appropriate for your conditions and record the various results. Stick only to CONFINED or UNCONFINED selections as appropriate.
8. Select Match → Solution. Select VISUAL, and draw a line from the left Y axis down to the X axis while holding down the left mouse key. The line should be drawn to cover the data set; if the set is curved, you can "average" it, or do it twice for early and later portions. Record all resulting data (shown in the box to the right). This is manually matching the data set. You can go right to AUTOMATIC for a solution, but sometimes it's good to run it manually first.
9. Select Match → Solution. Select AUTOMATIC. This is allowing AQTESOLV to match the data set. In the pop up window, select max iterations (50-100 or more, vary as needed), leave converge criteria at 1E-010, and check both Display Option boxes. Select "Estimate" and AQTESOLV will run the match. When it converges, another pop-up window opens and shows you the results. They are also displayed in the large window on the graph. Record all resulting data.
9. You can preserve each Solution and Matching run by selecting File → Print, and selecting Adobe PDF, saving the print to your project file. Note that sometime AQTESOLV is picky doing this, and yields a "jumbled" PDF. If this happens, just try it again.

10. Note that most Solutions will give you hydraulic conductivity K in the units you selected. The KGS solution will also give Specific Storativity. Cooper-Papadopulus yields Transmissivity and Storativity; you can get hydraulic conductivity by dividing Transmissivity by the aquifer saturated thickness.

7.0 SAFETY

Acute or chronic exposure to chemically-contaminated soil or water could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

8.0 REFERENCES

For additional information and to assist in implementing this procedure, the following documents related to this SOP may be reviewed:

- U.S. Environmental Protection Agency, SLUG TESTS, SOP# 2046, DATE: 10/03/94
- AQTESOLV Slug Test Forum
  http://www.aqtesolv.com/forum/slug.htm
- AQTESOLV User Manual
  http://www.hydrosys.net/myplus/bbs/table/hydrosys_soft/upload/2720_aqtw20070719.pdf

EWI staff who can provide technical assistance with AQTESOLV processing and evaluation:

- Bob Lanning
- Jason Smith
- Meredith Kenworthy
- Emily Austin
- Audrey Sima

FIELD GUIDE FOR SLUG TESTING AND DATA ANALYSIS™

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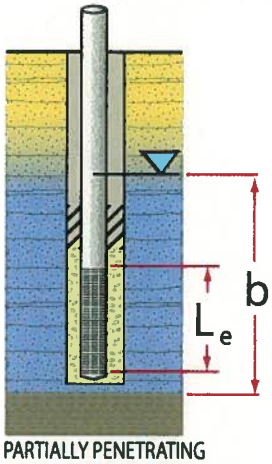
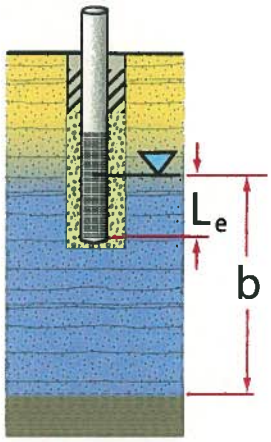
STEP ONE: TEST WELL CONFIGURATION

K = Hydraulic Conductivity
b = Thickness of Tested Unit
L_e = Effective Screen Length *(portion through which flow occurs, usually not the length of the filter pack)*

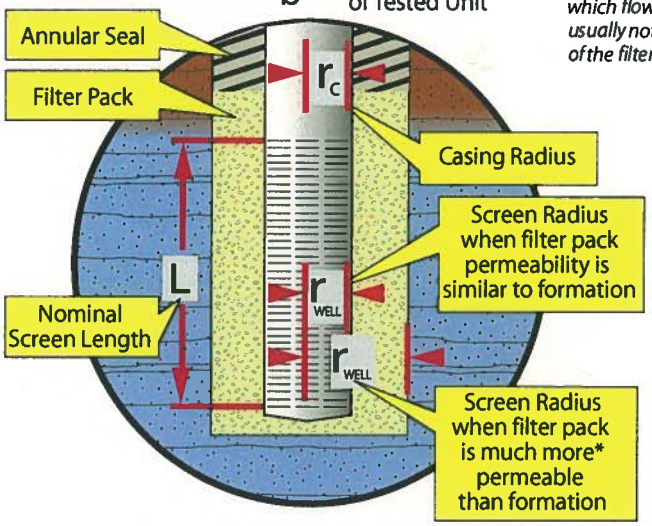
UNCONFINED CONDITIONS



PARTIALLY PENETRATING
Screened Below the Water Table
$L_e = L$

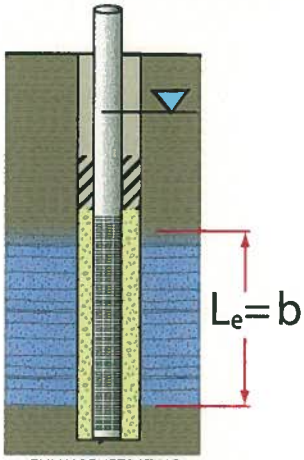


PARTIALLY PENETRATING
Screened Across the Water Table
$L_e < L$

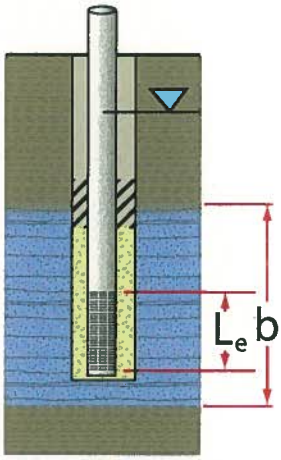


** factor of two or more*

CONFINED CONDITIONS

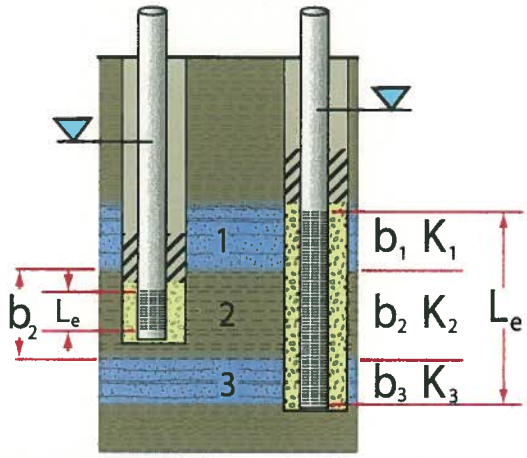


FULLY PENETRATING
Screened Across the Entire Unit
$L_e < L$



PARTIALLY PENETRATING
Screened Across a Portion of the Unit
$L_e = L$

LAYERED SETTINGS



PARTIALLY PENETRATING
Screened Across a Portion of a Layer
$L_e < b_2$
$K \approx K_2$

FULLY PENETRATING
Screened Across Multiple Layers

$$K \approx \frac{[(b_1 K_1)+(b_2 K_2)+(b_3 K_3)]}{L_e}$$

Slug tests are also an effective means of estimating K in aquitards. See Butler (1998) for specialized test procedures.

WELL DEVELOPMENT IS CRITICAL

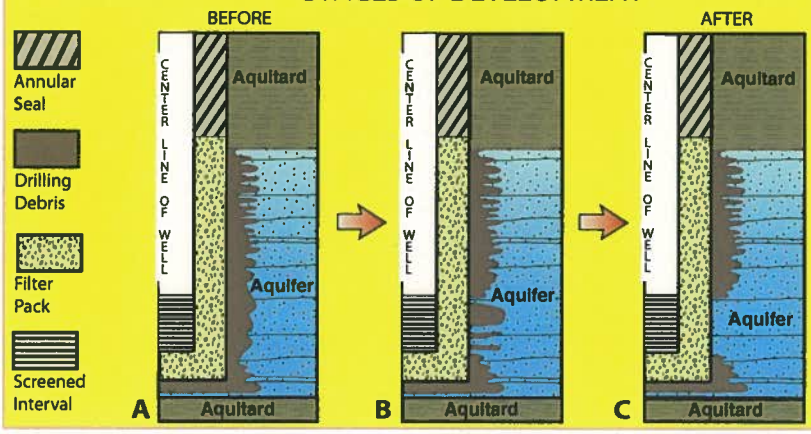
1. **MUST** develop well thoroughly before slug testing because a near-well zone of disturbance may be created during drilling. Characteristics of zone depend on formation properties and drilling method. Zone often consists of various types of "drilling debris".

   Hydraulic conductivity estimates from tests in poorly or undeveloped wells may be much less than formation K due to impact of "drilling debris".

2. Perform slug tests and assess the sufficiency of well development during data processing and analysis (see Steps 4 and 5).

   For monitoring wells, development should produce a situation between B and C. Assume $L_e = L$ for analysis.

STAGES OF DEVELOPMENT



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STEP TWO: SET UP AND TEST INITIATION

FOR TESTS USING SOLID SLUGS OR BAILERS

INITIAL ACTIVITIES

1. Measure depth to water.
2. Measure depth to bottom of well.
3. Measure slug volume (solid or bailer)

$$V_{SLUG} = \pi r^2_{SLUG} L_{SLUG}$$

EXAMPLE: Solid slug, 2.5-cm diameter, 75-cm long

$$V_{SLUG} = (3.14)(1.25cm)^2(75cm) = 368.2\ cm^3$$

4. Calculate expected initial displacement

$$H_0^* = V_{SLUG} / \pi r^2_{CASING}$$

EXAMPLE: Solid slug in 5-cm diameter well

$$H_0^* = (368.2\ cm^3) / (3.14)(2.5cm)^2 = 18.8\ cm$$

5. Calculate length of water column in well.
6. Check depth limit of transducer and determine appropriate transducer position.

Height of water column above transducer should allow sufficient room for slug introduction and removal.

EQUIPMENT

Must be appropriate for expected rate of head change. Always use a transducer and data logger for tests in moderate to high permeability formations (K > 0.001 cm/s). Manual measurement of water levels is a reasonable approach for tests in lower permeability formations.

SET UP

1. Submerge transducer to pre-determined depth and allow 15 to 20 minutes for transducer to thermally equilibrate with water and transducer cable to stretch.

Submerge transducer a sufficient distance to avoid interference during slug movement. If transducer is located within screened interval, place above well bottom to avoid plugging by settled fines.

2. Secure transducer cable to prevent movement during test.
3. Check data logger to ensure connectivity and communication.
4. Track water level through time to ensure near-static conditions have been achieved prior to test.
5. Prepare solid slug or bailer for test. Check bailer for leaks.

FALLING HEAD (Slug In) TEST

Place bottom of slug just above top of water column. Measure drop distance on cord and fasten cord prior to test.

RISING HEAD (Slug Out) TEST

Place top of slug just below top of water column. Measure removal distance on cord and prepare to fasten cord after removal.

TEST INITIATION

1. Double check data logger settings.
2. Verify water level has returned to static.
3. Start logging data 5 to 10 seconds prior to test initiation.
4. Create near-instantaneous water-level change relative to formation response.

For tests in high-permeability formations, water level change produced by a solid slug or bailer may not be fast enough. Use pneumatic method for tests initiation (see Step Three).

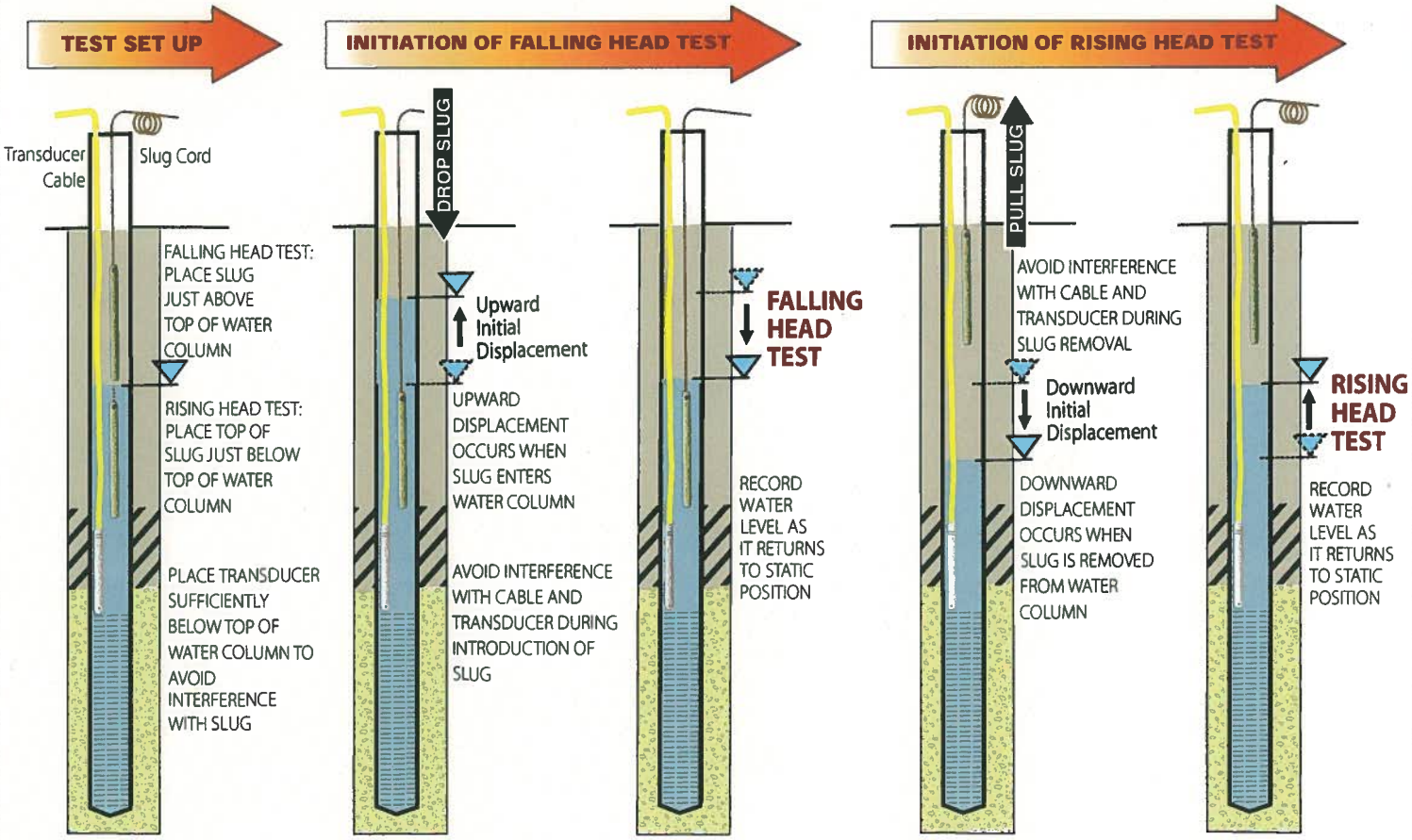
5. Prevent entanglement with transducer or its cable during test initiation.

When moving slug to initiate test, try to minimize distance of movement by positioning slug a short distance above or below top of water column. This will help avoid getting the slug entangled in the tranducer cable or hitting the transducer.

INITIAL DISPLACEMENT

In moderate or lower permeability formations (K < 0.02 cm/s), an initial displacement of 0.3 to 0.9 meters should produce a reasonable signal-to-noise ratio. In higher K formations, use smaller displacements (< 0.3 meters) to reduce non-Darcian flow losses. Slug size does not affect test radius - see Butler (1998).

FALLING & RISING HEAD TESTING



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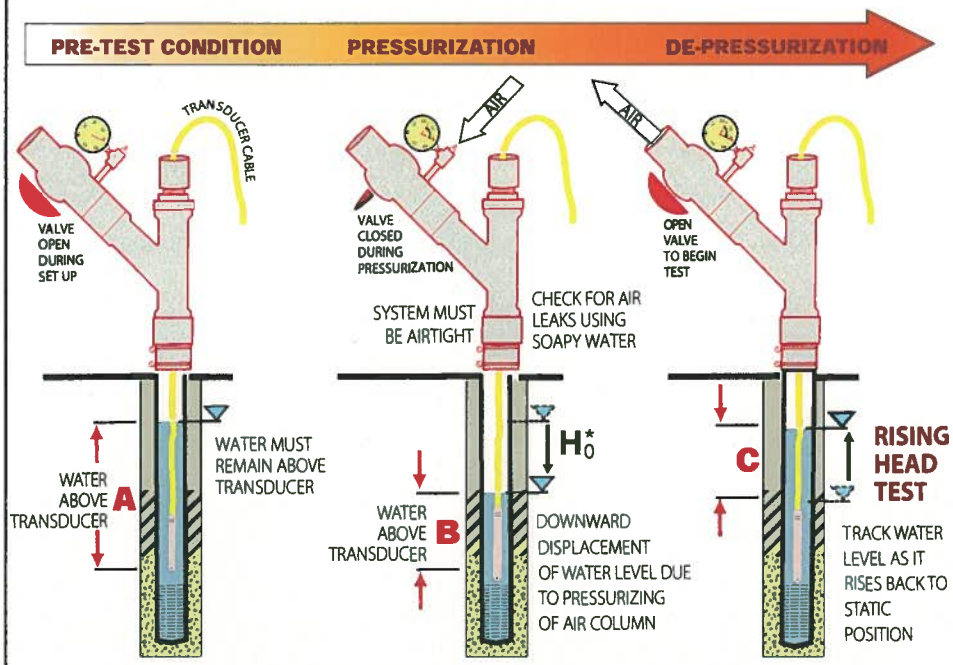
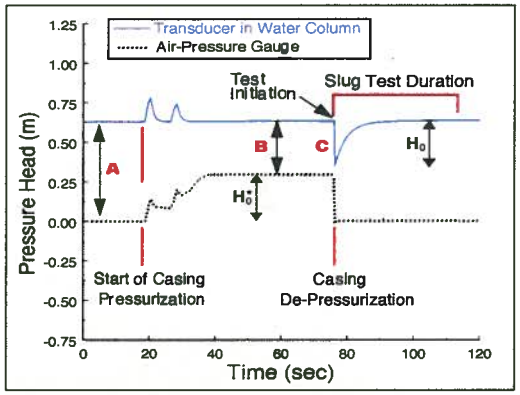
FOR TESTS USING PNEUMATIC INITIATION SYSTEM





1. Use pneumatic method to initiate tests in highly permeable formations. The pneumatic method uses air pressure, either positive or negative, to displace water. Water level must remain above screen and transducer.
2. Rising head tests are performed by pressurizing air column, allowing pressures to stabilize, and then depressurizing air column.
3. Falling head tests are performed in a similar manner by applying a vacuum to air column.

STEP THREE: TEST PERFORMANCE

GENERAL PERFORMANCE GUIDELINES

1. Perform three or more tests at each well.
2. Use at least two initial displacements varying by a factor of two or more.
3. Conduct both rising and falling head tests if possible. First and last tests should use approximately same initial displacement.

Repeat tests with different H_0^* are used to assess the viability of assumptions underlying slug test analysis methods.

4. Run each test to near completion (i.e. heads within 5% of static).

Running tests to near completion allows data to be analyzed with more sophisicated methods (Cooper et al. and KGS models). These methods can provide insights into impact of anisotropy, double-porosity behavior, and insufficient well development. See Butler (1998) for further details.

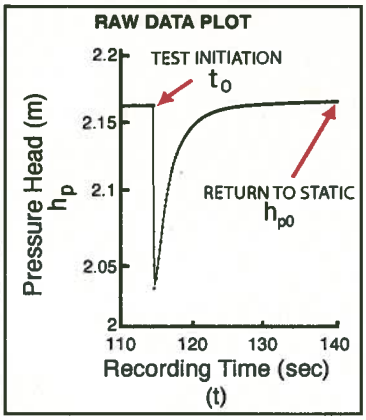
STEP FOUR: DATA PROCESSING

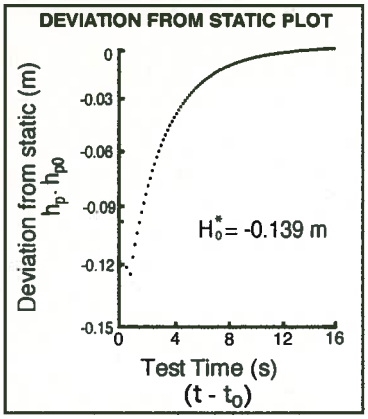
H_0^* = Expected initial displacement estimated from geometrical considerations (solid slug) or air pressure readings (pneumatic initiation).

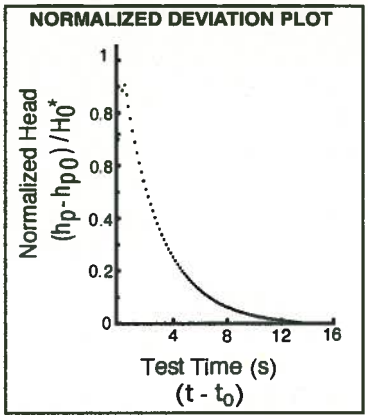
H_0 = Initial water-level displacement measured in well.

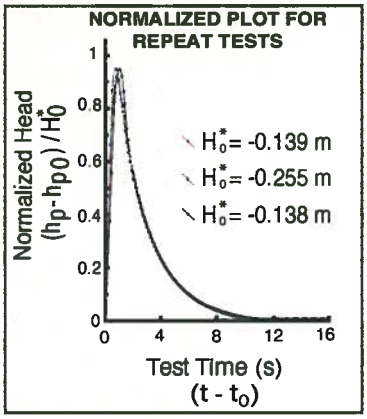
GENERAL PROCESSING GUIDELINES

1. Estimate time test began (t_0) and the pressure head at static conditions (h_{p0}) from the raw data plot.
2. Subtract h_{p0} and t_0 from the head (h_p) and time (t) records, respectively, to compute head deviation from static and time since test began (deviation from static plot).
3. Normalize data by dividing deviation data by the expected displacement (H_0^*).
4. Compare the expected displacement (H_0^*) with the initial water-level displacement measured in the well (H_0). Are they different? If so, possible explanations could include: (1) effective casing radius different from nominal casing radius, (2) test initiation too slow, (3) measurement rate too slow, and (4) transducer too deep in water column (high-K formation).
5. Compare normalized data plots from repeat tests at the same well. Coincidence of normalized plots suggests that assumptions underlying conventional analysis methods may be valid at that well. If normalized plots do not coincide, then more development may be necessary.









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STEP FIVE: DATA ANALYSIS

SELECTION OF TEST FOR ANALYSIS

1. If normalized plots from a series of slug tests coincide, choose only one test for analysis. The selected test should have the lowest data noise level of that series.
2. If normalized plots do not coincide, seek explanation for lack of coincidence. Possible explanations include insufficiently developed well and non-laminar flow losses. See Butler (1998) and Butler et al. (2003) for further explanations of lack of coincidence of normalized plots.

SELECTION OF TEST CATEGORY

Select appropriate category for well-formation configuration.

CATEGORY I - Wells in Confined Formations and Wells Screened Below the Water Table in Unconfined Formations.

CATEGORY II - Wells Screened Across the Water Table.

CATEGORY III - Wells in Category I and in Highly Permeable Conditions.

FRACTURED FORMATIONS

If formation is densely fractured and behaves as an equivalent porous media, standard methods are valid. If formation behaves as a double-porosity media, then validity decreases as well screen increases in length. If formation is sparsely fractured and flow is restricted to fractures, the validity of standard methods varies. If flow induced by test is radial, standard methods are valid. If flow is restricted to only a small portion of fracture plane, standard methods are not appropriate. See Butler (1998) and Shapiro and Hsieh (1998) for details.

TEST CATEGORIES

CATEGORY I ANALYSIS

A) Analyze data with Cooper et al. model for tests in fully penetrating wells.
B) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate can be calculated from the transmissivity (T) estimate using $K = T / L_e$
- If not, go to C.

C) Question: Is the well fully or partially penetrating?
- If fully pentrating well, test may be affected by insufficient development or double-porosity flow. See Butler (1998).
- If partially penetrating well, test may be affected by vertical flow above or below the screened interval. Go to D.

D) Analyze data with KGS model for tests in partially penetrating wells.
E) Question: Can a good fit be obtained using a physically plausible storage estimate?
- If so, the hydraulic conductivity estimate should be reasonable.
- If not, the test may be affected by insufficient development. See Butler (1998) for details.

CATEGORY II ANALYSIS

A) Question: Do data display a double straight line on a log normalized head vs. linear time plot (see Category II Figure)?
- If so, go to B.
- If not, go to A of Category I Analysis.

B) Fit a straight line to the formation response portion of the plot (2nd straight line segment).
C) Estimate K with Bouwer and Rice model.
- Use effective casing radius, not nominal casing radius, in analysis. See Butler (1998).

BOUWER & RICE AND HVORSLEV MODELS

These approximate methods involve fitting a straight line to data plotted in a log normalized head vs. linear time format. Although K estimates are obtained rapidly, these methods, unlike the Cooper et al. and KGS models, cannot provide clues that the test has been significantly impacted by insufficient development. If flow is primarily horizontal, data will display a concave-upward curvature in this plotting format. Straight line should be fit to the 0.15 - 0.25 (Hvorslev) and 0.2 - 0.3 (Bouwer & Rice) normalized head range. These ranges should be with respect to H_0^+ when data plot as a double straight line (see Catagory II Analysis Plot).

CATEGORY III ANALYSIS

A) Question: Are data oscillatory in nature or display a concave-downward curvature on a log normalized head vs. linear time plot?
- If so, go to B.
- If not, go to A of Category I Analysis.

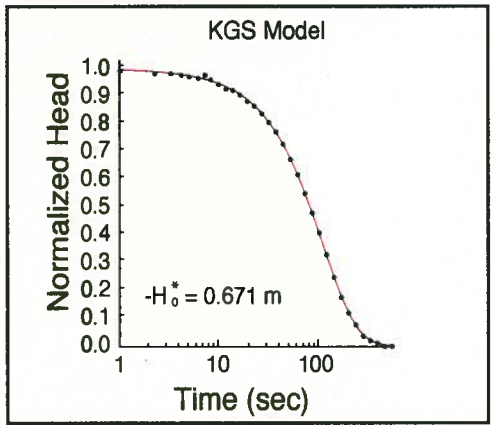
B) Question: Do normalized data plots coincide?
- If so, go to C.
- If not, go to D.

C) Question: Is well fully penetrating or nearly so?
- If so, analyze data with Butler & Zhan model.
- If not, analyze data with either Butler & Zhan model or high-K extensions of Hvorslev and Bouwer-Rice models.

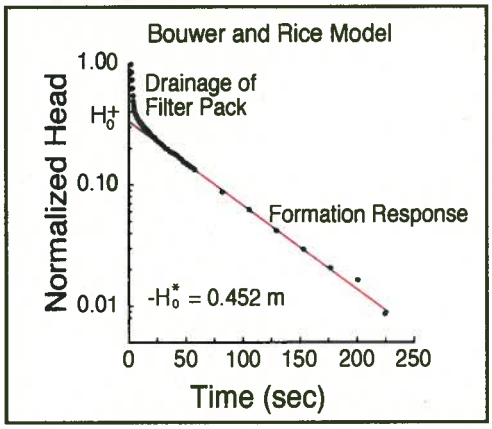
D) Question: Do normalized data plots from tests initiated with similar H_0^* coincide?
- If so, go to E.
- If not, further development may be needed.

E) Question: Can tests be repeated?
- If so, repeat tests with smaller initial displacements and go to B.
- If not, analyze data with non-linear slug test model of McElwee and Zenner. Note error in K estimate may increase as well approaches full penetration.

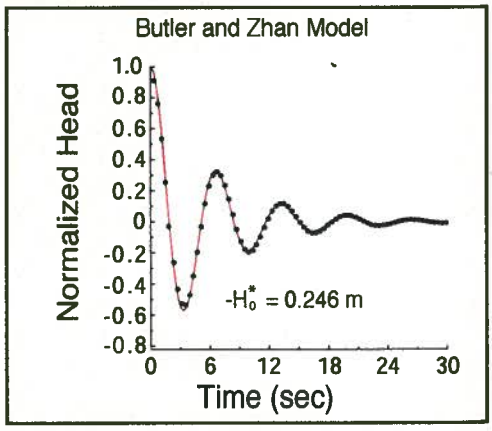
CATEGORY I ANALYSIS



CATEGORY II ANALYSIS



CATEGORY III ANALYSIS



REFERENCES *(Additional references listed at www.midwestgeo.com)*

Butler, 1998, *The Design, Performance, and Analysis of Slug Tests*, Lewis Publishers, 252 pp.

Butler, Garnett and Healey, 2003, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, v. 41, no. 5, 620 - 630 pp.

Shapiro and Hsieh, 1998, How good are estimates of transmissivity from slug tests in fractured rock? *Ground Water*, v. 36, no. 1, 37-48 pp.

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Springfield, Missouri 65802
Office: 417.890.9500
FAX: 417.823.9659

SLUG OR PUMPING TEST - WELL _____

PROJECT: _____ **NUMBER:** _____ **PHASE:** _____

DATE: _____ **PERSONNEL:** _____

INITIAL DATA PRODUCT LVL ft BTOC: _____ WATER LVL ft BTOC: _____ WELL TD: _____ WELL DIAM: _____

TYPE TEST: _____ **SLUG IN** _____ SLUG OUT _____ **PUMPING TEST**

SLUG/BAILER USED:	**PUMP USED:** _____	**AUTO RECORDER:** _____
Length:_____ Diam:_____	**DEPTH SET:** _____ **Ft BTOC**	**DEPTH SET:** _____ **Ft BTOC**

TIME	CUM MINUTES	MANUAL WATER LVL Ft BTOC	PUMP ON/OFF	WATER REMOVED	CUM WATER REMOVED	REMARKS
						STARTING WATER LEVEL
						SLUG IN/OUT OR PUMP ON TIME
						FIRST WATER LEVEL

SLUG/PUMPING LOG - WELL _____ PROJECT: _____ DATE: _____

TIME	CUM MINUTES	WATER LVL Ft BTOC	PUMP ON/OFF	WATER REMOVED	CUM WATER REMOVED	REMARKS

Slug Test - Data Acquisition Sheet

General Information

Date_____

Well Number_____ Tests Performed by:_____

Well Location_____ _____

Project_____ _____

Reported Well Depth from Land Surface_____ Date of Last Well Development_____

Measured Depth from TOC (top of casing)_____ Initial Static Water Level from TOC_____

Casing Diameter and Schedule_____ Final Static Water Level from TOC_____

Screen Length and Slot Size_____ TOC from land surface_____

Depth to Top of Screen from TOC_____ Borehole Diameter_____

Filter Pack Details_____ Annular Seal Details_____

	Type	Serial Number	Purpose and Placement	Reading in Air
Transducer #1				
Transducer #2				

Data Logger Type and Serial Number_____

Logging Program:_____ Acquisition Rate:_____

Pressure or Pressure Head Units: Time Units:

Comments:

Test Information

	Test 01	Test 02	Test 03	Test 04	Test 05
Initiation method					
Rising/falling head					
Pre-test value					
Post-test value					
Expected H_0					

Additional comments	
Test 01	
Test 02	
Test 03	
Test 04	
Test 05	

	Test 06	Test 07	Test 08	Test 09	Test 10
Initiation method					
Rising/falling head					
Pre-test value					
Post-test value					
Expected H_0					

Additional comments	
Test 06	
Test 07	
Test 08	
Test 09	
Test 10	

File for Field Data:

Slug Test - Data Processing and Analysis Sheet

Data Processing

Well No./Location: Test Date: Data File:

Pressure or Pressure Head Units: Time Units: Date of Processing: Processed by:

	Test 01	Test 02	Test 03	Test 04	Test 05
Start time					
Noisy initiation?					
Static head					
Change in static?					
Measured H_0					

	Measured H_0 = Expected H_0?	Data consistent with other tests?	Other comments
Test 01			
Test 02			
Test 03			
Test 04			
Test 05			

	Test 06	Test 07	Test 08	Test 09	Test 10
Start time					
Noisy initiation?					
Static head					
Change in static?					
Measured H_0					

	Measured H_0 = Expected H_0?	Data consistent with other tests?	Other comments
Test 06			
Test 07			
Test 08			
Test 09			
Test 10			

File for Processed Data:

Data Analysis

Tests Chosen for Analysis:

Rationale for Choice:

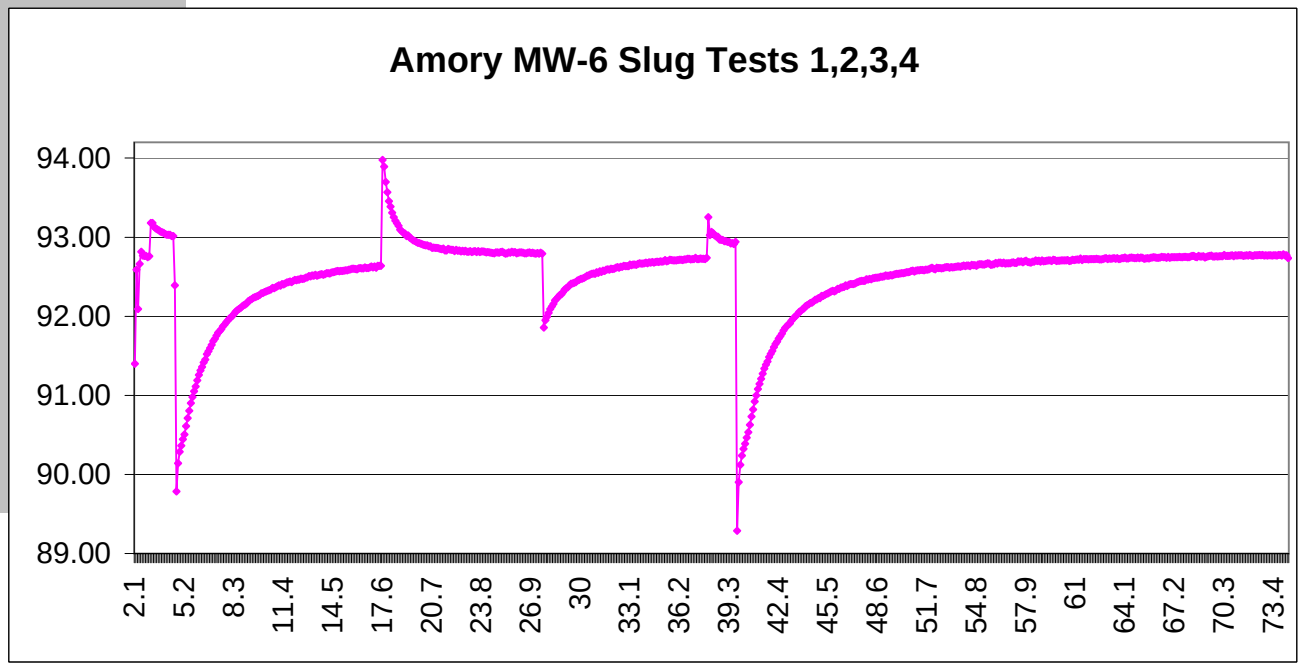
Analysis Software: Date of Analysis: Analyzed by:

	Test number and analysis model	K estimate	Indication of low-K skin?	Other comments
Analysis 1				
Analysis 2				
Analysis 3				
Analysis 4				
Analysis 5				

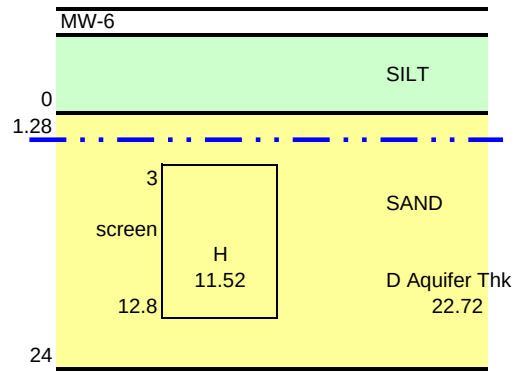
File for Analysis Results:

Report Date:	10/22/2009 11:49	
File Name	6851-MW6_20091022_140821390-BaroMerge.wsl	
Create Date	10/22/2009 11:48	
Device	Level TROLL 100	
Serial Number	152069	
Firmware Version	1.03	
Level Reference Settings At Log Creation		
	Level Measurement Mode	
	Specific Gravity	
Site	Amory MS	
Well Name	MW-6	
Date and Time	Note	
10/22/2009 9:07	Manual Stop Command	
10/22/2009 11:48	User Note: "Pressure & Level adjusted by fixed baro value: 14.58 (PSI)"	
Log Data:		
Record Count	779	
	TOC	95.00
	Troll Depth	12.00
	Elapsed Time	
Date and Time	Minutes	
10/22/2009 7:50	0	83.04
10/22/2009 7:50	0.1	83.04
10/22/2009 7:50	0.2	83.04
10/22/2009 7:50	0.3	83.03
10/22/2009 7:50	0.4	83.03
10/22/2009 7:50	0.5	83.05
10/22/2009 7:50	0.6	83.05
10/22/2009 7:50	0.7	83.05
10/22/2009 7:50	0.8	83.05
10/22/2009 7:50	0.9	83.04
10/22/2009 7:51	1	83.04
10/22/2009 7:51	1.1	83.03
10/22/2009 7:51	1.2	83.04
10/22/2009 7:51	1.3	83.04
10/22/2009 7:51	1.4	83.03
10/22/2009 7:51	1.5	83.04
10/22/2009 7:51	1.6	83.04
10/22/2009 7:51	1.7	83.04
10/22/2009 7:51	1.8	83.04
10/22/2009 7:51	1.9	83.04
10/22/2009 7:52	2	83.06
10/22/2009 7:52	2.1	91.40
10/22/2009 7:52	2.2	92.59
10/22/2009 7:52	2.3	92.09
10/22/2009 7:52	2.4	92.66
10/22/2009 7:52	2.5	92.82
10/22/2009 7:52	2.6	92.77
10/22/2009 7:52	2.7	92.76
10/22/2009 7:52	2.8	92.76

Atmospheric - Troll not installed



10/22/2009 7:52	2.9	92.75			
10/22/2009 7:53	3	92.76			
10/22/2009 7:53	3.1	93.18			
10/22/2009 7:53	3.2	93.18			
10/22/2009 7:53	3.3	93.13			
10/22/2009 7:53	3.4	93.11			
10/22/2009 7:53	3.5	93.10			
10/22/2009 7:53	3.6	93.09			
10/22/2009 7:53	3.7	93.07			
10/22/2009 7:53	3.8	93.06			
10/22/2009 7:53	3.9	93.06			
10/22/2009 7:54	4	93.04			
10/22/2009 7:54	4.1	93.03			
10/22/2009 7:54	4.2	93.03	Test Min	Ft Diff	Test 1 - Slug Out
10/22/2009 7:54	4.3	93.03			
10/22/2009 7:54	4.4	93.01			
10/22/2009 7:54	4.5	93.01			
10/22/2009 7:54	4.6	92.39			
10/22/2009 7:54	4.7	89.79	0.00	3.23	
10/22/2009 7:54	4.8	90.14	0.10	2.87	
10/22/2009 7:54	4.9	90.29	0.20	2.73	
10/22/2009 7:55	5	90.36	0.30	2.65	
10/22/2009 7:55	5.1	90.44	0.40	2.57	
10/22/2009 7:55	5.2	90.51	0.50	2.51	
10/22/2009 7:55	5.3	90.61	0.60	2.40	
10/22/2009 7:55	5.4	90.71	0.70	2.30	
10/22/2009 7:55	5.5	90.81	0.80	2.21	
10/22/2009 7:55	5.6	90.90	0.90	2.11	
10/22/2009 7:55	5.7	90.98	1.00	2.04	
10/22/2009 7:55	5.8	91.05	1.10	1.96	
10/22/2009 7:55	5.9	91.11	1.20	1.90	
10/22/2009 7:56	6	91.19	1.30	1.82	
10/22/2009 7:56	6.1	91.26	1.40	1.76	
10/22/2009 7:56	6.2	91.31	1.50	1.70	
10/22/2009 7:56	6.3	91.36	1.60	1.65	
10/22/2009 7:56	6.4	91.41	1.70	1.60	
10/22/2009 7:56	6.5	91.45	1.80	1.56	
10/22/2009 7:56	6.6	91.52	1.90	1.49	
10/22/2009 7:56	6.7	91.56	2.00	1.46	
10/22/2009 7:56	6.8	91.60	2.10	1.42	
10/22/2009 7:56	6.9	91.64	2.20	1.38	
10/22/2009 7:57	7	91.69	2.30	1.33	
10/22/2009 7:57	7.1	91.71	2.40	1.30	
10/22/2009 7:57	7.2	91.75	2.50	1.26	
10/22/2009 7:57	7.3	91.79	2.60	1.22	
10/22/2009 7:57	7.4	91.81	2.70	1.20	
10/22/2009 7:57	7.5	91.84	2.80	1.18	
10/22/2009 7:57	7.6	91.87	2.90	1.14	
10/22/2009 7:57	7.7	91.89	3.00	1.12	
10/22/2009 7:57	7.8	91.92	3.10	1.09	
10/22/2009 7:57	7.9	91.95	3.20	1.07	



WLs at end not equilibrated

MW-6 TEST 1 SLUGOUT UNCONFINED CONDITIONS
AQTESOLV Parameters
s(0) = 3.23 initial displacement
H = 11.52 (screen base - SWL) PARTIALLY PENETRATING
D Aq Thk = 22.72 (UNCONFINED)(Aq Base - SWL)
screen L = 9.8
r(c) = 0.0833333 ft (2" well casing)
r(w) = r(sk) = 0.25 (6" diam filter pack)
Eff porosity = 0.25
Anisotropy kv/kh = 0.85

Run AQTESOLV - **UNCONFINED SOLUTIONS**

Bower-Rice UNCONFINED Method Automatic
K = 0.00058 ft/min straight line avg for more of data set
y(0) = 2.47 ft greater variance from data set than manual

Bower-Rice UNCONFINED Method Visual
K = **0.000814 ft/min** Good straight line match of first part data field
y(o) = 2.919 ft good result

Hvorlelv UNCONFINED Method Automatic
K = 0.000845 ft/min straight line match for more of first part curve
y(o) = 2.47 ft Not as good match of points

Hvorlelv UNCONFINED Method Visual
K = **0.00124 ft/min** Straight line match of first part data field
y(o) = 2.929 ft good result

KGS UNCONFINED Automatic
Kr = 0.000198 ft/min Good match for data set
Ss = 0.000783 1/ft

KGS UNCONFINED Manual
Kr = **0.0003654 ft/min** Good curve match fo most of data set
Ss = 0.0000555 1/ft

10/22/2009 7:58	8	91.97	3.30	1.04
10/22/2009 7:58	8.1	91.99	3.40	1.03
10/22/2009 7:58	8.2	92.01	3.50	1.01
10/22/2009 7:58	8.3	92.03	3.60	0.98
10/22/2009 7:58	8.4	92.06	3.70	0.96
10/22/2009 7:58	8.5	92.08	3.80	0.94
10/22/2009 7:58	8.6	92.09	3.90	0.92
10/22/2009 7:58	8.7	92.10	4.00	0.91
10/22/2009 7:58	8.8	92.12	4.10	0.89
10/22/2009 7:58	8.9	92.14	4.20	0.87
10/22/2009 7:59	9	92.15	4.30	0.87
10/22/2009 7:59	9.1	92.17	4.40	0.85
10/22/2009 7:59	9.2	92.19	4.50	0.82
10/22/2009 7:59	9.3	92.20	4.60	0.81
10/22/2009 7:59	9.4	92.22	4.70	0.80
10/22/2009 7:59	9.5	92.23	4.80	0.78
10/22/2009 7:59	9.6	92.24	4.90	0.77
10/22/2009 7:59	9.7	92.25	5.00	0.76
10/22/2009 7:59	9.8	92.26	5.10	0.75
10/22/2009 7:59	9.9	92.27	5.20	0.74
10/22/2009 8:00	10	92.29	5.30	0.72
10/22/2009 8:00	10.1	92.30	5.40	0.72
10/22/2009 8:00	10.2	92.31	5.50	0.71
10/22/2009 8:00	10.3	92.31	5.60	0.70
10/22/2009 8:00	10.4	92.32	5.70	0.69
10/22/2009 8:00	10.5	92.33	5.80	0.68
10/22/2009 8:00	10.6	92.34	5.90	0.68
10/22/2009 8:00	10.7	92.36	6.00	0.65
10/22/2009 8:00	10.8	92.35	6.10	0.66
10/22/2009 8:00	10.9	92.37	6.20	0.65
10/22/2009 8:01	11	92.38	6.30	0.63
10/22/2009 8:01	11.1	92.39	6.40	0.62
10/22/2009 8:01	11.2	92.39	6.50	0.63
10/22/2009 8:01	11.3	92.41	6.60	0.61
10/22/2009 8:01	11.4	92.41	6.70	0.61
10/22/2009 8:01	11.5	92.42	6.80	0.60
10/22/2009 8:01	11.6	92.43	6.90	0.59
10/22/2009 8:01	11.7	92.43	7.00	0.58
10/22/2009 8:01	11.8	92.44	7.10	0.57
10/22/2009 8:01	11.9	92.43	7.20	0.58
10/22/2009 8:02	12	92.45	7.30	0.57
10/22/2009 8:02	12.1	92.46	7.40	0.55
10/22/2009 8:02	12.2	92.46	7.50	0.56
10/22/2009 8:02	12.3	92.46	7.60	0.55
10/22/2009 8:02	12.4	92.47	7.70	0.55
10/22/2009 8:02	12.5	92.48	7.80	0.54
10/22/2009 8:02	12.6	92.47	7.90	0.54
10/22/2009 8:02	12.7	92.48	8.00	0.54
10/22/2009 8:02	12.8	92.49	8.10	0.52
10/22/2009 8:02	12.9	92.49	8.20	0.52
10/22/2009 8:03	13	92.51	8.30	0.51
10/22/2009 8:03	13.1	92.50	8.40	0.51
10/22/2009 8:03	13.2	92.52	8.50	0.50
10/22/2009 8:03	13.3	92.51	8.60	0.50

Springer-Gelhar Inertial -UNCONFINED Automatic

K =	0.000269	ft/min	More avg match of entire set
C(D) =	10		Exceeds C(D) = 1; critically damped if over 1

Springer-Gehrhar Inertial -UNCONFINED Manual

K =	**0.000341**	**ft/min**	Only matches first part of curve
C(D) =	10		Exceeds C(D) = 1; critically damped if over 1

Skills Required:

1) 40-hour HAZWOPER training (if working on hazardous waste sites)
2) Understanding of, and ability to make decisions regarding, site-specific objectives
3) Training in working with monitoring wells, pump operations, and measuring water levels
4) Knowledge of using Excel spreadsheets and AQTESOLV software
5) Knowledge of EWI safety requirements, site health and safety plan, and quality control standards

1.0 OBJECTIVE / APPLICABILITY

The objective of this Standard Operating Procedure (SOP) is to provide a procedure for conducting a basic drawdown and recovery pumping test, collecting necessary field data, and determine hydraulic conductivity by processing the results in AQTESOLV software. This SOP should serve as a reference tool and facilitate consistency among Environmental Works, Inc. (EWI) personnel. If well conditions or equipment issues limit adherence to the procedures, any variance needs to be discussed with the project manager and recorded in field notes. The ultimate procedures employed should be documented in field notes and in related reports. Note that variance from the procedure may affect the quality of the results obtained.

2.0 SCOPE

This SOP outlines the procedure needed to collect field data from a simple drawdown and recovery pumping test in a monitoring well, and to determine the hydraulic conductivity of the geologic media in area of the well. Hydraulic conductivity (K) is an important parameter for modeling the flow of groundwater in an aquifer. Pumping tests yield a hydraulic conductivity more representative of the subsurface, because the test involves a larger volume of subsurface than just the immediate vicinity of the well (which is the case for slug testing). For data processing, pumping tests offer more choices in AQTESOLV solutions, including solutions for fractured environments.

Pumping tests can be performed in any size or depth well with a sufficient water column and pump with capacity appropriate for the speed of well recharge. For smaller diameter wells (2” to 4” wells) with a limited water column in the well and/or where hydraulic conductivity and recharge occur slowly, a slug test would probably be a more appropriate test (refer to the Slug Testing SOP).

3.0 CONSIDERATIONS

A pumping test measures the rate of water level decline and recovery in a well over time in response to a continuous removal of groundwater. The test can also measure the formation of a cone-of-depression (COD) by recording water level changes in wells near the pumping well. The primary advantages of using a slug test are listed below.

- Results are more representative of hydraulic properties of geologic materials than results from slug testing.
- Pumping tests can help evaluate the effect of fractured media, which cannot be done using slug testing.

- Measurements involving a surrounding observation well(s) provides additional hydraulic parameters for the geologic media of the entire area, and not just the pumping well.
- Results can be used to help design remedial systems involving pump-and-treat and/or hydraulic control of contamination.

Pumping tests also have adverse considerations, listed below.

- Pumping tests require more data collection: water level change in the pumped well over time, pumped volumes removed over time, and water levels in surrounding observation wells (if evaluating COD formation). Since pumping tests normally involved higher rates of recovery and water level change, automated recording devices should be used for single well pumping tests, and are required when involving multiple observation wells to obtain simultaneous data.
- Due to longer test times, barometric pressure data are needed during the period of the pumping test so that the effect of pressure changes can be removed from test data.
- The size and capacity of the pump must match well recharge rate. The pump must be able to remove sufficient water on a continual basis to maintain a lowered water level during the duration of the testing. It may be useful to perform a slug test on the well beforehand to determine recharge rate.
- Observation wells must be close enough to the pumped well to be affected.
- To obtain the most representative results, pumping should be continual until equilibrium conditions are met, i.e., until drawdown and pumping rate stabilize. This is required if evaluating COD formation for several wells.
- Pumping tests require more time than slug testing. Depending on geological materials involved, it may take several hours to more than a day to fully develop a COD.
- Pumped water will require collection, transportation, storage, possibly treatment, and disposal; pumped volumes can be significant.
- Poor data quality will likely result if the well recharges rapidly, e.g., produces more than one gallon per minute water.

Pumping tests can be performed as a *constant rate test* (water is pumped from the well at a constant rate and the water level is allowed to equilibrate), or a *constant head test* (pumping rate is varied to maintain a lowered but constant water level in the well). We normally will run a constant rate test, where we set a pumping rate, adjust as necessary, and wait for the water level to lower and equilibrate. The most accurate hydraulic parameters are obtained when WLs reach equilibration while minimizing changes in pumping rate.

When evaluating COD formation, it's desirable to have the greatest reduction in water level as possible in the pumped well, without pumping the well dry, with a fairly constant rate. The deeper the water level in the pumped well, the more extensive will be the radius of the COD. This will improve the likelihood of obtaining meaningful data from observation wells.

Once equilibrium is reached, the pump is turned off for the recovery portion. A check valve should be installed at the pump to prevent water in the effluent lines from running back into the well, as this will cause erroneous readings in water levels. Water levels in the pumped well (and any observation wells) should be recorded until levels equilibrate to pre-pumping conditions (~ 0.1 ft of initial conditions).

Pumping tests should only be conducted in developed wells, and after at least one week since development. Water levels must be at equilibrium conditions prior to conducting a pumping test. Pumping is not recommended for wells containing free product, as lowering water levels in the well may induce product movement into the well. This will alter the potentiometric response and introduce additional equipment decontamination and impacted water management issues.

4.0 EQUIPMENT

The following equipment is needed for the procedure depending on specific project conditions. All equipment will be calibrated per manufacturer specifications:

a. Pressure transducer (PTX), cable, and electronic data-logger (one set per well)
b. Manual water level (WL) meter or Interface probe
c. Tape measure
d. Watch with second hand or Stopwatch (for back up reading times)
e. Pumping Test Record (PTR) recording forms (see Appendix)
f. 55-gallon drums or tanks for water containment (appropriate size and number)
g. Pump of sufficient capacity, effluent tubing, and power source
h Field laptop with software to program & download automatic data recorder
i. Computer with AQTESOLV software installed (at office)

5.0 PROCEDURE

5.1 Pre-Operation

1. Obtain information on each well to be tested: date drilled, diameter, well depth, screened interval, WL ranges, geology of screened interval, anticipated recharge rate, confined/unconfined conditions, screen fully or partially penetrate aquifer, and known contaminants. For the pumped well, a pump must be capable of overcoming recharge rate to lower the water level in the well. Also, there must be room in well casing/screen or bore for pump, WL meter to reach water level, and PTX (if used).
2. Gather all equipment needed; check, calibrate, and decontaminate equipment.
3. At site, conduct health and safety review, complete Tailgate Safety form.
4. Remove well cap(s) and allow well(s) to stabilize for 30 minutes. Program and install PTX/recording device and pump in pumping well. If using observation wells, program and install WL recording devices. All WL recording devices should be programmed with synchronized time and set to start recording at the same time.

   Note: Each data logger should be programmed with well number, date, time, etc. Set data recording interval to 30 seconds in pumping well. Some loggers allow setting a logarithmic scale setting for measurements where more rapid readings are taken early and the frequency increases with time. Set all loggers to same interval to simplify post-test data processing.

   Note: Pump should be installed first, below PTX and PTX installed immediately above pump to maximize drawdown potential. Do not install PTX at same level as pump intake to avoid adverse effect on PTX pressure readings. Ideally, pump should be installed with a valve in discharge line or rheostat on electrical source control so pumping rate can be adjusted as needed during the test.

5. Measure the WL and record time and depth to water on the PTR form (see Appendix). Wait 5 minutes and re-measure the water level to ensure equilibrium.
6. Set up pump effluent line and receiving containers, using graduated buckets or marked tanks to enable accurate volume determination of pumped effluent during the test. Plan on recording volume every 5-10 minutes during initial pumping

5.2 Operation

1. When equilibrium water levels are verified and pump effluent management/ measurement system is ready, start the pump. Set rate to lower water level at a reasonable rate and adjust to maintain water level above PTX. Take manual measurements during initial pump down and throughout process to verify WL.

   Note: It may be desirable to run a quick pumping test to determine a reasonable starting pumping rate. You want a pumping rate that will lower the water level, but not so rapidly that major adjustments in the pumping rate are needed during the test. Large adjustments in pumping rate affect the accuracy of the results. If this is done, wait for WLs to recover before beginning the actual test.
2. Continue manual gauging of the pumped well WL, adjusting pumping rate as necessary to maximize drawdown while avoiding lowering the WL to below the PTX level. Record the manual depths and times as backup data. It is critical to take accurate time readings matching the WL depth readings.
3. Check and record pumped volume and time every 5-10 minutes and each time pumping rate is changed. Once rate and water level appear to be stabilizing, record pumped volumes every 15 to 30 minutes.
4. When water level appears to be stabilizing at maximum drawdown, continue pumping for at least 2 hours if pumping a well with no observation wells. If observations wells are employed, manually check levels and compare to initial readings to check for effect from pumping. If minimal effect is noted, pump for an additional 2 hrs and repeat measurements for effect. Record all WLs and times.
5. If evaluation of a COD is a major project need, pumping must continue until effects on observation wells are either observed and stabilized, or until sufficient pumping has been performed to indicate no effect on observation wells (i.e., too distant).
6. Once equilibrium conditions have been established and maintained for several hours, turn off the pump and monitor the recovery using manual water level readings in the pumping well and observation well(s) until equilibrium conditions are met.
7. Ensure all data are recorded on the pumping test record form(s) (see Appendix A), and all related information is documented on the form(s) and in field notes. This should include all manual water levels and related times, and all pumped volumes and related times.

5.3 Post-Operation

1. Decontaminate all down-well equipment, dry and pack.

2. Properly label all pumped groundwater drums/tanks, secure them, sample as required for disposal records, transport for storage as applicable, and dispose of the water in accordance with the approved site-specific work plan.
3. Complete all field documentation, DELS, etc. .
4. Download automated recorder (if used) to field laptop.

6.0 AQTESOLV PROCESSING

6.1 Data and Files Preparation

1. Download data from automatic recorder(s) to field laptop if not done, export to Excel file(s), and process with barometric pressure as required.
2. Make following columns in spreadsheet (see example in Attachment):

   Date/Time WL Elev Elapsed Min Ft Diff Gallons Pumped GPM Ft3/Min
3. Set Elapsed Min at "0" for row when pump turned ON. Add incremental minutes of readings for subsequent rows of elapsed minutes
4. At next row, enter Ft Diff for WL change. Highlight Row in Yellow. Calculate the change for subsequent rows from from the initial pre-pump WL.
5. Calculate/enter GPM and Ft3/min at appropriate times for pumped volumes data
6. Insert simple Chart showing the Time and Water Elev for reference (see example).
7. Draw simple diagram in Excel showing basic geology, top & bottom of aquifer, confining layer (if any), initial water level, well screen position. Color portions as desired, label entities with depth numbers (see example).
8. Below diagram, list following entries:

   H = _____ = depth of well screen penetration (Screen Base – SWL)
   D = _____ = saturated aquifer thickness
   UNCONFINED = Aquifer base depth – SWL
   CONFINED = Aquifer base depth – Confine layer base depth
   Screen L =_____ = total screen length (show top & bottom depths on figure)
   r(c) = _____ = radius of well casing, in FEET
   r(w) = _____ = radius of well bore, in FEET
   Anisotropy Kv/Kh = _____ ratio of vertical to horiz hydr conductivity
   (typically 0.1 for clays to 0.85 for sands)
   Note if Screen is fully or partially penetrating the aquifer
   Note if Aquifer is Unconfined or Confined

   If test in fractured bedrock, need the following info in feet (best guess):

   Double Porosity: Slab thickness (thickness rock between horizontal fractures)
   Spherical Block (size of block between horiz & vert fractures)

   Single Fracture: Length of Vertical fracture
   Depth of horizontal fracture
   Radius (distance) of horizontal fracture edge from well

6.2 AQTESOLV Setup and Operation

1. Open AQTESOLV. Select File→ New, or Open an existing file to Save-As & modify.
2. Select Edit → Units. Enter desired units (e.g. Feet and Minutes) & "consistent"
3. Select Edit → Annotations. Enter Title, Project Info, and Notes.
4. Select Edit → Aquifer Data and note tabs:

   Under General, enter Aquifer Sat thickness (b) & Kv/Kh ratio

   Skip Double Porosity & Single Fracture unless in bedrock with fractures
   If in fractured media, enter the data noted above with diagram

   Skip Wedge, Trench, and Boundaries unless you have those unique conditions with defining data
5. Select Edit → Wells then select one of the wells listed (should have two; one for pump down and one for recovery – may be the same well; may have more if observation wells are included). Select Modify tab:

   Under General, enter Well Name, and X,Y coordinates if known
   (note: X,Y needed if observation wells are used)

   Under Construction, select appropriate well type and enter needed data:
   #1 Fully Penetrating : no data to enter
   #2 Partial Penetrating : enter depth to well screen (d) & Screen Length (L)
   #3 Piezometer : enter water column height (z)
   #4 Horizontal well : enter depth (zh) & Length (Lh)
   Note for each type enter the unit well is completed in (normally aquifer)

   Under Radius, enter r(c) casing radius and r(w) well bore radius

   Under Rates, in table, enter Elapsed Time and associated Rate in ft3/min

   Note: Enter only Elapsed time of rate for that period;
   Only need entries where rate changes
   Note: Last entry must be of Elapsed Time with rate = 0 for pump off

   Under Observations, enter the Elapsed Min and Ft Difference data from Excel. NOTE: Do NOT enter Time=0 entry; start at row after T=0. If using SAVEAS file, you can Delete all existing entries. You can Add Rows as needed. I recommend copy and paste data from Excel. Include recovery WLs with continuing sequence of elapsed time (do not start at "0" for recovery).

   Ignore the Symbols, Curves, and Options tabs

   Slect APPLY, OK, and CLOSE
6. Select View → select "Displacement-Time"
   You can also try "Composite" and "Residual Drawdown"

7 Select Match → Solution. If unconfined, select "Unconfined Theis (1935)" to start, then try Cooper-Jacob and Neuman. Read the description under each selection to see which solutions might be appropriate for your situation. Stick only to CONFINED or UNCONFINED selections as appropriate. If you have bedrock fractured conditions, note the various "Fractured" solutions that are available to try.

8. Select Match → AUTOMATIC. This is allowing AQTESOLV to match the data set. In the pop up window, select max iterations (50-100 or more, vary as needed), leave

converge criteria at 1E-010, and check both Display Option boxes. Select "Estimate" and AQTESOLV will run the match. When it converges, another pop-up window opens and shows you the results. They are also displayed in the large window on the graph. Record all resulting data.

You can also select VISUAL and manually draw or place the matching curve to the data set – this varies between solutions. The overall objective is to draw a line that covers the data set trend; if the set is curved, you can "average" it, or run manual solutions twice – once for early and later portions of the data set and compare results.

9. You can preserve each Solution and Matching run by selecting File → Print, and selecting Adobe PDF, saving the print to your project file. Note that sometime AQTESOLV is picky doing this, and yields a "jumbled" PDF. If this happens, just try it again.
10. Note that all Solutions will give you hydraulic conductivity (K) or Transmissivity (T) in the units you selected; you can get hydraulic conductivity by dividing Transmissivity by the aquifer saturated thickness (b). Different solutions will also give various other hydraulic parameters such as Specific Storativity (Ss), Storativity (S), Specific Yield (Sy), Beta (b = ratio of vertical to horizontal K with factors of distance from pumping well and aquifer saturated thickness applied). Most fracture solutions will give hydraulic parameters for the fracture (K, Ss) and surrounding bedrock (prime ' symbol added. K', Ss').

7.0 SAFETY

Acute or chronic exposure to chemically-contaminated soil or water could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before mobilization so that proper PPE and monitoring are planned and implemented.

Conduct an on-site safety meeting each day before the start of field work utilizing a Tailgate Safety Meeting form. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment, PPE, health monitoring, and emergency procedures). Take appropriate action if personnel are injured on-site per EWI policy guidance.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), EWI Corporate Health and Safety Plan, and site-specific health and safety plan.

8.0 REFERENCES

To properly implement this procedure, please look to the following documents for further information related to this SOP.

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- U.S. Environmental Protection Agency, SLUG TESTS, SOP# 2046, DATE: 10/03/94.
- Weight, Willis D., Manual of Applied Field Hydrology, 2001.

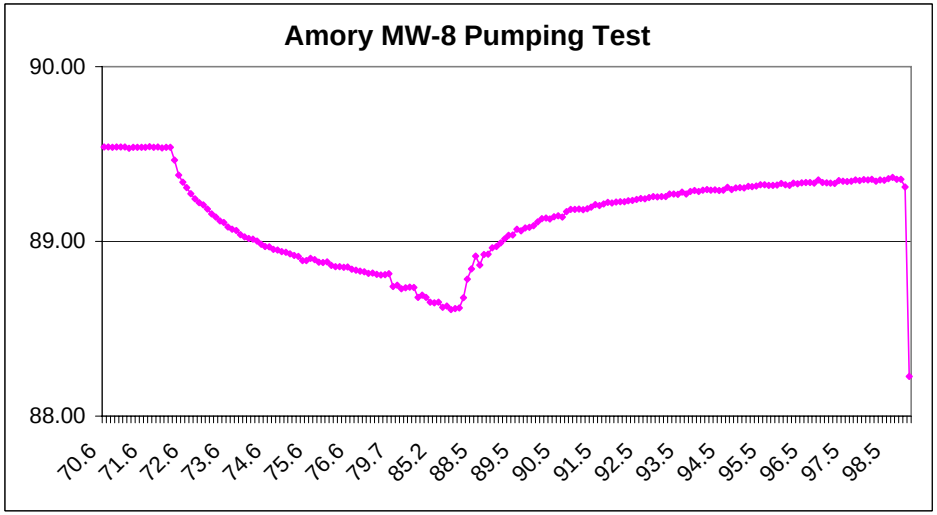
Level Reference Settings At Log Creation
Level Measurement Mode
Specific Gravity

Log Notes:

Date and Time	Note
10/22/2009 10:53	Manual Stop Command
10/22/2009 11:48	User Note: "Pressure & Level adjusted by fixed baro value: 14.58 (PSI)"

Log Data:

Record Count	1011	
	TOC	95.00
	Troll Depth	12.50



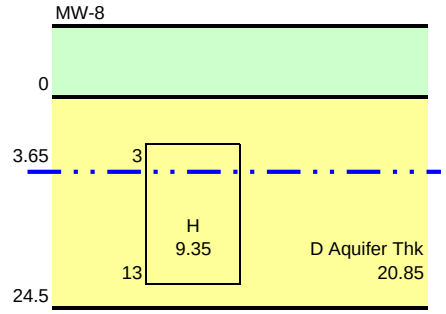
Date and Time	Cum Min	WL Elev	Elaps Min	Ft Diff	Gallons Pumped	GPM and Ft3/min
10/22/2009 10:22:36	70.6	89.54				
10/22/2009 10:22:42	70.7	89.54				
10/22/2009 10:22:48	70.8	89.54				
10/22/2009 10:22:54	70.9	89.54				
10/22/2009 10:23:00	71	89.54				
10/22/2009 10:23:06	71.1	89.54				
10/22/2009 10:23:12	71.2	89.53				
10/22/2009 10:23:18	71.3	89.54				
10/22/2009 10:23:24	71.4	89.54				
10/22/2009 10:23:30	71.5	89.54				
10/22/2009 10:23:36	71.6	89.54				
10/22/2009 10:23:42	71.7	89.54				
10/22/2009 10:23:48	71.8	89.54				
10/22/2009 10:23:54	71.9	89.54				
10/22/2009 10:24:00	72	89.53				
10/22/2009 10:24:06	72.1	89.54				
10/22/2009 10:24:12	72.2	89.54	0.00		Start Pumping Test	
10/22/2009 10:24:18	72.3	89.47	0.10	0.07		
10/22/2009 10:24:24	72.4	89.38	0.20	0.16		
10/22/2009 10:24:30	72.5	89.34	0.30	0.20		
10/22/2009 10:24:36	72.6	89.31	0.40	0.23		
10/22/2009 10:24:42	72.7	89.27	0.50	0.27		

10/22/2009 10:24:48	72.8	89.24	0.60	0.30		
10/22/2009 10:24:54	72.9	89.22	0.70	0.32		
10/22/2009 10:25:00	73	89.21	0.80	0.33		
10/22/2009 10:25:06	73.1	89.19	0.90	0.35		
10/22/2009 10:25:12	73.2	89.16	1.00	0.38		
10/22/2009 10:25:18	73.3	89.14	1.10	0.40		
10/22/2009 10:25:24	73.4	89.12	1.20	0.42		7.48 gallons/ft3
10/22/2009 10:25:30	73.5	89.11	1.30	0.43		
10/22/2009 10:25:36	73.6	89.08	1.40	0.46		
10/22/2009 10:25:42	73.7	89.07	1.50	0.47	Pumped 3 gallons	2.142857 GPM pumping rate
10/22/2009 10:25:48	73.8	89.06	1.60	0.48		0.286 Cubic ft/min
10/22/2009 10:25:54	73.9	89.04	1.70	0.50		
10/22/2009 10:26:00	74	89.03	1.80	0.51		
10/22/2009 10:26:06	74.1	89.02	1.90	0.52		
10/22/2009 10:26:12	74.2	89.01	2.00	0.53	Pumped 4 gallons	2.00 GPM pumping rate
10/22/2009 10:26:18	74.3	89.00	2.10	0.54		0.267 Cubic ft/min
10/22/2009 10:26:24	74.4	88.98	2.20	0.56		
10/22/2009 10:26:30	74.5	88.97	2.30	0.57		
10/22/2009 10:26:36	74.6	88.97	2.40	0.57		
10/22/2009 10:26:42	74.7	88.95	2.50	0.58	Pumped 5 gallons	2.00 GPM pumping rate
10/22/2009 10:26:48	74.8	88.95	2.60	0.59		0.267 Cubic ft/min
10/22/2009 10:26:54	74.9	88.94	2.70	0.60		
10/22/2009 10:27:00	75	88.94	2.80	0.60		
10/22/2009 10:27:06	75.1	88.93	2.90	0.61		
10/22/2009 10:27:12	75.2	88.92	3.00	0.62		
10/22/2009 10:27:18	75.3	88.91	3.10	0.63		
10/22/2009 10:27:24	75.4	88.89	3.20	0.65		
10/22/2009 10:27:30	75.5	88.89	3.30	0.65		
10/22/2009 10:27:36	75.6	88.90	3.40	0.64		
10/22/2009 10:27:42	75.7	88.90	3.50	0.64		
10/22/2009 10:27:48	75.8	88.88	3.60	0.66		
10/22/2009 10:27:54	75.9	88.88	3.70	0.66		
10/22/2009 10:28:00	76	88.88	3.80	0.66		
10/22/2009 10:28:06	76.1	88.86	3.90	0.68		
10/22/2009 10:28:12	76.2	88.85	4.00	0.68		
10/22/2009 10:28:18	76.3	88.86	4.10	0.68		
10/22/2009 10:28:24	76.4	88.85	4.20	0.69		
10/22/2009 10:28:30	76.5	88.85	4.30	0.69		
10/22/2009 10:28:36	76.6	88.84	4.40	0.70		
10/22/2009 10:28:42	76.7	88.84	4.50	0.70		
10/22/2009 10:28:48	76.8	88.83	4.60	0.71		
10/22/2009 10:28:54	76.9	88.83	4.70	0.71		
10/22/2009 10:29:00	77	88.82	4.80	0.72		
10/22/2009 10:29:06	77.1	88.82	4.90	0.72		
10/22/2009 10:29:12	77.2	88.81	5.00	0.73		
10/22/2009 10:29:18	77.3	88.81	5.10	0.73	Pumped 10 gallons	1.92 GPM pumping rate
10/22/2009 10:29:24	77.4	88.81	5.20	0.73		0.257 Cubic ft/min
10/22/2009 10:29:30	77.5	88.82	5.30	0.72		
10/22/2009 10:31:42	79.7	88.74	7.50	0.80		
10/22/2009 10:31:48	79.8	88.75	7.60	0.79		

PUMPING TEST SOLUTIONS

Time-Displacement Soulutions

UNCONFINED Thies (1935)			
	T	0.101	Ft2/min
	S	0.205	
	K	0.004844	ft/min calculated
UNCONFINED COOPER-JACOB (1946)			
	T	0.103	Ft2/min
	S	0.188	
	K	0.00494	ft/min calculated
UNCONFINED NEUMAN (1974)			
	T	0.103	Ft2/min
	S	0.188	
	K	0.00494	ft/min calculated
	Sy	0.139	
	Beta	0.071	



WLs at end nearly equilibrated

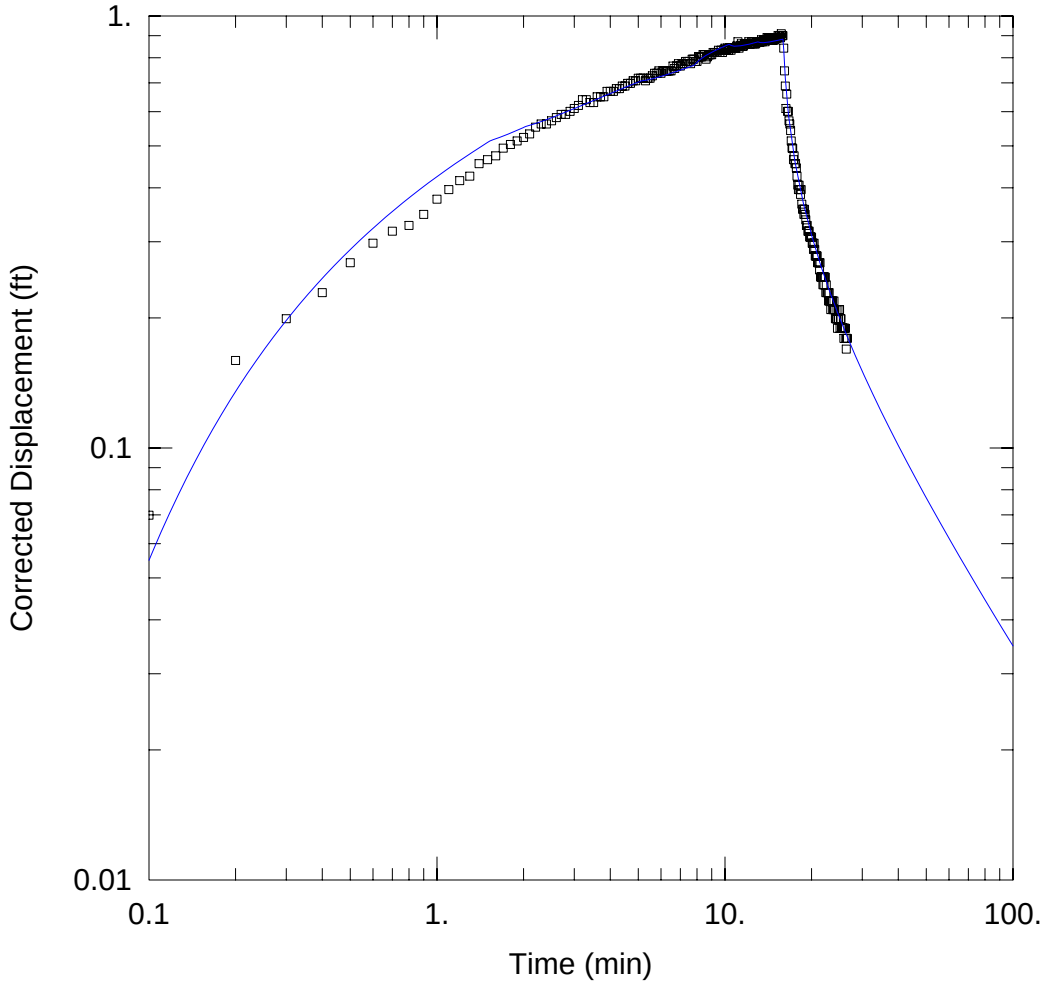
MW-8 TEST 1 UNCONFINED CONDITIONS

AQTESOLV Parameters

s(0) =	na	initial displacement
H =	9.35	(Screen base - SWL)
screen L =	10	(bottom screen - top screen)
D Aq Thk =	20.85	(Base Aquifer - SWL)(UNCONFINED)
r(c) = 0.25 ft		(radius of 6" well casing)
r(w) = r(sk) = 0.42		(radius of 10" diam filter pack)
Eff porosity = 0.25		
Anisotropy kv/kh =	0.85	(sands)

Partially penetrating screen

10/22/2009 10:31:54	79.9	88.73	7.70	0.81			
10/22/2009 10:32:00	80	88.73	7.80	0.81	Pumped 15 gallons	1.85	GPM pumping rate
10/22/2009 10:32:06	80.1	88.74	7.90	0.80		0.248	Cubic ft/min
10/22/2009 10:32:12	80.2	88.74	8.00	0.80			
10/22/2009 10:34:24	82.4	88.68	10.20	0.86			
10/22/2009 10:34:30	82.5	88.69	10.30	0.85	Pumped 20 gallons	2.00	GPM pumping rate
10/22/2009 10:34:36	82.6	88.68	10.40	0.86		0.267	Cubic ft/min
10/22/2009 10:37:06	85.1	88.65	12.90	0.89			
10/22/2009 10:37:12	85.2	88.65	13.00	0.89	Pumped 25 gallons	1.85	GPM pumping rate
10/22/2009 10:37:18	85.3	88.65	13.10	0.89		0.248	Cubic ft/min
10/22/2009 10:39:42	87.7	88.62	15.50	0.92			
10/22/2009 10:39:48	87.8	88.63	15.60	0.91			
10/22/2009 10:39:54	87.9	88.61	15.70	0.93		0.239	Cubic ft/min
10/22/2009 10:40:00	88	88.62	15.80	0.92	Pumped 30 gallons	1.79	GPM pumping rate
10/22/2009 10:40:06	88.1	88.62	15.90	0.92	Pump Off - Start Recovery		1040:50:00 on digital watch
10/22/2009 10:40:12	88.2	88.68	16.00	0.86			PC 44 seconds less than digital watch
10/22/2009 10:40:18	88.3	88.78	16.10	0.76			
10/22/2009 10:40:24	88.4	88.84	16.20	0.70			
10/22/2009 10:40:30	88.5	88.92	16.30	0.62			
10/22/2009 10:40:36	88.6	88.86	16.40	0.67			
10/22/2009 10:40:42	88.7	88.93	16.50	0.61			
10/22/2009 10:40:48	88.8	88.93	16.60	0.61			
10/22/2009 10:40:54	88.9	88.96	16.70	0.58			
10/22/2009 10:41:00	89	88.97	16.80	0.57			
10/22/2009 10:41:06	89.1	88.99	16.90	0.55			
10/22/2009 10:41:12	89.2	89.02	17.00	0.52			
10/22/2009 10:41:18	89.3	89.03	17.10	0.50			
10/22/2009 10:41:24	89.4	89.04	17.20	0.50			
10/22/2009 10:41:30	89.5	89.07	17.30	0.47			
10/22/2009 10:41:36	89.6	89.06	17.40	0.48			
10/22/2009 10:41:42	89.7	89.08	17.50	0.46			
10/22/2009 10:41:48	89.8	89.08	17.60	0.46			
10/22/2009 10:41:54	89.9	89.09	17.70	0.45			
10/22/2009 10:42:00	90	89.11	17.80	0.43			
10/22/2009 10:42:06	90.1	89.13	17.90	0.41			
10/22/2009 10:42:12	90.2	89.13	18.00	0.40			
10/22/2009 10:42:18	90.3	89.13	18.10	0.41			
10/22/2009 10:42:24	90.4	89.14	18.20	0.40			
10/22/2009 10:42:30	90.5	89.15	18.30	0.39			
10/22/2009 10:42:36	90.6	89.14	18.40	0.40			
10/22/2009 10:42:42	90.7	89.17	18.50	0.37			
10/22/2009 10:42:48	90.8	89.18	18.60	0.36			
10/22/2009 10:42:54	90.9	89.18	18.70	0.36			



MW-8 PUMPING DRAWDOWN TEST

Data Set: U:\...\6851-MW8_PumpTest.aqt
Date: 07/03/12 Time: 16:31:03

PROJECT INFORMATION

Company: EWI
Client: BNSF
Project: 6851
Location: Amory, MS
Test Well: MW-8
Test Date: 10-22-09

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-8	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ MW-8	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 0.1008 ft^2/min
S = 0.2047
Kz/Kr = 235.1
b = 20.85 ft

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-93/503 February 1993

Ground Water Issue

Suggested Operating Procedures for Aquifer Pumping Tests

Paul S. Osborne*

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange up-to-date information related to ground water remediation at Superfund sites.

A very important aspect of ground water remediation is the capability to determine accurate estimates of aquifer hydraulic characteristics. This document was developed to provide an overview of all the elements of an aquifer test to assist RPMs and OSCs in the initial design of such tests or in the review of tests performed by other groups.

For further information, contact Jerry Thornhill, RSKERL-Ada, 405/436-8604 or Paul Osborne, EPA Region VIII, 303/293-1418.

INTRODUCTION

In recent years, there has been an increased interest in ground water resources throughout the United States. This interest has resulted from a combination of an increase in ground water development for public and domestic use; an increase in mining, agricultural, and industrial activities which might impact ground water quality; and an increase in studies of already contaminated aquifers. Decision-making agencies involved in these ground water activities require studies of the aquifers to develop reliable information on the hydrologic properties and behavior of aquifers and aquitards.

The most reliable type of aquifer test usually conducted is a pumping test. In addition, some site studies involve the use of short term slug tests to obtain estimates of hydraulic conductivity, usually for a specific zone or very limited portion of the aquifer. It should be emphasized that slug tests provide very limited information on the hydraulic properties of the aquifer and often produce estimates which are only accurate within an order of magnitude. Many experts believe that slug tests are much too heavily relied upon in site characterization and contamination studies. This group of professionals recommends use of slug testing during the initial site studies to assist in developing a site conceptual model and in pumping test design.

This document is intended as a primer, describing the process for the design and performance of an “aquifer test” (how to obtain reliable data from a pumping test) to obtain accurate estimates of aquifer parameters. It is intended for use by those professionals involved in characterizing sites which require corrective action as well as those which are proposed for ground water development, agricultural development, industrial development, or disposal activities. The goal of the document is to provide the reader with a complete picture of all of the elements of aquifer (pumping) test design and performance and an understanding of how those elements can affect the quality of the final data.

The determination of accurate estimates of aquifer hydraulic characteristics is dependent on the availability of reliable data from an aquifer test. This document outlines the planning, equipment, and test procedures for designing and conducting an accurate aquifer test. The design and operation of a slug test is not included in this document, although slug tests are often run prior to the design and implementation of an aquifer test. The slug test information can be very useful in developing the aquifer test design (see ASTM D-18

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Walter W. Kovalick, Jr., Ph.D.
Director

Committee, D4050 and D4104). If an accurate conceptual model of the site is developed and the proper equipment, wells, and procedures are selected during the design phase, the resulting data should be reliable. The aquifer estimates obtained from analyzing the data will, of course, depend on the method of analysis.

This document is not intended to be an overview of aquifer test analysis. The analysis and evaluation of pumping test data is adequately covered by numerous texts on the subject (Dawson and Istok, 1991; Kruseman and de Ridder, 1991; Walton, 1962; and Ferris, Knowles, Brown, and Stallman, 1962). It should be emphasized, however, that information on the methods for analyzing test data should be reviewed in detail during the planning phase. This is especially important for determining the number, location, and construction details for all wells involved in the test.

A simple "pump" (specific capacity) test involves the pumping of a single well with no associated observation wells. The purpose of a pump test is to obtain information on well yield, observed drawdown, pump efficiency, and calculated specific capacity. The information is used mainly for developing the final design of the pump facility and water delivery system. The pump test usually has a duration of 2 to 12 hours with periodic water level and discharge measurements. The pump is generally allowed to run at maximum capacity with little or no attempt to maintain constant discharge. Discharge variations are often as high as 50 percent. Short-term pump tests with poor control of discharge are not suitable for estimating parameters needed for adequate aquifer characterization. If the pump test is, however, run in such a way that the discharge rate varies less than 5 percent and water levels are measured frequently, the test data can also be used to obtain some reliable estimates of aquifer performance. It should be emphasized that an estimate of aquifer transmissivity obtained in this manner will not be as accurate as that obtained using an aquifer test including observation wells.

By controlling the discharge variation and pumping for a sufficient duration, it is possible to obtain reliable estimates of transmissivity using water level data obtained during the pump test. However, this method does not provide information on boundaries, storativity, leaky aquifers, and other information needed to adequately characterize the hydrology of an aquifer. For the purpose of this document, an aquifer test is defined as a controlled field experiment using a discharging (control) well and at least one observation well.

The aquifer test is accomplished by applying a known stress to an aquifer of known or assumed dimensions and observing the water level response over time. Hydraulic characteristics which can be estimated, if the test is designed and implemented properly, include the coefficient of storage, specific yield, transmissivity, vertical and horizontal permeability, and confining layer leakage. Depending on the location of observation wells, it may be possible to determine the location of aquifer boundaries. If measurements are made on nearby springs, it may also be possible to determine the impact of pumping on surface-water features.

TEST DESIGN

Adequate attention to the planning and design phase of the aquifer pumping test will assure that the effort and expense of conducting a test will produce useful results. Individuals involved in designing an aquifer test should review the relevant ASTM Standards relating to: 1) appropriate field procedures for determining aquifer hydraulic properties (D4050 and D4106); 2) selection of aquifer test method (D4043); and 3) design and installation of ground water monitoring wells (D5092). The relevant portions of these standards should be incorporated into the design.

All available information regarding the aquifer and the site should be collected and reviewed at the commencement of the test design phase. This information will provide the basis for development of a conceptual model of the site and for selecting the final design. It is important that the geometry of the site, location and depth of observation wells and piezometers, and the pumping period agree with the mathematical model to be used in the analysis of the data. A test should be designed for the most important parameters to be determined, and other parameters may have to be de-emphasized.

Aquifer Data Needs

The initial element of the test design, formulating a conceptual model of the site, involves the collection and analysis of existing data regarding the aquifer and related geologic and hydrologic units. All available information on the aquifer itself, such as saturated thickness, locations of aquifer boundaries, locations of springs, information on all on-site and all nearby wells (construction, well logs, pumping schedules, etc.), estimates of regional transmissivities, and other pertinent data, should be collected. Detailed information relating to the geology and hydrology is needed to formulate the conceptual model and to determine which mathematical model should be utilized to estimate the most important parameters. It is also important to review various methods for the analyses and evaluation of pumping test data (Ferris, Knowles, Brown, and Stallman, 1962; Kruseman and De Ridder, 1991; and Walton, 1962 and 1970). Information relating to the various analytical methods and associated data needs will assist the hydrologist in reviewing the existing data, identifying gaps in information, and formulating a program for filling any gaps that exist.

The conceptual model of the site should be prepared after carrying out a detailed site visit and an evaluation of the assembled information. The review of available records should include files available from the U. S. Geological Survey, appropriate state agencies, and information from local drillers with experience in the area. Formulation of a conceptual model should include a brief analysis of how the local hydrology/geology fits into the regional hydrogeologic setting.

<u>Aquifer Location</u>

The depth to, thickness of, areal extent of, and lithology of the aquifer to be tested should be delineated, if possible.

<u>Aquifer Boundaries</u>

Nearby aquifer discontinuities caused by changes in lithology or by incised streams and lakes should be mapped. All known and suspected boundaries should be mapped such that

observation wells can be placed (chosen) where they will provide the best opportunity to measure the aquifer's response to the pumping and the boundary effects during the pumping test.

Hydraulic Properties

Estimates of all pertinent hydraulic properties of the aquifers and pertinent geologic units must be made by any means feasible. Estimates of transmissivity and the storage coefficient should be made, and if leaky confining beds are detected, leakage coefficients should be estimated. The estimation of transmissivity and the storage coefficient should be carried out by making a close examination of existing well logs and core data in the area or by gathering information from nearby aquifer tests, slug tests, or drill stem tests conducted on the aquifer(s) in question. It may also be feasible to run a slug test on the wells near the site to get preliminary values. (See ASTM Committee D-18 Standards D4044 and D4104). It should be noted that some investigators have found that slug tests often produce results which are as much as an order of magnitude low. Although some investigators have reported results which are two orders of magnitude high because the sand pack dominated the test. Such tests will, however, provide a starting point for the design. If no core analyses are available, the well log review should form a basis for utilizing an available table which correlates the type of aquifer material with the hydraulic conductivity. If detailed sample results from drill holes are available and they have grain size analyses, there are empirical formulas for estimation of transmissivity. Estimation of storage coefficient is more difficult, but can be based on the expected porosity of the material or the expected confinement of the aquifer. It is recommended that a range of values be chosen to provide a worst case and best case scenario (Freeze and Cherry, 1979). Trial calculations of well drawdown using these estimated values should be made to finalize the design, location, and operation of test and observation wells (Ferris and others, 1962; Campbell and Lehr, 1972; and Stallman, 1971).

If local perched aquifers are of a significant size and location to impact the pump test, this impact should be estimated if possible. The final test design should include adequate monitoring of any perched aquifers and leaky confining beds. This might involve the placing of piezometers into and/or above the leaky confining zone or into the perched aquifer.

Evaluation of Existing Well Information

Because the drilling of new production wells and observation wells expressly for an aquifer test can be expensive, it is advisable to use existing wells for conducting an aquifer test when possible. However, many existing wells are not suitable for aquifer testing. They may be unsuitably constructed (such as a well which is not completed in the same aquifer zone as the pumping well) or may be inappropriately located. It is also important to note that well logs and well completion data for existing facilities are not always reliable. Existing data should be verified whenever possible. The design of each well, whether existing or to be drilled, must be carefully considered to determine if it will meet the needs of the proposed test plan and analytical methods. Special attention must be paid to well location, the depth and interval of the well screen or perforation, and the present condition of existing perforations.

After the process of developing the site model and determining which analytical methods should be used, it is possible to move to the final design stage. The final stage of the design involves development of the key elements of the aquifer test: 1) number and location of observation wells; 2) design of observation wells; 3) approximate duration of the test; and 4) discharge rate.

Design of Pumping Facility

There are seven principal elements to be considered during the pumping facility design phase: 1) well construction; 2) the well development procedure; 3) well access for water level measurements; 4) a reliable power source; 5) the type of pump; 6) the discharge-control and measurement equipment; and 7) the method of water disposal. These elements are discussed in the following sections.

Well Construction

The diameter, depth and position of all intervals open to the aquifer in the pumping well should be known, as should total depth. The diameter must be large enough to accommodate a test pump and allow for water level measurements. All openings to the aquifer(s) must be known and only those openings located in the aquifer to be tested should be open to the well during the testing. If the pumping well has to be drilled, the type, size, and number of perforations should be established using data from existing well logs and from the information obtained during the drilling of the new well itself. The screen or perforated interval should be designed to have sufficient open area to minimize well losses caused by fluid entry into the well (Campbell and Lehr, 1972; and Driscoll, 1986).

A well into an unconsolidated aquifer should be completed with a filter pack in the annular space between the well screen and the aquifer material. To design an adequate filter pack, it is essential that the grain size makeup of the aquifer be defined. This is generally done by running a sieve analysis of the major lithologic units making up the aquifer. The sizing of the filter pack will depend on the grain size distribution of the aquifer material. The well screen size would be established by the sizing of the chosen filter pack (Driscoll,1986). The filter pack should extend at least one (1) foot above the top of the well screen. A seal of bentonite pellets should be placed on top of the filter pack. A minimum of three (3) feet of pellets should be used. An annulus seal of cement and/or bentonite grout should be placed on top of the bentonite pellets. The well casing should be protected at the surface with a concrete pad around the well to isolate the wellbore from surface runoff (ASTM Committee D-18, D5092; and Barcelona, Gibb, and Miller, 1983).

Well Development

Information on how the pumping well was constructed and developed should be collected during the review of existing site information. It may be necessary to interview the driller. If the well has not been adequately developed, the data collected from the well may not be representative of the aquifer. For instance, the efficiency of the well may be reduced, thereby causing increased drawdown in the pumping well. When a well is pumped, there are two components of

drawdown: 1) the head losses in the aquifer; and 2) the head losses associated with entry into the well. A well which is poorly constructed or has a plugged well screen will have a high head loss associated with entry into the well. These losses will affect the accuracy of the estimates of aquifer hydraulic parameters made using data from that well. If the well is suspected to have been poorly developed, or nothing is known, it is advisable to run a step drawdown test on the well to determine the extent of the problem. The step drawdown test entails conducting three or more steps of increasing discharge, producing drawdown curves such as shown in Figure 1. The data provided by the step drawdown test (multiple discharge test) can be analyzed using various techniques (Rorabough, 1953; and Driscoll, 1986) to obtain an estimate of well entry losses. If a determination is made that plugging results in significant losses, the well should be redeveloped prior to the pumping test using a surge block and/ or a pump until the well discharge is clear: i. e. the development results in the well achieving acceptable turbidity unit limits (Driscoll, 1986). In many cases, running a step drawdown test to determine well efficiency after the well has been surged is needed to assess the results of the development process. The results of the post development test should be compared with the step-drawdown test run prior to development. This analysis will provide a means of verifying the success of the well development.

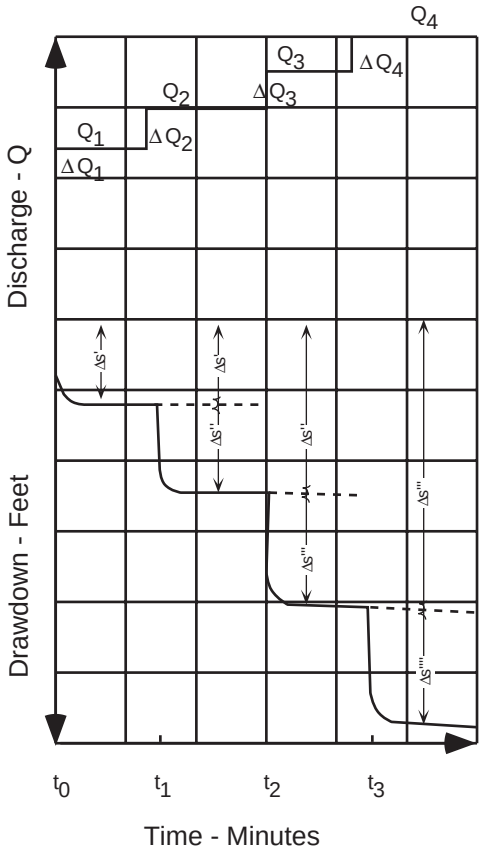

Figure 1. Variation of discharge and drawdown in multiple discharge tests (step drawdown tests).

Water Level Measurement Access

It must be possible to measure depth to the water level in the pumping well before, during, and after pumping. The quickest and generally the most accurate means of measuring the water levels in the pumped well during an aquifer test is to use an electric sounder or pressure transducer system. The transducer system may be expensive and may be difficult to install in an existing well. It may be possible to run a 1/4 inch copper line into the well as an air line. If the control well is newly constructed, the continuous copper line should be strapped to the pump column as it is being installed. If it is correctly installed, an air line can be used with somewhat less accuracy than an electric sounder or steel tape. An air line with a bubbler and either a transducer or precision pressure gage should be adequate for running an aquifer test.

With adequate temperature compensation, a surface mounted pressure transducer is as precise as one that is submerged. Steel tapes cannot always be used quickly enough in a pumping well, except in wells with a small depth to water (less than 100 feet) where the pump test crew has a fair amount of experience and the well is modified for access of the steel tape. Such modification often involves hanging a 3/4 inch pipe in the well as access for the steel tape. The pipe should be capped at the bottom with numerous 1/16 to 1/8 inch holes drilled in the pipe and cap (especially needed for wells subject to cascading water or surging). This will dampen water-level surging caused by the pump and will eliminate the problems caused by cascading water. In general, the use of a steel tape is usually confined to the later stages of the pump test where rapid changes in water levels are not occurring.

In cases where the pump is isolated by a packer to allow production from a particular zone, a transducer system should be used to monitor pumping hydraulic heads. It is important, however, to calibrate the transducers before and after the test. In addition, reference checks with an electric sounder or steel tape should be made before, during, and after the test. The ASTM Standard Test Method for determining subsurface liquid levels in a borehole or monitoring well (D4750) should be reviewed as part of the design process.

Reliable Power Source

Having power continuously available to the pump, for the duration of the test, is crucial to the success of the test. If power is interrupted during the test, it may be necessary to terminate the test and allow for sufficient recovery so that pre-pumping water-level trends can be extrapolated. At that point, a new test would be run. If, however, brief interruptions in power occur late in the test, the affect of the interruption can be eliminated by pumping at a calculated higher rate for some period so that the average rate remains unchanged. The increased rate must be calculated such that the final portion of the test compensates for the pumpage that would have occurred during the interruption of pumping.

Pump Selection

A reliable pump is a necessity during an aquifer test. The pump should be operated continuously during the test. Should a pump fail during the pumping period of the test, the time, effort, and expense of conducting the test could be

wasted. Electrically powered pumps produce the most constant discharge and are often recommended for use during an aquifer test. However, in irrigation areas, line loads can fluctuate greatly, causing variations in the pumping rate of electric motors. Furthermore, electric motors are nearly constant-load devices, so that as the lift increases (water level declines), the pumping rate decreases. This is a particular problem for inefficient wells or low transmissivity aquifers.

The discharge of engine-powered (usually gasoline or diesel) pumps may vary greatly over a 24 hour period, requiring more frequent monitoring of the discharge rate during the test. For example, under extreme conditions a diesel-powered turbine pump may have more than a 10 percent change in discharge as a result of the daily variation in temperature. The change in air temperature affects the combustion ratio of the engine resulting in a variation in engine revolutions per minute (rpm). The greater the daily temperature range,the greater the range in engine rpm. Variations in barometric pressure may also affect the engine operation and resulting rpm. Running the engine at full throttle will reduce operational flexibility for adjusting engine rpm and the resulting discharge. In areas where outside temperatures are extreme, such as the desert or a very cold region, it may be advisable to undertake measures to prevent the engine from overheating or freezing.

In order to obtain good data during the period of recovery at the end of pumping, it is necessary to have a check valve installed at the base of the pump column pipe in the discharging well. This will prevent the back flow of water from the column pipe into the well when the pumping portion of the test is terminated and the recovery begins. Any back flow into the well will interfere with or totally mask the water level recovery of the aquifer and this would make any aquifer analysis based on recovery data useless or, at best, questionable (Schafer, 1978).

Discharge-Control and Measurement Equipment

The well bore and discharge lines should be accessible for installing discharge control and monitoring equipment. When considering an existing well for the test well to be pumped (control well), the well must either already be equipped with discharge measuring and regulating equipment, or the well must have been constructed such that the necessary equipment can be added.

Control of the pumping rate during the test requires an accurate means for measuring the discharge of the pump and a convenient means of adjusting the rate to keep it as nearly constant as possible. Common methods of measuring well discharge include the use of an orifice plate and manometer, an inline flow meter, an inline calibrated pitot tube, a calibrated weir or flume, or, for low discharge rates, observing the length of time taken for the discharging water to fill a container of known volume (e.g. 5 gallon bucket; 55 gallon drum).

In addition to the potentially large variation in discharge associated with the pump motor or engine, the discharge rate is also related to the drop in water level near the pumping well during the aquifer test. As the pumping lift increases, the rate of discharge at a given level of power (such as engine rpm) will decrease. The pump should not be operated at its maximum rate. As a general rule, the pumping unit, including the engine, should be designed so that the maximum pumping rate is at least 20 percent more than the estimated long term sustainable yield of the aquifer. The long term yield of the aquifer should be determined by collecting data on pumping rates in nearby wells. If possible, a short term test of one to two hours should be run when the pump is installed. This test data should be compared to the historic data as part of the estimation process.

The pumping rate can be controlled by placing valves on the discharge line and/or by placing controls on the pump power source. A valve installed in the discharge line to create back pressure provides effective control of the discharge rate while conducting an aquifer test, especially when using an electric-powered pump. A rheostatic control on the electric pump will also allow accurate control of the discharge rate. When an engine-powered pump is being utilized, installation of a micrometer throttle adjustment device to accurately control engine rpm is recommended in addition to a valve in the line.

Water Disposal

Discharging water immediately adjacent to the pumping well can cause problems with the aquifer test, especially in tests of permeable unconfined alluvial aquifers. The water becomes a source of recharge which will affect the results of the test. It is essential that the volumes of produced water, the storage needs, the disposal alternatives, and the treatment needs be assessed early in the planning process. The produced water from the test well must be transported away from the control well and observation wells so it cannot return to the aquifer during the test. This may necessitate the laying of a temporary pipeline (sprinkler irrigation line is often used) to convey the discharge water a sufficient distance from the test site. In some cases, it may be necessary to have on-site storage, such as steel storage tanks or lined ponds. This is especially critical when testing contaminated zones where water treatment capacity is not available. The test designer should carefully review applicable requirements of the RCRA hazardous waste program, the underground injection control program, and the surface water discharge program prior to making decisions about this phase of the design. It may be necessary to obtain permits for on-site storage and final disposal of the contaminated fluids. Final disposal could involve treatment and reinjection into the source aquifer or appropriate treatment and discharge.

Design of Observation Well(s)

Verification of well response

As part of the process of selecting the location of the observation wells needed for the chosen aquifer test design, existing wells should be tested for their suitability as observation wells. The existing information regarding well construction should be reviewed as a screening mechanism for identifying suitable candidates. The wells that are identified as potential observation wells should be field tested to verify that they are suitable for monitoring aquifer response. The perforations or well screens of abandoned wells tend to become restricted by the buildup of iron compounds, carbonate compounds, sulfate compounds or bacterial growth as a result of not pumping the well. Consequently, the response test is one of the most important pre-pumping examinations to be made if such wells are to be used for observation (Stallman, 1971; and Black and Kip, 1977). The

reaction of all wells to changing water levels should be tested by injecting or removing a known volume of water into each well and measuring the subsequent change of water level. Any wells which appear to have poor response should be either redeveloped, replaced, or dropped from consideration in favor of another available well selected.

Total Depth

In general, observation wells should penetrate the tested aquifer to the same stratigraphic horizon as the well screen or perforated interval of the pumping well. This will require close evaluation of logs to adjust for dipping formations. This assumes the observation well is to be used for monitoring response in the same aquifer from which the discharging well is pumping. Actual screen design will depend on aquifer geometry and site specific lithology. If the aquifer test is designed to detect hydraulic connection between aquifers, one observation well should be screened in the strata for which hydraulic inter-connection is suspected. Depending on how much information is needed, additional wells screened in other strata may be needed (Bredehoeft and others, 1983; Walton, 1970; Dawson and Istok, 1991; and Hamlin, 1983).

Well Diameter

In general, observation well casing should have a diameter just large enough to allow for accurate, rapid water level measurements. A two-inch well casing is usually adequate for use as an observation well in shallow aquifers which are less than 100 feet in depth. They are, however, often difficult to develop. A four- to six-inch diameter well will withstand a more vigorous development process, and should have better aquifer response when properly developed. Additionally, a four or six inch diameter well may be required if a water-depth recorder is planned, depending on the type of recording equipment to be used. The difficulties in drilling a straight hole usually dictate that a well over 200 feet deep be at least four inches in diameter.

Well Construction

Ideally, the observation well(s) should have five to twenty feet of perforated casing or well screen near the bottom of the well. The final well screened interval(s) will depend on the nature of geologic conditions at the site and the types of parameters to be estimated. Any openings which allow water to enter the well from aquifers which are not to be tested should be sealed or closed off for the duration of the test. Ideally, the annular space between the casing and the hole wall should be gravel packed adjacent to the perforated interval to be tested. The use of a filter pack in wells with more than one screened interval will, however, create a problem. There is no reliable method for sealing the annular space of any unwanted filter packed interval even though the screen can be isolated. The size of the filter material should be based on the grain size distribution of the zone to be screened (preferably based on a sieve analysis of the material). The screen size should be determined based on the filter pack design (Driscoll, 1986). The space above the gravel should be sealed with a sufficient amount of bentonite or other grout to isolate the gravel pack from vertical flow from above. If the bentonite does not extend to the surface, it will be necessary to put a cement seal on top of the bentonite prior to back filling the remaining annular space. A concrete pad should be placed around the well to prevent surface fluids from entering the annular material. After installation is finished, the observation well should be developed by surging with a block, and/or submersible pump (Campbell and Lehr, 1972; and Driscoll, 1986) for a sufficient period (usually several hours) to meet a pre-determined level of turbidity.

Radial Distance and Location Relative to the Pumped Well

If only one observation well is to be used, it is usually located 50 to 300 feet from the pumped well. However, each test situation should be evaluated individually, because certain hydraulic conditions may exist which warrant the use of a closer or more distant observation well. If the test design requires multiple observation wells, the wells are often placed in a straight line or along rays that are perpendicular from the pumping well. In the case of multiple boundaries or leaky aquifers, the observation wells need to be located in a manner which will identify the location and effect of the boundaries. If the location of the boundary is suspected before the test, it is desirable to locate most of the wells along a line parallel to the boundary and running through the pumping well, as shown in Figure 2. If aquifer anisotropy is expected, the observation wells should be located in a pattern based on the suspected or known anisotropic conditions at the site (Bentall and others, 1963; Ferris and others, 1962; Walton, 1962 and 1970; and Dawson and Istok, 1991). If the principal directions of anisotropy are known, drawdown data from two wells located on different rays from the pumping well will be sufficient. If the principal directions of anisotropy are not known, at least three wells on different rays are needed.

FIELD PROCEDURES

Well thought out field procedures and accurate monitoring equipment are the key to a successful aquifer test. The following three sections provide an overview of the methods and equipment for establishing a pre-test baseline condition and running the test itself.

Necessary Equipment for Data Collection

During an aquifer test, equipment is needed to measure/record water levels, well discharges, and the time since the beginning of the test, and to record accumulated data. Appendix One contains a detailed description of the types of equipment commonly used during an aquifer test. Appendix Two is an example form for recording test data.

Establish Baseline Trend

Collecting data on pre-test water levels is essential if the analysis of the test data is to be completely successful. The baseline data provides a basis for correcting the test data to account for on-going regional water level changes. Although the wells on-site are the main target for baseline measurements, it is important to measure key wells adjacent to the site and to account for off-site pumping which may affect the test results.

Baseline water levels

Prior to beginning the test, it will be necessary to establish a

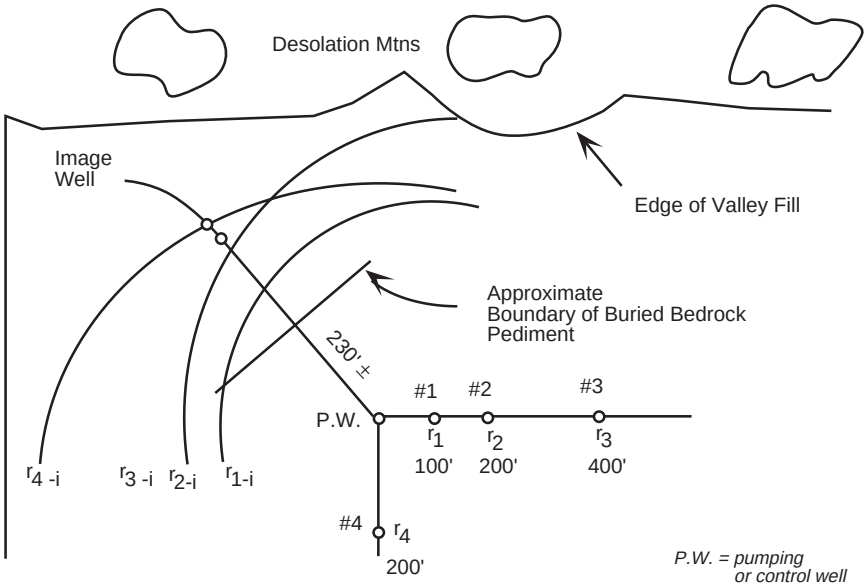

Figure 2. Observation well/pumping well location to determine buried impermeable boundary.

baseline trend in the water levels in the pumping and all observation wells. As a general rule, the period of observation before the start of the test (t_0), should be at least one week. Baseline measurements must be made for a period which is sufficient to establish the pre-pumping water level trends on site (see Figure 3). The baseline data must be sufficient to explain any differences between individual observation wells. As shown in Figure 3, the water levels in on-site wells were declining prior to the test. The drawdown during the test must be corrected to account for the pre-pumping trend.

Nearby pumping activities

During the baseline measurements, the on-off times should be recorded for any nearby wells in use. The well discharge rates should be noted as should any observed changes in the proposed on-site control well and observation wells. Baseline water level measurements should be made in all off-site wells within the anticipated area of influence. As shown in Figure 3, the baseline period should be sufficient to establish the pretest pumping trends and to explain any differences in trends between individual off-site wells.

Significant effects due to nearby pumping wells can often be removed from the test data if the on-off times of the wells are monitored before and during the test. Interference effects may not, however, always be observable. In any case, changes associated with nearby pumping wells will make analysis more difficult. If possible, the cooperation of nearby well owners should be obtained to either cease pumping prior to and during the test period or to control the discharge of these wells during the baseline and test period. The underlying principle is to minimize changes in regional effects during the baseline, test and recovery periods.

Barometric pressure changes

During the baseline trend observation period, it is desirable to monitor and record the barometric pressure to a sensitivity of plus or minus 0.01 inches of mercury. The monitoring should continue throughout the test and for at least one day to a week after the completion of the recovery measurement period. This data, when combined with the water level trends measured during the baseline period, can be used to correct for the effects of barometric changes that may occur during the test (Clark, 1967).

Local activities which may affect test

Changes in depth to water level, observed during the test, may be due to several variables such as recharge, barometric response, or “noise” resulting from operation of nearby wells, or loading of the aquifer by trains or other surface disturbances (King, 1982). It is important to identify all major activities (especially cyclic activities) which may impact the test data. Enough measurements have to be made to fully characterize the pre-pumping trends of these activities. This may necessitate the installation of recording equipment. A summary of this information should be noted in the comments section of the pumping test data forms.

Test Procedures

Initial water level measurements

Immediately before pumping is to begin, static water levels in all test wells should be recorded. Measurements of drawdown in the pumping well can be simplified by taping a calibrated steel tape to the electric sounder wire. The zero point of the tape may be taped at the point representing static water level. This will enable the drawdown to be measured directly rather than by depth to water.

Measuring water levels during test

If drawdown is expected in the observation well(s) soon after

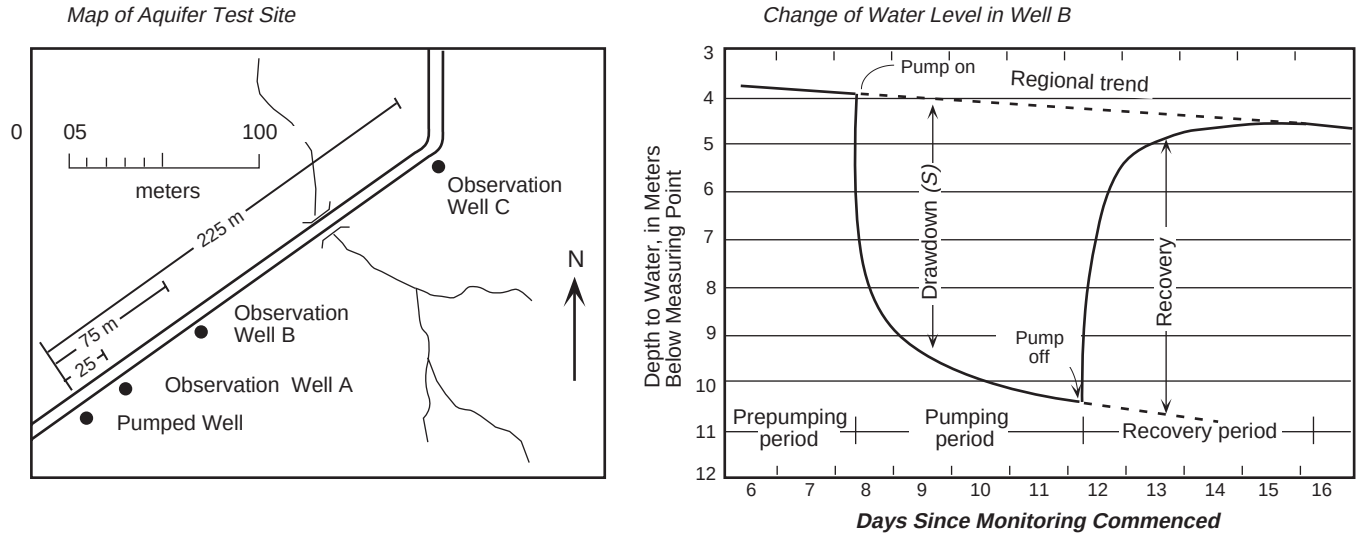

Figure 3. Example test site showing baseline, pumping test, and recovery water level measurements in one of the wells.

testing begins and continuous water level recorders are not installed, an observer should be stationed at each observation well to record water levels during the first two to three hours of testing. Subsequently, a single observer is usually able to record water levels in all wells because simultaneous measurements are unnecessary. If there are numerous observation wells, a pressure transducer/data-logging system should be considered to reduce manpower needs.

Time frame for measuring water levels

Table 1 shows the recommended maximum time intervals for recording water levels in the pumped well. NOTE: the times provided in Table 1 are only the maximum recommended time intervals--more frequent measurements may be taken if test conditions warrant. For instance, it is recommended that water level measurements be taken at least every 30 seconds for the first several minutes of the test (see ASTM Committee D-18, D 4050). Figure 4 is a hypothetical logarithmic plot of drawdown versus time for an observation well. This plot illustrates the need for the frequency of measurements given in Table 1. As shown on the plot, frequent measurements during early times are needed to define the drawdown curve. The data used in Figure 4 was collected with a downhole pressure transducer and electronic data recording equipment. Thus, water levels could be collected about every 6 seconds initially and less frequently as the test progresses. As time since pumping started increases, the logarithmic scale dictates that less frequent measurements are needed to adequately define the curve.

Measurements in the observation well(s) should occur often enough and soon enough after testing begins to avoid missing the initial drawdown values. Actual timing will depend on the aquifer and well conditions which vary from test area to test area. Estimates for timing should be made during the planning stages of aquifer testing using estimated aquifer parameters based on the conceptual model of the site.

Table 1. Maximum Recommended Time Intervals for Aquifer Test Water Level Measurements*

0 to 3 minutes	every 30 seconds
3 to 15 minutes	every minute
15 to 60 minutes	every 5 minutes
60 to 120 minutes	every 10 minutes
120 min. to 10 hours	every 30 minutes
10 hours to 48 hours	every 4 hours
48 hours to shut down	every 24 hours

** Dr. John Harshbarger, personal communication, 1968.*

Monitoring discharge rate

During the initial hour of the aquifer test, well discharge in the pumping well should be monitored and recorded as frequently as practical. Ideally, the pretest discharge will equal zero. If it does not, the discharge should be measured for the first time within a minute or two after the pump is started.

It is important when starting a test to bring the discharge up to the chosen rate as quickly as possible. How frequently the discharge needs to be measured and adjusted for a test depends on the pump, well, aquifer, and power characteristics. Output from electrically driven equipment requires less frequent adjustments than from all other pumping equipment. Engine-driven pumps generally require adjustments several times a day because of variation that occurs in the motor performance due to a number of factors, including air temperature effects. At a minimum, the discharge should be checked four times per day: 1) early

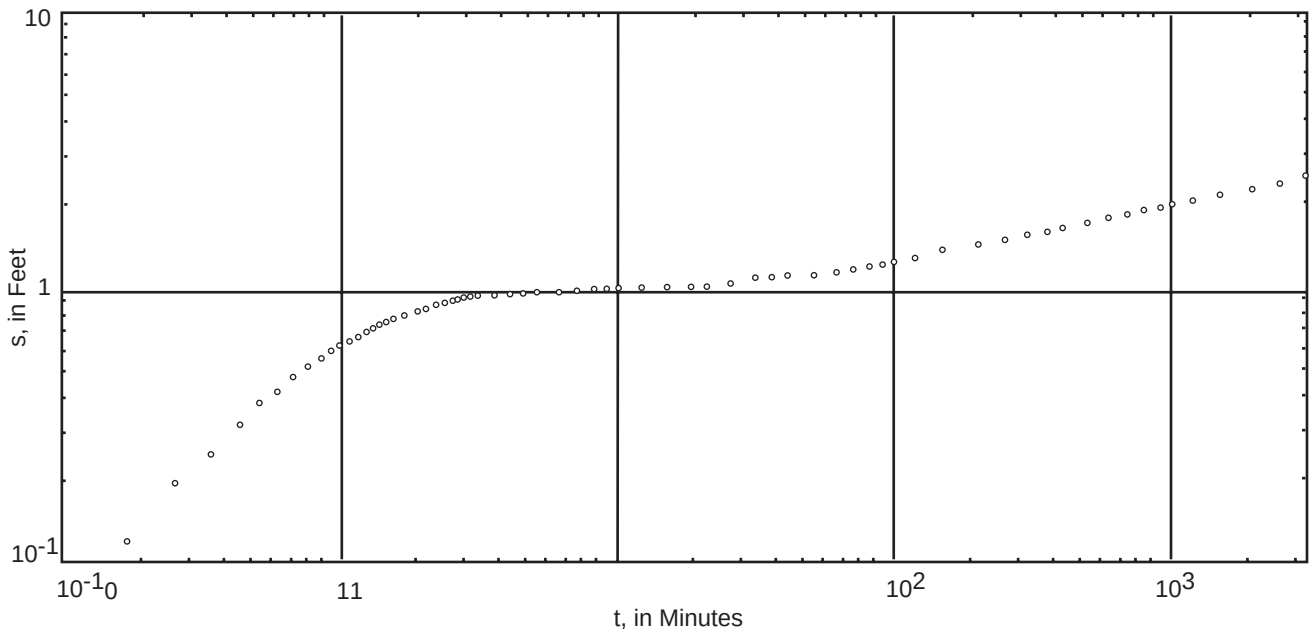

Figure 4. Logarithmic plot of s vs t for observation well.

morning (2 AM); 2) mid-morning (10 AM); 3) mid-afternoon (3 PM); and 4) early evening (8 PM). The discharge should never be allowed to vary more than plus or minus 5 percent (Ferris, J. G., personal communication, 1/19/68). The lower the discharge rate, the more important it is to hold the variation to less than 5 percent. The variation of discharge rate has a large effect on permeability estimates calculated using data collected during a test. The importance of controlling the discharge rate can be demonstrated using a sensitivity analysis of pumping test data. An analysis of this type indicates that a 10 percent variation in discharge can result in a 100 percent variation in the estimate of aquifer transmissivity. Thus, short-term pumping tests with poor control of discharge are not suitable for estimating parameters needed for adequate site characterization. If, however, the pumping test is run in such a way that the discharge rate varies less than 5 percent and water levels are measured frequently, the short-term pumping test data can be used to obtain some reliable estimates of aquifer performance.

It should be emphasized, however, that some random, short-term variations in discharge may be acceptable, if the average discharge does not vary by more than plus or minus 5 percent. A systematic or monotonic change in discharge (usually, a decrease in discharge with increasing time) is, however, unacceptable.

Water level recovery

Recovery measurements should be made in the same manner as the drawdown measurements. After pumping is terminated, recovery measurements should be taken at the same frequency as the drawdown measurements listed above in Table 1.

Length of test

The amount of time the aquifer should be pumped depends on the objectives of the test, the type of aquifer, location of suspected boundaries, the degree of accuracy needed to establish the storage coefficient and transmissivity, and the rate of pumping. The test should continue until the data are adequate to define the shape of the type curve sufficiently so that the parameters required are defined. This may require pumping for a significant period after the rate of water level change becomes small (so called water level “stabilization”). This is especially the case when the locations of boundaries or the effects of delayed drainage are of interest. Their influence may occur a few hours after pumping starts (see Figure 3), or it may be days or weeks. Some aquifer tests may never achieve equilibrium, or exhibit boundary effects.

Although it is not necessary for the pumping to continue until equilibrium is approached, it is recommended that pumping be continued for as long as possible and at least for 24 hours. Recovery measurements should be made for a similar period or until the projected pre-pumping water level trend has been attained. The costs of running the pump a few extra hours are low compared with the total costs of the test, and the improvement in additional information gained could be the difference between a conclusive and an inconclusive aquifer test.

Water disposal

As discussed previously, the water being pumped must be disposed of legally within applicable local, State, and Federal

rules and regulations. This is especially true if the ground water is contaminated or is of poor quality compared to that at the point of disposal. During the pumping test, the individuals carrying out the test should carry out water quality monitoring as required by the test plan and any necessary disposal permits. This monitoring should include periodic checks to assure that the water disposal procedures are following the test design and are not recharging the aquifer in a manner that would adversely affect the test results. The field notes for the test should document when and how monitoring was performed.

Recordkeeping

All data should be recorded on the forms prepared prior to testing (See Appendix 2). An accurate recording of the time, water level, and discharge measurements and comments during the test will prove valuable and necessary during the data analyses stage following the test.

Plotting data

During the test, a plot of drawdown versus time on semi-log paper should always be prepared and updated as new data is collected for each observation well. A plot of the data prepared during the actual test is essential for monitoring the status and effectiveness of the test. The plot of drawdown versus time will reveal the effects of boundaries or other hydraulic features if they are encountered during the test, and will indicate when enough data for a solution have been recorded. A semi-log or log-log mass plot of water level data from all observation wells should be prepared as time allows. Such a plot can be used to show when aquifer conditions are beginning to affect individual wells. More importantly, it enables the observer to identify erroneous data. This is especially important if transducers are being used for data collection. The utilization of a portable PC with a graphics package is an option for use in carrying out additional field manipulation of the data. It should not, however, be a substitute for a manual plot of the data.

Precautions

(a) Care should be taken for all observers to use the same measuring point on the top of the well casing for each well. If it is necessary to change the measuring point during the test, the time at which the point was changed should be noted and the new measuring point described in detail including the elevation of the new point.

(b) Regardless of the prescribed time interval, the actual time of measurement should be recorded for all measurements. It is recognized that the measurements will not be taken at the exact time intervals suggested.

(c) If measurements in observation well(s) are taken by several individuals during the early stages of testing, care should be taken to synchronize stop watches to assure that the time since pumping started is standardized.

(d) It is important to remember to start all stop watches at the time pumping is started (or stopped if performing a recovery test).

(e) Comments can be valuable in analyzing the data. It is important to note any problems, or situations which may alter the test data or the accuracy with which the observer is working.

(f) If several sounders are to be used, they should be compared before the start of the test to assure that constant readings can be made. If the sounder in use is changed, the change should be noted and the new sounder identified in the notes.

PUMPING TEST DATA REDUCTION AND PRESENTATION

All forms required for recording the test data should be prepared prior to the start of the test and should be attached to a clip board for ease of use in the field. It is an option to have a portable PC located on-site with appropriate spreadsheets and graphics package to allow for easier manipulation of the data during the test. The hard copy of the forms should be maintained for the files.

Tabular Data

All raw data in tabular form should be submitted along with the analysis and computations. The data should clearly indicate the well location(s), and date of test and type of test. All data corrections, for pre-pumping trends, barometric pressure fluctuations and other corrections should be given individually and clearly labeled. All graphs used for corrections should be referenced on the specific table. These graphs should be attached to the data package.

Graphs

All graphs or plots should be drafted carefully so that the individual points which reflect the measured data can be retrieved. Semi-logarithmic and logarithmic data plots (see Figures 5 and 6) should be on paper scaled appropriately for the anticipated length of the test and the anticipated drawdown. All X-Y coordinates shall be carefully labeled on each plot. All plots must include the well location, date of test, and an explanation of any points plotted or symbols used.

ANALYSIS OF TEST RESULTS

Data analysis involves using the raw field data to calculate estimated values of hydraulic properties. If the design and field-observation phases of the aquifer test are conducted successfully, data analyses should be routine and successful. The method(s) of analysis utilized will depend, of course, on particular aquifer conditions in the area (known or assumed) and the parameters to be estimated.

Calculations

All calculations and data analyses must accompany the final report. All calculations should clearly show the data used for input, the equations used and the results achieved. Any assumptions made as part of the analysis should be noted in the calculation section. This is especially important if the data were corrected to account for barometric pressure changes, off-site pumping changes, or other activities which have affected the test. The calculations should reference the appropriate tables and graphs used for a particular calculation.

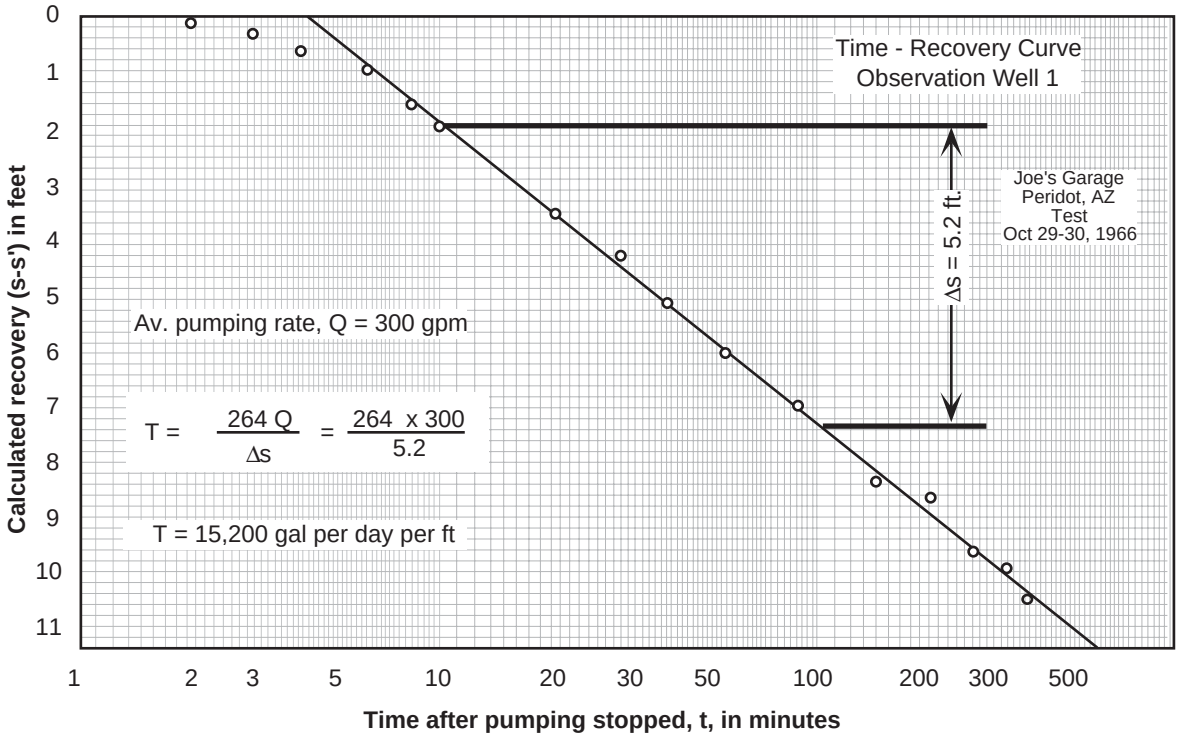

Figure 5. Time recovery curve for observation well - October 30, 1966.

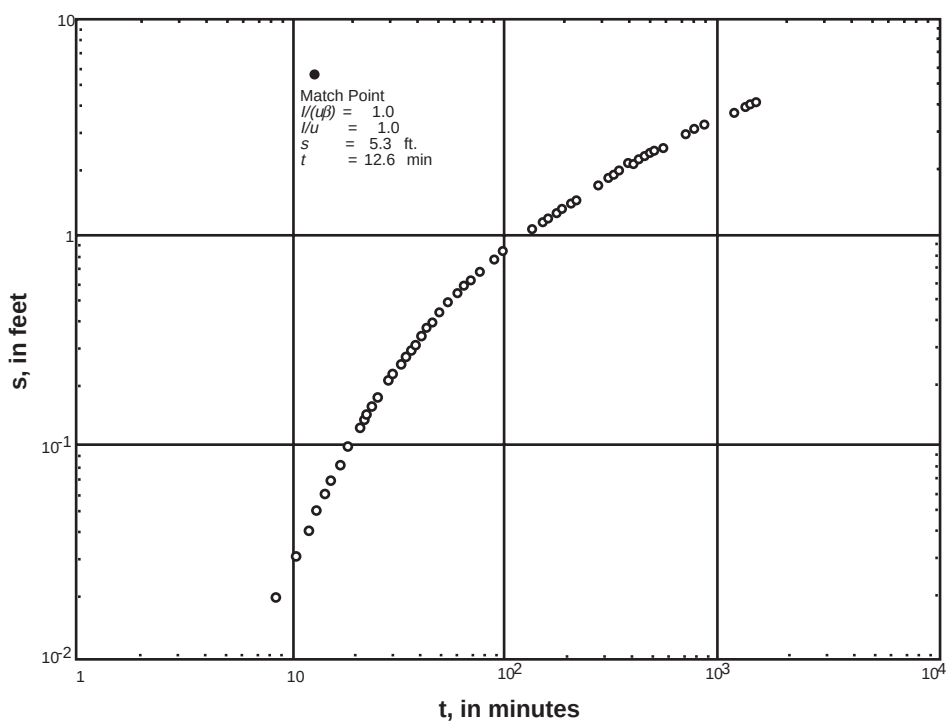

Figure 6. Logarithmic plot of s vs t for Observation Well 23S/25E-17Q_2 at Pixley, CA.

Aquifer Test Results

The results of an aquifer pumping and recovery test should be submitted in narrative format. The narrative report should include the raw data in tabular form, the plots of the data, the complete calculations and a summary of the results of the test. The assumptions made in utilizing a particular method of analysis should also be included.

SUMMARY-EXAMPLE FACILITY DESIGN

As a means of focusing the discussions presented in the preceding sections, the following example of an aquifer pumping test is described. The facility layout is shown in Figure 7. The site is located near a normally dry river channel which is subject to flood flows. The site was constructed for the purpose of carrying out experiments relating to artificial recharge of a shallow alluvial aquifer. The proposed methods of recharge involved use of a pit and a well.

The aquifer at the site is comprised of unconsolidated basin fill material, mainly silty sand and gravel with some clay lenses. The depth to water is generally greater than 50 feet and the river is a source of recharge when it flows. There are extensive gravel lenses above the water table which outcrop at the base of the river channel. These lenses occur beneath the site.

Figure 7 shows the locations of the various monitoring wells relative to the recharge facilities and the river. The well locations were selected to facilitate both characterization of the site and subsequent evaluation of the various recharge tests. The recharge well (used as the pumping well during the site aquifer tests) and the eight inch observation wells were completed to a depth of 150 feet in the upper water bearing unit of a basin fill aquifer. The depth to water in the area was about 75 feet. The recharge and observation wells were screened from about 80 feet to 140 feet. The 1-3/4 inch access tubes were 80-100 feet deep with a five-foot well screen on the bottom of each tube.

The eight-inch observation wells were placed in a line parallel to the river to assess both the effect of flood flows on the aquifer and the hydraulic characteristics of the recharge site itself. The 1-3/4 inch access tubes were positioned for monitoring ground-water movement near the top of the water table in response to aquifer recharge and discharge (pumping) tests. The two inch piezometers at varying depths were constructed to evaluate shallow ground-water movement in response to recharge.

Figure 8 is a plan view of the recharge facility showing the pumping/recharge well and the water distribution system. The pumping well was equipped with a downhole turbine pump powered by a methane driven, 6-cylinder engine. As indicated

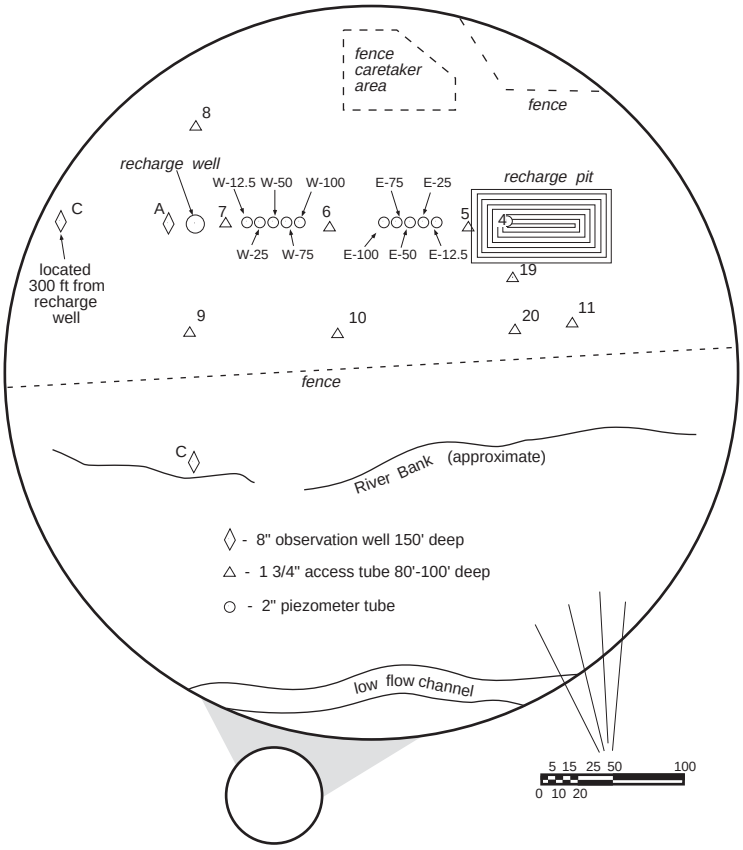

Figure 7. Recharge facility well layout.

on Figure 8, the pump discharge was measured using a Parshall flume (see Figure 9). The water from pumping tests was discharged off-site via the concrete box and distribution line. To prevent interference with test results from nearby recharge of the pumping test water, a temporary pipeline was constructed from irrigation pipe. This temporary line ran from the end of the river drain line to a point 1200 feet down stream out of the estimated area of influence. The ground water was not contaminated. Thus, special water quality monitoring was not required.

The pumping tests for site characterization involved the following monitoring procedure:

1. The eight-inch observation well closest to the recharge well (Well A) was equipped with a Stevens water stage recorder with an electric clock geared for a 4-hour chart cycle;

2. The other two eight-inch observation wells (Wells B and C) were equipped with Stevens water stage recorders with an electric clock geared for a 12-hour chart cycle;

3. The pumping well was equipped with a stilling well composed of a 3/4-inch pipe strapped to the pump column. The stilling well was drilled with 1/4-inch holes through the length. The stilling well was used for assessing the well for water level measurements with a 150-foot steel tape. The steel tape was marked in 0.01 ft. increments for the first 100 feet and in 0.1 ft. increments for the remaining 50 feet;

4. The 1-3/4 inch access wells were monitored at least once a day with a neutron moisture logger to assess changes in saturation as the water level declined in response to the test. This information was used to verify the water level declines in the regular monitoring wells and to aid in assessing the delayed drainage effects which were to be estimated using the water level response data from the eight-inch observation wells;

5. A continuous recording barograph was located in a standard construction, USDA weather station shed located between access Wells 9 and 10; and

6. The pump engine was equipped with an rpm gage to monitor pump performance and a micrometer adjustment on the throttle.

A step drawdown test and several short-term pumping tests were run at the site prior to running the principal aquifer characterization test. The step drawdown test was used as a means of selecting the final pumping test design. The short term tests were used to obtain an initial picture of aquifer response.

The results of the step drawdown test run on the recharge well after development indicated that the well was suitable for use as a test well. The results of the step test were also used to estimate well efficiency at different rates. Table 2 gives the efficiencies for three (3) discharge rates. As indicated, the well efficiency was greater than 90% for a rate of about 200

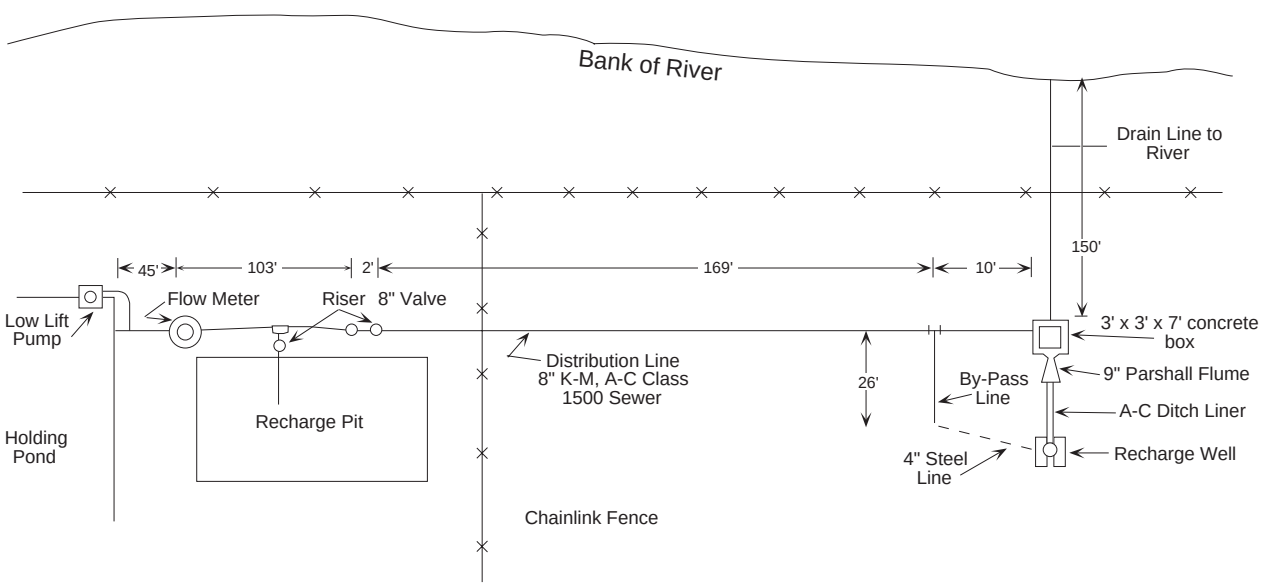

Figure 8. Water distribution and drainage facilities at the artificial recharge site.

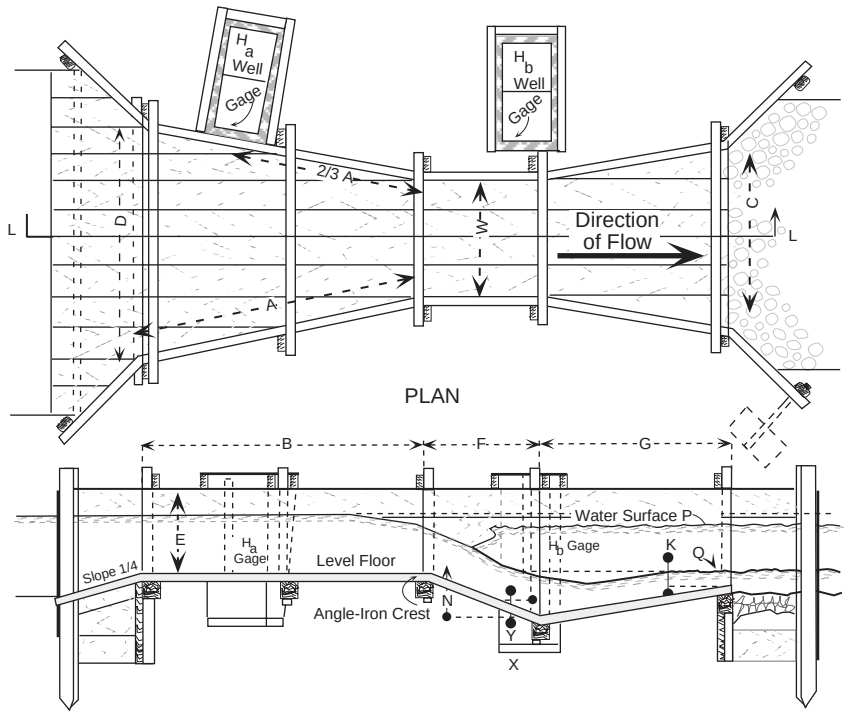

Figure 9. Parshall flume dimensions.

gpm. Based on this data, the design rate for the long-term test was set at about 200 gpm (actual average was 204 gpm).

Table 2. Well Efficiency of R#1 after 200 Minutes of Pumping

Discharge	Theoretical Drawdown	Actual Drawdown	Well Efficiency
gpm	*ft*	*ft*	*percent*
189	7.00	7.51	92
326	11.88	14.71	81
474	17.27	25.41	68

Because the initial short-term tests indicated that delayed drainage was an issue at the site, the main test was designed to run for a continuous period of at least 20 days. The actual scheduling of the test was established to try to avoid flow in the river as a result of a major precipitation event during the background, pumping, and recovery periods. The chosen test period was in the fall after the end of the irrigation season, which also minimized off-site pumping that might affect the results. It should be noted that two short-term tests were planned to follow the main pumping test during the winter rainy season when flow in the river was possible. This was done to allow the impacts of an uncontrolled recharge event on the system to be assessed. The main pumping test would provide a basis for comparison.

The discharging well was measured on a time schedule per the criteria in Table 1, except that measurements for the initial 10 minute period were taken every 30 seconds. The observation wells were observed manually on the same schedule for the initial 30 minute period and then the recorders were utilized. Discharge measurements were monitored at least every 5 minutes for the first 30 minutes and then were monitored with water levels for the first 12 hours. Discharge measurements were monitored at least four times daily until the end of the test. The access tubes were monitored twice daily to assess changes in saturation near the water table.

The results from the long term pumping test are shown on Figure 10 as a semi-log data mass plot (drawdown versus log time) of the data for the three (3) observation wells. The large initial water level decline for Observation Well A is due to its close proximity to the pumping well (15 feet). The rise in water level at the end of the test was caused by a slight decrease in discharge rate.

Values of T and S were obtained by the non-equilibrium method. The plots of drawdown as a function of log time did not give a good overlay on the non-equilibrium type curve for early times. For later times, it was possible to obtain a good match. The match points obtained for the three observation wells are listed in Table 3. The values of T and S are also shown in Table 3. As indicated, the estimates of T and S were in close agreement.

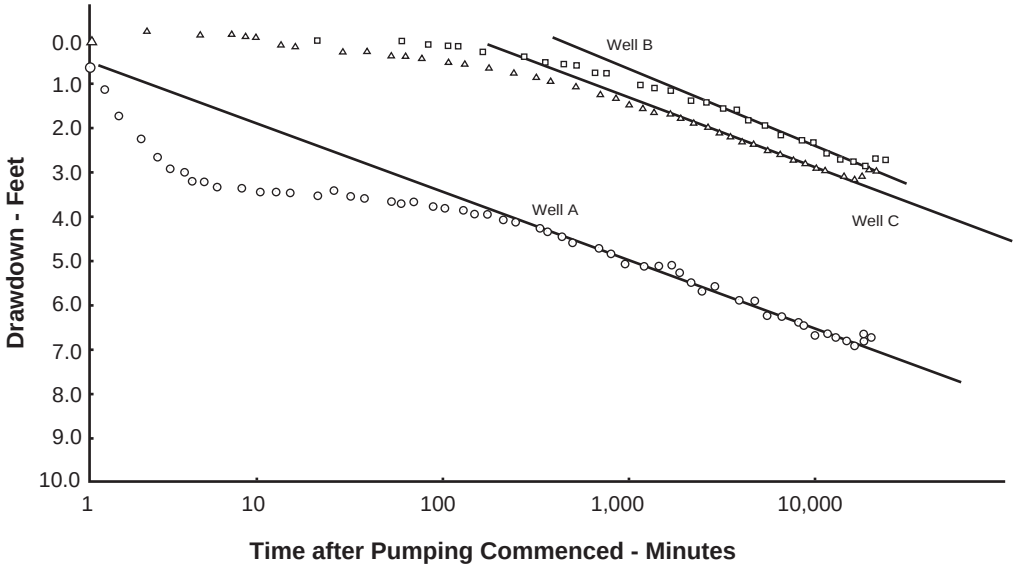

Figure 10. Drawdown versus log of time in observation wells A, B, and C during pumping of R#1.

Table 3. Values of T and S Obtained by Non-Equilibrium Equation for Discharge Conditions.

Location	w(u)	l/u	s	t	r	T	S
			ft	*min*	*ft*	*gpd/ft*	
Well A	110	10^5	0.62	14900	14.7	37,600	0.01
Well B	1	10	0.62	1780	280.0	37,600	0.03
Well C	1	10	0.58	530	175.4	40,200	0.03

The estimates for storativity were also in reasonable agreement. It is important to note that the test results showed delayed drainage to be a significant factor at this site. The initial estimates of storativity using data from the early part of the test were about 1×10^{-5} rather than 3×10^{-2} estimated after 20 days of pumping. This effect was expected because of the heterogeneous nature of the basin fill. As a means of comparison, water balance studies on a large well field located 15 miles away (completed in the same material) were reviewed. These studies provided an estimate of storage coefficient (based on 10 years of pumpage) of about 0.15. Thus, it was concluded that the aquifer at the site was under water table conditions, but significant delayed drainage effects were present.

The results of the pumping tests at the site were used to characterize the site and design several long-term recharge experiments. This included monitoring design for evaluation of the effect of river flows on the regional aquifer.

Appendix One

Equipment for Data Collection

a. Water Levels

Water level measurements can be made with electric sounders, air line and pressure gages, calibrated steel tapes, or pressure transducers (Garber and Koopman, 1968; and Bentall and others, 1963).

(1) Electric Sounders

(a) An electric sounder is recommended for measuring water levels in the pumping well because it will allow for rapid, multiple water level readings, especially important during the early stages of aquifer pumping and recovery tests.

(b) A dedicated sounder should be assigned to each observation well throughout the duration of the test. This is particularly important in ground-water quality studies to prevent cross contamination.

(c) Each sounder should be calibrated prior to the commencement of testing to assure accurate readings during the test.

(2) Air Lines and Pressure Gages

(a) Air lines are only recommended when electric sounders or steel tapes cannot be used to obtain water level measurements. Their usefulness is limited by the accuracy of the gage used and by difficulties in eliminating leakage from the air line. A gage capable of being read to 0.01 psi will be needed to obtain the necessary level of accuracy for determining water level change. A continuous copper or plastic line of known length should be strapped to the column pipe when the pump is installed. This will minimize the potential for leaks.

(b) When air lines are used, the same precision pressure gage should be used on all wells.

(c) Each pressure gage should be calibrated immediately prior to and after the test to assure accurate readings.

(d) The air line and pressure gage assembly should also be calibrated prior to the test by obtaining static water level by another method, if possible.

(3) Calibrated Steel Tapes

(a) Steel tapes marked to .01 ft. are preferred unless rapid water level drawdown or buildup is anticipated. If rapid drawdown, cascading water, or high frequency oscillation are anticipated, electric sounders, float actuated recorders or pressure transducers are preferred.

(b) Steel tapes are not recommended for use in the pumping well because of fluctuating water levels caused by the pump action, possible cascading water and the necessity for obtaining rapid water level measurements during the early portions of the aquifer pumping and recovery tests. If tapes are used, and the water level fluctuates, the well must be equipped with a means of dampening fluctuating water levels. Additional manpower will be needed during the initial stages of the test.

(4) Pressure Transducers

Pressure transducers are often used in situations where access to the well is restricted, such as a well where packers are being used to isolate a certain zone. They may also be applicable in large-scale tests using a computerized data collection system. Such a system will significantly reduce the manpower needed during the initial stages of a multiple well test. The most common installation uses down hole transducers with recording of the results taking place on the surface.

(a) Transducers should be calibrated prior to installation, and should be capable of accurately detecting changes of less than .005 psi. Transducer systems which will accurately record water level changes of .001 feet are available. The resolution of transducers, however, depends on the full scale range. Where large drawdowns are expected, such resolution is not possible.

(b) After installation, the transducers and recording equipment should be calibrated by comparing pressure readings to actual water level measurements taken with a steel tape. Periodic measurements of the water level should be made during the test to verify that the transducers are functioning properly.

(c) The effect of barometric changes on the transducers should be determined prior to and during the test. This will require continuous monitoring of the barometric pressure at the site as well as periodic comparisons of water level and transducer readings (Clark, 1967).

b. Discharge Measurement

The equipment commonly used for measuring discharge in the pumping well includes orifice plates, in-line water meters, Parshall flumes and recorders, V-notch weirs, or, for low discharge rates, a container of known volume, and a stop watch (Driscoll, 1986). The choice of method will depend upon a combination of factors, including i) accuracy needed, ii) planned discharge rate, iii) facility layout, and iv) point of discharge. If, for instance, it is

necessary to discharge the water a half mile from the pump, a flume or weir will probably not be used, because the distance between the point of discharge control and the point of discharge would make logistics too difficult. An in-line flow meter or a pitot tube would be the most likely calibrated devices (U.S. Bureau of Reclamation, 1981; King, 1982; U.S. EPA, 1982; and Leopold and Stevens, 1987).

(1) Orifice Plate

(a) Orifice plates with manometers (see Figure 11) are an inexpensive and accurate means of obtaining discharge measurements during testing. The thin plate orifice is the best choice for the typical pump test. An orifice plate has an opening smaller than that of the discharge pipe. A manometer is installed into and onto the end of the discharge pipe. The diameter of the plate opening must be small enough to ensure that the discharge pipe behind the plate is full at the chosen rate of discharge. The reading shown on the manometer represents the difference between the upstream and downstream heads.

(b) Assuming the devices are manufactured accurately and are installed correctly, an orifice plate will provide an accuracy of between two and five percent. The orifice tube must be horizontal and full at all times to achieve the design accuracy.

(c) The accuracy should be established prior to testing by pumping into a container of known volume over a given time. This should be repeated for several rates.

(2) In-line Flow Meter

(a) In-line flow meters can give accurate readings of the flow if they are installed and calibrated properly. The meter must be located sufficiently far from valves, bends in the pipe, couplings, etc., to minimize turbulence which will affect the accuracy of the meter. **The meter must be installed so that it is completely submerged during operation.**

(b) Use of a meter is an easy way to monitor the discharge rate by recording the volume of flow through the meter using a totalizer or other means at one minute intervals and subtracting the two readings. Some meters register instantaneous rate of flow and total flow volume.

(c) The meter should be calibrated after installation (prior to the test) to insure its accuracy.

(3) Flumes and Weirs

(a) There are numerous accurate flumes and weirs on the market. The choice depends mainly on the approximate discharge anticipated, the location of the discharge point and the nature of the facility. The cost of installation will preclude use at many non-permanent facilities.

(b) The weir (see Figure 12) or flume should be located close to the pump. There should be a permanent recorder on the device as well as means of making manual measurements (e.g., staff gage).

(c) The discharge canal should have a sufficient length of unobstructed upstream channel so as not to affect the accuracy of the chosen weir or flume.

(4) Pitot Tube

(a) The pitot tube is a velocity meter which is installed in the discharge pipe to establish the velocity profile in the pipe. Commercially available devices consist of a combined piezometer and a total head meter.

(b) The tube must be installed at a point such that the upstream section is free of valves, tees,

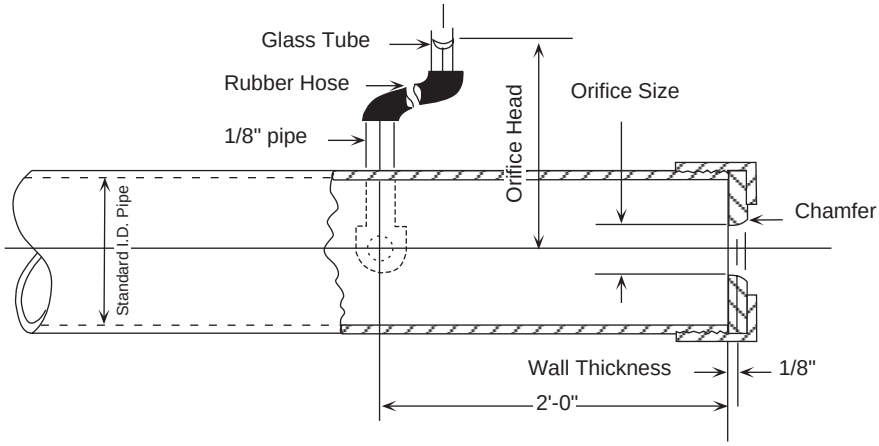

Figure 11. Diagram of orifice meter.

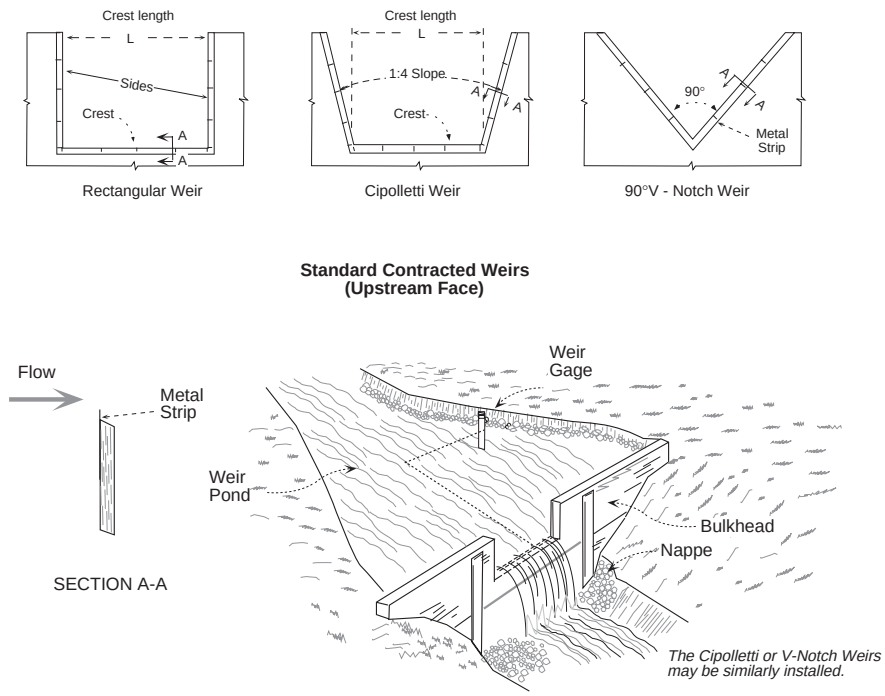

Figure 12. Standard contracted weirs, and temporary discharging at free flow.

elbows, etc., for a minimum distance equal to 15 to 20 times the pipe diameter to minimize turbulence at the location of the tube.

(c) Since the pitot tube becomes inaccurate at low velocities, the diameter of the pipe should be small enough to maintain reasonably high velocities.

(5) Container of Known Volume and Stop Watch

(a) The use of a container of known volume and a stop watch is a simple way to measure the discharge rate of a low volume discharging well.

(b) By recording the length of time taken for the discharging water to fill a container of known volume, the discharge rate can be calculated.

(c) This method can be used only where it is possible to precisely measure the time interval required for a known volume to be collected. If rates are sufficiently high so that water “sloshes” in the container, or they prohibit development of a relatively smooth surface on the water in the container, this method is likely to be inaccurate. Restricting use of this method to flows of less than 10 gpm is probably a conservative rule of thumb.

c. Discharge Regulation

(1) The size of the discharge line and the gate valve should be such that the valve will be from one-half to three-fourths open when pumping at the desired rate (during the initial phase of the test) with a full pipe.

(2) The valve should be placed a minimum of five (5) pipe diameters down-stream from an in-line flow meter, to ensure that the pipe is full and flow is not disturbed by excessive turbulence. In the case of some meters, such as a pitot tube, an in-line manometer, or an orifice plate, the valve would need to be upstream. (In this case the pipe downstream of the valve must be sized to be full at all times.)

d. Time

(1) A stop watch is recommended for use during an aquifer pumping and recovery test. Time should be recorded to the nearest second while drawdown is rapid, and to the nearest minute as the time period between measurements is increased beyond 15 minutes.

(2) If more than one stop watch is to be used during the testing, then all watches should be synchronized to assure that there is no error caused by the imprecise measurements of elapsed time.

(3) Accuracy of time is critical during the early stage of a pump or aquifer test and it is crucial to have all stop watches reflect the exact time. Later in the test the time recorded to the nearest minute becomes less critical.

(4) A master clock should be kept on site for tests longer than one day. This will provide a backup in case of

stop watch problems.

Appendix Two

Recording Forms

It is very important that each well data form stand alone. The data forms must contain all information which may have a bearing on the analysis of the data. See the suggested format for pumping test data recording sheets located at the end of this appendix. The form should allow for the following data to be recorded on the data sheet for each well:

(a) date
(b) temperature
(c) discharge rate
(d) weather
(e) well location
(f) well number
(g) owner of the well
(h) type of test (drawdown or recovery)
(i) description of measuring point
(j) elevation of measuring point
(k) type of measuring equipment
(l) radial distance from center of pumped well to the center of the observation well
(m) static depth to water
(n) person recording the data
(o) page number of total pages

In addition to the above information to be recorded on each page, the forms should have columns for recording of the following data:

(a) the elapsed time since pumping started, shown as the value (t)
(b) the elapsed time since pumping stopped, shown as (t')
(c) the depth in feet to the water level
(d) drawdown or recovery of the water level in feet
(e) the time since pumping started divided by the time since pumping stopped, shown as (t/t')
(f) the discharge rate in gallons per minute
(g) a column for comments to note any problems encountered, weather changes (i.e. barometric changes, precipitation), natural disasters, or other pertinent data.

AQUIFER TEST FIELD DATA SHEET

Page___ of____

_____ Pumped Well No._____ Date _____

_____ Observation Well No._____ Weather _____

Owner _____ Location _____

Observers: _____

Measuring Point is _____ which is _____ feet above/below surface.

Static Water Level _____ feet below land surface.

Distance to pumped well _____ feet. Type of Test _____

Discharge rate of pumped well _____ gpm (gallons per minute).

Total number of observation wells _____ .

Water Measurement Technique _____ .

Recorded by _____ . Temperature during test _____ .

Clock Time	Elapsed Time Since Pump Started or Stopped (min)	Depth to Water Below Land (feet)	Drawdown or Recovery (feet)	Discharge or Recharge (GPM)	t/t'	Comments

AQUIFER TEST FIELD DATA SHEET

Continuation Sheet

Distance to pumped well _____ Bearing _____ Page _____ of _____

_____ Pumped Well No._____ Date _____

_____ Observation Well No._____ Recorded by _____

Clock Time	Elapsed Time Since Pump Started or Stopped (min)	Depth to Water Below Land (feet)	Drawdown or Recovery (feet)	Discharge or Recharge (GPM)	t/t'	Comments

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Glossary

Aquifer: A unit of geologic material that contains sufficient saturated permeable material to conduct ground water and to yield economically significant quantities of ground water to wells and springs. The term was originally defined by Meinzer (1923, p. 30) as any water-bearing formation. Syn: water horizon; ground-water reservoir; nappe; aquafer.

Aquifer Test: A test involving the withdrawal of measured quantities of water from, or addition of water to, a well and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition.

Aquitard: A confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer; a leaky confining bed. It does not readily yield water to wells or springs, but may serve as a confining bed storage unit for ground water. Cf: aquifuge; aquiclude.

Capillary Fringe: The lower subdivision of the zone of aeration, immediately above the water table in which the interstices contain water under pressure less than that of the atmosphere, being continuous with the water below the water table but held above it by surface tension. Its upper boundary with the intermediate belt is indistinct, but is sometimes defined arbitrarily as the level at which 50 percent of the interstices are filled with water. Syn: zone of capillarity; capillary-moisture zone.

Confined Aquifer: An aquifer bounded above and below by impermeable beds or beds of distinctly lower permeability than that of the aquifer itself; an aquifer containing confined ground water. Syn: artesian aquifer.

Confining Bed: A confining bed is a unit of distinctly less permeable geologic material stratigraphically adjacent to an aquifer. "Aquitard" is a commonly used synonym. Confining beds can have a wide range of hydraulic conductivities and a confining bed of one area may have a hydraulic conductivity greater than an aquifer of another area.

Drawdown: The vertical distance between the static water level and the surface of the cone of depression at a given location and point of time.

Effective Porosity: Effective porosity refers to the amount of interconnected pore space and fracture openings available for the transmission of fluids, expressed as the volume of interconnected pores and openings to the volume of rock.

Ground Water: Subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated.

Hydraulic Conductivity: Hydraulic conductivity, K, replaces the term "coefficient of permeability" and is a volume of water that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. Hydraulic conductivity is a function of the properties of the medium and the fluid viscosity and specific gravity; intrinsic permeability times specific gravity divided by viscosity. Dimensions are L/T with common units being centimeters per second or feet/day.

Hydraulic Gradient: Hydraulic gradient is the change in head per unit of distance in the direction of maximum rate of decrease in head.

Hydraulic Head: Hydraulic head is the sum of two components: the elevation of the point of measurement and the pressure head.

Intrinsic Permeability: Intrinsic permeability, k, is a property of the porous medium and has dimensions of L^2. It is a measure of the resistance to fluid flow through a given porous medium. It is, however, often used incorrectly to mean the same thing as hydraulic conductivity.

Porosity: Porosity of a rock or soil expresses its property of containing interstices or voids and is the ratio of the volume of interstices to the total volume, expressed as a decimal or percentage. Total porosity is comprised of primary and secondary openings. Primary porosity is controlled by shape, sorting and packing arrangements of grains and is independent of grain size. Secondary porosity is that void space created sometime after the initial formation of the porous medium due to secondary solution phenomena and fracture formation.

Potentiometric Surface: Potentiometric surface is an imaginary surface representing the static head of ground water and defined by the level to which water will rise in a well under static conditions. The water table is a particular potentiometric surface for an

unconfined aquifer representing zero atmospheric gage pressure.

Recharge Zone: A recharge zone is the area in which water is absorbed and added to the saturated soil or geologic formation, either directly into a formation, or indirectly by way of another formation.

Residual Drawdown: The difference between the original static water level and the depth to water at a given instant during the recovery period.

Saturated Zone: The saturated zone is that part of the water-bearing material in which all voids are filled with water. Fluid pressure is always greater than or equal to atmospheric, and the hydraulic conductivity does not vary with pressure head.

Specific Capacity: The rate of discharge of a water well per unit of drawdown, commonly expressed in gpm/ft. It varies with duration of discharge.

Specific Storage: Specific storage, S, is defined as the volume of water that a unit volume of aquifer releases from storage because of expansion of the water and compression of the matrix or medium under a unit decline in average hydraulic head within the unit volume. For an unconfined aquifer, for all practical purposes, it has the same value as specific yield. The dimensions are L^{1}. It is a property of both the medium and the fluid.

Specific Yield: Specific yield is the fraction of drainable water yielded by gravity drainage when the water table declines. It is the ratio of the volume of water yielded by gravity to the volume of rock. Specific yield is equal to total porosity minus specific retention. Dimensionless.

Storage Coefficient: The storage coefficient, S, or storativity, is defined as the volume of water an aquifer releases from or takes into storage per unit surface area of aquifer per unit change in hydraulic head. It is dimensionless.

Transmissivity: Transmissivity, T, is defined as the rate of flow of water through a vertical strip of aquifer one unit wide extending the full saturated thickness of the aquifer under a unit hydraulic gradient. It is equal to hydraulic conductivity times aquifer saturated thickness. Dimensions are L^2/t.

Unconfined Ground Water: Unconfined ground water is water in an aquifer that has a water table. Also, it is aquifer water found at or near atmospheric pressure.

Unsaturated Zone: The unsaturated zone (also referred to as the vadose zone) is the soil or rock material between the land surface and water table. It includes the capillary fringe. Characteristically this zone contains liquid water under less than atmospheric pressure, with water vapor and other gases generally at atmospheric pressure.

Water Table: The water table is an imaginary surface in an unconfined water body at which the water pressure is atmospheric. It is essentially the top of the saturated zone.

Well Efficiency: The well efficiency is the theoretical drawdown divided by the measured drawdown. The theoretical drawdown is estimated by using pumping test data from several observation wells to construct a distance drawdown graph to estimate drawdown in the pumping well if there were no losses.

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32) Walton, W. C., 1962. Selected Analytical Methods for Well and Aquifer Evaluations. Illinois State Water Survey Bulletin 49, Urbana, IL, 81 pp.

33) Walton, W. C., 1970. Ground Water Resource Evaluation. McGraw-Hill Book Co., New York, NY, 664 pp.

Skills Required:

1) Stormwater Pollution and Prevention Plan (SWPPP) training
2) Understanding of, and ability to make decisions, regarding site-specific objectives
3) Knowledge of erosion control objectives
4) Knowledge of EWI quality standards
5) Knowledge of corporate safety requirements and health and safety plan

1.0 OBJECTIVE / SCOPE

Stormwater is water that originates from precipitation events such as rain or snow. Stormwater that does not absorb into the ground can flow across the ground carrying pollution such as debris, pesticides, soil, and other pollutants. If left unmanaged, the stormwater channels into storm sewers or waterways and eventually discharges into surface waters, contaminating the surrounding environment. The objective of this Standard Operating Procedure (SOP) is to describe the proper procedure for inspecting a site to ensure that stormwater is being properly managed.

Environmental works, Inc. (EWI) employees conducting stormwater inspections must have training in the proper procedures for identifying best management practices (BMPs) for stormwater compliance. This SOP outlines actions to be undertaken by EWI employees when conducting a stormwater inspection. This SOP also addresses the roles and responsibilities of EWI employees pertaining to record keeping and environmental compliance.

This SOP should serve as a reference tool and facilitate consistency among EWI personnel. These procedures may vary depending upon site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented in field notes and included in project documentation.

2.0 APPLICABILITY

2.1 Construction/Land Disturbance Permits

Land disturbance permits are required for construction sites over one acre in size. Site-specific SWPPPs are developed for these projects to meet permit requirements. For construction sites in Missouri, and many other locations, weekly BMP inspections are required. Additional inspections are required within 48 hours following rainfall events causing flow on-site.

2.2 Stormwater Operating Permits

Stormwater operating permits are required for certain facilities to manage their stormwater discharge. Inspection frequency requirements vary dependent upon the nature of the permit; however, a site-specific SWPPP will generally be developed to outline the requirements.

3.0 EQUIPMENT

Some or all of the following equipment is needed for SWPPP inspections based on project conditions:

1. Field truck
2. EWI identification badge
3. Inspection forms

4. Field note forms
5. Camera
6. Leather gloves
7. Personal Protective Equipment (PPE) - safety glasses, steel-toed boots, reflective vest
8. Spill kit (pads, booms, floor dry)

A field kit containing a marker, tape, cutting utensil, Ziploc bag, sample gloves, sample containers, a list of emergency contacts, tape measure, labels, trash bags, and hand wipes is encouraged.

4.0 PROCEDURES

Stormwater inspections conducted by EWI personnel involve a thorough understanding of BMPs and general erosion prevention and sediment control. EWI personnel conducting inspections must also be familiar with reviewing and interpreting a SWPPP. Many sites must be inspected on a regular schedule. Depending on the site, protocols for pre-arrival, attendance, and departure will vary. Consult with the EWI project manager for briefing on any site-specific protocols before leaving to conduct the inspection. Wear proper attire and PPE for inspections. The following procedures are meant to aid EWI employees in the completion of stormwater inspections.

4.1 Pre-Inspection Preparation

Plan a stormwater inspection during anticipated rain events or immediately following actual rain events. Review copies of the site's past inspection reports and SWPPP and be aware any past issues or areas of concern. Become familiar with maps of the site and take note of the outfalls or construction activities. Detailed facility maps and topographic maps will be available in the SWPPP for reference in determining stormwater flow direction. Review specific BMPs outlined in the SWPPP for the site. (See example BMP design and maintenance documents in the SOP Attachment).

4.2 Entry

Upon arriving at an inspection site, inform the site personnel of your arrival. Take special precautions to follow any onsite safety procedures.

4.3 Records Review

If necessary, conduct a review of the SWPPP to ensure it is up to date and all recordkeeping is in order. A copy of the SWPPP must be kept onsite at all times.

4.4 Site Inspection

Safely conduct a thorough inspection of the site, paying particular attention to potential sources of stormwater pollution. The inspection will include specific observations, such as:

- Condition of the outfalls (i.e. blocked by debris, evidence of erosion)
- Condition of the BMPs (i.e. silt fence in need of repair)
- Evidence of spills or leaks of materials
- Drums or other containers stored in contact with, or exposed to, stormwater

- Availability of spill control and emergency response equipment
- Trash/debris in stormwater ditches
- General good housekeeping practices

4.5 Inspection checklists

Inspection checklists for sites managed by EWI will be provided to EWI personnel conducting site inspections. All inspection forms should be neatly filled out in blue or black ink. If a mistake is made on an inspection form, draw one line through the error and initial nearby. Ensure that all information is accurate and complete before obtaining site personnel signatures (if required), such as:

- Facility name
- Date and time of inspection
- Inspector's name
- Recent rainfall amounts and current weather conditions
- Inspection results
- Any specific observations or comments

After obtaining a signature, make copies of the inspection document(s) and follow proper protocols for record retention for the site being inspected. (See example Construction Site Inspection Checklist in the SOP Attachment).

5.0 SAFETY

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) for anticipated hazardous substances before the initiation of sampling soil, groundwater, or another medium.

EWI employees should follow any site or facility-specific Site Safety and Health Plan that exists and also follow the procedures in the EWI Corporate Health and Safety Plan. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, required PPE, health monitoring, emergency procedures, alertness to heavy equipment). Take appropriate action if personnel are injured on-site in accordance with EWI directives.

When working in an outdoor setting, consider potential risks that may be encountered, such as wildlife, extreme temperatures, and rough terrain. Wear appropriate attire, use protective repellents, bring plenty of water, etc.

6.0 REFERENCES

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- MDNR <www.dnr.mo.gov/env/wpp/stormwater/sw-industrial-permits.htm>.
- MDNR Field Guide to Erosion, Sediment and Stormwater Best Management Practices for Development Sites in Missori and Kansas <www.dnr.mo.gov/env/wpp/wpcp-guide.htm>
- City of Springfield, Storm Water Services <www.springfieldmo.gov/stormwater/esc/esc_bmp.html>
- Greene County <www.greenecountymo.org/resource_management/sw_regulations.php>

Environmental Works, Inc. SOP No. 14

Stormwater Inspections

ATTACHMENTS

Example Inspection Form

&

Example BMP Documentation

Example Construction Site Inspection Checklist

Permit Information			
Project/Permit #:			
Inspection Information			
Date of Inspection		Weather Conditions:	
Inspection Type	☐ Weekly		☐ Within 48 hours of rainfall event
Date of Last Rainfall			Approximate Rainfall Amount (in):

Corrective Actions Taken Since Last Inspection	
Date	**Corrective Action**
Were corrections made within 7 days?	❑Yes (Attach photos) ❑No (Explain):

BMP Inspection		
BMP	**BMP Maintenance Required?**	**Corrective Action Needed and Notes**
Sediment Basin	❑Yes ❑No	If yes, which basin (refer to map ID): Explain:
		If sediment filled to 1/3 of volume, 1/3 height of basin, or less than 3,600 cubic feet per acre drained was it promptly removed? ❑Yes ❑ No (Explain):
Silt fence, silt socks, straw bales	❑Yes ❑No	

Land Disturbance	
If soil disturbance in an area has ceased, was interim stabilization installed within 14 days?	❑Yes ❑ No (Explain):
If the slope is greater than 3:1 or 3% and greater than 150' long, was interim stabilization installed within 7 days?	❑Yes ❑ No (Explain):

General Site Inspection			
	Activity		**Corrective Action Needed and Notes**
1.	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	
2.	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	
3.	Are discharge points (outfalls) and receiving waters (50' downstream from outfalls) free of any sediment deposits?	❑Yes ❑No	
4.	Are discharge points (outfalls) free of any erosion?	❑Yes ❑No	
5.	Are trucks being prevented from tracking sediment from the construction exit into the street?	❑Yes ❑No	
6.	Is trash/litter from work areas disposed of properly?	❑Yes ❑No	
7.	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills and leaks?	❑Yes ❑No	
8.	Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	
9.	Has re-vegetation occurred on all areas except where work is ongoing? (No more than 10 acres may be worked at one time.)	❑Yes ❑No	
10.	Is an area of the site that has been finally stabilized inspected once per month?	❑Yes ❑No ❑NA Last Date: _____	
11.	Are copies of the permit, SWPPP and inspection reports available on site at all times?	❑Yes ❑No	
12.	Are there deficiencies in the SWPPP or BMPs that require an SWPPP update or amendment?	❑Yes ❑No	

Print name and title: _____

Signature: _____ **Date:**_____

Skills Required:

1) Stormwater Pollution and Prevention Plan (SWPPP) training
2) Review and knowledge of EPA 832-B-09-003, Sampling Guide
3) Understanding of, and ability to make decisions, regarding site-specific objectives
4) Knowledge of how to collect water samples
5) Knowledge of EWI quality standards
6) Knowledge of corporate safety requirements and health and safety plan

1.0 OBJECTIVE / SCOPE / APPLICABILITY

Stormwater is water that originates from precipitation events such as rain or snow. Stormwater that does not absorb into the ground can flow across the ground carrying pollution such as debris, pesticides, soil, and other pollutants. If left unmanaged, the stormwater channels into storm sewers or waterways and eventually discharges into surface waters, contaminating the surrounding environment. The objective of this Standard Operating Procedure (SOP) is to describe the proper procedure for sampling a site to ensure that stormwater samples are within permit requirements.

Environmental Works, Inc. (EWI) employees sampling stormwater must have training in the proper procedures for identifying best management practices (BMPs) for stormwater compliance (see SOP No. #14). This SOP outlines actions to be undertaken by EWI employees when conducting a stormwater sampling event. This SOP also addresses the roles and responsibilities of EWI employees pertaining to stormwater permits.

This SOP should serve as a reference tool and facilitate consistency among EWI personnel. These procedures may vary depending upon site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented in field notes and included in project documentation.

2.0 EQUIPMENT

Some or all of the following equipment is needed for stormwater sampling based on project conditions:

1. Field truck
2. Sample containers and labels
3. Chain of custody
4. Disposable gloves
5. Zip-lock bags
6. Cooler and ice
7. Personal Protective Equipment (PPE) - safety glasses, steel-toed boots, reflective vest
8. Shipping labels (if required)
9. pH meter
10. Writing instrument
11. Associated site specific sampling tools if required for difficult access areas.
12. Associated site specific gate keys or badges required to gain access to the facility.

A field kit containing a marker, tape, cutting utensil, extra sample gloves, sample containers, a list of emergency contacts, tape measurer, labels, trash bags, and hand wipes is encouraged.

3.0 STORMWATER PERMITS

Stormwater sampling events conducted by EWI personnel involve a thorough understanding of stormwater permits and sampling techniques. EWI personnel sampling for stormwater must also be familiar with the site in which they are sampling and aware of the flow directions of the runoff. The following procedures are meant to aid EWI employees in the completion of stormwater sampling.

Some site-specific stormwater permits include periodic sampling requirements. These permits include an overview of the sample locations (outfalls), effluent limitations, and monitoring requirements. Knowledge of MDNR general and stormwater permits is an important part of stormwater sampling. It is important to ensure that the COC and sampling vessels match the requirements of the permit. Do not assume the lab has provided exactly what you require.

3.1 Sample Locations

The outfalls are locations where stormwater leaves the site. These locations may be a storm water culvert, enclosed pipe, v-notched weir, open ditch or an area of sheet flow leaving the property. These locations should be clearly marked at the site. However, clients do not always have the appropriate signs in place. Project managers should provide maps with details on sampling locations for each facility. It is important to understand the exact location where the sample is required to be taken. Detailed facility maps and topographic maps will be available in the SWPPP for reference in determining stormwater flow direction.

3.2 Effluent Limitations

Effluent limitations are established in permits to monitor pollutants that may be discharged in stormwater from the site. Effluent limitations are specific for each outfall, and therefore the parameter limits may differ within a site. Generally, required parameters are based upon site activities and potential pollutants. A thorough understanding of permit sampling requirements is key to ensure accurate sampling. Consult with the project manager if you are unsure of the sampling requirements

3.3 Monitoring Requirements/Sampling Frequency

Consult with the EWI project manager and review the site-specific permit for these requirements.

See example of Missouri State Operating Permit (MSOP) and Discharge Monitoring Report (DMR) in the SOP Attachments for additional references regarding permit requirements.

4.0 PROCEDURE

4.1 Preparation

When weather forecasts indicate probable flow to conduct stormwater sampling, the project must begin immediately to avoid delay in arrival at the site. A list of items needed for stormwater sampling events is listed in Section 2.0. It is important to evaluate weather conditions wisely to avoid unnecessary trips. The rainfall event should be expected to be in excess of 0.10 of an inch per MDNR permit requirements. It is also important to note that facilities require differing amounts of rainfall to produce flow at their facility outfalls. EPA guidance and permit requirements require samples to be collected within 60 minutes of discharge at the facility outfall. Site familiarization and communications with the project manager are essential to ensure samples are collected in an efficient manner.

4.2 Collection

The following procedure outlines the sampling technique:

- Site specific sample jars and the instructions will be provided by the EWI project manager.
- Wear disposable powder-free gloves
- Grab samples with the use of a zip-lock bag and transfer the contents to the sample jar. Use of the zip-lock bag to transfer the sample into sample jars will prevent loss of the preservative within the sample jar. Oil and Grease samples should not be collected in a zip-lock bag if possible. The collection in a plastic bag has the potential to alter the integrity of the sample. However, it is important to collect a sample and the use of a plastic bag is often necessary.
- Hands should be kept away from the opening of the sample bottle to prevent contamination.
- Always hold the zip-lock bag facing upstream so the water does not flow over your hand or around the bag, leading to possible contamination.
- Sample where the water has moderate flow with some turbulence, ensuring a well-mixed representative of the stormwater runoff is being collected.
- Sample from a central portion of the stormwater flow and avoid touching the bottoms or the sides of a channel to avoid stirring up solid particles.
- Do not rinse or overfill bottles. This can be especially important if there is an acid-fixed solution already in the bottle. Unless zero headspace is required, fill the bottle to about ½ inch from the top to ensure no preservatives are lost. If you do overfill the bottle it is important to communicate this with the lab. They can often add preservative if needed.
- As soon as the sample is collected, cap the bottle and label it (see Section 4.3). Follow any specific storage conditions, such as storage in ice to keep the bottle cold. Do not wait until getting back to EWI before following these procedures.
- If you are on site and do not have the appropriate sample bottles for whatever reason samples can often be collected in alternate containers. Glass jars can be purchased from most supermarkets and are a useful tool for sample collection. The lab can often add the appropriate preservative if required.

4.3 Record Keeping

When collecting a stormwater sample, it is important to label the container correctly. The following list is an example of common items to include in a sample label:

- Sample Date
- Sample Time
- Sample Location
- Name of Individual Who Performed the Sampling

It is also important to document how a sample was taken, such as a grab. Record any necessary field measurements and the time these measurements were taken (i.e. pH, see example of DMR in SOP attachments). Document all field notes/observations while conducting stormwater sampling. Note if there are unusual circumstances that may affect the results of an analytical test. If BMPs are

not efficiently controlling the stormwater runoff at a site, it should be brought to the attention of the EWI project manager immediately. Photos are a useful tool and should be taken if possible. Photos can be an important tool for client communications regarding stormwater issues at their facility. Photos should be taken if there is no discharge at the outfall.

4.4 Delivery

The chain of custody is an important part of the delivery process and provides important documentation. Refer to EWI SOP #5 "Chain of Custody Documentation" for the proper procedures for handling a chain of custody form. Consult with the EWI project manager for debriefing on laboratory delivery requirements.

5.0 SAFETY

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) for anticipated hazardous substances before the initiation of sampling soil, groundwater, or another medium.

EWI employees should follow any site or facility-specific Site Safety and Health Plan that exists and also follow the procedures in the EWI Corporate Health and Safety Plan. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, required PPE, health monitoring, emergency procedures, alertness to heavy equipment). Take appropriate action if personnel are injured on-site in accordance with EWI directives.

When working in an outdoor setting, consider potential risks that may be encountered, such as wildlife, extreme temperatures, and rough terrain. Wear appropriate attire, use protective repellents, bring plenty of water, etc.

Stormwater sampling can be dangerous for a number of weather related reasons. Never take unnecessary risks to collect a sample. You should communicate with your project manager or a 'buddy' if you plan to collect samples, especially at night or on weekends.

6.0 REFERENCES

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- MDNR <www.dnr.mo.gov/env/wpp/permits/wpcpermits-stormwater.htm>.
- Industrial Stormwater Monitoring and Sampling Guide. EPA 832-B-09-003.

Environmental Works, Inc. SOP No.15

Stormwater Sampling

ATTACHMENTS

Example MSOP

Example DMR

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM - WATER POLLUTION BRANCH

DISCHARGE MONITORING REPORT FOR STORM WATER AND WASTE WATER DISCHARGES UNDER GENERAL PERMIT

THIS REPORT COVERS THE PERIOD FROM (MONTH/YEAR)	THROUGH (MONTH/YEAR)
/	/

PART I: FACILITY INFORMATION

FACILITY NAME	COUNTY	PERMIT #
		MO-

PART II: MONITORING INFORMATION

SAMPLES COLLECTED BY	PHONE NUMBER	NUMBER OF SAMPLES	LABORATORY (NAME AND ADDRESS)
FIRM		ANALYSIS PERFORMED BY: PLEASE TYPE OR PRINT	

PART III: ANALYTICAL RESULTS

OUTFALL #		001		002		003				SAMPLE TYPE	ANALYTICAL METHOD
DATE AND TIME OF SAMPLE COLLECTION		DATE	ANALYSIS DATE	DATE	ANALYSIS DATE	DATE	ANALYSIS DATE	DATE	ANALYSIS DATE		
Parameter	Unit	TIME		TIME		TIME		TIME			
Rainfall Amount	in.										
Flow	MGD										
pH	Units										
Settleable Solids	mL/L/hr										
Oil & Grease	mg/L										
Other (list)											

NAME OF INDIVIDUAL PREPARING REPORT (PLEASE TYPE OR PRINT)	FIRM

SIGNATURE OF INDIVIDUAL PREPARING REPORT	PHONE NUMBER

REPORT APPROVED BY OWNER	PHONE NUMBER	DATE

MO 780-1560 (7-04)

INSTRUCTIONS

Report should be typed or neatly printed.

PART I:

1. Fill in facility information and permit number.

PART II:

2. Give the name of the individual who actually collected the sample. Indicate whether samples were collected by owner or by personnel of the lab performing the analysis. Indicate the number of samples taken.

PART III:

3. Report results for those parameters listed in Part A of your permit. Write N.A. (Not Applicable) if your permit does not require one of the pre-printed parameters. List under "Other" any additional sampling results required by your permit.

   If a storm water sample, indicate the amount of rainfall for the rainfall event in which the sample was taken and write the source of this data (e.g., rain gauge, weather data, etc.) under "Analytical Method" column. If not a storm water discharge, write N.A. in the "Rainfall Amount" column.

4. File a report even if no discharge occurred during the monitoring period. Complete the Facility Information section, write "ND" (no discharge) in the Flow column in Part III, and sign the report. NOTE: If a discharge of storm water occurs at any time during the monitoring period, it must be reported.

5. Record Sample Types as G, C, M or E. G = grab, C = composite, M = measured, and E = estimate. See permit for type of sample required for each parameter.

6. Narrative monitoring requirements for "chemicals stored outside", "soluble bulk materials stored outside", etc. are required only if specifically requested by the department in written form. If you have questions about these requirements, contact the Water Protection Program.

7. Add pages if reporting for additional outfalls or sampling dates is needed.

8. Report must be signed by owner and individual preparing the report. Please provide a phone number where each can be reached. Print the name of the individual who prepared the report.

9. Mail to the appropriate DNR regional office as noted in your permit cover letter.

Note: This form is a universal reporting form for General Permits for storm water and waste water discharges with a permit number beginning MO-R or MO-G. Industries and individuals who have report forms designed for their specific needs may substitute their forms. A suitable substitute must meet the following specifications:
(a) Form must be 8½" by 11".
(b) Report must show all of the information indicated on the standard form.

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

MISSOURI STATE OPERATING PERMIT

In compliance with the Missouri Clean Water Law, (Chapter 644 R.S. Mo. as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No. MO-R23A000

Owner:
Address:

Continuing Authority:
Address:

Facility Name:
Facility Address:

Legal Description:
Latitude/Longitude:

Receiving Stream:
First Classified Stream and ID:
USGS Basin & Sub-watershed No.:

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein:

FACILITY DESCRIPTION

All Outfalls

Storm water runoff from facilities engaged in chemical manufacturing.

(For SIC Codes see page two)

This permit authorizes only wastewater discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System; it does not apply to other regulated areas. This permit may be appealed in accordance with Section 644.051.6 of the Law.

March 12, 2010
Effective Date

Mark N. Templeton, Director, Department of Natural Resources

March 11, 2015
Expiration Date

Scott B. Totten, Acting Director, Water Protection Program

APPLICABILITY

1. This permit authorizes the discharge of storm water runoff from chemical and lubricant manufacturing facilities and storage operations to waters of the state of Missouri, including, but not limited to, establishments with a primary Standard Industrial Classification Code (SIC) of 28xx, except 282x (certain plastics and rubbers), 2869 (biodiesel), and 287x (agrichemical facilities) and 2992. These activities are covered under different general permits.

2. This permit **does not authorize** storm water discharges:

   (a) Within 1,000 feet of streams identified as a losing stream, sinkhole, or other conduit to groundwater*,
   (b) Within 1,000 feet of streams or lakes listed as an outstanding state resource water*,
   (c) Within 1,000 feet of reservoirs or lakes used for public drinking water supplies (class L1)*,
   (d) Within 1,000 feet of streams, lakes, or reservoirs identified as critical habitat for endangered species.
   (e) Within 500 feet of intermittent streams (class C) or wetlands*,
   (f) Within 100 feet of a permanent stream (class P)* or major reservoir (class L2)*,
   (g) Within two stream miles upstream of biocriteria reference locations*, or
   (h) Within the watersheds of streams or lakes listed as an outstanding national resource water* or their tributaries.

   * Identified or described in 10 CSR 20, Chapter 7. These regulations are available at many libraries and online at www.sos.mo.gov, or may be purchased from MDNR by calling the Water Protection Program.

3. If at any time the Missouri Department of Natural Resources determines that the quality of waters of the state may be better protected by requiring the owner/operator of the permitted site to apply for a site specific permit, the department may do so.

4. If at any time the permittee should desire to apply for an individual State Operating Permit, the owner may do so. Holders of current individual State Operating permits who desire to apply for inclusion under this general permit should contact the department for application requirements.

5. This permit does not authorize the discharge of waters other than storm water. Discharge of other wastewaters, spills, or other materials is a violation of Missouri Clean Water Law.

6. Facilities that are located within the watershed of the 303(d) listing of impaired waters will need to be evaluated, on a case-by-case basis, for inclusion under this general permit. Facilities that are found to be discharging the listed pollutant(s) of concern for an impaired water may be required to obtain a site-specific permit.

A. MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The monitoring requirements shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	MONITORING REQUIREMENTS				
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
All outfalls Report by January 28th of each year						
Flow	MGD	*			twice/year	24 hr. estimate
Storm Water Sampling Report (see Sampling Requirements)		*			twice/year	grab
Chemicals listed in 40 CFR 122 Appendix D (see pages 8-10)		*			once/year	grab
Other Soluble Bulk Materials**		*			once/year	grab

MONITORING REPORTS SHALL BE SUBMITTED ANNUALLY; THE FIRST REPORT IS DUE January 28, 2010. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

A. MONITORING REQUIREMENTS (continued)

* Monitoring requirement only.
** Other soluble bulk materials that are not listed in 40 CFR 122 Appendix D that are stored outside and exposed to storm water must also be monitored.

SAMPLING REQUIREMENTS AND BENCHMARKS

1. Sampling and analysis of storm water discharges for Chemical Oxygen Demand, Total Suspended Solids, pH and Oil & Grease must occur at least twice per year. One sample must be collected between January 1st and June 30th, and another sample between July 1st and December 31st. Reports are to be submitted by January 28th of each year. Sampling and analysis of storm water discharges for any chemicals listed in 40 CFR 122 Appendix D stored outdoors, and other soluble materials stored outdoors must occur at least once per year, and reported by January 28th. The department may also require sampling and reporting as a result of illegal discharges, compliance issues, complaint investigations, or evidence of off site impacts from activities at the facility. If such an action is needed, the department will specify in writing the sampling requirements, including such information as location and extent. It is a violation of this permit to fail to comply with said written notification to sample.

2. Storm water samples shall be collected within the first 60 minutes of discharge occurring as a result of precipitation events of 0.1 inches or greater. Precipitation events include rainfall as well as run-off from the melting of frozen precipitation.

3. This permit stipulates pollutant Benchmarks applicable to your discharge. The Benchmarks do not constitute direct numeric effluent limitations; a benchmark exceedance alone, therefore, is not a permit violation. Benchmark monitoring data are primarily for your use (and department's use as described in #1, above) to determine the overall effectiveness of your SWPPP and to assist you in knowing when additional corrective action may be necessary to protect water quality. If a sample exceeds a benchmark concentration you must review your SWPPP and your BMPs to determine what improvements or additional controls are needed to reduce that pollutant in your storm water discharge(s). Failure to improve BMPs and achieve compliance with the Benchmarks is a permit violation. Exceedances believed to be the result of legacy chemical uses at the facility are not exempted from this requirement. Permittees are encouraged to contact the Department to formulate a plan for investigation and clean-up if legacy chemical uses are suspected to be the cause of exceedances.

SAMPLING REQUIREMENTS AND BENCHMARKS

4. The following Benchmarks are considered necessary to protect water quality and shall not be exceeded. The BMPs at the facility should be designed to meet these benchmarks during rainfall events up to the 1-in-10 year, 24 hour rain event.

Benchmarks Table

Parameter	**Benchmark**
Chemical Oxygen Demand$_5$	90 mg/L
Total Suspended Solids	50 mg/L
pH – Units	6.5-9.0 Standard Units
Oil & Grease	10 mg/L
Chemicals listed in 40 CFR 122 Appendix D	Non Detect
Other Soluble Bulk Materials	Non Detect

5. Chemicals listed in 40 CFR 122 Appendix D appear in this permit beginning on page 8 of this permit. Sampling must occur **only** for chemicals which are currently or have been stored or disposed of outside in the last three years in open or unsecured containers, loaded or unloaded, or treated and exposed to storm water. A secure container shall be deemed to be a container with a lid which has never been opened since it was originally sealed.

6. Other soluble bulk materials that are not listed in 40 CFR 122 Appendix D that are stored outside and exposed to storm water must also be monitored. If permittee has questions concerning which parameters to sample and test for, contact the Water Protection Program.

7. If data becomes available that indicates existing water quality will be protected by alternative Benchmarks specific to this industry, the department will propose to incorporate those Benchmarks into this permit as part of a permit modification. Such data must be approved by the department as appropriate and representative before it can be considered.

8. At no time shall any discharge result in a violation of Water Quality Standards (as described in Requirements #9). A facility will be required to obtain a site specific permit if the department determines that a site specific permit is necessary to protect water quality.

REQUIREMENTS

Note: These requirements do not supersede nor remove liability for compliance with county and other local ordinances.

1. **For New or Expanding Facilities**: The primary requirement of this permit is the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). For new facilities applying for coverage under this general permit, or those seeking to expand, accompanying the permit application must be a SWPPP that includes an analysis of the Best Management Practices (BMPs). This analysis is a structured evaluation of BMPs that are reasonable and cost effective. The evaluation should include practices that are designed to be 1) non-degrading 2) less degrading, or 3) degrading water quality. The chosen BMP will be the most reasonable and cost effective while ensuring that the highest statutory and regulatory requirements are achieved and the highest quality water attainable for the facility is discharged. The analysis must demonstrate why "no discharge" or "no exposure" is not a feasible alternative at the facility. This structured analysis of BMPs serves as the Antidegradation review, fulfilling the requirements of 10 CSR 20-7.031(2).

   For both new and expanding facilities, the Best Management Practices chosen through the Alternative Analysis must be implemented and maintained at the facility. Failure to implement and maintain the chosen alternative is a permit violation.

   The Pollutants of Concern for this permit are listed in the Benchmarks Table on Page 4 of this permit. A demonstration may be made that the expansion will not result in an increase in the discharge of Pollutants of Concern.

   For existing facilities, because a SWPPP was not previously required for these facilities, the SWPPP must be prepared within 60 days and fully implemented within 120 days. The SWPPP must be kept on-site and should not be sent to DNR unless specifically requested. The permittee shall select, install, use, operate, and maintain the Best Management Practices prescribed in the SWPPP in accordance with the concepts and methods described in the following document:

   Developing Your Stormwater Pollution Prevention Plan, A Guide for Industrial Operators, (Document number EPA 833-B-09-002) published by the United States Environmental Protection Agency (USEPA) in February 2009.

   The SWPPP must include the following:
   (a) An assessment of all storm water discharges associated with the facility, including any materials stored onsite in sealed containers, deicing of surfaces, loading and unloading areas, etc. This must include a list of potential contaminants and an annual estimate of amounts that will be used in the described activities.
   (b) A listing of Best Management Practices (BMPs) and a narrative explaining how BMPs will be implemented to control and minimize the amount of potential contaminants that may enter storm water.
   (c) A schedule for implementing the BMPs, if necessary.
   (d) The SWPPP must include a schedule for monthly site inspections and a brief written report. The inspections must include observation and evaluation of BMP effectiveness, deficiencies, and corrective measures that will be taken. The Department must be notified within fifteen (15) days by letter of any corrections of deficiencies. Deficiencies that consist of minor repairs or maintenance must be corrected within seven (7) days. Deficiencies that require additional time or installation of a treatment device to correct should be detailed in the written notification. Installation of a treatment device, such as an oil water separator, may require a construction permit. Inspection reports must be kept on site with the SWPPP. These must be made available to DNR personnel upon request.
   (e) A provision for designating an individual to be responsible for environmental matters.
   (f) A provision for providing training to all personnel involved in material handling and storage, and housekeeping of areas having materials exposed to storm water. This may be satisfied by in-house training provided by facility staff. Proof of training shall be submitted upon request of DNR.

2. The purpose of the SWPPP and the BMPs listed therein is to prevent pollutants from entering waters of the state. A deficiency of a BMP means it was not effective in preventing pollution [10 CSR20-2.010(56)] of waters of the state, or failed to achieve compliance with benchmarks. Corrective action means the facility took steps to eliminate the deficiency.

REQUIREMENTS (continued)

3. The following are minimum BMPs that must be implemented at all facilities:

   (a) Collection facilities shall be provided on-site, and arrangements made for proper disposal of waste products which may be exposed to storm water.
   (b) All fueling facilities present on-site shall adhere to applicable federal and state regulations concerning underground storage, above ground storage, and dispensers, including spill prevention, control and counter measures.
   (c) Substances regulated by federal law under the Resource Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) that are transported, stored, or used for maintenance, cleaning or repair shall be managed according to the provisions of RCRA and CERCLA.
   (d) All chemicals and waste products (except fuels), and storage containers (such as drums cans, or cartons) shall be stored so that these materials are not exposed to storm water. Drums, barrels, tanks and similar containers that are sealed without operational taps or valves are not considered exposed to storm water. Spill prevention, control, and/or management shall be provided sufficient to prevent any spills of these pollutants from entering waters of the state. Any containment system used to implement this requirement shall be constructed of materials compatible with the substances contained and shall also prevent the contamination of groundwater.
   (e) Good housekeeping practices shall be maintained on the site to keep solid waste from entry into waters of the state.

4. All spills must be **cleaned up** within 24 hours or as soon as possible, and a written report of the incident supplied with the facility's Storm Water Sampling Report. The following spills must be **reported** to the department at the earliest practicable moment, but no greater than 24 hours after the spill occurs:
   (a) Any spill, of any material, that leaves the property of the facility;
   (b) Any spill, of any material outside of secondary containment and exposed to precipitation, greater than 25 gallons or equivalent volume of solid material.

   The department may require the submittal of a written report detailing measures taken to clean up the spill within 5 days of the spill. Whether the written report is submitted with the Storm Water Sampling Report or required to be submitted within 5 days, it must include the type of material spilled, volume, date of spill, date clean-up completed, clean-up method, and final disposal method. If the spill occurs outside of normal business hours, or if the permit holder cannot reach regional office staff for any reason, the permit holder is instructed to report the spill to the department's 24 hour Environmental Emergency Response hotline at (573) 634-2436. Leaving a message on a department staff member voice-mail does not satisfy this reporting requirement. These reporting requirements apply whether or not the spill results in chemicals or materials leaving the permitted property or reaching waters of the state. This requirement is in addition to the Noncompliance Reporting requirement found in Standard Conditions Part I.

   Federal Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

5. This permit may be reopened and modified, or alternatively revoked and reissued, to:
   (a) Comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a) (2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:
      (1) contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
      (2) controls any pollutant not limited in the permit.
   (b) Incorporate new or modified effluent limitations or other conditions, if the result of a waste load allocation study, toxicity test or other information indicates changes are necessary to assure compliance with Missouri's Water Quality Standards.
   (c) Incorporate new or modified effluent limitations or other conditions if, as the result of a watershed analysis, a Total Maximum Daily Load (TMDL) limitation is developed for the receiving waters which are currently included in Missouri's list of waters of the state not fully achieving the state's water quality standards, also called the 303(d) list.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Clean Water Act then applicable.

6. All outfalls must be clearly marked in the field.

REQUIREMENTS (continued)

7. Changes in Discharges of Toxic Substances

The permittee shall notify the Director as soon as it knows or has reason to believe:

(a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:"
   (1) One hundred micrograms per liter (100 µg/L);
   (2) Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2,5 dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
   (3) Five (5) times the maximum concentration value reported for the pollutant in the permit application;
   (4) The level established in Part A of the permit by the Director.

(b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant, which was not reported in the permit application.

8. Report as no-discharge when a discharge does not occur during the report period.

9. Water Quality Standards

(a) Discharges to waters of the state shall not cause a violation of water quality standards rule under 10 CSR 20-7.031, including both specific and general criteria.

(b) General Criteria. The following general water quality criteria shall be applicable to all waters of the state at all times including mixing zones. No water contaminant, by itself or in combination with other substances, shall prevent the waters of the state from meeting the following conditions:
   (1) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses;
   (2) Waters shall be free from oil, scum and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
   (3) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses;
   (4) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life;
   (5) There shall be no significant human health hazard from incidental contact with the water;
   (6) There shall be no acute toxicity to livestock or wildlife watering;
   (7) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community;
   (8) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to section 260.200-260.247.

PERMIT TRANSFER

This permit may be transferred to a new owner by submitting an “Application for Transfer of Operating Permit” signed by the seller and buyer of the facility, along with the appropriate modification fee.

TERMINATION

Coverage under this permit may be terminated when activities covered by this permit have ceased and no significant materials or residual contamination remain at the site, or have the potential to cause pollution. If such a termination is sought, the permittee shall submit Form H, Termination of a General Permit.

PERMIT RENEWAL REQUIREMENTS

Unless this permit is terminated, the permittee shall submit an application for the renewal of this permit no later than six (6) months prior to the permit’s expiration date. Failure to apply for renewal may result in termination of this permit and enforcement action to compel compliance with this condition and the Missouri Clean Water Law.

DUTY OF COMPLIANCE

The permittee shall comply with all conditions of this general permit. Any noncompliance with this general permit constitutes a violation of Chapter 644, Missouri Clean Water Law, and 10 CSR 20-6. Noncompliance may result in enforcement action, termination of this authorization, or denial of the permittee's request for renewal.

This permit authorizes only the activities described in this permit. Compliance with this permit may not be considered a shield from compliance with any local ordinance, State Regulation or State Law.

Appendix D, To Part 122 - NPDES Permit Application Testing Requirements (122.21)

Table II - Organic Toxic Pollutants In Each Of Four Fractions In Analysis By Gas Chromatography/Mass Spectroscopy (GS/MS).

	Volatiles
1	Vacrolein
2	Vacrylonitrile
3	Vbenzene
5	Vbromoform
6	Vcarbon tetrechloride
7	Vchlorobenzene
8	Vchlorodibromomethane
9	Vchloroethane
10	V2-chloroethylvinyl ether
11	Vchloroform
12	Vdichlorobromomethane
14	V1,1-dichloroethane
15	V1,2-dichloroethane
16	V1,1-dichloroethylene
17	V1,2-dichloropropane
18	V1,3-dichloropropylene
19	Vethylbenzene
20	Vmethyl bromide
21	Vmethyl chloride
22	Vmethylene chloride
23	V1,1,2,2-tetrachloroethane
24	Vtetrachloroethylene
25	Vtoluene
26	V1,2-trans-dichloroethylene
27	V1,1,1-trichloroethane
28	V1,1,2-trichloroethane
29	Vtrichloroethylene
31	Vvinyl chloride

1A	2-chlorophenol
2A	2,4-dichlorophenol
3A	2,4-dimethylphenol
4A	4,6-dinitro-o-cresol
5A	2,4 dinitrophenol
6A	2-nitrophenol
7A	4-nitrophenol
8A	p-chloro-m-cresol
9A	pentachlorophenol
10A	phenol
11A	2,4,6-trichlorophenol

	Base/Neutral
1B	acenaphthene
2B	acenaphthylene
3B	anthracene
4B	benzidine
5B	benzo(a)anthracene
6B	benzo(a)pyrene
7B	3,4-benzofluoranthene
8B	benzo(ghi)perylene
9B	benzo(k)fluoranthene
10B	bis(2-chloroethoxy)methane
11B	bis(2-chloroethyl)ether
12B	bis(2-chloroisopropyl)ether
13B	bis(2-ethylhexyl)phthalate
14B	4-bromophenyl phenyl ether
15B	butylbenzyl phthalate
16B	2-chloronaphthalene
17B	4-chlorophenyl phenyl ehter
18B	chrysene
19B	dibenzo(a,h)anthracene
20B	1,2-dichlorobenzene
21B	1,3-dichlorobenzene
22B	1,4-dichlorobenzene
23B	3,3'-dichlorobenzidine
24B	diethyl phthalate
25B	dimethyl phthalate
26B	di-n-butyl phthalate
27B	2,4-dinitrotoluene
28B	2,6-dinitrotoluene
29B	di-n-octyl phthalate
31B	fluroranthene
32B	fluorene
33B	hexachlorobenzene
34B	hexachlorobutadiene
35B	hexachlorocyclopentadiene
36B	hexachloroethane
37B	indeno(1,2,3-cd)pyrene
38B	isophorone
39B	napthalene
40B	nitrobenzene
41B	N-nitrosodimethylamine
42B	N-nitrosodi-n-propylamine
43B	N-nitrosodiphenylamine
44B	phenanthrene
45B	pyrene
46B	1,2,4-trichlorobenzene

(continued on next page)

Appendix D, To Part 122 - NPDES Permit Application Testing Requirements (122.21)

Pesticides

1 Paldrin
2 Palpha-BHC
3 Pbeta-BHC
4 Pgamma-BHC
5 Pdelta-BHC
6 Pchlordane
7 P4,4'-DDT
8 P4,4'-DDE
9 P4,4'-DDD
10 Pdieldrin
11 Palpha-endosulfan
12 Pbeta-endosulfan
13 Pendosulfan sulfate
14 Pendrin
15 Pendrin aldehyde
16 Pheptachlor
17 Pheptachlor epoxide
18 PPCB-1242
19 PPCB-1254
20 PPCB-1221
21 PPCB-1232
22 PPCB-1248
23 PPCB-1260
24 PPCB-1016
25 Ptoxaphene

Table III – Other Toxic Pollutants (Metals and Cyanide) and Total Phenols

Antimony, Total
Arsenic, Total
Beryllium, Total
Cadmium, Total
Chromium, Total
Copper, Total
Lead, Total
Mercury, Total
Nickel, Total
Selenium, Total
Silver, Total
Thallium, Total
Zinc, Total
Cyanide, Total
Phenols, Total

Table IV – Conventional and Nonconventional Pollutants Required to be Tested by Existing Dischargers if Expected to be Present

Bromide
Chlorine, Total Residual
Color
Fecal Coliform
Fluoride
Nitrate-Nitrite
Nitrogen, Total Organic
Oil and Grease
Phosphorus, Total
Radioactivity
Sulfate
Sulfide
Sulfite
Surfactants
Aluminum, Total
Barium, Total
Boron, Total
Cobalt, Total
Iron, Total
Magnesium, Total
Molybdenum, Total
Manganese, Total
Tin, Total
Titanium, Total

Table V – Toxic Pollutants and Hazardous Substances Requierd to be Identifed by Existing Dischargers if Expected to be Present

Toxic Pollutants

Asbestos

Hazardous Substances

Acetaldehyde
Allyl alcohol
Allyl chloride
Amyl acetate
Aniline
Benzonitrile
Benzyl chloride
Butyl acetate
Butylamine
Captan
Carbaryl
Carbofuran

(continued on next page)

Appendix D, To Part 122 - NPDES Permit Application Testing Requirements (122.21)

Table V (continued)

Hazardous Substances (continued)

Carbon disulfide
Chlorpyrifos
Coumaphos
Cresol
Crotonaldehyde
Cyclohexane
2,4-D(2,4-Dichlorophenoxy acetic acid)
Diazinon
Dicamba
Dichlobenil
Dichlone
2,2-Dichloropropionic acid
Dichlorvos
Diethyl amine
Dimethyl amine
Dintrobenzene
Diquat
Disulfoton
Diuron
Epichlorohydrin
Ethion
Ethylene diamine
Ethylene dibromide
Formaldehyde
Furfural
Guthion
Isoprene
Isopropanolamine Dodecylbenzenesulfonate
Kelthane
Kepone
Malathion
Mercaptodimethur
Methoxychlor
Methyl mercaptan
Methyl methacrylate
Methyl parathion
Mevinphos
Mexacarbate
Monoethyl amine
Monomethyl amine
Naled
Napthenic acid
Nitrotoluene
Parathion
Phenolsulfanate
Phosgene
Propargite
Propylene oxide
Pyrethrins
Quinoline
Resorcinol
Strontium
Strychnine
Styrene
2,4,5-T(2,4,5-Trichlorophenoxy acetic acid)
TDE(Tetrachlorodiphenylethane)
2,4,5-TP [2-(2,4,5-Trichlorophenoxy) propanoic acid]
Trichlorofan
Triethanolamine dodecylbenzenesulfonate
Triethylamine
Trimethylamine
Uranium
Vanadium
Vinyl acetate
Xylene
Xylenol
Zirconium

Skills Required:

1) Resource Conservation and Recovery Act (RCRA) training
2) Understanding of, and ability to make decisions, regarding site-specific objectives
3) Knowledge of state and federal requirements
4) Knowledge of site-specific checklists
5) Knowledge of EWI quality standards
6) Knowledge of corporate safety requirements and health and safety plan.

1.0 OBJECTIVE / SCOPE

The Resource Conservation and Recovery Act (RCRA) regulates solid, universal and hazardous waste, from generation through disposal ("cradle to grave"). The USEPA enacted these regulations in 1976 and is the overarching authority. However, the states have been delegated authority by USEPA and so have to comply with the federal regulations; each state may also have additional requirements, as long as they are not more strict than USEPA's.

There are numerous requirements under RCRA for managing waste, from waste identification through storage, transport and disposal. Some of the most strict and detailed requirements involve the storage of waste, a common practice for EWI's clients. Therefore, the objective of this Standard Operating Procedure (SOP) is to describe the proper procedure for conducting inspections of hazardous waste storage areas in compliance with RCRA. This SOP outlines actions to be undertaken by all EWI employees to ensure hazardous waste is properly managed during storage.

This SOP should serve as a reference tool to facilitate consistency among EWI personnel. These procedures may vary depending upon site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented in field notes and included in project documentation.

2.0 APPLICABILITY

Any facility or person who generates hazardous waste as defined under 40 CFR 261 is subject to the inspection requirements outlined below. Generators are divided into three categories: Conditionally Exempt Small Quantity Generators (CESQGS); Small Quantity Generators (SQGs) and Large Quantity Generators (LQGs). A CESQG generates less than 220 pounds of hazardous waste a month. A SQG generates 220 to 2,200 pounds of hazardous waste per month. A LQG exceeds 2,200 pounds per month in generation. All these generators are restricted to generating less than 2.2 pounds of acutely hazardous waste in one month. The more waste generated, the more restrictive the requirements.

For a generator, regardless of volume, there are two types of storage allowed for hazardous waste: satellite e and accumulation point. ***Satellite storage*** is located at or near the point of waste generation. It is limited by volume - only 55 gallons of a hazardous waste stream may be stored in a Satellite. Its purpose is to provide a convenient storage place for waste as its being generated. In Missouri, a generator can only store waste in a satellite for one year (the satellite start date must be written on the container). Once a container is full or that waste is finished being generated, then the generator has 72 hours to move the drum from the Satellite to the Accumulation Point. It is at that time that the "Accumulation Date" is filled in on the label and the clock starts on the storage time as described below.

The ***Accumulation Point*** is the location of waste that is ready to be picked up and transported for disposal. It is limited by time, and that time is determined by the type of generator. SQGs have 180 days to

store the waste before it must be transported offsite for disposal. LQGs have 90 days. CESQGs have no prescribed limits; however, a Best Management Practice of 180 days is recommended. Again, the clock starts ticking on storage time as soon as the waste is done being generated and the container is full (and it's being moved from the Satellite).

Satellites and Accumulation Points have different requirements and so will require separate inspection forms.

2.1 Universal Waste

Universal waste is a subset of Hazardous Wastes, and includes wastes that are typically generated in great volume (fluorescent light bulbs, batteries). To aid in the proper disposal of these wastes, USEPA implemented a separate, less stringent set of regulations. Storage areas must be maintained in a manner to prevent spills and leaks, and the generator can store the universal wastes for one year. EWI utilizes a separate checklist for Universal Wastes.

3.0 EQUIPMENT

Some or all of the following equipment is needed for RCRA inspections based on project conditions:

1. Field truck
2. EWI identification badge
3. Inspection forms (typically site specific)
4. Field note forms
5. Hazardous waste and DOT labels
6. Camera
7. Leather gloves
8. Personal Protective Equipment (PPE) - safety glasses, steel-toed boots, reflective vest
9. Spill kit (pads, booms, floor dry)
10. Sharpie or other indelible marker

4.0 PROCEDURES

RCRA inspections conducted by EWI personnel involve a thorough understanding of waste storage requirements. The following procedures are meant to aid EWI employees in the completion of RCRA inspections.

4.1 Pre-Inspection Preparation

Review the inspection forms and become familiar with the common wastes and storage areas at the facility. Ensure that you have a separate inspection form for each area and for each type of area (Satellite vs. Accumulation Point).

4.2 Entry

Upon arriving at an inspection site, inform the site personnel of your arrival. Take special precautions to follow any onsite safety procedures.

4.3 Site Inspection

Safely conduct a thorough inspection of the waste storage areas, using the inspection checklists as your guide. The inspection will include specific observations, such as:

- Condition of the containers;
- Compatibility of the containers with the waste;
- Compatibility of different waste streams;
- Security of the containers;
- Location within the facility;
- Accessibility in case of emergency;
- Satellite accumulation start dates;
- Notice of any accumulated water in the containment or on the containers;
- Condition of containment;
- Accumulation start dates;
- Proper Signage;
- Proper labeling on the containers;
- Type and volume of waste being stored;
- Spills, releases, or issues with the drums;
- General good housekeeping practices.

4.4 Inspection checklists

Inspection checklists for sites managed by EWI will be provided to EWI personnel conducting site inspections. All inspection forms should be neatly filled out in blue or black ink. If a mistake is made on an inspection form, draw one line through the error and initial nearby. Ensure that all information is accurate and complete before obtaining site personnel signatures (if required), such as:

- Facility name
- Date and time of inspection
- Inspector's name
- Inspection results
- Any specific observations or comments

After obtaining a signature, make copies of the inspection document(s) and follow proper protocols for record retention for the site being inspected; copies of the inspection checklists must remain onsite in a central, easily accessed location. Also bring any deficiencies to the attention of the facility personnel; ensure that all deficiencies are corrected and that the correction is noted on the inspection checklist along with the date of correction.

5.0 SAFETY

Acute or chronic exposure to hazardous substances could result in health issues. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) for anticipated hazardous substances before the initiation of the inspection process.

EWI employees should follow any site or facility-specific Site Safety and Health Plan that exists and also follow the procedures in the EWI Corporate Health and Safety Plan. Review safety hazards (e.g. high-traffic

areas, exposure to chemicals, required PPE, health monitoring, emergency procedures, alertness to heavy equipment). Take appropriate action if personnel are injured on-site in accordance with EWI directives.

6.0 REFERENCES

- "Corporate Health and Safety Plan" Environmental Works, Incorporated.
- 40 CFR 260 - 268
- MDNR's Large Quantity Generator Inspection Checklist < http://www.dnr.mo.gov/forms/780-1525-f.pdf
- MDNR's Small Quantity Generator Inspection Checklist http://www.dnr.mo.gov/forms/780-1602-f.pdf

Environmental Works, Inc. SOP No. 16

RCRA Inspections

ATTACHMENTS

Example Inspection Forms

Storage Area Inspection Checklist

RCRA Large Quantity Generators

Facility Name _____ Date _____

Inspector Name/Company _____ Time _____

Accumulation Points	Yes	No	NA
Is waste stored within 90 day limit?			
Are containers labeled with Hazardous Waste labels?			
Is waste packaged/labeled/marked per DOT regulations?			
Are containers labeled with accumulation start dates?			
Are containers free of corrosion/leaks/damage?			
Are containers compatible with the waste?			
Are incompatible wastes stored separately?			
Are DOT-approved containers being used?			
Are containers closed?			
Storage area has sufficient secondary containment if container holds > 1000 kg?			
Is telephone or other device available to summon emergency assistance?			
Is emergency information posted next to telephone?			
Are No Smoking signs posted next to ignitable or reactive wastes?			
Is spill containment equipment readily available?			
Is fire fighting equipment readily available and location posted next to telephone?			
Is sufficient space maintained to allow easy access to storage area?			
Is ignitable or reactive waste stored 50 ft from the property line?			
Is the storage area secure?			
Is hazardous waste being properly segregated from nonhazardous waste?			
Volume of waste per type/accumulation date:			
Other Issues or Comments? (include corrective actions taken)			

Satellite Accumulation Points	Yes	No	NA
Is the waste volume less than 55 gallons?			
Is Satellite Start date marked on the container?			
Are partially-full containers disposed after being in Satellite area for one year?			
When a drum is full, is it being moved to the accumulation area within 72 hours?			
Is the waste labeled as "Hazardous Waste" or with the waste name?			
Are the containers free of corrosion/leaks?			
Are DOT-approved containers being used?			
Are containers compatible with the waste?			
Are incompatible wastes stored separately?			
Is hazardous waste being properly segregated from nonhazardous waste?			
Are containers closed?			
Is the waste stored near the point of generation?			
Is ignitable or reactive waste stored 50 ft from the property line?			
Are "No Smoking" signs posted?			
Are measures being taken to prevent the containers from being damaged?			
Other Issues or comments (include corrective actions taken)			

Bass Pro Shops signature: _____ Date: _____

BNSF SPRINGFIELD YARD
WEEKLY INSPECTION CHECKLIST

Facility Name: BNSF Springfield Yard _____ Date:_____

Inspector Name/Company:_____/EWI

HAZARDOUS WASTE STORAGE AREA

1.	Waste stored within 180 day limit?	Yes	No	N/A
2.	Is total hazardous waste volume less than 2,200 lbs?	Yes	No	N/A
3.	Containers labeled with Hazardous Waste labels?	Yes	No	N/A
4.	Waste packaged/labeled/marked per DOT regulations?	Yes	No	N/A
5.	Containers labeled with accumulation start dates?	Yes	No	N/A
6.	Containers free of corrosion/leaks/damage?	Yes	No	N/A
7.	Are containers compatible with the waste?	Yes	No	N/A
8.	Are incompatible wastes stored separately?	Yes	No	N/A
9.	Are DOT-approved containers being used?	Yes	No	N/A
10.	Are containers closed?	Yes	No	N/A
11.	No Smoking signs posted next to ignitable or reactive wastes?	Yes	No	N/A
12.	Is spill containment equipment readily available?	Yes	No	N/A
13.	Is fire fighting equipment readily available?	Yes	No	N/A
14.	Is sufficient space maintained to allow easy access to storage area?	Yes	No	N/A
15.	Is ignitable or reactive waste stored >50 ft from the property line?	Yes	No	N/A
16.	Is the storage area secure?	Yes	No	N/A
17.	Is hazardous waste being properly segregated from non-hazardous waste?	Yes	No	N/A

Volume of waste per type/accumulation date:_____

_____

_____

Other Issues or Comments? (include corrective actions taken)_____

_____

_____

BNSF SPRINGFIELD YARD
WEEKLY INSPECTION CHECKLIST

Facility Name: BNSF Springfield Yard _____ Date:_____

Inspector Name/Company:_____/EWI

HAZARDOUS WASTE SATELLITE ACCUMULATION POINTS

Type of Waste?	Signal Shop Aerosol Drum	Signal Shop Paint Waste Drum	Signal Shop Inside Shot Blast Drum	Signal Shop Outside Shot Blast Drum	B&B Paint Waste Drum	Rip Track Aerosol Drum	Other
Satellite start date? (enter date)							
Drum stored within the one year allowed for satellite storage?							
Number of drums in place?							
Quantity in drum (inches)?	N/A					N/A	
Quantity in drum (gallons)? (one inch = 1.64 gallons)							
Is hazardous waste being accumulated only in authorized areas?							
Is container under operator's control?							
Is container in good condition?							
Are containers closed?							
Is Hazardous waste labeling correct, legible and visible?							
Is the area free of spills and Is there adequate aisle space which, is free of obstruction?							

Comments / corrective actions. "No" answers requires explanation.

_____

_____

_____

Skills Required by the Reviewer:

1) Must know site-specific data quality objectives (DQO) and corporate quality assurance.
2) Must have a complete understanding of the intended use of the data.
3) Must understand all components of laboratory reports, including QA/QC parameters and how to evaluate them.

1.0 OBJECTIVE / APPLICABILITY / SCOPE

The objective of this Standard Operating Procedure (SOP) is to provide information and procedures for EWI personnel to perform a technical review of analytical data generated by a laboratory. The data review process provides information on the analytical limitations of data based on specific QC criteria.

Topics and procedures discussed in this SOP are supported in reference to the United States Environmental Protection Agency (US EPA) Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review.

This is a standard operating procedure, which should be followed as closely as possible, but varied depending upon specific site data quality objectives, regulatory oversight requirements for the site, and contract agreements with the laboratory. Discrepancies in use of reporting associated with this SOP must be documented in project records and appropriate reports..

2.0 ACRONYMS AND DEFINITIONS

See the listing of laboratory report definitions and acronyms in the Attachments; following are additional definitions or report definitions to emphasize.

Quality Assurance (QA): Refers to a program for the systematic monitoring and evaluation of the various aspects of a project, service, or facility to ensure the standards of quality are being met.

Quality Control (QC): A process by which persons review the quality of all factors involved in production.

Accuracy: A QA/QC function that quantifies a laboratory's ability to generate data that is in agreement with the true concentration or a reference value.

Precision: A QA/QC function that quantifies a laboratory's ability to generate reproducible data for multiple analyses of the same sample.

Holding Time: The time from sample collection to the time of extraction or analysis. One of the most critical aspects that can affect a sample's data quality.

Method Detection Limit (MDL): The lowest concentration of a chemical that can be distinguished from the absence of that chemical (a blank) for a given analytical method within a stated confidence limit.

Reporting Limit (RL): lowest reported concentration at a high confidence level of quantification provided on the sample analysis data report, after corrections have been made for sample dilution, sample weight, and for soils and sediments, the amount of moisture in the sample

Estimated Quantity (J): Reported concentration of an analyte that falls between the MDL and the RL; quantification confidence level is lower than that of the reporting limit.

Laboratory Control Sample (LCS): Known concentrations of target analytes in pure blank water, in mid-calibration range, to test equipment accuracy within control limits.

Matrix Spike/Matirx Duplicate (MS/MSD): Known concentration of target analytes put into two field samples to allow duplicate testing of results; percent recovery comparison evaluates accuracy and precision of the method.

Surrogate (S): Known concentration of non-target analytes (not found at site) put into field samples to test percent recovery for assessing accuracy of the method and potential for matrix interference.

3.0 PROCEDURES

The following outlines the procedures for QA/QC review of laboratory analytical results. These procedures provide details for filling out the attached QA/QC checklist, which is utilized as the formal review for each data package. Write in the sampling event/laboratory project number, the project site, the laboratory used, the name of the reviewer, and the date in the appropriate boxes at the top of all pages. Then conduct a review utilizing the following procedures and the checklist. Procedures are applicable for review of all analytes and sample media types. Also see the annotated laboratory report which serves as a guide of what to look for on the lab reports.

3.1 Data Packages

(1) Transfer the portable document format (PDF) and electronic data deliverable (EDD) data packages to the project directory.

(2) Review the PDF and the EDD versions of the data package for completeness.

(3) Verify that analytical results in the PDF format match the EDD. Note that j-flagged (estimated) data values and MDLs may not be entered into the EDD; Check the PDF for these values.

3.2 Invoice

(4) Verify that the invoice for the sample analysis has been approved and given to accounting. If not, mark "no" on the checklist and follow-up with the laboratory.

(5) Verify that the invoice includes the following:
   a. The correct client project name;
   b. The correct laboratory project number;
   c. The correct quantity of the samples analyzed;
   d. The correct method(s) of analysis;
   e. The correct sample matrix; and,
   f. The correct pricing.

(6) Approve the invoice and give to accounting. Make sure to write any special instructions (e.g. no markup for PSTIF sites), if applicable, on the invoice prior to turning in to accounting.

3.3 Chain-of-Custody (COC)

(7) Confirm project information was entered correctly on the COC.

(8) Review the COC for completeness (see EWI SOP #5).

(9) Confirm that the COC has been signed and dated as received by the laboratory representative.

(10) Review laboratory comments on the COC (i.e. cooler temperature, sample conditions) as well as the laboratory completed "cooler receipt form" or "sample receipt checklist." List any unusual conditions noted by the laboratory on page 2 of the QA/QC review checklist.

3.4 Samples

(11) Verify that all samples sent to the laboratory were analyzed and the results were reported.

(12) Check the data for anomalies and compare to the applicable target levels and historic data. If there are anomalies with no qualifier, contact the laboratory to discuss.

(13) If duplicate or split samples were collected, compare the results to the primary sample, noting discrepancies on page 2.

(14) Check the sample results for qualifiers (flags). If a sample has a qualifier, note it on page 2.

(15) Check the reporting limits/MDL for each sample and compare them to the required limits for the site. If reporting limits are not met, then explain the discrepancies on page 2 and contact the laboratory to discuss.

Note that estimated (J) values are not normally provided unless requested for the project. Pending DQOs, estimated values can be requested post-analysis; however the laboratory may charge an additional cost for this.

3.5 Hold Times

(16) Review the hold time for each sample; regulatory hold times vary for different analyses. A hold time chart for organic and inorganic chemicals of concern is attached. This is a critical parameter for data quality.

(17) Make sure the time between sampling date/time and extraction or analysis date/time does not exceed the hold time for that analysis.

(18) Contact the laboratory for explanation, significance, and options if samples were analyzed out of hold time.

3.6 QA/QC Deliverables Review and Evaluation

(19) Make sure the laboratory provided the appropriate QA/QC deliverables, as requested on the COC (i.e. Level 1 – Level 4). There are four possibilities for QA/QC deliverables; the most frequently requested is Level 2. A description of Level 2 report deliverables is attached.

(20) If a pH preservative was used, note appropriate levels (>11 for TSP, ≤2 for HCl). Record discrepancies on page 2.

(21) Review QA/QC data for acceptable results of laboratory Surrogates (S); these may be listed with each sample or separately in the laboratory QC section of the report. Percent recovery has to fall within listed percent range. If outside limits, should be noted by a qualifier code. Note specifics on page 2 and contact the laboratory for significance. High contaminant levels may disrupt surrogate detections.

(22) Review QA/QC data for acceptable results of laboratory Method Blank; should be one for each analytical method run. Note absence of detections (ND) and associated Surrogates (S) within % range limits. If detections, record specifics on page 2, and note QC Batch group and associated samples – similar concentrations of analytes in sample will be suspect. Record affected samples in Comments on page 2. Contact the laboratory for explanation.

Note: common lab external contaminants are acetone, methylene chloride, phthalates, iron, nickel, copper, and zinc.

(23) Review QA/QC data for acceptable results of Laboratory Control Samples (LCS); should be an LCS for every Method Blank sample. Make sure LCS % recoveries are within the percent recovery limits.

If the LCS % recoveries are outside the limits, note specific discrepancies and affected samples on page 2, and contact the laboratory for effect on samples. Use following guide regarding potential effect:

- LCS % above limit & sample is ND = No issue
- LCS% above limit & sample is high = May be biased High
- LCS% below limit & sample is high = May be biased Low
- LCS% below limit & sample is ND = Potential false negative

(24) Review QA/QC data for acceptable results of laboratory Matrix Spikes (MS) /MS Duplicates (MSD). Percent recoveries must fall within listed percent range, and relative percent difference (RPD) must not exceed max RPD listed. If any parameters outside limits, should have a qualifier code. Note specifics on page 2 and contact the laboratory for significance. High contaminant levels may disrupt results.

Note: MS/MSD failures are not used as accept/reject criteria for sample data. Method Blank detections and LCS failures are more critical.

(25) Review analytical data for acceptable results of field blanks, trip blanks, rinsate blanks, and duplicates. Record specifics of blank detections on page 2, and note significant differences (> 50% for low concentrations and >20% for high concentration ranges, or as specified in project sampling plan) in duplicate values on page 2.

4.0 REFERENCES

(1) U.S. EPA. November 2002. Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8).

(2) U.S. EPA. March 2006. Guidelines for Data Review of Contract Laboratory Program Analytical Services Volatile and Semivolatile Data Packages. Standard Operating Procedure 901, U.S. EPA Region 9.

(3) U.S. EPA Contract Laboratory Program. January 2010. National Functional Guidelines for Inorganic Superfund Data Review (U.S. EPA-540-R-10-011).

(4) U.S. EPA Contract Laboratory Program. June 2008. National Functional Guidelines for Superfund Organics Data Review (U.S. EPA-540-R-08-01).

(5) Pace Analytical Laboratories, in-house training at EWI headquarters, March 5, 2010.

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SAMPLE SUMMARY

Project: JUMP 8
Pace Project No.: 6065663

Lab ID	Sample ID	Matrix	Date Collected	Date Received
6065663001	SB-1 3'	Solid	09/08/09 11:40	09/09/09 07:17
6065663002	SB-1 4.5-5'	Solid	09/08/09 11:50	09/09/09 07:17
6065663003	SB-1 9-9.5'	Solid	09/08/09 12:00	09/09/09 07:17
6065663004	SB-1 14-14.5'	Solid	09/08/09 12:15	09/09/09 07:17
6065663005	SB-2 2.5-3'	Solid	09/08/09 12:45	09/09/09 07:17
6065663006	SB-2 4.5-5'	Solid	09/08/09 12:55	09/09/09 07:17
6065663007	SB-2 7-7.5'	Solid	09/08/09 13:00	09/09/09 07:17
6065663008	SB-2 14.5'	Solid	09/08/09 13:10	09/09/09 07:17
6065663009	SB-3 9'	Solid	09/08/09 12:30	09/09/09 07:17
6065663010	PT-1	Water	09/08/09 13:50	09/09/09 07:17
6065663011	TRIP BLANK	Water	09/08/09 13:50	09/09/09 07:17
6065663012	TRIP BLANK	Solid	09/08/09 13:50	09/09/09 07:17

CHECK TIMES (DAYS)

should not be more than one day

our sample #

LAB ID reference

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EWI Sample ID

Lab Sample ID

Can also compare here for no more than one day

ANALYTICAL RESULTS

Project: JUMP 8
Pace Project No.: 6065663

Sample: SB-1 3' **Lab ID: 6065663001** Collected: 09/08/09 11:40 Received: 09/09/09 07:17 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV GRO and Oxygenates	Analytical Method: EPA 5035A/8260							
TPH-GRO	**2.1**	mg/kg	0.60	1		09/10/09 13:17		
Benzene	ND	mg/kg	0.0060	1		09/10/09 13:17	71-43-2	
Toluene	ND	mg/kg	0.0060	1		09/10/09 13:17	108-88-3	
Ethylbenzene	ND	mg/kg	0.0060	1		09/10/09 13:17	100-41-4	
Xylene (Total)	ND	mg/kg	0.012	1		09/10/09 13:17	1330-20-7	
Naphthalene	ND	mg/kg	0.024	1		09/10/09 13:17	91-20-3	
Methyl-tert-butyl ether	**0.0074**	mg/kg	0.0060	1		09/10/09 13:17	1634-04-4	
tert-Amylmethyl ether	ND	mg/kg	0.0060	1		09/10/09 13:17	994-05-8	
tert-Butyl Alcohol	ND	mg/kg	0.030	1		09/10/09 13:17	75-65-0	
Ethyl-tert-butyl ether	ND	mg/kg	0.0060	1		09/10/09 13:17	637-92-3	
Diisopropyl ether	ND	mg/kg	0.0060	1		09/10/09 13:17	108-20-3	
Toluene-d8 (S)	112	%	81-121	1		09/10/09 13:17	2037-26-5	
4-Bromofluorobenzene (S)	112	%	75-131	1		09/10/09 13:17	460-00-4	
1,2-Dichloroethane-d4 (S)	108	%	77-131	1		09/10/09 13:17	17060-07-0	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**23.1**	%	0.10	1		09/10/09 00:00		

compare for HOLD TIME

Surrogate

% should be within range

If a QC issue, there should be a qualifier code here

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ANALYTICAL RESULTS

Project: JUMP 8
Pace Project No.: 6065663

Sample: SB-1 4.5-5' **Lab ID: 6065663002** Collected: 09/08/09 11:50 Received: 09/09/09 07:17 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV GRO and Oxygenates	Analytical Method: EPA 5035A/8260							
TPH-GRO	**585**	mg/kg	28.1	50		09/11/09 16:45		
Benzene	**2.1**	mg/kg	0.28	50		09/11/09 16:45	71-43-2	
Toluene	**0.27**	mg/kg	0.0052	1		09/10/09 13:34	108-88-3	
Ethylbenzene	**13.1**	mg/kg	0.28	50		09/11/09 16:45	100-41-4	
Xylene (Total)	**8.8**	mg/kg	0.56	50		09/11/09 16:45	1330-20-7	
Naphthalene	**6.8**	mg/kg	1.1	50		09/11/09 16:45	91-20-3	
Methyl-tert-butyl ether	**0.012**	mg/kg	0.0052	1		09/10/09 13:34	1634-04-4	
tert-Amylmethyl ether	ND	mg/kg	0.0052	1		09/10/09 13:34	994-05-8	
tert-Butyl Alcohol	ND	mg/kg	0.026	1		09/10/09 13:34	75-65-0	
Ethyl-tert-butyl ether	ND	mg/kg	0.0052	1		09/10/09 13:34	637-92-3	
Diisopropyl ether	ND	mg/kg	0.0052	1		09/10/09 13:34	108-20-3	
Toluene-d8 (S)	154	%	81-121	1		09/10/09 13:34	2037-26-5	S2
4-Bromofluorobenzene (S)	149	%	75-131	1		09/10/09 13:34	460-00-4	S2
1,2-Dichloroethane-d4 (S)	122	%	77-131	1		09/10/09 13:34	17060-07-0	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**20.7**	%	0.10	1		09/10/09 00:00		

Note outside of range

qualifier code (see "Qualifiers" page near end of lab report)

pH > 11.0 (TSP)
~ 2 (HCl)

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Associated QC Batch

If detections in method Blank, will affect these samples

QUALITY CONTROL DATA

There will be method Blanks for every method run

Project: JUMP 8
Pace Project No.: 6065663

QC Batch: MSV/23475 — Analysis Method: EPA 5035A/8260
QC Batch Method: EPA 5035A/8260 — Analysis Description: 8260 MSV GRO and Oxygenates
~~Associated Lab~~ Samples: 6065663001, 6065663002, 6065663006

METHOD BLANK: 534417 — Matrix: Solid
Associated Lab Samples: 6065663001, 6065663002, 6065663006

METHOD BLANK

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Benzene	mg/kg	ND	0.0050	09/10/09 11:37	
Diisopropyl ether	mg/kg	ND	0.0050	09/10/09 11:37	
Ethyl-tert-butyl ether	mg/kg	ND	0.0050	09/10/09 11:37	
Ethylbenzene	mg/kg	ND	0.0050	09/10/09 11:37	
Methyl-tert-butyl ether	mg/kg	ND	0.0050	09/10/09 11:37	
Naphthalene	mg/kg	ND	0.020	09/10/09 11:37	
tert-Amylmethyl ether	mg/kg	ND	0.0050	09/10/09 11:37	
tert-Butyl Alcohol	mg/kg	ND	0.025	09/10/09 11:37	
Toluene	mg/kg	ND	0.0050	09/10/09 11:37	
TPH-GRO	mg/kg	ND	0.50	09/10/09 11:37	
Xylene (Total)	mg/kg	ND	0.010	09/10/09 11:37	
1,2-Dichloroethane-d4 (S)	%	93	77-131	09/10/09 11:37	
4-Bromofluorobenzene (S)	%	103	75-131	09/10/09 11:37	
Toluene-d8 (S)	%	106	81-121	09/10/09 11:37	

WANT ND

Check within range limits

Check for codes

LABORATORY CONTROL SAMPLE: 534418

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Benzene	mg/kg	.05	0.046	91	79-117	
Diisopropyl ether	mg/kg	.05	0.044	89	72-127	
Ethyl-tert-butyl ether	mg/kg	.05	0.047	94	78-124	
Ethylbenzene	mg/kg	.05	0.047	94	82-118	
Methyl-tert-butyl ether	mg/kg	.05	0.044	88	70-118	
Naphthalene	mg/kg	.05	0.060	120	74-138	
tert-Amylmethyl ether	mg/kg	.05	0.049	99	79-121	
tert-Butyl Alcohol	mg/kg	.25	0.23	91	64-131	
Toluene	mg/kg	.05	0.051	103	78-117	
TPH-GRO	mg/kg	4	3.8	94	60-126	
Xylene (Total)	mg/kg	.15	0.14	95	79-119	
1,2-Dichloroethane-d4 (S)	%			92	77-131	
4-Bromofluorobenzene (S)	%			100	75-131	
Toluene-d8 (S)	%			108	81-121	

LCS

should be one for each method group

want all within limits

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QUALITY CONTROL DATA

Project: JUMP 8
Pace Project No.: 6065663

QC Batch: MPRP/9633 | Analysis Method: EPA 6010
QC Batch Method: EPA 3010 | Analysis Description: 6010 MET
Associated Lab Samples: 6065663010

METHOD BLANK: 534635 | Matrix: Water
Associated Lab Samples: 6065663010

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Lead	mg/L	ND	0.0050	09/11/09 10:37	

LABORATORY CONTROL SAMPLE: 534636

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Lead	mg/L	1	0.97	97	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 534637 534638

Parameter	Units	6065773001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Lead	mg/L	ND	1	1	0.98	0.98	98	97	75-125	0	20	

MS/MSD

Note 2 Lab ID's

both to be within limits

< Max

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QUALIFIERS

Project: JUMP 8
Pace Project No.: 6065663

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

U - Indicates the compound was analyzed for, but not detected.

BATCH QUALIFIERS

Batch: MSV/23475

[M5] A matrix spike/matrix spike duplicate was not performed for this batch due to insufficient sample volume.

Batch: MSV/23547

[M5] A matrix spike/matrix spike duplicate was not performed for this batch due to insufficient sample volume.

Batch: MSV/23548

[M5] A matrix spike/matrix spike duplicate was not performed for this batch due to insufficient sample volume.

ANALYTE QUALIFIERS

H6 Analysis initiated more than 15 minutes after sample collection.

M0 Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.

S2 Surrogate recovery outside laboratory control limits due to matrix interferences (confirmed by similar results from sample re-analysis).

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: JUMP 8
Pace Project No.: 6065663

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
6065663001	SB-1 3'	ASTM D2974-87	PMST/4473		
6065663002	SB-1 4.5-5'	ASTM D2974-87	PMST/4473		
6065663003	SB-1 9-9.5'	ASTM D2974-87	PMST/4473		
6065663004	SB-1 14-14.5'	ASTM D2974-87	PMST/4473		
6065663005	SB-2 2.5-3'	ASTM D2974-87	PMST/4473		
6065663001	SB-1 3'	EPA 5035A/8260	MSV/23475		
6065663002	SB-1 4.5-5'	EPA 5035A/8260	MSV/23475		
6065663006	SB-2 4.5-5'	EPA 5035A/8260	MSV/23475		
6065663010	PT-1	SM 4500-H+B	WET/19439		
6065663010	PT-1	EPA 3010	MPRP/9633	EPA 6010	ICP/8497
6065663006	SB-2 4.5-5'	ASTM D2974-87	PMST/4479		
6065663007	SB-2 7-7.5'	ASTM D2974-87	PMST/4479		
6065663008	SB-2 14.5'	ASTM D2974-87	PMST/4479		
6065663009	SB-3 9'	ASTM D2974-87	PMST/4479		
6065663010	PT-1	SM 2540D	WET/19462		
6065663003	SB-1 9-9.5'	EPA 5035A/8260	MSV/23547		
6065663004	SB-1 14-14.5'	EPA 5035A/8260	MSV/23547		
6065663005	SB-2 2.5-3'	EPA 5035A/8260	MSV/23547		
6065663007	SB-2 7-7.5'	EPA 5035A/8260	MSV/23547		
6065663008	SB-2 14.5'	EPA 5035A/8260	MSV/23547		
6065663009	SB-3 9'	EPA 5035A/8260	MSV/23547		
6065663010	PT-1	EPA 8260	MSV/23548		
6065663010	PT-1	EPA 410.4	WETA/10941		

USE TO DETERMINE / VERIFY WHICH SAMPLES ARE IN WHIC QC BATCH

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LAB PROJECT NUMBER FOR THESE SAMPLES

WO#: 60138722

60138722

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Sample Condition Upon Receipt

NOTE COOLER TEMP

Client Name: Environmental Works

Optional
Proj Due Date:
Proj Name:

Courier: Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ Other ☑ via

Tracking #: _____ Pace Shipping Label Used? Yes ☐ No ☑

Custody Seal on Cooler/Box Present: Yes ☑ No ☐ Seals intact: Yes ☑ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☑ Foam ☑ None ☐ Other ☐

Thermometer Used: T-112 / T-194 **Type of Ice:** Wet Blue None (circle one) ☐ Samples received on ice, cooling process has begun

Cooler Temperature: 2.6

Temperature should be above freezing to 6°C

Date and initials of person examining contents: 2/14/13

Chain of Custody present:	☑Yes	☐No	☐N/A	1.	
Chain of Custody filled out:	☑Yes	☐No	☐N/A	2.	
Chain of Custody relinquished:	☑Yes	☐No	☐N/A	3.	
Sampler name & signature on COC:	☑Yes	☐No	☐N/A	4.	
Samples arrived within holding time:	☑Yes	☐No	☐N/A	5.	
Short Hold Time analyses (<72hr):	☐Yes	☑No	☐N/A	6.	
Rush Turn Around Time requested:	☐Yes	☑No	☐N/A	7.	
Sufficient volume:	☑Yes	☐No	☐N/A	8.	
Correct containers used:	☑Yes	☐No	☐N/A		
Pace containers used:	☑Yes	☐No	☐N/A	9.	
Containers intact:	☑Yes	☐No	☐N/A	10.	
Unpreserved 5035A soils frozen w/in 48hrs?	☐Yes	☐No	☑N/A	11.	
Filtered volume received for dissolved tests?	☐Yes	☐No	☑N/A	12.	
Sample labels match COC:	☑Yes	☐No	☐N/A		
Includes date/time/ID/analyses Matrix: WT				13.	
All containers needing preservation have been checked	☐Yes	☐No	☑N/A		
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes	☐No	☑N/A	14.	
Exceptions: VOA, coliform, TOC, O&G, WI-DRO (water), Phenolics	☑Yes	☐No		Initial when completed	Lot # of added preservative
Trip Blank present:	☐Yes	☐No	☐N/A		
Pace Trip Blank lot # (if purchased): 101512-3				15.	
Headspace in VOA vials (>6mm):	☐Yes	☑No	☐N/A	16.	
Project sampled in USDA Regulated Area:	☐Yes	☐No	☑N/A	17. List State:	

NOTE ANY DISCREPANCIES

Client Notification/ Resolution: Copy COC to Client? Y (N) Field Data Required? Y (N)

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

NOTE LAB PM SIGN-OFF

Project Manager Review: _____ Date: 2/14/13

F-KS-C-003-Rev 7, 04December2012

Level 2 Report Deliverables

Cover/Signature Page
Table of Contents
Report Narrative
Executive Summary
Method Summary
Method/Analyst Summary
Sample Analtytical Data Sheets
Surrogate Recovery Report (may be with each separate analysis)
QC Reports (Method Blanks, LCS, LCSD, MS/MSD)
Method Blank Report (should be one for each analytical method)
Initial and Continuing Calibration Blanks (Metals Inorganic Fractions)
Pre-Digestion Matrix Spike Recoveries Summary (Metals Inorganic Fractions)
QC Batch / Sample Association Summary
Glossary / Qualifiers (batch and analyte runs)
Sample Receipt Checklist
Client Chain of Custody

Note: The report deliverables may vary by laboratory

Acronyms:
DF = Dilution Factor
DUP - Duplicate
J = Estimated quantity (> MDL but < RL)
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
MDL = Method Detection Limit
MS = matrix spike
MSD = matrix spike duplicate
ND = not detected at or above the reporting limit
RL = Reporting Limit
RSD = Relative Percent Difference
S = Surrogate
U = Undetected

Analytical Method / Hold Time Chart

Analyses	Matrix	Method	Container	Temperature	Preservative	Holding Time
INORGANICS						
Biocehmical Oxygen Demand (BOD)	W or WW	405.1	1 L/AG	Cool, 4°C		DAYS 2
Anions: Bromide, Chloride, Fluoride, Nitrate, Nitrite, Ortho-Phos and Sulfate	W or WW	300/4500	500 mL/P			2 for NO_2, NO_3, OrthoP; all others 28
	S or SW	9056	4 oz./G	Cool, 4°C		28
Cyanide	W or WW	335.2/4500	1 L/P		NaOH, pH>12	14
	S or SW	9010A	4 oz./G	Cool, 4°C		14
Mercury	W or WW	245.1	500 mL/P		HNO_3, pH<2	28
	S or SW	7470/7471	4 oz./G	Cool, 4°C		28
Total Metals ICP/ICP-MS	W or WW	200.7/200.8	500 mL/P		HNO_3, pH<2	180
	S or SW	6010B	4 oz./G	Cool, 4°C		180
TCLP Metals	S or SW	1311/6010/7471	8 oz./G	Cool, 4°C		14 (Leach) 180 (on extract)
ORGANICS						
BTEX / GRO (Gasoline Range Organics)	W or WW	8021/8015	4 x 40 mL Voa Vial	Cool, 4°C	HCl, pH<2	14
	S or SW	8021/8015	4 oz./G	Cool, 4°C		14
Oil & Grease and / or TPH	W or WW	1664	1 L/AG each	Cool, 4°C	H_2SO_4, pH<2	28
	S or SW		8 oz./G			28
DRO (Diesel Range Organics)	W or WW	8015	1 L/AG each	Cool, 4°C		7
	S or SW		8 oz./G			14
Volatile Organic Compounds (VOCs)	W or WW	524/624/8260	Vial	Cool, 4°C	HCl, pH<2	14
	S or SW	8260	4 oz./G			14
Organochlorine Pesticides and/or PCBs	W or WW	508/608/8081/8082	1 L/AG each	Cool, 4°C		7
	S or SW	8082	8 oz./G			14
Semivolatile Organics, Polynuclear Aromatics (PNAs/PAHs)	W or WW	625/8270	1 L/AG	Cool, 4°C		7
	S or SW	8270	8 oz./G			14
TCLP Semivolatiles, Pesticides, and Herbicides	S or SW	1311/8270/8081/8082/8151	8 oz./G	Cool, 4°C		14 (Leach) 7 (on extract)
TCLP Volatiles	S or SW	1311/8260	8 oz./G	Cool, 4°C		14 (Leach) 7 (on extract)
ICP Metals: Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Ni, Na, Pb, Se, Si, Sn, Sr, Tl, Ti, Vn, Zn ICP-MS Metals: Ag, Al, As, B, Ba, Be, Bi, Cd, Cr, Co, Cu, Hg, Mn, Mo, Ni, Pb, Se, Tl, U, Vn, Zn						

Abrreviations:

Analysis
BOD = biochemical oxygen demand
ICP = inductively coupled plasma
ICP-MS = inductively coupled plasma mass spectrometry
TCLP = toxicity characteristic leaching procedure
BTEX = benzene, toluene, ethylbenzene, xylenes
GRO = gasoline range organics
TPH = total petroleum hydrocarbons
DRO = diesel range organics
VOCs = volatile organic compounds
PCBs = polychlorinated biphenyls
PNAs = polynuclear aromatics
PAHs = polynuclear aromatic hydrocarbons

Matrix
W = water
WW = wastewater
S = soil/sediment
SW = solid waste

Container
L = liter
AG = Amber Glass
mL = milliliter
P = plastic
oz = ounce
G = glass

Preservative
HCl = hydrochloric acid
HNO_3 = nitric acid
NaOH = sodium hydroxide
H_2SO_4 = sulfuric acid
TSP = Trisodium phosphate

Metals
Ag = Silver
Al = Aluminum
As = Arsenic
B = Boron
Ba = Barium
Be = Beryllium
Bi = Bismuth
Ca = Calcium
Cd = Cadmium
Co = Cobalt
Cr = Chromium
Cu = Copper
Fe = Iron
Hg = Mercury
K = Potassium
Li = Lithium
Mg = Magnesium
Mn = Manganese
Mo = Molybdenum
Na = Sodium
Ni = Nickel
Pb = Lead
Se = Selenium
Si = Silicon
Sn = Tin
Sr = Strontium
Ti = Titanium
Tl = Thallium
U = Uranium
Vn = Vanadium
Zn = Zinc

QA/QC Review of Laboratory Analytical Reports

Sampling Event: Lab Project No:	Project Site Name: Site City, State:	Laboratory Used: Lab City, State:	Report Reviewed By: Date:

QA/QC Checklist

Yes	No	N/A	
☐	☐	☐	Raw data have been transferred to project directory (PDF, EDD).
☐	☐	☐	Invoice approved and given to accounting.
☐	☐	☐	Chain-of-Custody (COC) has been signed/dated as received by laboratory.
☐	☐	☐	Confirm the project information was entered appropriately on the COC.
☐	☐	☐	Review laboratory comments on the COC (ie cooler temperature, sample conditions), as well as the lab-completed "COOLER RECEIPT FORM. Unusual Conditions: YES ☐ NO ☐ If YES, list conditions on page 2
☐	☐	☐	Verify that all samples sent to the laboratory were analyzed and results reported.
☐	☐	☐	Verify proper sample holding times were observed for the particular analysis/parameter.
☐	☐	☐	Were Duplicate or Split samples collected? YES ☐ NO ☐ If so, compare to the primary sample, note discrepancies on Page 2.
☐	☐	☐	Analytical data checked for anomalies and compared to applicable target levels and historic data.
☐	☐	☐	Laboratory provided appropriate QA/QC deliverables as requested on the COC (i.e. Level 1 – Level 4).
☐	☐	☐	Analytical results in the PDF format match the EDD (if provided).
☐	☐	☐	Required reporting limits met for all samples/analytes. If not, explain discrepancies and how resolved with laboratory on Page 2.
☐	☐	☐	Reported QA/QC data provide acceptable results for laboratory spikes, surrogates, and duplicates with all RPD values within limits***.
☐	☐	☐	Reported QA/QC data provide acceptable results for Laboratory Control Samples (LCS) and Method/Equipment Blanks***.
☐	☐	☐	Field, Trip, and Rinsate Blanks report acceptable results***.

*** Describe all QA/QC and Blanks discrepancies on Page 2

QA/QC Review of Laboratory Analytical Reports

Project / #:_____ Lab Project # _____ Date: _____

Summary of QA/QC Observations

Sample ID	Lab Proj #	Observation	Requested Action	Comments

Prepared by: April Brennan	Approved by: RML as DRAFT	Review Date:

1.0 OBJECTIVE / APPLICABILITY

This standard operating procedure (SOP) delineates the process for characterizing and managing wastes generated during corrective action activities conducted by Environmental Works, Incorporated, and their subcontractors.

This procedure is limited to the planning, implementation, and management activities for all wastes generated by the project, and the preparation, approval, and retention of all required documentation associated with waste generation, management, and disposal. The project manager should assume that wastes generated during an investigation will require compliance with federal requirements for generation, storage, transportation, or disposal. In addition, there may be state regulations that govern the disposal action.

The work plan for a site investigation must include a description of control procedures for contaminated materials. This plan should assess the type of contamination, estimate the amounts that would be produced, describe containment equipment and procedures, and delineate storage or disposal methods. Adequate budget must be allocated for these purposes. As a general policy, it is wise to select investigation methods that minimize the generation of contaminated materials. The handling and the disposing of potentially hazardous materials are expensive; however, the consequences and penalties for improper handling are significant.

2.0 DEFINITIONS

2.1 **Accumulation date** – the date a hazardous waste is first generated, or the date that hazardous waste collected in a satellite accumulation are exceeds: (a) 55 gallons of hazardous waste, or (b) 1 kilogram of acute hazardous waste, or (c) 100 kilograms of any residue or contaminated soil, waste, or other debris resulting from the cleanup of a spill, into or onto any land or water of any acute hazardous waste.

2.2 **Acute hazardous waste** – Environmental Protection Agency (EPA) hazardous waste number designated with an (H) in the "hazard code" column of Title 40, Code of Federal Regulations (40 CFR) 261.31-33.

2.3 **Area of contamination (AOC)** – A certain discrete area of generally dispersed contamination which is considered to be equivalent to a RCRA unit. Because an AOC is equated to a RCRA unit, consolidation or treatment within the AOC does not create a new point of hazardous waste generation for purposes of RCRA.

2.4 **By-product material** – Radioactive material resulting from producing or processing nuclear materials.

2.5 **Code of Federal Regulations (CFR)** – The CFR is a codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government. The CFR is divided into 50 "titles", which represent broad areas subject to federal regulation. Each title is divided into chapters, which usually bear the name of the issuing agency.

2.6 **Commercial Chemical Product** – A chemical substance that is manufactured or formulated for commercial or manufacturing use.

2.7 **Committed dose equivalent** – The predicted dose equivalent to a tissue or organ over a 50-year period after an intake of a radionuclide into the body. It does not include dose contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert).

2.8 **Committed effective dose equivalent (CEDE)** – The sum of the committed dose equivalents to various organs or tissues in the body from radioactive material taken into the body, each multiplied by the tissue-specific weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

2.9 **Construction and demolition debris** – Materials generally considered to be not water soluble and non-hazardous in nature, including, but not limited to, steel, glass, brick, concrete, asphalt roofing materials, pipe, gypsum wallboard, lumber, and other materials discarded during the construction or destruction of a structure or project. Construction and demolition debris also includes rocks, soil, tree remains, trees, and other vegetative matter that normally results from land clearing.

2.10 **Department of Transportation (DOT)** – Federal agency that oversees all national transportation systems and regulates the transport of hazardous materials.

2.11 **Environmental media** – Borehole cuttings and core, soil, rock, sediments, surface water, and groundwater that are displaced during corrective action.

2.12 **Hazardous constituent (hazardous waste constituent)** – (1) a constituent that causes the administrative authority to list the hazardous waste in 40 CFR Part 261, Subpart D, or a constituent listed in Table 1 of 40 CFR Part 261.24; (2) According to the March 1, 2005, Compliance Order of Consent (Consent Order), any constituent identified in Appendix VIII of Part 261.

2.13 **Hazardous waste** – 1) solid waste (as defined in 40 CFR 261.2 and incorporated by 20.3.1.200 NMAC) that is not excluded from regulation as a hazardous waste and is a listed waste (as provided in 40 CFR Part 261, Subpart D) or a waste that exhibits any of the characteristics of hazardous waste (i.e. ignitability, corrosivity, reactivity, or toxicity, as provided in 40 CFR Part 261, Subpart D).

2.14 **High-level waste** – A highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

2.15 **Incompatible waste** – A waste that can cause corrosion or decay of containment materials, or is unsuitable for comingling with another waste or material because a dangerous reaction might occur. See 40 CFR Part 265, Appendix V for more examples.

2.16 **Industrial waste** – Solid waste generated by manufacturing or industrial processes that is not hazardous waste regulated under Subtitle C of RCRA.

2.17 **Investigative-derived waste (IDW)** – Solid or hazardous waste that was generated as a result of investigation and/or characterization corrective action activities. IDW may include drilling muds, cuttings, and purge water from test put and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE), and solutions (aqueous

or otherwise) used to decontaminate non-disposable PPE (EPA Office of Solid Waste and Emergency Response, Publication 9345.3-03FS, January 1992).

2.18 **Large Quantity Generator** – A business that generates more than 2,200 lbs (1,000 kg) per month of hazardous waste.

2.19 **Low-level waste** – Radioactive waste that is not classified as high-level waste, spent nuclear fuel, transuranic (TRU) waste, by-product material (as defined in section 11e(c) of the Atomic Energy Act of 1954, as amended), or naturally occurring and accelerator-produced radioactive material.

2.20 **Material Safety Data Sheet (MSDS)** – Chemical manufacturers and importers prepare detailed technical bulletins called Material Safety Data Sheets about the hazards of each chemical they produce and import. Suppliers must send an MSDS at the time of the first shipment of the chemical and any time the MSDS is updated with new and significant information about the hazards. MSDSs include information about components and contaminants, including exposure limits, physical data, fire and explosion hazards, toxicity, and health hazard data. It also discusses emergency and first aid procedures and information about storage and disposal and spill or leak procedures.

2.21 **Mixed waste** – Any waste containing both hazardous waste and source, special nuclear, or by-product materials subject to the Atomic Energy Act of 1954.

2.22 **Naturally occurring and accelerator-produced radioactive material** – Radioactive materials that are considered either naturally occurring and are not source, special nuclear, or by-product material or are produced in a charged particle accelerator.

2.23 **Non-radioactive waste** – Waste that meets the ISD 121-1.0, Table 14-2 release criteria for both surface and volume contamination.

2.24 **Polychlorinated biphenyl (PCB)** – Any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances which contains such substance.

2.25 **PCB remediation waste** – Waste containing PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations:

- Materials disposed of prior to April 18, 1978, that are currently at concentrations where the original source was greater than or equal to 500 parts per million (ppm) PCBs, regardless of the concentration of the original spill;
- Materials that are currently at any volume or concentration where the original source was greater than or equal to 500 ppm PCBs beginning on April 18, 1978, or greater than or equal to 50 ppm beginning on July 2, 1979; and,
- Materials that are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under 40 CFR Part 761.

PCB remediation waste means soil, rags, and other debris generated as a result of any PCB spill cleanup, including, but not limited to:

- Environmental media containing PCBs, such as soil and gravel; dredge materials (e.g., sediments); settled sediment fines; and aqueous decantate from sediment;

- Sewage sludge containing less than 50 ppm PCBs and that is not a use regulated by 40 CFR Parts 257, 258, and 503;
- PCB sewage sludge;
- Commercial or industrial sludge contaminated as the result of a spill of PCBs including sludges located in or removed from any pollution control device or aqueous decantate from an industrial sludge;
- Building or other man-made structures (such as concrete floors, wood floors, or walls contaminated with a leaking PCB or PCB-contaminated transformer), porous surfaces, and non-porous surfaces.

2.26 **Publicly Owned Treatment Works (POTW)** – A municipal wastewater treatment plant that receives wastewater through the public sewer from households, office buildings, factories, and industrial facilities, and other places where people live and work.

2.27 **Radioactive waste** – solid, liquid, or containerized gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and is of negligible economic value, considering costs of recovery. Radioactive waste has radioactive surface contamination or volume contamination in excess of the ISD 121-1.0 Table 14-2 release criteria.

2.28 **Radiological controlled area (RCA)** – Any area to which access is managed to protect individuals from exposure to radiation or radioactive materials.

2.29 **Recycled** – A material that is used, reused, or reclaimed.

2.30 **Reclaimed** – A material that is processed to recover usable products or is regenerated.

2.31 **Satellite accumulation area** – A designated space for accumulating hazardous and mixed waste where the volume of waste shall not exceed 55 gallons or the volume of acutely hazardous/mixed waste shall not exceed 1 kilogram (40 CFR 262.34).

2.32 **Segregate** – To separate wastes that can be managed together based on similar characteristics and ultimate handling approach (such as radioactively contaminated vs. non-radioactive waste).

2.33 **Site-Specific Health and Safety Plan (SSHASP)** – A health and safety plan that is specific to a site or ER-related field activity that has been approved by an ER health and safety representative. This document contains information specific to the project, including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g. PPE) and hazard mitigation.

2.34 **Solid waste** – Any garbage, refuse, sludge, from a waste treatment plant, water-supply treatment plant, or air-pollution control facility or other discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities.

2.35 **Spent material** – Any material that has been used and, as a result of contamination, can no longer serve the purpose for which it was produced without first processing it.

2.36 **Small Quantity Generator (SQG)** – A business that generates between 220 and 2,200 lbs (100 and 1,000 kg) per month of hazardous waste.

2.37 **Sludge** – Any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial waste-water treatment plant, water supply treatment plant, or air pollution control facility, exclusive of the treated effluent from a wastewater treatment plant.

2.38 **Treatment, Storage, and Disposal Facility (TSDF)** – Refers to a facility that treats, stores, or disposes of hazardous waste; TSDFs have specific requirements under RCRA.

2.39 **Volatile Organic Compounds (VOCs)** – VOCs are highly evaporative organic gases that can be produced during the manufacture or use of chemicals such as paints, solvents, and cleaners.

2.40 **Waste generator** – Any person, by site, whose act or process produces hazardous waste or whose act first causes a hazardous waste to become subject to regulation (40 CFR 260.10).

Note: The definition above is specific to hazardous waste because it is defined in the hazardous waste management regulations. In this SOP "any person" means EWI personnel or their sub-contractors.

3.0 SCOPE

Wastes generated by personnel of Environmental Works, Incorporated, and their sub-contractors, include hazardous waste, mixed hazardous waste, industrial waste, and municipal solid waste. Environmental media (e.g. soil, tuff, and groundwater) may fall into any of the above regulatory classifications.

Waste management activities are implemented in the field through a site-specific work plan. Documentation and characterization requirements beyond those described in this procedure may exist for treatment, storage, and disposal (TSD) facilities.

The procedures for the different categories of investigation derived waste (IDW) described in this document are to be used by EWI personnel to manage the IDW generated during site investigations. On the occasion that EWI personnel determine that any of the procedures described in this SOP are inappropriate, inadequate or impractical and that another procedure must be used to manage IDW generated at a particular site, the variant procedure will be documented in the field log book and final report, along with a description of the circumstances requiring its use.

4.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Personnel of EWI, by the requirements of their job descriptions and through ongoing training, are qualified to perform the task required by this procedure.

4.1 Project Manager

The Project Manager provides the Field Manager with a Project Assignment form and a site-safety plan (see Appendix A) for waste management and the Equipment Manager with a checklist of equipment needed for the procedure (see Appendix A). The Project Manager oversees on-site safety of the field crew and completion of the waste management.

4.2 Field Manager

The Field Manager works with the Project Manager to schedule the waste management procedure.

4.3 Equipment Manager

The Equipment Manager gathers the equipment needed for the waste management procedure, and troubleshoots problems with the equipment.

4.4 Field Technician

The field technician follows the guidance of the Project Manager in proper management of waste disposal.

5.0 TYPES OF INVESTIGATION DERIVED WASTE (IDW)

Materials which may become IDW include, but are not limited to:

(1) PPE – This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.;
(2) Disposable equipment and items – this includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.;
(3) Soil cuttings from drilling or hand augering;
(4) Drilling mud or water used for mud or water rotary drilling;
(5) Trash;
(6) Groundwater obtained through well development or well purging;
(7) Cleaning fluids such as spent solvents and wash water; and,
(8) Packing and shipping materials.

Table 1.0 (see Appendix B) lists the types of IDW commonly generated during field investigations and the current disposal practices for these materials.

For the purpose of determining the ultimate disposition of IDW, it is typically distinguished as being either hazardous or non-hazardous. This determination is based on either clear regulatory guidance or by subsequent analysis. This determination and subsequent management is the responsibility of the Project Manager.

6.0 SOURCES OF CONTAMINATED MATERIALS AND CONTAINMENT METHODS

6.1 Decontamination Solutions

Decontamination solutions and rinses must be assumed to contain the chemicals associated with the site, which could either be hazardous or non-hazardous. The solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment requires cleaning.

6.1.1 Decontamination Solutions containing Hazardous Waste(s)

Small amounts of rinse solutions, such as those generated by the personnel decontamination station (PDS), are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. As a rule of thumb, use of a temporary PDS will generate 55 to 110 gallons of decontamination solution per day for every five persons using it. If the amounts generated by a PDS exceed one or two 55-gallon drums each day, a larger capacity above ground storage vessel, such as a fiberglass tank or collapsible rubber bladder, should be considered. If individual drums are used, they should be marked with sufficient information so that personnel can determine what contaminants may be present. This information should be based on analytical results fro the sampling campaign.

Larger equipment, such as backhoes and tractors, must be decontaminated in an area that has a method of controlling and collecting the spent fluids. A decontamination area for large equipment can consist of a shallow depression lined with plastic which is covered with clean sand or gravel, or the area may be a bermed concrete pad with a floor drain leading to a holding tank. The amounts generated by typical equipment cleaning devices usually exceed 500 gallons per cleaning. Spill prevention and containment measures should be I mplemented for larger fluid containers, or if many drums of fluid are left on-site. Protection from vandals is also needed.

6.2 Disposable Equipment

6.2.1 Disposable Equipment containing Hazardous Waste(s)

Disposable equipment that could be contaminated during a site investigation typically includes tools, rubber gloves, boots, broken sample containers, and chemically resistant clothing. These items are small and can easily be contained in 55-gallon drums with removable lids. Secure containment within the

containers is provided by sealing them at the end of each work day and upon project completion. Additionally, containers are labeled in accordance with the applicable Department of Transportation (DOT) regulations on hazardous materials under 49 CFR 172.304. Adequate protection from vandals, theft, and adverse must be provided for all containers.

6.2.2 Disposal Equipment containing Non-Hazardous Waste(s)

EWI personnel should follow procedures outlined in section 6.2.1 for disposing of equipment containing non-hazardous waste, except this waste is not regulated under 49 CFR 172.304.

6.3 Drilling Muds and Well-Development Fluids

Drilling muds and well development fluids are materials used when installing groundwater monitoring wells. Their use could result in the surface accumulation of contaminated liquids and solids that require containment. Monitoring wells are often placed in uncontaminated areas to determine if hazardous chemicals have migrated below ground. Materials from these wells require especially careful management since they threaten contamination of otherwise clean property.

The volume of drilling and well-development fluids requiring containment will depend on the number of wells, diameters and depths, groundwater characteristics, and geologic formations. There are no simple mathematical formulas available for accurately predicting these volumes. It is best to rely on the experience of hydrogeologists and/or reputable well drillers who are familiar with the local conditions and the well installation techniques selected. These individuals should be able to estimate the volume of contaminated fluid to be contained.

Drilling fluid (mud) is mixed and stored in a container commonly referred to as a mud pit. This mud pit consists of a suction section from which drilling fluid is withdrawn and pumped through hoses down the drill pipe to the bit and then back up the hole to the settling section of the mud pit. In the settling section, the fluid velocity is reduced by a screen and by several flow-restriction devices, thereby allowing the well cuttings to settle out of the fluid.

The mud pit may be either a portable aboveground tank, commonly made of steel, or a stationary/pit that is in the ground. The aboveground tanks have a major advantage over pits in the ground because the tanks isolate the contaminated fluids from the surface environment. The tanks are also portable and can usually be cleaned easily.

As the well is drilled, the sediments that accumulate in the settling section must be removed. Removal is best done by shoveling sediments into drums or other similar containers. When the drilling is complete, the contents of the above ground tank are likewise shoveled or pumped into drums, and the tank is cleaned and made available for reuse.

If in-ground pits are used, they shall not extend into the natural water table. They shall also be lined with a bentonite-cement mixture followed by a layer of flexible impermeable material such as plastic sheeting. To maintain its impermeable seal, the material used must be nonreactive with the contaminants. An advantage of the in-ground pit is that well cuttings do not necessarily have to be removed periodically during drilling because the pit can be made deep enough to contain them. Depending on site conditions, the in-ground pit may have to be totally re-excavated and refilled with uncontaminated natural soils when the drilling operation is complete.

When the aboveground tank or the in-ground pit is used, a reserve tank or pit should be located at the site as a backup for leaks, spills, and overflows. In either case, drainage shall be such that any excess fluid can be controlled within the immediate area of the drill site. In-ground pits must also be barricaded and lighted to prevent accidents.

The containment procedure for well-development fluids is similar to that for drilling fluids. The volume and weight of contaminated fluid will be determined by the method of development. When a new well is bailed to produce clear water, substantially less volume and weight of fluid will result, than when backwashing or high-velocity jetting is used.

6.4 Spill-contaminated Materials

A spill is always possible when a site investigation involves opening and moving containers of liquids. Contaminated sorbents and soils resulting from spills will have to be contained and cleaned up. Small quantities of spill-contaminated materials are usually best contained in drums while larger quantities can be placed in lined pits or in other impermeable structures. In some cases, onsite containment may not be feasible and immediate transport to an approved disposal site will be required.

7.0 MANAGEMENT OF NON-HAZARDOUS IDW

Disposal of non-hazardous IDW should be addressed in the project assignment for the investigation. To reduce the volume of any IDW transported back to the office, it may be necessary to compact the waste into a reusable container, such as a 55-gallon drum.

If the waste is from an active facility, permission should be sought from the operator of the facility to place the non-hazardous PPE, disposable equipment, and/or paper/cardboard into the facilities' dumpsters. If necessary, these materials may be placed into municipal dumpsters with the permission of the owner. These materials may also be taken to a nearby permitted landfill. On larger studies, waste hauling services may be obtained and a dumpster located at the site.

Disposal of non-hazardous IDW such as drill cuttings, purge or development water, decontamination wash water, drilling mud, etc., should be specified in the approved project assignment. These materials should be placed into a unit with an environmental permit, such as a landfill or sanitary sewer. **These materials must not be placed into dumpsters**.

The minimum requirements for this subsection are:

(1) Under no circumstances should monitoring well purge water be placed back into the well from which it came. The water should be disposed of accordingly.
(2) Soap and water decontamination fluids and rinsates of such cannot be placed in any water bodies and must be collected for proper disposal.
(3) The collection, handling, and proposed disposal method must be specified in the project assignment.

8.0 MANAGEMENT OF HAZARDOUS IDW

8.1 Defining Hazardous Waste(s)

A waste is any solid, liquid, or contained gaseous material that is discarded by being disposed of, burned or incinerated, or recycled (there are some exceptions for recycled materials). It can be the by-product of a manufacturing process or simply a commercial product that is used in a business (e.g. cleaning fluid or battery acid).

Hazardous waste can be one of two types:

(1) Listed waste. Waste is considered hazardous if it appears on one of four lists published in the Code of Federal Regulations (40 CFR Part 261). Currently, more than 500 wastes are listed. Wastes are listed as hazardous because they are known to be harmful to human health and the environment when not managed properly.

Even when managed properly, some listed wastes are so dangerous that they are called acutely hazardous wastes. Examples of acutely hazardous wastes include wastes generated from pesticides and that can be fatal to humans even in low doses.

(2) Characteristic waste. If the waste does not appear on one of the hazardous waste lists, it still might be considered hazardous if it demonstrates one or more of the following characteristics:

- It catches fire under certain conditions. This is known as ignitable waste. Examples are plaints and certain degreasers and solvents.
- It corrodes metals or has a very high or low pH. This is known as a corrosive waste. Examples are rust removers, acid or alkaline cleaning fluids, and battery acid.
- It is unstable and explodes or produces toxic fumes, gases, and vapors when mixed with water or under other conditions such as heat or pressure. This is known as a reactive waste. Examples are certain cyanides or sulfide-bearing wastes.
- It is harmful or fatal when ingested or absorbed, or it leaches toxic chemicals into the soil or ground water when disposed of on land. This is known as a toxic waste. Examples are wastes that contain high concentrations of heavy metals, such as cadmium, lead, or mercury.

8.2 Accumulating Waste On-Site

Accumulating hazardous waste on-site can pose a threat to human health and the environment, so it can only remain for a short time without a permit. Sites that are small quantity generators (SQGs) can accumulate no more than 13,228 lbs (6,000 kg) of hazardous waste on-site for up to 180 days without a permit. The amount of time can increase to 270 days if the generator must transport it more than 200 miles away for recovery, treatment, or disposal.

On-site hazardous waste must be accumulated in storage tanks and containers and managed according to EPA requirements summarized below:

(1) Label each container appropriately (see the hazardous waste EWI specialist to obtain proper labeling information);
(2) Use a container made of, or line with, a material that is compatible with the hazardous waste to be stored;
(3) Keep all containers holding hazardous waste closed during storage, except when adding or removing waste. Do not open, handle, or store (e.g. stack) containers in a way that might rupture them, cause them to leak, or otherwise fall; and,
(4) Do not mix incompatible wastes or materials, including mixing non-hazardous waste with hazardous waste.

8.3 Shipping Waste Off-Site

All hazardous waste has to be sent to a regulated Treatment, Storage, and Disposal Facility (TSDF) or recycler. Most regulated TSDFs and recyclers will have a permit fro the state or EPA. Some, however, may operate under other regulations that do not require a permit. Check with the appropriate state authorities to be sure the facility you select has any necessary permits. All TSDFs and recyclers must have EPA identification numbers.

Project Manager's must ensure that waste is properly packaged, labeled, marked hazrdous, and shipped in a vehicle placard for hazardous waste following Department of Transportation (DOT) regulations. For additional information, consult the DOT regulations (49 CFR Parts 172 and 173) or call the DOT hazardous materials information line at 202-366-4488 or 1-800-467-4922.

8.4 Preparing Hazardous Waste Manifests

The Hazardous Waste Manifest System is a set of forms, reports, and procedures designed to seamlessly track hazardous waste from the time it leaves the generator until it reaches the off-site waste management facility that will store, treat, or dispose of the hazardous waste. The system allows the waste generator to verify that its waste has been properly delivered and that no waste has been lost or unaccounted for in the process.

The key component of this system is the Uniform Hazardous Waste Manifest, which is a multipart form prepared by most generators that transport hazardous waste for off-site

treatment, recycling, storage, or disposal. The manifest is required by both the DOT and EPA. When completed, it contains information on the type and quantity of the waste being transported, instructions for handling the waste, and signatures of all parties involved in the off-site treatments, recycling, storage, or disposal process. Each party also must retain a copy of the manifest. This process ensures critical accountability in the transportation and disposal process. Once the waste reaches its destination, the receiving facility returns a signed copy of the manifest to the generator, confirming that the waste has been received. An example of a hazardous waste manifest is included as Appendix C. **All hazardous waste shipments must be accompanied by a hazardous waste manifest**.

9.0 SAFETY

Acute or chronic exposure to petroleum-contaminated soil could result in bodily injury. Routes of exposure include inhalation, ingestion, and dermal contact. Consult the appropriate chemical material safety data sheet (MSDS) before the initiation of soil sampling. The appropriate MSDS' are located in the Field Manager's office.

Conduct an on-site safety meeting each day before the start of the project. Review safety hazards (e.g. high-traffic areas, exposure to chemicals, alertness to heavy equipment). Have all personnel sign the Site Safety Meeting log (see Appendix A) each day before the start of the project. Take appropriate action if personnel are injured on-site.

When working with potentially hazardous substances, follow the United States Environmental Protection Agency (US EPA), Occupational Safety and Health Administration (OSHA), or EWI Corporate Health and Safety Plan.

10.0REFERENCES

(1) SW-846 EPA publication "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm

(2) "Memorandum: Clarification Regarding Use of SW-846 Methods" http://clu-in.org/goto.cfm?link=%2Fproducts%2Fregs%2Fsw846.htm

(3) "Corporate Health and Safety Plan" Environmental Works, Incorporated.

(4) "HAZWOPER Training Manual: 40-Hour Hazardous Waste & Emergency Response Training." Safety Source, Inc.

APPENDIX 4

EXAMPLE FORMS

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 High Street, Springfield, Missouri

AUTO RECORD PTX DOWNLOADING FORM

ENVIRONMENTAL WORKS

Log into download software. Connect to device.
Intial Set up: Install PTX, note depth BTOC & manual WL.
Follow up downloading: Download and view data. Verify depth of cable.

WELL

DOWNLOAD RECORD

	PSI Range	PTX Depth BTOC	APTX Elevation
S/N:			

Date installed:

Personnel:

Site:	
Log File:	

Parameters ☐ Pressure ☐ Temp ☐ Depth

Downloaded By:	DATE	TIME	MANUAL WATER LEVEL	BARO PRESSURE

NOTES:

ENVIRONMENTAL WORKS

Field Telog / Transmitter Set Up

Well ID: _____ Date: _____

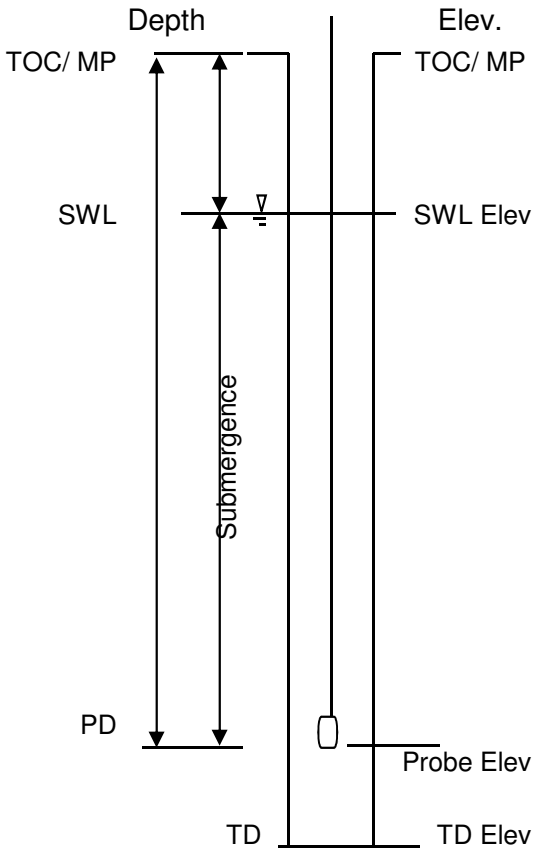
Telog S/N & Channel: _____ Ch: _____ Project: _____

Probe Serial Number: _____ Personnel: _____

Transmitter Range: _____ psi = _____ ft (psi x 2.31) Total Well Depth: _____ feet

Telog Battery Volts: _____ v DC

Battery Changed? yes no



TRANSMITTER SCALING

	Previous Data	Current Data
Top of Casing/MP Elev:		
Cable Length:		
Elev of Probe:		
Top of Casing/MP Elev:		
- SWL:		
SWL Elev:		
SWL Elev:		
- Elev of Probe:		
Submergence (subm):		
mAmp at probe depth:		
mAmp at zero submergence:		

Zero submergence should be ~ 4 mAmps

Manual SWL Elev:		
Electronic SWL Elev:		
△		

Difference must be within +/- 0.05 ft

Recal Needed? yes no

Recal Good? yes no

Example Computer Input

	mAmp	ft elev
0 psi	reading 1	PD elev
PD psi	reading 2	SWL elev

Actual Computer Input

	mAmp	ft elev
0 psi		
PD psi		

mAmp SCALING

User Units	Format
mAmps	#0.0#
Ch Pt 1	User Pt. 1
4	4
Ch. Pt. 2	User Pt. 2
20	20

CAL FORMAT

User Units	Format
Ft Elev	#,##0.0#
Ch Pt 1	User Pt. 1
0 mAmp	PD elev
Ch. Pt. 2	User Pt. 2
PD mAmp	SWL elev

NEW CAL VALUES

0 sub mA			PD elev
PD sub mA			SWL elev

OLD CAL VALUES

ENVIRONMENTAL WORKS

LOG OF BORING / WELL NO:

SHEET NUMBER OF

PROJECT NAME:	DRILLING/PROBING CONTRACTOR:
PROJECT LOCATION:	DRILLING METHOD / BORE DIAMETER:
	SAMPLING METHOD:
PROJECT NUMBER:	TOTAL DEPTH (feet):
GEOLOGIST:	START DATE:
DRILLER:	COMPLETION DATE:

Water Level Data

Date	***Depth***

Survey Data

Ground Surface:

Top Of Casing:

SAMPLE AND TIME	**PID** (PPM)	**RECOVERY** (FEET)	**DEPTH** (FEET)	**WELL CONSTRUCTION**	GEOLOGIC DESCRIPTION (NAME, color, particle size, characteristics)	*NOTES:*

LEGEND: *SS - Split Spoon* *PID - Photoionization Detector* *- Concrete* *- Fill* *- Limestone* *- Sand* *ST - Shelby Tube* *HSA - Hollow Stem Augers*

ENVIRONMENTAL WORKS

Confined Space Entry Log

1. Employees have been informed that the entry into this space is an OSHA Permit Required Confined Space (Hazardouns atmospheric conditions, e.g. oxygen deficiency, harful or toxic airborne such as hydrocarbon vapors, H2S, etc, A potentional for engulfment, A configuration that can entrap, Any serious safety or health hazard that may exist)?

☐ Yes ☐ No

If answer to the above question is YES, list all hazards that make this an OSHA Permit Required Confined Space with Hazardous Environments.

Company Name	Entrant's Name (Print)	Time In	Time Out
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
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		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM
		☐ AM ☐ PM	☐ AM ☐ PM

If any NEW hazards were found or created during entry, please list:

Project:
Date:

Pre-Planning Checklist- GROUNDWATER SAMPLING

	ITEM	NOTES
	Confirm date with EWI personnel	
	Confirm date with client	
	Contact Off-site property owner(s)	
	Notify PSTIF (>5 days)	
	Notify MDNR representative	
	Order sample kits from lab	
	Received sample kits from lab	
	Confirm analyte list	
	Contact Off-site property owner(s)	
	Copy of approved budget	
	Vehicle request	
	Order QED supplies for low flow	
	WRF packet assembled	
	Supplies check list	
	HASP	
	Extra COC and labels	
	Soil & GW analytical tables, SWL table	

Post-Sampling Checklist

	ITEM	NOTES
	Samples to lab	
	Upload photo documentation	
	Check SAF	
	Update WL table	
	Receive GW results	
	QA/QC reports	
	Update analytical tables	

Notes:

Environmental Works, Inc.

Daily Equipment Log

Revised 11/25/15

PM Approval & Date

Date:	Project ID:	Phase ID:
Project Description:		Project Manager:

PERSONNEL

EMPLOYEE NAMES	Position	Start	End	BREAKS	TOTAL	Per Diem
						[ ]
						[ ]
						[ ]
						[ ]
						[ ]
						[ ]

LICENSED VEHICLES

DESCRIPTION	UNIT	USED
Field Vehicle (enter truck #s used):		
Dump Truck	per hour	
Liquid Vacuum Truck (3,000 gal cap)	per hour	
Air-Moving Vacuum Truck (Guzzler)	per hour	
Air-Moving Vacuum Truck (Hi-Rail)	per hour	
Combo Unit (Guzzler/Jetter)	per hour	
End Dump w/ Tractor	per hour	
Tanker w/ Tractor	per hour	
Roll-off Trailer w/ Tractor	per hour	

TRAILERS & OFFROAD VEHICLES

DESCRIPTION	UNIT	USED
Gator	per day	
All Terrain Vehicle (ATV)	per day	
Hydraulic Dump Trailer	per day	
Response Trailer – 26'	per day	
Lo-Boy Trailer	per day	
Flat Bed Trailer (18')	per day	
Tilt Bed Trailer	per day	
Gooseneck Flatbed Trailer	per day	

PERSONAL PROTECTIVE EQUIPMENT & SIGNS

PPE Level A, per hour, per person	per hour	
PPE Level B, per hour, per person	per hour	
PPE Level C, per day, per person	per day	
PPE Level D, per day, per person	per day	
Fall Protection Ensemble, per man	per day	
SCBA	per day	
Confined Space Assembly	per day	
Rubber gloves 11mil	per pair	
Leather Gloves	per pair	
Nitrile Gloves	per box	
Tychem QC Coveralls	each	
Tyvek Coveralls	each	
Safety Highway Sign	per day	
Safety Fence, 100'	per day	
Safety Barricades	per day	

EXPENDABLE SUPPLIES

55-Gallon Metal Drum DOT 17 H (Open Top)	each	
55-Gallon Poly Drum (Open Top)	each	
85-Gallon Overpack Drums	each	
Absorbent Boom 5" x 10'	each	
Absorbent Boom 8" x 10'	each	
Absorbent Pads	each	
Polyethylene Film 100' roll	per roll	
Silt Fence 3' x 100' roll	each	
Drum Liner/Burial Bag	each	
3/8" Discharge Tubing (Whale) - 100' roll	per roll	
Disposable Bailers (single-check valve)	each	
Oil Dry	per bag	
J-Plugs (note size: _____)	each	
PMD	per day	
Batch Tank: __Gasoline __Diesel Approx Gallons:		

DEMOLITION / DIRT-MOVING EQUIPMENT

DESCRIPTION	UNIT	USED
Backhoe	per hour	
Skid Steer	per hour	
Tractor	per day	
Grapple Bucket	per day	
Hitachi Excavator, 225	per hour	
Komatsu Excavator, 138	per hour	
Concrete Saw	per day	
Tractor Implements	per day	

INDUSTRIAL SERVICES/RESPONSE EQUIPMENT

Hydro Blaster	per day	
Liquid Vacuum Trailer	per hour	
Air-Moving Vacuum Trailer (Ditch Witch)	per hour	
Line Jetter	per day	
4K PSI Pressure Washer	per day	
7K PSI Pressure Washer	per day	
Heated Pressure Washer (Hotsy)	per day	
Combustible Dust Foamer	per day	
Negative Air Machine (2,000 CFM)	per day	
Air Compressor (Trailer Mounted)	per day	
Portable Air Compressor	per day	
Electric Blower (930 CFM)	per day	
Portable Generator	per day	
Light Stand	per day	
Explosion Proof Light	per day	
Pneumatic Blower (3500 CFM)	per day	
Pneumatic Vacuum (Tornado Vac)	per day	
Pneumatic Tank Saw (Nibbler)	per day	
Cutting Torch	per day	
Vacuum (HEPA)	per day	
Portable Storage Tank (polyethylene) - Volume -_____	per tank	
Pump - 1" Diaphragm	per day	
Pump - 2" Diaphragm	per day	
Pump - 2" Trash	per day	
Pump - 1" (Acid)	per day	
Multi-Gas Meter	per day	
Chain Saw	per day	
Leaf Blower	per day	
Weed Eater	per day	
Hand Tools	per day	
Emergency Response Boat	per day	

INVESTIGATION/REMEDIATION EQUIPMENT & INSTRUMENTS

Pump - Peristatlic	per day	
D.C. Purge Pump (Whale)	per day	
Electric Sampling Pump w/ Controller (Grundfos)	per day	
Low-Flow GW Sampling Controller & Pump	per day	
Pressure Transducer	per event	
Digital pH Meter	per day	
Dissolved Oxygen Meter	per day	
Hydac Water Quality Meter	per day	
Interface Probe	per day	
Organic Vapor Meter (PID)	per day	
Survey Equipment	per day	
Turbidity Meter	per day	
Water Level Indicator	per day	
YSI Water Quality Meter	per day	
XRF	per day	
Sampling Trailer (10')	per day	

Environmental Works, Inc.

Field Notes

Project ID/Phase ID:	Consultant:	Date:
Site Name:	Field Supervisor:	
General Work Description:		
Weather Conditions:		

TIME	SITE ACTIVITIES

EWI Field Work Request Form

Consultant: Bob Lanning **Current Date:** 12/17/15

EWI Client Code/Project #: EXPLORE #80419 Phase (multiple) **Client Name:**

Site Name: _ **Onsite Contact:** , property owner **Phone #:** 417-
, property owner

Project Location/Address: **F/W Due Date:**

Personnel Requested:	**Type**	**Code**	**Quantity**
	AS	_____	1
	AS / FT	_____	1
		_____	
		_____	
		_____	

Field Work Duration: 0 **Days** 8 **Hours**
Billing Type: Lump Sum ☐ T&M ☒
Billable O/T: Yes ☐ No ☒
Insurance Fund: Yes ☐ No ☒
Overnight Stay: Yes ☐ No ☒
Hotel Accommodations: Single ☐ Shared ☐

Purpose: All Water Levels, Waterloo Emitters /O2 Tank Checks , TROLL downloads, FP checks and recovery, YSI readings.

Scope of Work:

- Gather equipment and verify both parts of interface probe work (batteries good). Make sure laptop is charged and you have both download cables.
- Mobe to Pinkston - Visit Edwards Spring- check booms are clean and secure-note any visible free product and note any other conditions. Get YSI readings.
- Measure WLs MW-11B, download Trolls at MW-10B. Can also go to Pinkston N pasture NE corner and walk thru woods to download MW-8B and get WL at MW-9B.
- Mobilize to Grantham and park truck on Parrish side. Do not drive the truck on to Grantham property. Gate MUST remain closed and secured while you are on-site.
- Start Troll D/L at MW-7B, then 6A/6B, then 4AB, 8B (if not done from Pinkston), 2B, 1B. Measure WL and D/L Troll . D/L baro Troll at 1B! Measure WLs at 9B, 5B, 3A, 2A. Get YSI readings at wells per log form.
- Note flow at Pipeline drain and condition of ground (how wet), and grass height throughout site. Note condition of pillows in pipeline drain filter.
- At Trench Boxes, and MP-1 to MP-4, note product presence/absence and odors
- Check oxygen tanks and record pressures (psi) in MW-4AB, 2B, and1B. Purge lines. Pull WE and check condition, record in notes. Check connections before re-installing W.E. If an O2 tank is empty-make a note on the emitter form, remove the empty tank and return to EWI. At MW-1B conduct FPR BEFORE removing WE. Wrap an absorbent pad around a bailer to clear out any residual FP in MW-1B before removing W.E.
- MW-1B, use bailer to check FP. Pull Passive Skimmer and record amount of FP and water in it. Check hydrophobic element and condition of unit. Record FP amount recovered and place in tank. Get YSI readings
- If time permits, exchange any empty O2 tank at Airgas-collect correct documentation (1 returned, 1 shipped, e.g.) and sign/date. USE BOB LANNINGs account (Environmental Works Acct., Bob Lanning)

NOTE: Randy Grantham called 24 hours in advance: _____RML 12/17/15_____

NOTE: See Bob Lanning with any questions, call if unusual conditions found (office or cell 417-860-2625), and turn in all forms to Bob Lanning. Make copy of receipts for any purchases.

Equipment Requested	**Units**	**Chk**
Truck # _____	1	
Gator & trailer	set	
100' interface probe	1	
Paper towels and sprays (to clean/decon)	set	
Bailers & line	2	
Calibrated bucket	1	
Nitrile gloves	box	
Green over gloves	2 set	
Gate Key from Rode	1	
Explorer Tool bag (yellow)-Babs' locker	1	
Tool box	set	
Computer w both/ troll connectors	set	
Decon bucket w/ water and sprayer	set	
YSI		
Rubber boots optional	set	
Floppy Hat optional	set	

Additional Forms Attached:

	Yes	**No**		**Yes**	**No**
Directions	☐	☐	**GWM Form**	☒	☐
Site Location Map	☒	☐	**FPR Form**	☒	☐
Site Map/other	☒	☐	**W.E. O2 Forms**	☒	☐
Site Safety Plan	☒	☐	**Shipping Form**	☐	☐
TGSM Form	☒	☐	**Disposal Manifests**	☐	☐

Environmental Works, Inc.
1455 East Chestnut Expwy
Springfield, Missouri 65802
Office: 417.890.9500
FAX: 417.823.9659

MANUAL PRODUCT RECOVERY - WELL _____

PROJECT: _____ **NUMBER:** _____ **PHASE:** _____

DATE: _____ **PERSONNEL:** _____

INITIAL DATA **PRODUCT LVL** ft BTOC: _____ **WATER LVL** ft BTOC: _____ **FT PRODUCT:** _____ **GALLONS*:** _____

*FACTOR: 2" diam well = 0.2 3.5" diam well = 0.5 4" diam well = 0.7 6" diam well = 1.5 8" diam well = 2.6 gal/foot

BAILER SIZE USED: **PUMP USED:**

2" bailer volume = 0.0075 gal / inch **4" bailer volume = 0.0319 gal / inch**

TIME	PRODUCT IN BAILER (4" bailer marked 1/10s Gallon)	WATER (if kept)	CUMULATIVE PROD REMOVED		REMARKS
			BAILER	BUCKET	

Environmental Works, Inc.
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Springfield, Missouri 65802
Office: 417.890.9500
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MANUAL PRODUCT RECOVERY - WELL _____

PROJECT: _____ **NUMBER:** _____ **PHASE:** _____

DATE: _____ **PERSONNEL:** _____

INITIAL DATA **PRODUCT LVL** ft BTOC: _____ **WATER LVL** ft BTOC: _____ **FT PRODUCT:** _____ **GALLONS*:** _____

*FACTOR: 2" diam well = 0.2 3.5" diam well = 0.5 4" diam well = 0.7 6" diam well = 1.5 8" diam well = 2.6 gal/foot

BAILER SIZE USED: **PUMP USED:**

TIME	PRODUCT IN BAILER (4" bailer marked 1/10s Gallon)	WATER (if kept)	CUMULATIVE PROD REMOVED		REMARKS
			BAILER	BUCKET	

GROUNDWATER SAMPLING: PRE-PLANNING CHECKLIST

_____ Place sample bottle order (find analysis in Initial Site Plan-Sampling Protocal heading)

_____ Double check sample kits upon arrival (container #, types, analysis, COCs, seals/labels)

_____ QA/QC? Are duplicates/split samples needed?

_____ Contact Client and/or property owner, PSTIF, off-site property owner (if applicable)

_____ Notify agencies (if necessary)

_____ Complete field packet (directions, site diagram, FWR, TGSM, field notes, GW sampling data forms, Water Level Record form, DEL, access agreements [if necessary], etc.)

_____ Vehicle Requested

_____ Check Weather

_____ Gather Equipment: Camera, GW Tote, pens/sharpie/calculator/field notebook, sampling kits, interface probe & cleaner, 5-gallon buckets, filters & pump (if lead sampling), tool box, drums, buckets, keys [offsite wells, access, etc.], spare parts, bug/wasp spray, weedeater, etc.

_____ Pump or Bailer? (Typical water volumes purged at Site) What size are the wells at the Site (1-inch, 2-inch, 4-inch)? Power supply for pump?

_____ WINTER: Take shovel, metal detector, ice pick, brush burner, etc.

_____ Is GW Tote fully stocked?

_____ Safety / Security issues at the Site? (Remote area, active site, access issues, etc.) BNSF? Site Safety Action Plan completed? Copy in the field packet?

_____ Proper PPE? (Is the site active or vacant? Active = wear safety orange, take traffic cones and/or barricades)

_____ Review FWR with PM to ensure all on-site tasks are understood

_____ Review previous field notes

Post-Sampling

_____ Sample shipping method? (BanCourier, FedEx, UPS) Closest shipper to site & directions?

_____ Restock GW Tote if any expendables (bolts, tubing, etc.) were used

_____ If spare batteries were used on any equipment, put dead batteries on charger & place new spare batteries with equipment

_____ Purge water amount & details entered on Batch Tank Form

_____ Equipment returned to appropriate place

_____ Paperwork & DEL (w/receipts if over $10) given to PM

Environmental Works, Inc.
1455 E. Chestneut Expwy
Springfield, Missouri 65802
Office: 417-890-9500
FAX: 417-823-9659

GROUNDWATER SAMPLING LOG

PROJECT NAME: _____

PROJECT / NO: _____ **EVENT:** _____

DATE: _____ **TIME:** _____ **PERSONNEL:** _____

WELL ID: _____ **WELL DIAMETER:** _____ **SAMPLE ID:** _____

EVACUATION DATA

WATER LEVEL: _____ **WELL TD:** _____ **FT WATER IN WELL:** _____ X FACTOR* = _____ **GALLONS**

EVACUATION METHOD: _____ **TOTAL GAL PURGED:** _____

***FACTOR: 2" diam well = 0.2 3.5" diam well = 0.5 4" diam well = 0.7 6" diam well = 1.5 8" diam well = 2.6**

PARAMETER MEASUREMENTS

TIME	VOLUME	COLOR	ODOR	TEMP	pH	DO%	COND	

SAMPLING DATA

SAMPLING METHOD: _____ **DATE:** _____ **TIME:** _____

ANALYTES: **CONTAINER:** **PRESERV:**

APPEARANCE: _____ **COLOR:** _____ **ODOR:** _____

DUPLICATE COLLECTED? Y / N **SAMPLE ID:**_____ **SPLIT SAMPLE?** _____ **FOR WHO?** _____

WELL ID: _____ **WELL DIAMETER:** _____ **SAMPLE ID:** _____

EVACUATION DATA

WATER LEVEL: _____ **WELL TD:** _____ **FT WATER IN WELL:** _____ X FACTOR* = _____ **GALLONS**

EVACUATION METHOD: _____ **TOTAL GAL PURGED:** _____

***FACTOR: 2" diam well = 0.2 3.5" diam well = 0.5 4" diam well = 0.7 6" diam well = 1.5 8" diam well = 2.6**

PARAMETER MEASUREMENTS

TIME	VOLUME	COLOR	ODOR	TEMP	pH	DO%	COND	

SAMPLING DATA

SAMPLING METHOD: _____ **DATE:** _____ **TIME:** _____

ANALYTES: **CONTAINER:** **PRESERV:**

APPEARANCE: _____ **COLOR:** _____ **ODOR:** _____

DUPLICATE COLLECTED? Y / N **SAMPLE ID:**_____ **SPLIT SAMPLE?** _____ **FOR WHO?** _____

ENVIRONMENTAL WORKS

Environmental Works, Inc.
1455 E. Chestnut Expressway
Springfield, Missouri 65802
Office: 417-890-9500
FAX: 417-823-9659

LOW FLOW WELL SAMPLING LOG

WELL: ____________________________

PROJ. NAME/NO.: ___________________________________

DATE: ______________________ **TIME:** __________ **PERSONNEL:** ___________________________________

WATER LEVEL: _________ **WELL TD:** ________ **PUMP DEPTH:** ________ **MODEL:** _________________

LOW FLOW PURGING DATA

TIME	FLOW RATE	COLOR	ODOR	W. LEVEL	TEMP	COND	DO%	pH	ORP	TURBID
TARGET CRITERIA FOR STABLIZATION				0.33' diff	3%	3%	10%	0.1	10 mV	10%

SAMPLING DATA

(fill in blanks or circle as appropriate)

VOLUME PURGED: ______________ **DATE/TIME COLLECTED:** ____________/________ **SAMPLE ID**: ____________________

ANALYTES: VOC TPH-DRO TPH-GRO TPH-ORO Oxygenates PAH METALS Other ___________

CONTAINER: 40 ml VOA (#____) 100mL Amber Glass (#____) 250 ml Poly (#____) 500 ml Poly (#____)
PRESERV. None Hydrocloric Acid Sulfuric Acid Nitric Acid TSP
APPEARANCE: ____________________ **COLOR:** ______________________ **ODOR:** ____________________
DUPLICATE COLLECTED? ____ **ID:** _____________ **SPLIT SAMPLE?** ____ **FOR WHO?** ________________

SAMPLING NOTES:

Environmental Works Field Services — Job Safety Analysis

Client (Name, Place, Contact No):	EWI Supervisor:	Date & Time JSA Completed:
	Job Description:	

Required Permits : [ ] Safe Work [ ] Hot Work [ ] Confined Space [ ] Excavation [ ] Lockout/Tagout [ ] Other [ ] No Permit Required

Emergency Data:

Plant Emergency No:_____ Primary Evacuation Point:_____ Secondary Evaluation Point: _____

Emergency Equipment:

Fire Extinguisher: Type:_____ Inspection Date:_____ Fire Hydrant Location:_____

Emergency Eyewash/Shower Location:_____ Wind Direction_____

Job Site Access:

[ ] Scaffold (inspected) [ ] Ladder (tied off) [ ] Height (fall protection) [ ] Aerial Lift (fall protection) [ ] Other

Personal Protective Equipment (check all that apply):

Eye and Face Protection: [ ] Safety Glasses [ ] Goggles [ ] Face Shield [ ]Other:_____ **Head Protection:** [ ] Hard Hat [ ] Other:_____

Hearing Protection: [ ] Ear Plugs [ ] Ear Muffs **Foot Protection:** [ ] Steel Toe Boots [ ] Rubber Boots [ ] Other:

Hand Protection (Gloves): [ ] Leather [ ] PVC [ ] Neoprene [ ] Other [ ] Other:_____ **Protective Clothing:** [ ] Nomex [ ] Tyvek [ ] Slicker Suit [ ] Acid Suit [ ] Turtle Suit [ ] Other [ ] Other_____

Respiratory Protection: [ ] Yes [ ] No *If YES:* [ ] Half Face [ ] Full Face [ ] Cartridge Type [ ] SCBA [ ] Supplied Air

Cartridge Type: [ ] N/A [ ] OV/AG [ ] Ammonia [ ] Particulate [ ] Mercury [ ] Other:_____

Fall Protection: [ ] Yes [ ]No *If YES:* [ ] Body Harness [ ] Shock Absorbing Lanyard [ ] Retractable Lanyard [ ] Other:_____

HazCom: Will anyone be using any chemical product? [ ]Yes [ ] No Is an MSDS readily available and reviewed? [ ] Yes [ ] No H2S Monitor: [ ] Yes [ ] No

Confined Space Entry Checklist **Will Confined spaces be entered: [ ] Yes (*complete section below*) [ ] No [ ] N/A**

Will you have to break the plane of the vessel at any point during the operation? [ ] Yes [ ] No If "YES": a Confined Space Entry Permit is REQUIRED!

Check which permit program being used. [ ] EWI [ ] Client [ ] CSE Administrator Notified? Time:_____ Name:_____

If you are using a Client permit, has it been approved by EWI? [ ] Yes [ ] No If "NO", use Client's and EWI's permits.

Task Hazard Analysis (Identify and Evaluate Discrete Task for the job being done)

TASKS	HAZARDS	ELIMINATION OF HAZARDS OF PPE

HYDROBLASTING SAFETY RULES:

[ ] Review the Hydroblasting Safety Rules with the Crew? (Use the Hydroblasting Laminated Safety Rules to satisfy this item)

Have all Hydroblasting Safety Rules been implemented? [ ] Yes [ ]No **If NO, a Variance must be initiated:** Has a Variance been initiated? [ ] Yes [ ] No

Has Variance been approved by proper authority and reviewed by entire crew? [ ] Yes [ ] No [ ] N/A (The variance must be reviewed by the crew before proceeding)

Tools/Equipment : Place an "X" by each item indicating they have been completed.

[ ] Hoses/fittings have been inspected and are Stainless Steel and show no signs of physical defect (Teeth marks in the barrel, worn threads, etc.)

[ ] All safety guards are in place (i.e. 48" Shotgun, Trigger Safety Lock, Plungers Guards), Unit is grounded? Anti-withdrawal devices available with correct Bushings?

[ ] Hoses have been inspected - Current Inspection band in place, absolutely no braids showing/torn, no wires protruding from hose, all whip checks in place

[ ] All Hydroblasting tools/equipment needed for the job On-Site are in serviceable condition (Foot Pedals, Dump Systems, Rupture Discs, Hose Shroud, Whip Checks)

[ ] Has Pre-Trip been completed? [ ] Yes [ ] No Arc fluids correct? [ ] Yes [ ] No Hydroblasting Check list completed? [ ] Yes [ ] No

JOB HAZARD ASSESSMENT (For every hazard identified you must show how you eliminated that hazard)

TYPES OF HAZARDS	POTENTIAL HAZARDS IDENTIFIED	HOW TO ELIMINATE/PROTECT FROM HAZARD
Access: (e.g.) heights, CSE, uneven surfaces, scaffolding		
Chemicals/Materials: (e.g.) in immediate work area are brought in		
Environment: (e.g.) weather, noise, heat/cold, hazardous environment, power lines		
Physical: (e.g.) ergonomics, body positioning, lifting, pulling		
Potential (Stored) Energy: (e.g.) static, LOTO, GFCI		
Tools/Equipment: (e.g.) heavy machinery, condition, etc.		
Other: (e.g.) pinch points, tripping, etc.		

Ergonomics:

[ ] Body Placement - Pinch Points/line of fire	[ ] Eye Contact - Worker communication	[ ] Lifting - Pushing - Pulling
[ ] Close Clearance/Congestion	[ ] Repetitive Motion/Vibration of Tool	[ ] Lifting> 50 lbs. / 50-120 lbs.
[ ] Stability	[ ] Working, above shoulders, to sides	[ ] 2 Persons -Above 120 lbs. - Mechanical
[ ] Excessive Reaching, Bending, Twisting	[ ] Force Exertion	[ ] Frequent Heavy Lifting> 40 lbs.

All incidents MUST be reported immediately to your supervisor and the client contact.

I HAVE READ AND UNDERSTAND THE JSA /WORK PERMIT AND ALL ITS PARTS AND DO AGREE WITH THE CONTENTS. I AGREE TO ADHERE TO ALL SAFETY PRECAUTIONS AND PROCEDURES TO COMPLETE THIS JOB SAFELY.

Completed by:	Date and Time:
Reviewed by:	Date and Time:
Audited by:	Date and Time:

QA/QC Review of Laboratory Analytical Reports

Sampling Event: Lab Project No:	Project Site Name: Site City, State:	Laboratory Used: Lab City, State:	Report Reviewed By: Date:

QA/QC Checklist

Yes	No	N/A	
☐	☐	☐	Raw data have been transferred to project directory (PDF, EDD).
☐	☐	☐	Invoice approved and given to accounting.
☐	☐	☐	Chain-of-Custody (COC) has been signed/dated as received by laboratory.
☐	☐	☐	Confirm the project information was entered appropriately on the COC.
☐	☐	☐	Review laboratory comments on the COC (ie cooler temperature, sample conditions), as well as the lab-completed "COOLER RECEIPT FORM. Unusual Conditions: YES ☐ NO ☐ If YES, list conditions on page 2
☐	☐	☐	Verify that all samples sent to the laboratory were analyzed and results reported.
☐	☐	☐	Verify proper sample holding times were observed for the particular analysis/parameter.
☐	☐	☐	Were Duplicate or Split samples collected? YES ☐ NO ☐ If so, compare to the primary sample, note discrepancies on Page 2.
☐	☐	☐	Analytical data checked for anomalies and compared to applicable target levels and historic data.
☐	☐	☐	Laboratory provided appropriate QA/QC deliverables as requested on the COC (i.e. Level 1 – Level 4).
☐	☐	☐	Analytical results in the PDF format match the EDD (if provided).
☐	☐	☐	Required reporting limits met for all samples/analytes. If not, explain discrepancies and how resolved with laboratory on Page 2.
☐	☐	☐	Reported QA/QC data provide acceptable results for laboratory spikes, surrogates, and duplicates with all RPD values within limits***.
☐	☐	☐	Reported QA/QC data provide acceptable results for Laboratory Control Samples (LCS) and Method/Equipment Blanks***.
☐	☐	☐	Field, Trip, and Rinsate Blanks report acceptable results***.

*** Describe all QA/QC and Blanks discrepancies on Page 2

QA/QC Review of Laboratory Analytical Reports

Project / #:_____ Lab Project # _____ Date: _____

Summary of QA/QC Observations

Sample ID	Lab Proj #	Observation	Requested Action	Comments

Boring ID: _____ **Logged By:** _____

Drilled By: _____

Aboveground:
Casing height agl _____

Protective Casing: Aboveground or Flush Mount (circle one)

Flush Mount: Traffic Rated Y or N
Diameter:_____

Surface Pad Diameter:_____

Land Surface

Cement Pad Depth:_____bls

Well Cap: Lockable Y or N

Top of Bentonite Cement Grout:_____bls

Grout Seal: Neat Cement or
Bentonite Cement or Bentonite Slurry (circle one)
_____ # Bags cement (wt/bag _____)
_____ % Bentonite by dry weight

Blank Casing: _____
Diameter: _____
Type: Sch 40 PVC or Stainless Steel (circle one)

Top of Bentonite Seal:_____bls

Bentonite Seal: Pellets or Chips or Slurry (circle one)
_____ # Bags (wt/bag: _____)

Top of Filter Pack:_____bls

Filter Pack:
Type: _____
Size: _____
_____ # Bags (wt/bag:_____)

Top of Screen:_____bls

Screen Casing: _____
Slot Size: _____
Diameter: _____
Type: Sch 40 PVC or Stainless Steel (circle one)

Bottom Cap (length _____)

Bottom of Screen:_____bls

Total Boring Depth:_____bls

Borehole Diameter_____

NOT TO SCALE

Well Construction Details Form

DRAWN	CHECKED	APPROVED	DATE
FILENAME			

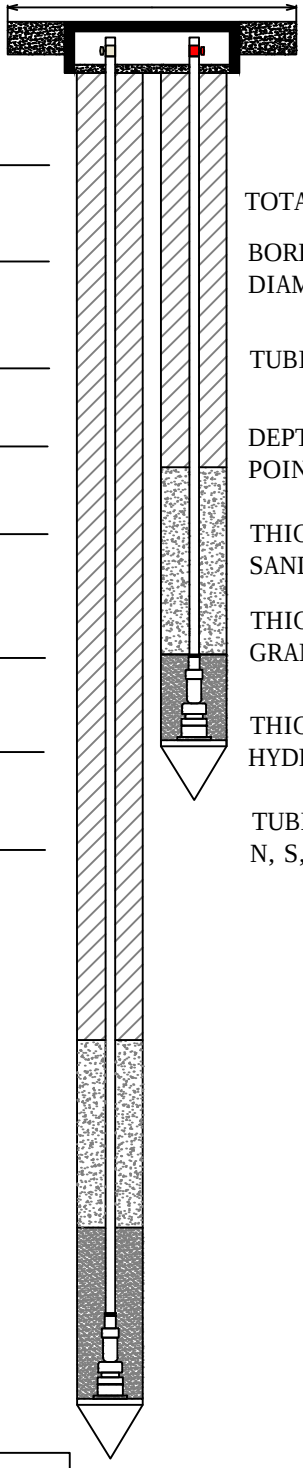
ENVIRONMENTAL WORKS

NESTED SOIL VAPOR WELL DIAGRAM

PROJECT NAME: _____ SOIL VAPOR WELL: _____ PROJECT NUMBER: _____

SURFACE PAD DIAMETER: _____

CEMENT PAD DEPTH: _____



DEEP SV WELL

TOTAL DEPTH: _____

BOREHOLE DIAMETER: _____

TUBING OD: _____

DEPTH OF SV POINT: _____

THICKNESS OF SAND PACK: _____

THICKNESS OF GRANULATED BENTONITE: _____

THICKNESS OF HYDRATED BENTONITE: _____

TUBING LOCATED N, S, E, W, IN VAULT: _____

SHALLOW SV WELL

TOTAL DEPTH: _____

BOREHOLE DIAMETER: _____

TUBING OD: _____

DEPTH OF SV POINT: _____

THICKNESS OF SAND PACK: _____

THICKNESS OF GRANULATED BENTONITE: _____

THICKNESS OF HYDRATED BENTONITE: _____

TUBING LOCATED N, S, E, W, IN VAULT: _____

LOGGED BY: _____

DRILLED BY: _____

DATE: _____

TIME: _____

KEY

= CONCRETE

= HYDRATED BENTONITE

= SAND PACK

= GRANULATED BENTONITE

= SOIL VAPOR POINT

= RED VALVE (USED FOR SHALLOW VAPOR WELL)

= VALVE

NOT-TO-SCALE

ENVIRONMENTAL WORKS

1455 E. Chestnut Expressway, Springfield, MO 65802

Photographic Description Record

Environmental Works, Inc.

Name: _____

Date: _____

Site: _____

Project Number: _____

Photo Number	Description

Environmental Works, Inc.
1145 E. Chestnut Expwy
Springfield, Missouri 65802
Office: 417-890-9500
FAX: 417-823-9659

PUMPING TESTING LOG

PROJECT NAME: _____

PROJECT / NO: _____ **EVENT:** _____

DATE: _____ **PERSONNEL:** _____

PUMPING WELL: _____

TYPE/SIZE PUMP: _____

PUMP DEPTH: _____

OBS WELLS:				
METHOD TO RECORD DATA:				
DEPTH OF RECORDER:				

WEATHER / NOTES: _____

TIME	PUMP ON/OFF	INTERVAL VOLUME	CUMUL VOLUME	WATER LEVEL	COMMENTS

Environmental Works, Inc.
1016 West Battlefield Street
Springfield, Missouri 65807
Office: 417-890-9500
FAX: 417-823-9659

PUMPING TESTING LOG

PROJECT NAME: _____

PROJECT / NO: _____

EVENT: _____

DATE: _____

PUMPING WELL: _____

TIME	PUMP ON/OFF	INTERVAL VOLUME	CUMUL VOLUME	WATER LEVEL	COMMENTS

Environmental Works, Inc
QA/QC Field Log

Date:_____

Sampler:_____

Equipment:_____

Site Name:_____

Project Number:_____

Sample ID	Date	Time	QAQC TYPE	Description

Environmental Works, Inc
QA/QC Field Log

Date:_____

Sampler:_____

Equipment:_____

Site Name:_____

Project Number:_____

Sample ID	Date	Time	QAQC TYPE	Description

ENVIRONMENTAL WORKS

Field Recorder /PTX Set Up

Well ID: _____ Date: _____

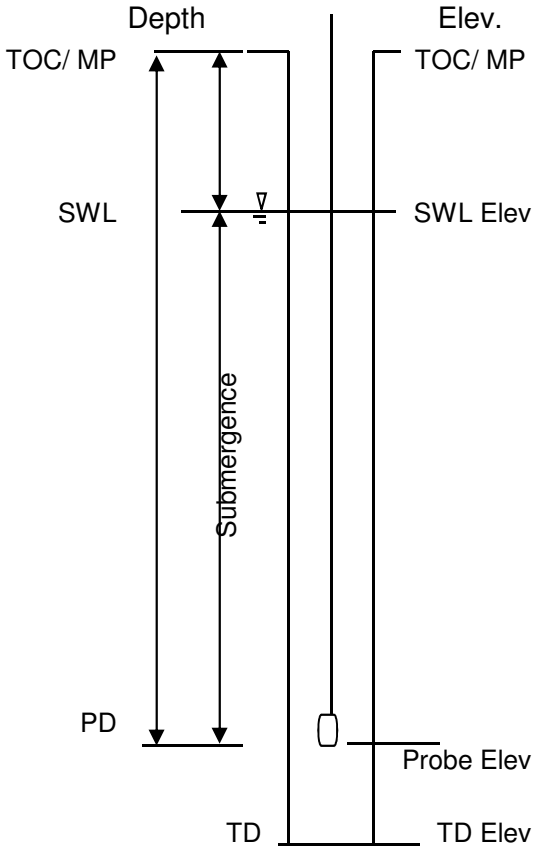
Telog S/N & Channel: _____ Ch: _____ Project: _____

Probe Serial Number: _____ Personnel: _____

Transmitter Range: _____ psi = _____ ft (psi x 2.31) Total Well Depth: _____ feet

Telog Battery Volts: _____ v DC

Battery Changed? yes no



TRANSMITTER SCALING

	Previous Data	Current Data
Top of Casing/MP Elev:		
Cable Length:		
Elev of Probe:		
Top of Casing/MP Elev:		
- SWL:		
SWL Elev:		
SWL Elev:		
- Elev of Probe:		
Submergence (subm):		
mAmp at probe depth:		
mAmp at zero submergence:		

Zero submergence should be ~ 4 mAmps

Manual SWL Elev:		
Electronic SWL Elev:		
Δ		

Difference must be within +/- 0.05 ft

Recal Needed? yes no

Recal Good? yes no

Example Computer Input

	mAmp	ft elev
0 psi	reading 1	PD elev
PD psi	reading 2	SWL elev

Actual Computer Input

	mAmp	ft elev
0 psi		
PD psi		

mAmp SCALING

User Units	Format
mAmps	#0.0#
Ch Pt 1	User Pt. 1
4	4
Ch. Pt. 2	User Pt. 2
20	20

CAL FORMAT

User Units	Format
Ft Elev	#,##0.0#
Ch Pt 1	User Pt. 1
0 mAmp	PD elev
Ch. Pt. 2	User Pt. 2
PD mAmp	SWL elev

NEW CAL VALUES

0 sub mA			PD elev
PD sub mA			SWL elev

OLD CAL VALUES

Environmental Works, Inc.

Soil Boring Log

Date: _____

Sampler: _____

Boring ID: _____

Driller: _____

Site Name: _____

Drill Equipm't and Method: _____

Location: _____

Depth	Recovery	Sample Depth / ID	PID BZ	Sample PID	Description of Material	USCS

SOIL VAPOR SAMPLING LOG - Permanent Points

ENVIRONMENTAL WORKS
1455 E. Chestnut Expy.
Springfield, MO 65802
Main: 417.890.9500

Project/ Phase ID: _____
Date: _____
Sample ID: _____

Personnel: _____ **Consultant:** _____
Temperature (F°): _____ **Wind:** _____
Barometric Pressure change: _____ **Analysis:** _____
Tracer Gas: _____ **Duplicate:** **YES / NO**
Duplicate ID: _____ **Duplicate Time:** _____

Purge Volume Extracted:_____mL **Vacuum Test on Train**:_____
Sample Volume Extracted:_____ mL **Sample Time:**_____
Duplicate ID: _____ **Dupe Time:** _____

Sample rate of <200 mL/min maintained during sampling? **YES / NO**

Once the Tedlar bag has been filled and sampling is complete, the gauge was flushed with ambient air - correct? : **YES / NO**

Purge Volume Calculations - Permanent Wells

Inner diameter (ID) of tubing: 3/16 " Assume syringe = 60 ml / stroke
Volume of 3/26" I.D. tubing per foot (ml/ft): 5.43
Sand pack volume (1.5" hole) = 132 ml, **use 3.0 strokes (180 ml) to develop** each point once after installation. Wait at least 48 hours before purging / sampling.
Purge Volume (3 volumes) for a SV point at **3.0** feet: 65 ml (1 stroke) at each sampling event
Purge Volume (3 volumes) for a SV point at **9.5** feet: 171 ml (3 strokes) per sampling event
Purge Volume (3 volumes) for a SV point at **X** feet = 5.43 x 3 x (**X**+1)

NOTES:

ENVIRONMENTAL WORKS

TAILGATE SAFETY MEETING

Project Name:	FORMERTRONOX	**Date:**	
Project Number:	150683	**Time:**	
Location:	Springfield, MO	**Meeting Conducted By:**	
Activity Description:			

SAFETY TOPICS PRESENTED

Physical Hazards:

Chemical Hazards:

Required PPE:

Emergency Procedures:

Hospital/Clinic:		**Phone:**	
Ambulance:		**Phone:**	
Directions:			
Other:			

ATTENDEES

Print Name	Signature

Utility Information / Vapor Monitoring

Site: _____

Date/ Time	Personnel	Type of Utility	Type of Material	Flow Direction	Depth of burial	Monitoring Point Description (including depth)	PID reading (ppm)	Instrument Used

Notes: _____

WATER LEVEL RECORD

Project Name: _____ Project Number_____
Date: _____ Personnel: _____ Weather: _____

TIME	WELL ID	Depth to Product	Depth to Water	Depth to Well Terminus	COMMENTS

Additional Information: (site conditions, well pad conditions, drums onsite, well caps missing, etc.)

_____
_____
_____
_____
_____

ENVIRONMENTAL WORKS

WELL DEVELOPMENT FORM

Well No: _____

Project Name: _____ Date: _____ Time: _____

Project No: _____ Well Type: Monitor Extraction Other: _____

Recorded By: _____ Sampled By: _____

WELL PURGING

PURGE VOLUME:

Casing Diameter (inches): _____

2-inch 4-inch 6-inch Other: _____

Total Depth of Well (TD in feet BTOC): _____

Water Level Depth (WL in feet BTOC): _____

Number of Well Volumes to be Purged (# Vols)

3 4 5 10 Other: _____

PURGE METHOD:

Bailer -Type: _____

Submersible Centrifugal Bladder; Pump No: _____

Other - Type: _____

PUMP INTAKE SETTING:

Near Bottom Near Top Other: _____

Depth in feet (BTOC): _____

Screen Interval in Feet (BTOC) from _____ to _____

PURGE VOLUME CALCULATION:

(_____ - _____) X _____ ^{2} X _____ X 0.0408 = _____ gallons

TD (feet) WL (feet) D (inches) # Vols Cal. Purge Volume

PURGE TIME:

_____ Start _____ Stop _____ Elapsed

PURGE RATE:

Initial _____ gpm Final _____ gpm

ACTUAL PURGE VOL:

_____ gallons

FIELD PARAMETER MEASUREMENTS

Minutes Since Purging Began	pH	Cond. (µmhos/cm)	Temp. C F	Description: well condition, turbidity, color, odor, etc.

Discharge Water Disposal: Sanitary Sewer Storm Sewer Drummed/Retained Onsite

Other (describe): _____

APPENDIX 5

SUBCONTRACTOR DOCUMENTS AND QUALITY ASSURANCE

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 High Street, Springfield, Missouri

Eurofins Document Reference	1-P-QM-GDL-9015377	**Revision**	13
Effective Date	Aug 8, 2014	**Status**	Effective
Historical/Local Document Number	DOD - Environmental Quality Policy Manual		
Local Document Level	Level 1		
Local Document Type	POL - Policy		
Local Document Category	ES - Environmental Sciences		

Prepared by	Christiane Sweigart and Kathryn Brungard
Reviewed and Approved by	Duane Luckenbill;Review;Tuesday, July 29, 2014 11:25:24 AM EDT Robert Strocko;Review;Wednesday, July 30, 2014 1:34:51 PM EDT Dorothy Love;Approval;Wednesday, July 30, 2014 2:00:20 PM EDT

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Environmental Quality Policy Manual

Eurofins Lancaster Laboratories Environmental, LLC

2425 New Holland Pike
Lancaster, PA 17601
Phone: 717-656-2300
Fax: 717-656-2681

Reviewed and Approved by:
Vice-President/Technical Director
Microbiology Technical Director
Quality Assurance Manager
(as documented on page 1)

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Revision Log:

Revision: 13	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Throughout Document	Reflect re-identification of documents in EtQ	Replaced all prior Level 1, 2, 3, and 4 document numbers (analyses excluded) with EDR numbers
Title Page	Regulatory compliance	Added text for address, phone, reviewer/approver titles (previously listed on hardcopy covers and pre-EtQ versions)
Section 1	Updated training requirements	Removed requirement for all employees to read the appendices, they are available as resources; required for dept 4052 only.
Section 1.2	Regulatory compliance	Inserted additional ISO17025 text at opening and closing of Quality Policy Statement
Section 2.1.1	New Section	Summarize processes to ensure business continuity and contingency plans
Section 2.2	Reflect current structure	Moved summation of technical director and QA manager to this section; changed employee responsible for daily operation from COB to VP. Throughout document, clarified management structure to include VP.
Section 2.6	Added process	Added ability for management and/or QA to issue a stop work notice.
Section 2.16	Regulatory compliance	Inserted additional ISO17025 text regarding ensuring impartiality, operation integrity, etc.
Section 3	Added building	Added building D
Section 4.2	Clarification	Noted that interim amendments to controlled procedures are not allowed.
Section 5.5	Added information	Noted that minimum sample retention period is 2 weeks form reporting
Section 6.4	Clarification	Standardized use or the terminology for equipment (supporting units) vs instruments (data producing units)
Section 6.5.1.9	New section	Added to address passwords and audit trails for systems used to process electronic data
Section 6.5.2	Clarification	Clarified SDLC processes
Section 8.1	Added information	Added reference to laboratory website for all current accreditation records
Section 10.2	Added information	Added information regarding electronic data, signatures, and audit trails
Section 10.4	Regulatory compliance	Added DoD reporting requirements for DL, LOD, LOQ
Section 10.5	Clarification	Clarified process and intent of data review
Section 10.7	Updated process	Added process for identification of accreditation status Noted use of LlabWeb for secure data transfer
Section 12.1	Added process	Added ability for management and/or QA to issue a stop work notice.
Section 12.4	Clarification, new process	Clarified processes that address preventive action; changed “PPI” to “Lean”
Section 13.2	Clarification	Added detail on project evaluations
13.4	Added detail	Added information regarding the subcontractor warranty and the need to ensure subcontractor can meet accreditation requirements
Appendices A-J	Updated for current information	Updated to reflect current SOPs, personnel, methods, etc.

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Revision: 12		Effective Date: Jul 29, 2013
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Throughout Document	Reflect re-identification of documents in EtQ	Replaced all prior Level 1, 2, 3, and 4 document numbers (analyses excluded) with EDR numbers
Section 1.1	Not required	Deleted “Our Unique Promise of Value” statement
Section 2.1	Reflect current organization	Added new company name and incorporation state
Section 2.3.1	Detail	Added section to describe the responsibilities of the technical director.
Section 2.5	Document Consolidation	Added language consistent with SOP-QC-024 so that procedure can be inactivated.
Section 4.2	Document Consolidation	Added language from SOP-QC-024 regarding QA’s signature so that procedure can be inactivated.
Sections 5.3 and 5.6	Document Consolidation Clarification	Added information from LOM-SOP-ES-212 so that procedure can be inactivated. Added information to clarify the difference between and LSAR and a legal chain of custody.
Section 9	Document Consolidation	Added information from LOM-SOP-ES-213 so that procedure can be inactivated.
Section 10.4	Enhancement	Added definition and detail for LOD (Limit of Detection)

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INTRODUCTION

This *Quality Policy Manual* is based upon Eurofins Lancaster Laboratories Environmental LLC's (herein referred to as the laboratory) overall business and management philosophies, mission, and goals. This manual is written to present the policies employed by the laboratory as well as the support departments that serve the environmental laboratories and to comply with the requirements of the National Environmental Laboratory Accreditation Program, ISO 17025, and the Department of Defense (DoD). These policies define the "what" we do with emphasis on management's responsibilities and commitment to quality. Governing SOPs are in place within the organization, to ensure the proper execution of this policy document (refer to Appendix A). This manual is required reading for laboratory personnel. The appendices are available resources to all personnel but are not required reading for all employees. The most recent and up-to-date *Quality Policy Manual* and all referenced documents are available to all laboratory personnel who work in or support the laboratory. The laboratory actively strives for continuous improvement of its quality systems to better serve our clients.

1.1. Mission Statement

The laboratory offers analytical and consulting services in the chemical and biological sciences with comprehensive expertise in environmental laboratory applications. The company mission statement describes the corporate philosophy:

At Eurofins Lancaster Laboratories, Environmental LLC we are people working together to serve the health and environmental needs of society through science and technology. We strive to be the recognized leader in all that we do.

Our mission is to provide independent laboratory services in the chemical and biological sciences with excellent quality and service. As a corporate community, we:

- Deliver quality by fully understanding and always meeting the requirements of those we serve.
- Live our values by relating to our clients, coworkers, shareholders, suppliers, and community in a fair and ethical manner.
- Manage our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders, and maintain our meaningful and enriching workplace.

1.2. Quality Policy

The Executive Management Group recognizes quality as a key element of the laboratory's standard of service. The group supports the laboratory's commitment to quality as defined by NELAP, ISO 17025, DoD, and other regulatory agencies (i.e. states) through the strict adherence to the Quality Policy Statement. The Quality Assurance Manager wrote the Quality Policy Statement, with final approval from the laboratory Vice-President. The policy can not be revised without their approval.

The Quality Policy Statement gives employees clear requirements for the production of analytical data. Employees are trained on the components of the Quality Policy Statement during their first day of orientation. Each employee signs the statement upon hire as agreement to implement the policy in all aspects of their work. Employee agreement to any subsequent revisions of the statement are obtained by documented reading and understanding of and agreement to follow the Quality Manual, which contains the current version of the statement. The statement is as follows:

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As an organization, all personnel are committed to high quality professional practice, testing and data, and service to our clients.

We strive to provide the highest quality data achievable by:

- Following all documentation requirements; describing clearly and accurately all activities performed; documenting "real time" as the task is carried out; understanding that it is never acceptable to "back date" entries and should additional information be required at a later date, the actual date and by whom the notation is made must be documented.
- Providing accountability and traceability for each sample analyzed through proper sample handling, labeling, preparation, instrument calibration/qualification, analysis, and reporting; establishing an audit trail that identifies date, time, analyst, instrument used, instrument conditions, quality control samples (where appropriate and/or required by the method), and associated standard material.
- Emphasizing a total quality management process and commitment to continuous improvement which provides accuracy, and strict compliance with agency regulations and client requirements, giving the highest degree of confidence; understanding that meeting the requirements of the next employee in the work flow process is just as important as meeting the needs of the external client.
- Providing thorough documentation and explanation to qualify reported data that may not meet all requirements and specifications, but is still of use to the client; understanding this occurs only after discussion with the client on the data limitations and acceptability of this approach.
- Responding immediately to indications of questionable data, out-of-specification occurrences, equipment malfunctions, and other types of laboratory problems, with investigation and applicable corrective action; documenting these activities completely, including the reasons for the decisions made.
- Providing a work environment that ensures accessibility to all levels of management and encourages questions and expression of concern on quality issues to management.

We each take personal responsibility to provide this quality product while meeting the company's high standards of integrity and ethics, understanding that improprieties, such as failure to conduct the required test, manipulation of test procedures or data, or inaccurate documentation will not be tolerated. Intentional misrepresentation of the activities performed is considered fraud and is grounds for termination.

I understand the expectations and commit to implementation of all applicable policies and procedures and to providing quality data.

1.3. Statement of Values

As a corporate community, we embrace our heritage of integrity and strive to live by the following principles:

- Fairness and honesty in all our relationships
- Mutual trust
- A respect for ourselves and others
- A sense of caring that leads us to act responsibly toward each other and society, now and in the future
- Loyalty to our clients and one another
- A spirit of open-mindedness as we deal with all

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- Dedication to service
- Good stewardship of our resources
- A commitment to flexibility and continuous improvement

We each take personal responsibility to live these values in all of our dealings, knowing full well our pledge may involve difficult choices, hard work, and courage.

1.4. Sample Flow-Through Diagram

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1.5. Certifications, Accreditations, and Registrations

Accreditation/Certification is the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications and/or standards. It is the one generally accepted method by which a laboratory such as ours can demonstrate its capability of generating acceptable, professional, quality test results in those areas in which it claims competence. To this end, we have actively sought accreditation by organizations offering it in those areas relevant to our technical expertise. We strive to ensure that the facilities, equipment, procedures, records, and methods used by the laboratory in the testing of environmental samples are in compliance with the requirements of these standards.

Although organizations offering accreditation differ somewhat in the details of their programs, they generally evaluate laboratories in four basic areas: personnel (adequate staffing, education, training, and experience), physical facilities, instrumentation/equipment, and quality assurance program. This evaluation is performed by one or more of the following procedures: periodic on-site inspections of the laboratory by assessors experienced in technical operations, quality systems, and management; periodic analysis of proficiency test samples; and periodic updating of the laboratory's file to reflect changes in personnel, equipment, or services offered. Some states offer reciprocity with other state programs.

Appendix B lists accreditations and registrations held by the laboratory in support of environmental work. Current copies of all scopes of accreditation are kept on file in the Quality Assurance Department.

2. ORGANIZATION AND PERSONNEL

2.1. Company Overview and History

The laboratory was founded in 1961 by Dr. Earl Hess in response to a need for high quality technical services by the agricultural and industrial communities in southeastern Pennsylvania. Nourished in a culture of quality and caring about all those associated with the business, the corporation became an industry leader known for innovative business practices and people-friendly policies. The company was independently owned until the retirement of Dr. Hess in 1995. At that time, the laboratory was acquired by a publicly held company, Thermo TerraTech, Inc., a Thermo Electron company. Ownership changed in September 2000, when the laboratory was acquired by Goldner, Hawn, Johnson, and Morrison, Inc. (GHJ&M), a private equity investment firm. In August 2005, the laboratory was acquired by Fisher Scientific under their BioPharma Division. On November 9, 2006, Thermo Electron and Fisher Scientific merged to form Thermo Fisher Scientific. In April 2011, Thermo Fisher Scientific sold the laboratory to Eurofins Scientific. Effective July 1, 2013, the Pharmaceutical and Environmental Divisions were split into separate business entities and the company name became Eurofins Lancaster Laboratories Environmental, LLC. The laboratory continues to operate as an independent laboratory and is incorporated by the State of Delaware.

The laboratory provides a wide array of laboratory services to clients working in environmental industries. We strive to offer high quality technical services in the chemical and biological sciences with personal attention to client needs. These services include chemical analyses, microbiological testing, and analytical method development. We are, therefore, a technical service company and do not manufacturer or distribute goods. Our "product" is accurate and timely technical information and our continued existence depends on the quality of the services we offer and efficiency with which we deliver them.

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2.1.1 Business Continuity and Contingency Plans

Various policies and practices are in place to address continuity of business and contingency plans to ensure continued operations or minimal disruption in operations should unplanned events (natural disasters, unexpected management changes, etc.) occur.

Section 2.2 of this document explains the identification of deputies for key management positions. Section 3.3 discusses the disaster recovery plan. Section 6.5 addresses the security and backup of our computer systems. Section 10.8 addresses handling of client records should the company have a change in ownership or go out of business.

2.2. Organizational Structure

The laboratory Vice-President/Technical Director, Duane Luckenbill, is responsible for the daily operations of the laboratory.

The Executive Management Group is defined as the Eurofins Environment Testing US Chairman of the Board and President and Eurofins Lancaster Laboratories Environmental, LLC Vice-President.

The management staff includes directors, managers and group leaders. Organizational charts are presented in Appendix C. A list of key personnel is also provided. The Vice-President and Quality Assurance (QA) Manager have identified deputies for all key management personnel.

2.2.1 Technical Director

The Technical Director ensures that the laboratory's policies and objectives for quality of testing services are documented in this quality manual. The Technical Director must assure that the manual is communicated to, understood, and implemented by all personnel concerned.

2.2.2. Quality Assurance Manager

The Quality Assurance Manager ensures that the quality system is followed at all times. The QA Manager reports directly to the Vice-President thus ensuring corrective actions to quality issues are taken promptly and are separate from business decisions. The QA Manager has no direct supervisory responsibility for the generation of technical data to avoid any conflict of interest in administrating the QA program. The QA Manager has the final authority to stop work that compromises our integrity or data quality. The situation must be investigated and appropriate corrective action must be put in place before the QA Manager will authorize the resumption of work. The specific duties of the QA Manager are communicated in job plan format.

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2.3. Management Responsibilities

Laboratory management duties are outlined for supervisory personnel using a job plan format, which details each individual's responsibilities along with expected results. Typically, management duties include, but are not limited to:

- Personnel hiring and training
- Supervision of personnel
- Providing resources to ensure a work environment free from commercial, financial, and other undue pressures that may adversely affect the quality of their work
- Providing resources to ensure a safe work environment
- Directing daily work operations, including scheduling of work
- Ensuring compliance with the TNI Standards, ISO 17025, Department of Defense quality Systems Manual, state agency programs, analytical methods, and client requirements.
- Assessing laboratory capacity and workload
- Resource allocation
- Ensuring quality of data produced
- Contributing to the continuous improvement of the laboratory operation
- Ensuring that corrective actions are carried out in an appropriate and agreed time-frame.
- Communicating problems and concerns to Senior and Executive Management to enlist a higher level of support for corrections and continuous improvements.
- Maintaining awareness of technical developments and regulatory requirements

2.4. Overview of the Quality Assurance Program

Quality Assurance (QA) is responsible for developing planned activities whose purpose is to provide assurance to all levels of management that a quality program is in place within the laboratory, and that it is functioning in an effective manner that is consistent with the requirements of NELAP, ISO 17025, DoD, and any other regulatory agencies (i.e. states) in which we hold accreditation. Although the laboratory is a wholly owned subsidiary of Eurofins Scientific, the Quality Assurance and Quality Systems operations described in this manual are specific to the Lancaster site.

The administration of the QA program is the responsibility of the QA Manager in cooperation with all levels of management.

The QA program, as directed by executive management, was established to:

- Ensure accountability, accuracy, and traceability of all analytical data generated.
- Ensure that current regulatory, agency, and client requirements are being met.
- Ensure that operating procedures are in place to minimize the possible loss, damage, and tampering with data, in addition to ensuring that raw data is stored in a secured area and is maintained by designated archivists and/or system administrators.
- Ensure that curriculum vitae (CVs) and training records are maintained to document that staff members have the necessary education, training, and experience to perform their job responsibilities and functions.
- Ensure that regulatory training is provided to applicable employees on a routine and ongoing basis.
- Ensure that all procedures are available, controlled, and current.

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- Ensure that documentation demonstrates that procedures are carried out in a compliant and effective manner.
- Ensure that all equipment and instrumentation is qualified, maintained, and calibrated, as appropriate, in accordance with written standard operating procedures.
- Ensure that all significant laboratory problems are investigated, evaluated for root cause and corrective action is put in place as documented
- Ensure that an internal audit program is in place to provide on-going monitoring and confirm that laboratory personnel are adhering to standard operating procedures and applicable regulations.
- Ensure that quality issues are brought to the attention of management in a timely manner.

2.5 Quality Assurance Responsibilities

The QA Manager assigns tasks with input from the company Vice President. The primary responsibilities of QA include, but are not limited to the following:

- Oversee the laboratories' internal audit program which consists of various audit types and applies to all laboratory activities (technical and administrative).
- Review and approve standard operating procedures and analytical methods.
- Review and approve validation documentation.
- Review non-conforming quality control data
- Perform tracking and trending of quality measurements and report the status and effectiveness of the quality system to management.
- Approve investigation and corrective action reports (ICARs) and audit responses to ensure that they are completed in a timely manner, evaluated for root cause, and corrective actions are implemented as needed. To monitor corrective action for effectiveness.
- Host client and regulatory agencies during facility audits and follow-up to any cited deficiencies.
- Provide regulatory guidance to the laboratory and support areas.
- Monitor Good Laboratory Practice (GLP) regulatory activities.
- Communicate quality issues to management in a timely manner
- Provide and/or coordinate on-going regulatory training (e.g., GLP).
- Participate in the vendor and supplier approval process, including subcontractors.
- Review analytical data for compliance with our procedures.
- Prepare and review QA project plans (QAPPs) as required by EPA and client projects.
- Maintain and update this *Quality Policy Manual*.
- Maintenance of the Laboratory's accreditations, including but not limited to, administration of the proficiency test sample programs, both single and double blinds.
- Communicate (within 30 days) to the relevant state authorities when there are management or facility changes that impact the laboratory. Changes in the technical director must be made within 20 days.

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2.6. Communication of Quality Issues to Management

The QA Department is responsible for preparing reports to Management to keep them apprised of outstanding quality issues. Reports to management foster communication, review, and refinement of QA activities to ensure that the QA program is adequate to meet regulatory and the laboratory's quality objectives. The following reports are used to communicate quality issues and include, but are not limited to:

- Internal, client, and agency audit reports and corrective action plans
- Proficiency test reports
- Investigation and corrective action reports
- Monthly and quarterly quality status reports
- Plans for corrective action

Upon review of quality issues, management and/or QA may issue a stop work notice if an issue indicates the potential for a problem on a broader scale with an analysis. The investigation would need to be completed and the issue resolved before work could continue. The information is tracked through our Investigation and Corrective Action Report (ICAR) process.

2.7. Personnel Qualifications and Responsibilities

Full resumes and responsibilities of key personnel are provided in Appendix D.

Due to the number of analysts on staff, entry level chemists, technicians, and support personnel are not included in the resume section. However, all employees have job plans that define their responsibilities. Duties for these personnel typically include:

- Sample storage
- Sample preparations
- Performance of tests
- Calibration, operation, and maintenance of instruments
- Data entry
- Standard and reagent preparation
- Glassware preparation
- Data deliverables preparation

2.8. Relationship of Functional Groups and the Quality Assurance Program

In addition to this *Quality Policy Manual*, aspects of the QA program are documented in a series of standard operating procedures that support the proper execution of this document. Technical operation procedures with required quality components are also in place. A list of the titles of relevant SOPs is provided in Appendix E. There are a variety of mechanisms used to communicate requirements and verify compliance with the QA program, including:

- Management requires that all employees read and be trained in the policies and SOPs that are pertinent to their jobs.
- Employee job plans define individual responsibilities. All job plans (PMDs) include QA aspects, and performance is reviewed annually.
- Laboratory audit findings are circulated to management and require a response and follow-up to items needing corrective action.

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- Cross-functional meetings, including representatives from QA, Client Services, Marketing, management, and technical operations are held regularly to review specific projects and quality issues.

2.9. Balancing Laboratory Capacity and Workload

Evaluating laboratory capacity to perform specific projects is the responsibility of the Vice-President, laboratory directors and managers, and the Client Services director and manager. These responsibilities are documented in the individual job plans for these positions.

The laboratory facilities and staff size are very large compared to other laboratories serving the environmental industry. Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in case of malfunctions. This minimizes the need to evaluate small and medium size projects against capacity available to complete them. Large projects are reviewed against capacity estimates before bids are submitted to ensure that the client's analysis schedule is met.

Regularly scheduled meetings are held with upper management, laboratory middle management, Client Services and QA personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Laboratory capacity and backlog is tracked on a continuous basis using information from the Laboratory Sample Information System (LIMS) including turnaround time, and work in-house.

2.10. Identification of Approved Signatories

All data is reviewed and verified prior to release to the client. Based on complexity or regulatory needs, some projects are designated for secondary (technical and/or QA) review of the Analysis Reports and/or data deliverables. Approved signatories for these secondary reviews are defined in the SOP on Data Entry, Verification, and Reporting. Directors, managers, group leaders, and other designated employees (such as QA, project managers, and senior technical staff) are designated to approve/release Analysis Reports. Request for approval of an employee to approve/release reports must be made through the QA Department. These authorized personnel are designated with an asterisk in the personnel list provided in Appendix C.

2.11. Personnel Training

The experience and training received by personnel is of great importance to our clients and regulatory agencies. Curricula Vitae (CVs) and on-going training documentation are available to demonstrate how personnel have been prepared for the tasks they routinely perform. To ensure the highest quality of services at the laboratory, training programs and plans are developed to match skills with job functions. Accurate training documentation is the responsibility of both the employee and their supervisor. On a routine basis, the supervisor reviews and approves training documentation to verify that it is complete and current.

Training requirements can be met through education, prior job experience, internal and external training classes, on-the-job training, TRN training modules, procedure reading, or any combination thereof, to enable the person to perform assigned job functions and meet regulatory compliance.

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Each analyst training to perform a new analysis is required to perform an initial demonstration of capability and meet the requirements for accuracy and precision before working independently on the test method. Typically, this is accomplished by the successful analysis of four known samples. However, there are certain tests performed that are not required by the mandated test method or regulation to perform the above procedure (i.e., EPA 1010, 9095). In this case, the analyst's documentation of proficiency is satisfied by the sign-off of having read, understood, and agreed to follow the SOP as written and observation by a senior analyst.

Management personnel are responsible for planning ongoing professional growth and development activities for an employee through on-the–job training and/or internal and external training courses so an employee can maintain a current skill set to match job responsibilities.

An annual performance review based on job accountabilities, objective measures, and pre-defined standards is completed by management personnel for each employee. This assessment is documented and maintained. Input is obtained from other managerial personnel as needed.

2.11.1. New Hire Training

New employees are oriented as part of a year-long process that is designed to make the employee feel welcome and comfortable by defining our culture, traditions, philosophies, and work practices. During the orientation process an employee learns about personnel and safety policies and business strategies in addition to quality, ethics, and customer satisfaction expectations through a formal process administered by our Human Resources Department.

New employees are required to attend "core" technical orientation, as applicable, which can entail the participation in training module exercises, short session attendance, and/or other skill training specific to their assigned department or job function. Additional job-specific training required for an employee is based upon their assigned duties and is identified by their supervisor. Technical orientation occurs during the first few weeks of employment.

The orientation process is designed to enable employees to initiate and take responsibility for their personal and professional career growth at the laboratory. The orientation process is conducted without regard to employee race, color, creed, national origin, sex, age, or disability in accordance with the laboratory's Employee Equal Opportunity (EEO) policy.

2.11.2. Ongoing Training

Refresher and ongoing training occurs through various means, which include but are not limited to, training in or independently review new/updated standard operating procedures and TRN training procedures; on-going regulatory training; in-house or off-site classes or seminars. The goal of this training is to ensure that employees remain current with changes to laboratory systems and practices, as applicable to their job function. Retraining and re-qualification activities occur as directed by procedures or regulations. Employees are retrained if an issue or investigation warrants that retraining is a necessary corrective action. Management directs when employee re-training is required, and the extent of the re-training.

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2.12. Regulatory Training

The QA Department is responsible for coordinating and conducting initial and ongoing regulatory training (i.e., GLP) for all applicable laboratory and support personnel. It is the responsibility of management within each department to ensure that personnel attend the required training sessions.

The choice of training format and topics covered for ongoing regulatory training is left to the discretion of QA and the trainer. All training sessions reinforce the concepts in the regulations as they are relevant to the laboratory.

Whenever possible, after training is completed, a demonstration of proficiency of the training topic is given. The demonstration of proficiency is generally in the form of a quiz although other demonstrations of proficiency are acceptable depending on the scope and content of the training. If necessary, training is presented and/or repeated one-on-one with individuals who do not demonstrate proficiency in the training topic. This is performed by QA in conjunction with applicable laboratory management personnel.

2.13. Employee Safety

The laboratory, being mindful of its responsibilities as an employer and active corporate citizen, has established the following objectives of its safety program:

- Provide a safe environment for its employees, visitors, and the community surrounding its place of business.
- Provide ongoing safety training for employees.
- Provide all necessary facilities and equipment to ensure the safety of its employees and to minimize all chemical exposure during the normal performance of their required tasks, and to take all necessary precautions to safeguard the surrounding environment.
- Provide periodic health physicals for employees.
- Foster and encourage safe operations and a proper safety attitude on the part of our employees through general operations and systems, training, and the *Chemical Hygiene Plan* (CHP).

The CHP addresses various aspects of our safety program in greater detail.

A Safety Committee works to enhance our overall safety program. The committee meets on a routine and ongoing basis and its specific responsibilities are detailed below:

- Review accident and incident reports. Make recommendations for methods of prevention to eliminate further accidents.
- Promote safety awareness and distribute safety information by various means (e.g., posters, videotapes, pamphlets, and books). Use internal communication channels to promote safety awareness.
- Enhance and recommend safety-training programs for all employees, as necessary.
- Maintain up-to-date information on employee concerns that are safety related. Offer input and information to the Chemical Hygiene Officer and/or Safety Officer, as needed.

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2.14. Client Services/Project Management Responsibilities

Members of the laboratory Client Services/Project Management Group are responsible for organizing and managing client projects. Clients are assigned a project manager (a.k.a. "CSR") who serves as their primary contact at the laboratory. It is the project manager's responsibility to act as the client advocate by communicating client requirements to laboratory personnel and ensuring that clients provide complete information needed by the laboratory to meet those requirements. All client verbal communications are documented by the project manager in a controlled notebook. In addition to information management, Project Management responsibilities include:

- Coordinating and preparing proposals in conjunction with technical staff.
- Confirming certification status.
- Hosting client visits and audits.
- Coordinating and communicating turnaround time (TAT) requirements for high priority samples/projects.
- Answering common technical questions, facilitating problem resolution.
- Providing clients with sample status report or results (partial reports) prior to receipt of the final Analysis Reports (e.g., fax, e-mail, phone).
- Scheduling sample submissions, sample containers, and sample pick-up via the laboratory courier service.
- Informing the client of deviation from their contract.

2.15. Confidentiality

Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are willingly provided.

All employees are required to protect company technical data, including client names and test results from disclosure to any third party. This policy, as described in the *Eurofins Lancaster Laboratories Employee Handbook*, is provided and presented to employees during their orientation period.

Intellectual property associated with the testing that we perform under contract for a client is the property of the client.

In an attempt to ensure the confidentiality of our systems and procedures within our laboratory, it is our policy to restrict the distribution of our internal procedures to clients. Clients are permitted to review our procedures while on-site as part of an audit or visit. Based on this policy, we would request that any documents viewed would not be shared or made available to any third parties without the permission of the laboratory.

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2.16. Business Conduct

Our business conduct policy applies to all operations of the company. All employees must avoid involvement in any activities that would diminish confidence in their competence, impartiality, judgment, or operational integrity. All employees must further avoid any relationship with other individuals or organizations (including Eurofins Scientific sister companies) that might impair, or even appear to impair, the proper performance of their company-related responsibilities. Employees must avoid any situation that might affect their independence of judgment with respect to any business dealings between the company and any other organization or individual. Any employee who believes that they have such a conflict, whether actual or potential, or who is aware of any conflict involving any other employee must report all pertinent details to the Vice-President or President of the company. The company's management vigorously enforces this policy and takes prompt and appropriate action, including termination, against any employee found to be in violation.

2.17. Operational Integrity

All employees sign an Employee Ethics Statement on their first day of employment. Employees responsible for generating, handling, or reviewing laboratory data understand that the laboratory mission is to perform all work with the highest level of integrity. Under no circumstances are shortcuts or generating results to suit a client's purpose rather than good scientific practice considered acceptable. Any violation of the laboratory ethics policy results in a detailed investigation that could lead to termination.

All levels of management consider the following activities unacceptable:

- Knowingly recording inaccurate data.
- Fabrication of data without performing the work needed to generate the information. This includes creating any type of fictitious data or documentation.
- Time travel or adjusting clocks on computerized systems to make it appear that data was acquired at some time other than the actual time.
- Manipulation of data for the express purpose of passing system suitability or quality control criteria.
- Selective use of data generated, or not using data that was legitimately generated and has an impact on the outcome of the test.
- Executing significant deviations from approved test methods and procedures without prior approval from the laboratory management and/or the client.

If an issue does arise which could compromise data integrity, personnel are instructed to perform the following activities:

- Clearly document the situation and maintain all data generated. There is a big difference between poor judgment and fraud. Fraud usually involves intent to conceal an action taken. Therefore, the more documentation that is maintained, the less likely an action is considered fraudulent if further scrutinized.
- When out-of-specification results or quality type issues are detected, all supporting data and relative background information must be documented and presented for management review. Problem resolution and client contact, as applicable, must also be documented.
- Review any questionable situations and decisions with a supervisor.

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- Bring a questionable or uncomfortable issue directly to the QA Manager or a member of the QA Department as part of our QA open door policy.
- Utilize the company's Ethics Committee. See Section 12.4 of this manual.

3. BUILDINGS AND FACILITIES

3.1. Facility

The laboratory is located at 2425 New Holland Pike, Lancaster PA. The facility consists of two campuses located on the North and South sides of Route 23. The two campuses are connected by a pedestrian bridge that spans route 23.

The North campus sits on a commercial plot measuring 5.2 acres. Several structures occupy this plot. The primary structure, Building A, is a 3-story building of concrete, brick, and wood construction. It is approximately 116,000 square feet and consists of approximately 62,000 square feet of laboratory space; 25,000 square feet of office space; and 29,000 square feet of storage, mechanical, and service space. Ancillary structures include a 1000 square foot chemical storage building (organic solvent, acid, and gas cylinder storage), a 10,000 square foot Butler building which houses stability chambers, and a 3,000 square foot storage warehouse which also houses a bottle packing area.

Property adjacent to Building A also includes two buildings that are leased. This space includes an 1800 square foot garage for recycling and for auto maintenance, and a 3500 square foot barn for shop and maintenance areas.

The South Campus sits on a plot measuring 14.48 acres on the south side of Route 23. Three primary laboratory and three ancillary storage buildings occupy this plot. Buildings B and C are 3-story buildings of steel and concrete construction. Building D is a 4-story building of steel and concrete construction. Each building is equipped with sprinkler protection. Building B is approximately 50,000 square feet and consists of approximately 20,000 square feet of laboratory space; 18,000 square feet of office space; and 12,000 square feet of storage, mechanical, and service space. Building C is approximately 45,000 square feet and consists of approximately 24,000 square feet of laboratory space, 9,000 square feet of office space, and 6,000 square feet of storage, service, and mechanical space. Building D is approximately 84,000 square feet and consists of approximately 35,000 square feet of laboratory space, 19,000 square feet of office space, and 24,000 square feet of storage, service, and mechanical space. Ancillary structures include a 400 square foot chemical storage building (organic solvent) and a 200 square foot medical waste storage building.

Property adjacent to Buildings B, C, and D also includes one building that is leased. This space includes approximately 8,000 square feet of warehouse space and 2000 square feet of Training laboratories, offices, and conference rooms.

There is an automatic fire alarm and security system hooked up at the facility. This system is monitored offsite by Choice Security. The entire campus and all exterior doors are monitored by video surveillance.

This facility is serviced by public sewer. Drinking water comes from a private well while the facility sprinkler system is fed by the public water supply. The closest surface water is the Conestoga Creek.

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3.2. Security

The laboratory is considered a secure facility. All outside doors except the main lobby entrance are locked during normal business hours to prevent unauthorized entry. An attendant monitors this entrance at all times.

During evenings, weekends, and holidays, all doors are locked and Security personnel are on site to prevent unauthorized entry into the building. Video cameras are utilized by Security personnel to monitor the facility grounds.

Every employee is issued a photo ID badge which also serves as a building access card. This badge must be worn at all times while on laboratory property so that employees are easily identified. Access to secured/designated areas within the building is limited to only applicable employees through the building security system. This system is administered by Security staff.

All visitors must register with the lobby attendant and are issued a visitor badge. A staff person must accompany visitors while in the facility. Additional visitor rules are outlined in the *Visitor Security and Safety Rules* pamphlet which is provided to all guests.

Building access cards are issued on a temporary basis to contractors or service technicians (e.g., electricians and plumbers) who need access to the building to work on a project. These cards provide the contractor with limited access during the normal workday and must be returned when the work is complete.

3.3. Disaster Recovery

A disaster recovery plan is in place to provide direction for situations where normal operations of the laboratory are not possible. In the event that the building would be severely challenged, a designated disaster recovery team, which includes Physical Services, Maintenance, Safety, Corporate Management, Public Relations, and other applicable personnel depending on the scope of the disaster, would assemble at a designated area to assess the situation and formulate a plan.

The plan addresses, in general terms, how to approach the following issues: electrical failures, heating/air conditioning failures, fire/building evacuation, computer failures, hazardous material spills, injury to employees, pandemic flu, disruption of phone service, and stability chamber failures.

3.4. Environmental Monitoring

The air handling system for the main laboratory is specially designed to protect sensitive instruments from harmful vapors to ensure that samples are not contaminated. The Physical Services/Maintenance Group is responsible for maintaining the HVAC and exhaust hood systems. This is particularly important in our instrumentation rooms and computer center where a controlled environment, positive pressure system is maintained.

Most refrigerators, freezers, incubators, and ovens used for analysis are monitored by a computerized system equipped with stationary thermometer temperature probes linked to a master panel that is accessed through a computer. If a unit is outside of a predefined temperature range for a specified period of time, the system alarms. Units not on the computerized system must be monitored manually by recording thermometer temperature readings twice daily.

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The laboratory is set up so that there is effective separation between neighboring areas in which there is potential for contamination. Laboratory storage blanks are also used to evaluate conditions under which samples for volatile analysis are stored to monitor for cross-contamination potential. QA provides oversight of the environmental monitoring system.

3.5. Water Systems

Well water and the public sewer system service the facility. The water system is monitored to meet the permit requirements of the Pennsylvania Department of Environmental Protection.

Reagent water is available to analysts for sample preparation (including dilution) and glassware cleaning. Two reverse-osmosis deionized water systems deliver highly purified water to a sealed fiberglass storage tank. From the storage tank the water is delivered to an ion-exchange-carbon filter system for further polishing. The water is also exposed to an in-line ultraviolet sterilization lamp before being circulated to taps throughout the laboratory.

Daily monitoring and preventive maintenance for the system is the responsibility of the Maintenance Department. Monthly and annual testing is performed as required by regulatory guidance. QA provides oversight of the water system monitoring. In addition, method blanks are tested with each batch (≤20) of samples.

3.6. Housekeeping/Cleaning

The laboratory is dedicated to providing a clean workplace. A third party professional cleaning service provides routine cleaning of “common areas” that include lavatories, drinking fountains, floors, and windows. Technical staff are responsible for the cleaning (or the contract of cleaning) of specific laboratory work areas.

Detergents used for cleaning contain no to very low levels of metals, pesticides/herbicides/ fungicides, or volatile solvents.

3.7. Insect & Rodent Control

Steps are taken to prevent, monitor, and control insect and rodent infestation. The coordination of this program is the responsibility of the Physical Services Department under the direction of QA. An outside service firm is contracted to perform routine and ongoing monitoring of the facility to ensure that preventive measures which are in place are effective and are working as intended.

No insect or rodent control chemical agents in a liquid or vapor form are applied or sprayed in any laboratory building, unless there is no other option, in which case department management must be contacted for approval.

3.8. Emergency Power Supply

The laboratory is located at the junction of two power grids that supply electrical service to the facility. If one of the power grids fails, we have the ability to work with the power company to have service switched to the other grid. Various types of diesel and natural gas generators are also available on a standby basis to supply power to selected areas of the laboratory in case of a power outage.

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To reduce spikes and spurious line voltage changes to laboratory instruments that can affect results or damage electronic equipment, “conditional power” is fed to these sensitive instruments. All essential computer systems are on uninterrupted power supply (UPS) which is a battery system that provides continuous conditional power for a limited time period in the event of a short power outage.

3.9. Facility Changes

Procedures are in place to manage change, ensure communication, and to minimize negative consequences through active participation of personnel involved in a facility change. The goal is to ensure that physical and environmental condition changes are adequately evaluated for impact and reduction of risk to quality, safety, health, employee, environment, property, analytical services, and business operations before and after the change is implemented.

4. DOCUMENT CONTROL

The administration of the document control system including tracking, filing, updating, and archiving of historical copies is the responsibility of the Office Services (OS) Department.

It is our policy to restrict the distribution of our internal procedures to clients and we discourage the distribution of company confidential documents outside of the facility. Clients are permitted to review our procedures while on-site as part of an audit or visit. Any documents that are distributed are only sent with the approval of QA.

The goals of the document control process are:

- Format documents according to consistent and defined standards
- Review and approve new documents
- Schedule review of existing documents
- Control of document versions and effective dates
- Review and approval of document changes
- Control document distribution and removal of obsolete documents
- Archive and protect obsolete documents

4.1. Hierarchy of Internal Operating Procedures

The hierarchy of controlled procedures at the laboratory is defined. These procedures and documentation are made available to promote consistency throughout the organization and to meet regulatory requirements. A list of relevant methods and procedures is located in Appendix E. The development of new procedures and the updating and reclassification of current procedures is an ongoing project.

4.1.1. Level 1 – *Quality Policy Manual* and Company Policies

The intent of these documents is to define “what” we do with emphasis on Executive and Management’s responsibility for quality.

The purpose of the *Quality Policy Manual* is to provide a framework to outline the quality systems at the laboratory. Organizational charts, list of SOPs, a list of equipment, instrumentation, and personnel resumes are included as attachments to this manual.

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- Executive Management is responsible for ensuring that adequate personnel, resources, and support are available to carry out the requirements of this *Quality Policy Manual*.
- Management is responsible for ensuring that SOPs or other appropriate documents are written and available to personnel to define the practices and systems which support these policies.
- All employees are responsible for conducting business in a manner which is compliant with quality and company policies and associated SOPs or other appropriate documents. Review of these policies and procedures must be documented.

Additional company policies are written to support and expand upon this *Quality Policy Manual*. These policies contain more detailed information about a subject with approval signatures executed at the Executive and/or Management level.

4.1.2. Level 2 – Standard Operating Procedures

The intent of these standard operating procedures is to define "who, what, where, and when." These procedures provide specific information for a process or topic so that the requirements outlined in this *Quality Policy Manual* and company policies can be achieved. The review and approval of these SOPs is performed at the director/manager/group leader level, including QA review and signoff, and the responsibility of these SOPs lies with the area or person directing the operation.

SOPs can apply to site-wide operations, the entire company, across multiple departments, or a specific operating area.

4.1.3. Level 3 – Work Instructions (at a departmental level)

The intent of these procedures or documents is to define in greater detail the specific "how to". The level of detail in these documents must be sufficient so any appropriately trained person can perform the task accurately. Examples include, but are not limited to standard operating procedures (SOPs); maintenance and calibration procedures; and the laboratory analytical methods. Departmental level procedures/documents are reviewed and approved at the manager or group leader level including QA review and signoff.

4.1.4. Level 4 – Quality Records

The intent of these documents is to provide documented evidence to support our quality systems and operations. Examples include but are not limited to, data notebooks/logbooks, and preformatted data recording forms.

4.2. Document Approval, Issue, Control, and Maintenance

The document control process ensures that documents are approved and adequate for use. It ensures that documents are readily available to personnel and at locations where essential operations are performed.

Procedures are available in electronic form on the company's intranet site through our document management system. The Document Control Group maintains this system in a current and accurate state. These procedures can be printed from this system for reference by employees as the corresponding task is being performed. Prior to using a printed document, the employee must ensure that it is the current version.

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Each procedure is uniquely identified and includes effective date, revision identification, and page numbering (total number of pages). All documents are searchable and uniquely identified in the document management system.

Controlled policies, procedures, and work instructions are reviewed and approved by appropriate individuals and are formally issued and administered through the Office Services Group.

Word versions of each procedure can be accessed within the document management system by designated personnel within the Document Control group. A PDF copy is maintained on a separate limited access server as a back up to the system.

Procedures are reviewed to ensure that they are accurate, current, and compliant. The frequency of review is either annual or biennial, depending on the procedure. QA is the final signature on procedures which gives QA the authority to implement the procedure; the exception is the Quality Assurance procedures for which the Vice President or his designee is the final signature. Upon the effective date of new or updated documents, all copies of obsolete documents are removed from service. The original historical copy of each outdated/obsolete procedure is clearly identified as a historical version and maintained in a permanent archive file separate from any current versions. (Note: OH EPA is required to review all revised documents applicable to its certification prior to the document being made effective).

Interim amendments to procedures are not allowed. Any needed changes require a revision to the document.

4.3. Client-Supplied Methods and Documentation

Client documentation to support environmental testing at the laboratory is maintained in a centralized area. This information is organized by client/project in the Client Services/Project Management Group. Client documentation includes the following information depending on project size and scope:

- Client supplied analyte lists
- Client supplied project plans
- Client contract quality manuals with specified limits, QC criteria, etc.
- Communication/correspondence records which relate to testing requirements, interpretation of results, or reporting formats

4.4. Laboratory Notebooks, Logbooks, and Forms

Procedures are in place to ensure that all data is traceable, authentic, complete, and retrievable. The following general requirements outline our system for the issuing, control, and archival of laboratory notebook and logbooks.

- The administration of notebooks and logbooks is controlled by the Office Services Group. They maintain a master index to uniquely number and identify each book distributed.
- Notebooks and logbooks can contain blank or preformatted pages.
- Notebooks and logbooks are bound, uniquely identified and have sequentially pre-numbered pages.

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- If notebooks or logbooks contain preprinted laboratory form pages:
  - A unique identification number is assigned to each form
  - Forms are approved by appropriate management personnel before they are put into use
  - Forms are reviewed on a routine basis to ensure they are still accurate and current
- Completed notebooks are returned to an archivist. Incomplete books are returned to Document Control:
  - Two years from the issue date
  - for employee specific notebooks – when the employee leaves the company
  - for project specific notebooks – when the project for which it was used is complete
- In specific situations, records are bound to create books at the time of archival (e.g., temperature charts).
- At the time of archival any page(s) in the notebook or logbook that does not contain data documentation is crossed-out or a statement is written on the last page used to note that the book is complete to prevent data from being entered at a later date.
- Notebooks and logbooks identified as requiring permanent archival are assigned a designated qualifier.

4.5. Control of External Documents

Hard copy versions of external documents are controlled through the form system.

External documents such as copies of the 40 CFR and ASTM methods are stored exclusively in the QA Department. QA also keeps applicable agency documents on file, these include, but are not limited to, the TNI (The NELAC Institute) and ISO 17025 standards.

Environmental methods from the EPA or Standard Methods are available in the QA Department, but the technical areas also have copies that pertain to the tests that they perform. Any external document that is maintained in these areas must be inventoried and listed on a controlled form. Some methods are available on-line and are accessed through the Internet.

It is the laboratory's understanding that the need to control external documents is to ensure that the most current version of a method is referenced or appropriate manual is being used. Regulatory methods are used as references by the laboratory and testing is performed as per written SOPs that fall under our existing document control system and have scheduled reviews. The scheduled review of SOPs is used to ensure that the proper version of a method is referenced. While using the most current version of an analytical method is our typical practice, there are specific client needs and accreditation rules that require previous versions of a method to be used.

The technical areas are responsible for ensuring that all manufacturers' manuals are current and available to analysts. The vendor provides instrument manuals when new equipment is purchased or existing instruments are updated. These manuals are kept with the instruments to which they are associated.

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5. SAMPLE HANDLING

5.1. Sample Collection

It is the responsibility of the client to send us representative and/or homogeneous and properly preserved samples of the system from which they are drawn. The laboratory assumes that all multiple sample containers with the same designator/description and bottle type contain a homogeneous, representative sample. We also assume that it is acceptable to deplete one container and move to the next, without implications unless otherwise indicated by the client.

The laboratory provides the appropriate sample containers, required preservative, chain-of-custody (COC) forms, shipping containers, labels, and custody seals. The laboratory also provides trip blanks and analyte-free water for field blanks. Preparation of methanol containers for field preservation of volatile soil samples is available.

Sample containers are purchased pre-cleaned by the supplier. For pre-preserved bottles, each lot of preservative is checked for contaminants before use and this testing is documented.

The laboratory provides instructions with all bottle orders that define how to sample, preserve, store, and ship the samples prior to their delivery at the laboratory. These instructions inform the client of the importance of proper sampling and advise them that non-compliant samples are rejected or reported with a qualifier.

If samples are collected by the laboratory personnel, applicable sampling methods are in place to perform the sampling operation.

As samples are analyzed at the laboratory, there are times when additional sample volume is necessary to complete testing or perform retesting. If this situation arises, “additional sample” is requested by the laboratory and/or submitted by a client to supplement current work being performed within our facility. Additional sample received is either assigned a new laboratory sample ID number and/or a comment noted on the final report to state that additional sample was received, depending on the situation. It is our goal to provide accurate traceability between sample submission and when testing is performed.

5.2. Sample Receipt and Entry

5.2.1. Sample Receipt

Samples can be received at the laboratory 24 hours a day, 7 days a week, 365 days of the year. Receipt can occur in one of three ways:

- The laboratory courier services (i.e., Transportation Department)
- Personal delivery
- Commercial courier

All samples received for testing are delivered to the Sample Administration Department immediately upon arrival. This group is responsible for the unpacking and organizing of the samples. This process includes checking custody seals if present, paperwork agreement, signing the chain of custody, recording cooler temperatures, documenting the condition of containers, accounting for all sample bottles, and observing any safety hazards, and reporting any problems to Client Services for communication to the client. This receipt process is documented in the LIMS.

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5.2.2. Sample Entry

As soon as practical after sample receipt, all samples are entered into our laboratory information management system (LIMS). Samples awaiting log-in are stored in temporary holding areas, at appropriate storage conditions to maintain sample integrity. Samples scheduled for Volatile analysis are stored separately. If there is doubt about the suitability of items received or if items do not conform to the description provided or the testing required is not clear or specified, the client is contacted and the conversation documented.

At the time of entry, the LIMS assigns a unique the laboratory' sample number to each sample. This number is sequentially assigned and a label is generated and is attached to the sample container.

Samples are tracked to the minute upon arrival. This allows the client to see exactly how long it took the samples to pass through receipt, unpacking, and entry.

A sample acknowledgement is generated from the LIMS per sample entry group. Upon request, a copy of the Acknowledgement may be sent to the client to confirm sample receipt and entry on the day following sample log-in. Internally, appropriate personnel audit all applicable sample entry and client paperwork.

5.2.3. Sample Preservation Check

Support personnel check and document preservation of non-volatile liquid samples after the samples have been entered into the LIMS and before they are placed into storage. Any checks of volatile samples are performed and documented at the time of analysis.

5.2.4. Sample Rejection Policy

Any time a sample is received in a condition that does not meet the method, regulatory, or client requirements, the condition of the sample is clearly documented on a sample administration documentation log or sample problem form. This information is forwarded to the CSR and the client is contacted to discuss the best course of action. The client is given the option to resample or have the sample analyzed and reported with a comment.

5.3. Sample Identification and Tracking

A sample label is generated for each sample and, in addition to the assigned unique sample number, the following information is displayed on the label: client name, sample identification assigned by the client, sample collection information, bottle code ID, analyses requested, and any applicable notes to laboratory personnel. The label includes a barcode that is used to trace the sample storage location.

To ensure accountability of results, the unique sample number assigned is used to identify the sample in all laboratory data documentation, including notebooks, instrument printouts, and final reports. The sample number is also used to identify additional containers of the sample that are created during sample preparation and analysis (e.g., subsamples, extracts, digests).

Routine sample tracking is documented using the Laboratory Sample Analysis Record (LSAR) which captures the date, time and analyst for each sample preparation and analysis. The information is compiled in the LIMS using electronic record tracking from the data upload and entry functions. This displays, per sample, on each Analysis Report.

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5.4. Sample Storage

After sample entry, samples are placed in an assigned and identified storage location until needed for analysis. Room temperature, refrigerated, and frozen storage are available and samples are stored in accordance with regulatory, method, or client direction. The LIMS is used to assign storage locations, which assists in the orderly storage of samples. Sample storage locations are secured and monitored for accurate temperature control.

The central locked storage facility contains 3430 square feet of refrigerated space, including 2740 square feet equipped for automated sample retrieval. Samples are stored in the laboratory's automated storage and retrieval system (ASRS) or other assigned storage locations (separate volatiles areas) within the laboratory until completion of all analytical work.

When a sample is scheduled for analysis, the analyst retrieves it from the storage area. To maintain the integrity and security of the sample(s), the amount needed for analysis is removed and the sample(s) returned to storage as soon as possible

5.5. Sample Return/Disposal

Samples remain in the storage area following analysis until the testing results have been verified and the analysis report has been generated. On a regular basis, a list is generated from the LIMS that summarizes samples that can be removed from the storage area. At a minimum, samples are held for 2 weeks after reporting before they would be eligible for disposal. Samples are either returned to the client or disposed of in accordance with local, state, and federal regulations.

Due to the variety of waste generated at the laboratory, several general categories of wastes and waste streams have been identified. Identification of waste occurs through information provided by the client, historical information, and/or analytical testing. The laboratory uses a sophisticated, computerized LIMS, which includes programming to assist in the identification of hazardous wastes at time of discard.

For reasons of environmental liability, client confidentiality, proprietary product formulation protection, etc., wastes generated by the laboratory are disposed of via incineration at EPA licensed facilities. The three exceptions include bulk neutralized acid waste, COD analysis waste, and lab pack waste containing mercury. None of these exceptions involve containers with client information.

5.6. Legal Chain of Custody

Samples being tested for litigation require locked storage and documentation of the time and personnel responsible when the sample was not in storage. This level of documentation is available upon client request and procedures to define these activities are in place and include the following:

- A chain-of-custody document is initiated for each bottle type submitted by the client.
- The chain of custody is signed each time the sample is stored, removed from storage, or changes hands.
- Clients requesting internal chain-of-custody documentation receive the completed forms after the analysis is complete.

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5.7. Representativeness of Samples

Each analytical method provides specific procedures for ensuring that a representative aliquot of the sample is used for testing. These procedures include shaking water samples and mixing solid samples. Analysts are instructed in sampling techniques that prevent contamination of samples.

6. TECHNICAL REQUIREMENTS – TRACEABILITY OF MEASUREMENTS

6.1. Reagents and Solvents

The reliability of our analytical results can be directly affected by the quality of reagents used in the laboratory. Procedures are in place to address labeling, storage, and evaluation of these materials. Reagents and solvents include acids, bases, indicators, buffer solutions, colorimetric solutions (CS), test solutions (TS), and volumetric solutions (VS). The *Chemical Hygiene Plan* provides safety information in regard to the storage and handling of laboratory chemicals.

Each analytical method includes a list of reagents needed to perform the test. Reagents are fully described, including chemical name, purity, and description of preparation. Where applicable, shelf life and storage conditions are also listed. The laboratory is responsible for checking that new supplies meet the method requirements. These checks are documented and maintained.

Departmental management ensures that an adequate inventory of reagents needed to perform testing is maintained. Reagents received at the laboratory funnel through the Shipping and Receiving Department and deliveries are verified and labeled with the date of receipt. Large volume reagents (e.g., solvents, acids) are stored in a building outside of the laboratory until needed for use.

In addition to the name and concentration of the reagent, all reagents are labeled with the manufacturer/vendor, storage conditions, the date opened, and an expiration or re-evaluation date. Before using any reagent, the analyst must ensure that the material was properly stored and labeled. If a reagent has passed its expiration date or shows signs of deterioration, the material is not to be used in the laboratory and must be discarded or segregated as expired. In some method development or research work, expired reagents may be used. These must be labeled as such or stored in a designated location.

If a re-evaluation date is reached before a reagent is completely consumed, the reagent will be inspected by physical observation for signs of degradation. Physical signs include, but are not limited to, color changes, clumping or other texture changes for solids and formation of precipitate in solutions. This evaluation is performed by an experienced chemist or microbiologist.

Subsequent reagent solutions or mixtures prepared at the laboratory are fully documented in a logbook and labeled to include: unique name, concentration, date prepared, name of analyst who prepared the reagent, storage conditions or reference to the logbook containing these details, and expiration/re-evaluation date. The information recorded allows these solutions to be traced to the original stock solution. The reference to the logbook is intended for use on containers that are too small to clearly document all of the information.

All reagent certificates and MSDSs are retained by the laboratory.

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6.2. Media

Within the microbiology laboratory, procedures are in place to address preparation, labeling, storage, expiration, documentation, and quality/sterility evaluation requirements for these materials. These procedures are described in Appendix K.

6.3. Calibration Standards

Written calibration procedures are required, where applicable, for all instruments and equipment used in the laboratory. The source and accuracy of standards used for calibration purposes are integral to obtaining quality data. Requirements for calibration are provided in each analytical method including specifications for the standards used. Where available and practicable, calibration measurements made by the laboratory must be traceable to national standards of measurement (e.g., NIST). C of As are maintained for each material, as applicable.

Standards are usually purchased from commercial supply houses either as neat compounds or as solutions with certified concentrations. The accuracy and quality of these purchased standards is documented on a C of A and these certificates are maintained on file in the laboratory. Upon receipt at the laboratory, material must be labeled with a date of receipt and stored appropriately.

Most solutions and all neat materials require subsequent dilution to an appropriate working range. Records of all standard preparations include the dilution(s) made and a reference to the original and any intermediate mixtures. Solutions are labeled according to laboratory procedures and assigned unique names or code numbers that provide traceability to the original components and stored appropriately. Each new preparation of standard is tested for integrity by comparison to standards from another source or previously prepared solutions. Standards are not used for sample analyses in the laboratory past their expiration date. In some method development or research work, expired standards may be used. These must be labeled as such or stored in a designated location.

6.4. Equipment and Instrumentation

The laboratory is equipped with all equipment and instrumentation required for testing the scope of work which it supports. All equipment and instrumentation is maintained in proper working order. A master list of our equipment and instruments is maintained by our accounting department and includes the date received and the condition at receipt (new v. used). Our major equipment and instrumentation capabilities are summarized in Appendix F. In addition, we have numerous other instruments including pH meters along with support equipment such as ovens, incubators, centrifuges, balances, etc.

6.4.1. General Requirements

- Equipment/instrumentation is assigned a unique designation. This unique number or system identification is used to track the equipment or instrument within data documentation.
- A maintenance logbook is established in conjunction with installation and is readily available to document all incidents that pertain to the equipment or instrument as they occur.
- All test, measuring, and inspection of laboratory systems, equipment, and instrumentation used at the laboratory is routinely calibrated and maintained in accordance with applicable standard operating procedures.

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- A member of the technical group, or designated individual, performs routinely scheduled maintenance and calibration of laboratory equipment and instruments as required by laboratory procedures. These activities are documented.
- If appropriate standards or expertise for calibration or maintenance are not available in-house, the operation is conducted by an outside service firm, with appropriate accreditation. Certificates or other data generated by the service firm are reviewed by applicable the laboratory personnel to verify acceptability. This information is maintained on file.
- All equipment or instruments taken out of service are tagged "DO NOT USE". The following minimum information is documented:
  - Date taken out of service
  - Employee who took the equipment/instrument out of service
  - Reason for tag-out
- The date that the equipment/instrument is returned to service, the corrective action taken, and performance checks performed is documented.

6.4.2. Standard Operating Procedures

Information regarding operation, maintenance, and calibration of equipment and instrumentation are found in respective SOPs. The procedures include a routine schedule for applicable preventive maintenance and calibration along with acceptance criteria and remedial action to be taken in the event of failure. These procedures are maintained in the document control system and reviewed on a regular basis to verify they remain current and accurate. Vendor supplied manuals are also available to provide additional information in regard to operation and maintenance.

6.4.3. Maintenance

- Instrument and equipment maintenance is performed as either a preventive or corrective operation.
- Preventive maintenance procedures and schedules are developed for each instrument or piece of equipment, where applicable. Preventive maintenance operations are performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel). Documentation is maintained in the associated maintenance log for the procedure(s) performed as part of the preventive maintenance operation. It is the responsibility of departmental management to ensure that a preventive maintenance schedule is addressed by a procedure where appropriate and is followed.
- Corrective maintenance is performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel) in response to indications of equipment or instrument malfunctions. The unit must be clearly tagged as out of service. All corrective actions taken to bring the unit back into service are documented in the associated maintenance log. After repair, further notation is made in the log regarding the functional status. Calibration activities are performed, as applicable, and documented in the log before the unit is placed back into service.

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- A supply of commonly needed replacement parts is maintained by the laboratory.
- A preventive maintenance schedule for major instruments is given in Appendix G. Maintenance of equipment used in microbiological testing is documented in Appendix K.

6.4.4. Calibration

- Calibration is the establishment of, under specified conditions, the relationship between the values/response indicated by a measuring instrument or system and the corresponding known/certified values associated with the standards used. Some types of calibrations are performed with a set frequency (e.g. daily) while others provide intermediate checks to ensure that the instrument response has not changed significantly.
- All measuring and testing instruments and equipment having an effect on the accuracy, precision, or validity of calibrations and tests are calibrated and/or verified on an on-going and routine basis. Methods for calibration of instruments and equipment vary widely with the nature of the device and the direction given by analytical procedures, departmental procedures, or manufacturer recommendations. Frequency of calibration can also depend on additional factors including ruggedness of the instrument or equipment and the frequency of use.
- Departmental management is responsible for developing or acquiring written calibration procedures for the types of instruments and equipment employed within their area, as applicable. Procedures address the following aspects: description of the calibration method, frequency/schedule for calibration, acceptance criteria, and corrective actions if failure occurs.
- Calibration information is recorded in a logbook that is associated with the instrument/equipment and/or a calibration certificate is maintained and/or data is generated and filed to document the activity.
- Calibration measurements are traceable to national standards of measurement (e.g., NIST) where available. Physical standards, such as NIST certified weights or thermometers are re-certified on a routine basis. Calibration certificates are maintained on file, where applicable, to indicate the traceability to national standards of measurement. These physical standards are used for no other purpose than calibration.
- Calibration failures are documented in the associated logbook and/or within the data generated from the instruments or equipment. Management personnel perform an evaluation and review of failures and assess any potential impact the failure might have on previously generated data. The laboratory utilizes “real-time” controls to ensure the accuracy of the data. These controls are used to assist in assessing the impact of the situation.
- After repair, adjustments, or relocation that could affect instrument response, calibration/verification activities are performed, as applicable, before the unit is returned to service.
- Analytical data is not reported from instrumentation or equipment that fails to meet calibration requirements.
- A summary of the calibrations for most major instruments and equipment is given in Appendix H.

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- Procedures for calibration of equipment used in microbiological testing are documented in Appendix K.

6.5. Computerized Systems and Computer Software

6.5.1. Computer Usage

The laboratory provides computer equipment for employees to use as a tool in performing their work. Computer equipment is the property of the laboratory and used in accordance with defined terms and conditions. Our goal is to provide standard hardware and software that meets the needs of the user. The majority of desktop PCs in use are standardized using cloning software.

6.5.1.1. Physical security of computer systems – It is company policy to protect computer hardware, software and data documentation from misuse, theft, unauthorized access and environmental hazards. The corporate computer area and computer "Hot-Site" is locked and requires identification/building card access. All vendors, contractors, or other visitors must be escorted into this area. Controlled access of the laboratory buildings is outlined in Section 3.2.

6.5.1.2. Passwords – Passwords are important for the security of company data and resources. The laboratory's primary network operating system is Windows and each employee must have a user ID and password combination to access the system. Other computer systems also require a user ID password combination for access. The following procedures apply regardless of which system(s) is being utilized:

- Passwords must be kept confidential
- Users must log-out of a system when not in use to prevent unauthorized access. In addition, the network access will automatically timeout after a set period of inactivity, requiring a user to log-in to access the system.
- Forgotten passwords can only be reset by the Computer Systems Department or by an appropriate System Administrator.
- Network and LIMS passwords automatically expire every 90 days. The computer prompts a user to change the password when the expiration date nears.

6.5.1.3. Computer viruses – The laboratory centrally and continuously monitors the computer network for computer viruses. Employees are prohibited from using the company's computer equipment to propagate any virus. Anti-virus software is employed to detect viruses on the Windows network. A notification is sent when there is a particularly dangerous or virulent data destructive program that employees need to be aware of. However, employees are reminded to always be cautious and observant even if there are no current warnings. Employees must report any virus concerns to the anti-virus administrator or Computer Service Management as soon as possible. Employees who share files between their home computer and the laboratory should install anti-virus software on their home computer. If an employee does not have such software, the laboratory can suggest various no-cost anti-virus software products.

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6.5.1.4. Internet and e-mail system – The e-mail system is used primarily for the laboratory's business purposes. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to system usage. Employee access to the internet is restricted to those employees who have a business need for it. All employees have access to e-mail. Access to the internet is configured through a user's Windows network account. All internet and e-mail activity is subject to monitoring. All messages created, sent or received over the internet are company property and can be regarded as public information. E-mail and website filtering software is utilized.

6.5.1.5. The laboratory's Intranet (LabLinks) – The Intranet is designed to be a useful tool for employees to acquire company information and to provide a company communication system. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to usage.

6.5.1.6. Software policy

- Copyright laws protect software, and the laboratory's intent is to abide by all software agreements.
- Software purchases must be formally requested and approved by management and/or validation personnel, as necessary.
- All software is used in accordance with applicable license agreements.
- Employees are not to install any software on computer(s) unless authorized by the Computer Systems Department.
- Software upgrades must occur in accordance with applicable change control procedure
- Employees must not give software to outsiders (e.g., clients, contractors), unless approval is granted by management.
- Users must not make copies of any licensed software or related documentation without permission. Any user that illegally reproduces software is subject to civil and criminal penalties including fines and imprisonment.

6.5.1.7. Computer system backup, data restoration, and data archival – Mission critical data is stored on several computers throughout the laboratory. These computers are connected through the local area network. Selected files on these computers are backed up using an enterprise-level backup software program. The objective of this backup is to have the ability to restore data after a total loss (e.g., theft, fire, natural disaster). Procedures are in place to perform data backups and restores.

6.5.1.8. Remote access to computer systems – Employees are able to remotely connect to the laboratory computer systems through an encrypted (SSL) login. When logging in, users are authenticated with their Windows Active Directory account and password.

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6.5.1.9. Electronic data – Instrument software used for processing data must, when available, have password access and audit trails enabled. All data processed through the LIMS includes tracking features to document who and when data was entered and/or changed.

6.5.2. System and Software Verification – The laboratory LIMS is an in-house developed program. The design and updates to the system are written following typical Software Development Life Cycle (SDLC) processes for initial planning through testing and implementation. Before a new computer system/program or significant modification of an existing system/program is implemented in our laboratory, it is necessary to generate and Validation Project Plan which specifies the level of documentation required for the new or updated application. The following are the typical documents that are required for these updates:

- Requirements documents – Describe the required system functionality and specifications
- Design documents – System overview, screen design, report layout, data description, system configuration, file structure and module design
- Testing documentation for system development/verification – Structural testing of the internal mechanisms and user testing of the installation and system qualification
- Standard operating procedures and/or manuals

6.6. Change Control

Procedures are in place to define how to maintain processes, instrumentation, equipment, computerized systems, and computer software in a validated or controlled state through a plan of change control. Successful changes require a thorough evaluation and testing for potential consequences prior to implementation. Planning, authorizing, testing, and reviewing of proposed changes are documented throughout the change process. Changes are planned or could be made in response to an emergency situation. The following "general" elements apply to changes, as appropriate:

- Request to perform a change
- Evaluation of a change
- Authorization of a change request
- Preparation for an authorized change
- Execution and testing of the change
- Documentation of the change
- Approval of the change
- Change implementation and follow-up (Formal approval of the change is performed by designated responsible individuals and QA.)

6.7. Labware Cleaning

Dedicated washroom personnel support the laboratory operations in regard to labware preparation, washing, rinsing, and drying. Labware can include, but is not limited to glassware, plastic ware, utensils, and pipettes. Procedures are in place to outline the washing process for each type of labware. Most labware is cleaned using a Miele glass washing machine. Some labware is still washed by hand and either air-dried or dried in specifically designed ovens.

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Most of the labware used in the laboratory is “common or non-dedicated” labware (common to a department), but some of the labware used in the laboratory is identified as “dedicated” labware and exclusively used for certain analyses. Examples of dedicated labware include glassware used for MBAS and Ortho Phosphate analyses (acid washed) and “oils” glassware. This labware is isolated and cleaned only with “like” labware.

All glassware is class A and 100% visually inspected for breakage (e.g., cracks, chips), cleanliness, and dryness before being returned to the laboratory for use.

Generally, each test has controls in place to ensure that results are not adversely affected by unclean labware. These controls include blanks to detect positive interferences and recovery controls to detect negative interferences.

7. PURCHASING EQUIPMENT AND SUPPLIES

7.1. Procurement

It is the responsibility of management personnel within each department to ensure that the appropriate supplies are available and/or ordered with sufficient lead-time to perform analytical testing or to provide support to the testing areas. The individual technical departments have trained personnel who enter the supply order into the company’s requisition software system. The selection of these products is based on technical input at the analyst level and authorized by technical departmental management. The Purchasing Department maintains an ordering system in which purchase requisitions are managed. Common laboratory items (e.g., beakers, flasks, reagents) are ordered directly through the Purchasing Department. Purchase orders over a specified dollar amount require verification from the appropriate member(s) of the Executive Management Group before an order can be placed.

Upon receipt of an order, the Purchasing Department checks the order to ensure that all items were received as specified. Products that have specific storage requirements are taken to the technical area upon receipt. It is the technical area’s responsibility to ensure that the product is stored in the appropriate manner. Any checks on the quality of the materials received for use in a specific test are the responsibility of the laboratory using them. This is based upon the experience of the laboratory with the usability of the product. Generally, each test has controls in place to ensure that test results are not adversely affected by the materials.

Any problems encountered when using a material in the laboratory must be brought to the attention of the Purchasing Department and/or Quality Assurance as applicable, to ensure that follow-up and corrective action occur.

7.2. Supplier Evaluation

Procedures are in place to evaluate vendors who supply us with: new equipment, instrumentation, computerized systems and computer software; commercially purchased glassware, including sample bottleware, reagents, chemicals, solvents, gases, media, and standards; and contracted and subcontracted services.

The laboratory strives to ensure that our suppliers continually improve their quality systems and we reserve the right to purchase from suppliers of our choice in order to best fulfill the needs of our clients and our business. When directed by a client to purchase from a specific supplier, we will do so. In this instance it is the client’s responsibility to “qualify” the specified supplier. We attempt to purchase from businesses that we have an established purchase history or have previously acquired information regarding the supplier’s quality programs.

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The laboratory does not evaluate every supplier. Risk assessment is taken into consideration when making this decision. The risk assessment analysis includes system, material, services, and number of samples or operations the purchase may affect or support. Evaluations are not required for computer operating systems, utilities, toolsets, or systems software. They also are not required for any off-the-shelf configurable software package that has an extensive market performance history (e.g., Microsoft Word, Excel, Access).

Additional quality systems are also in place within the laboratory to further verify and support the materials used:

- C of A for every lot of purchased prepared microbiological media and for purchased chemicals, where available, are reviewed and maintained on file.
- For most chemical analyses a blank and a recovery check are routinely analyzed and serve as real time suitability testing of the reagent being used.
- Microbiological testing often employs positive and negative controls, which serve as real time control checks.

8. ANALYTICAL METHODS

8.1. Scope of Testing

Samples are analyzed in accordance with official published methods, standard methods, client-supplied methodology, or validated in-house methods. We recognize the importance of providing verifiable results and, therefore, use methods accepted and approved by a broad range of federal and state regulatory agencies. In order to meet the needs of our clients as well as regulatory agencies, the laboratory sometimes needs to support different versions of the same method (i.e. SW-846 8081A and 8081B). The laboratory can also assist in developing and validating analytical methods for specific products and matrices. All methods submitted for our review, as well as all analytical results, are considered confidential.

The laboratory performs a wide variety of environmental testing in support of the Safe Drinking Water Act (SDWA); Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA/Superfund); and the Clean Air Act (CAA). Methods approved by ASTM are also used in testing. Potable water, wastewater, soil, sediment, sludge, oils, biota, tissue, soil gas, and air are among the matrices typically analyzed.

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Our areas of expertise include:

Standard Services	Specialty Services
• Volatiles • Semivolatiles • Metals • Pesticides/PCBs/Herbicides • Petroleum Analysis • Waste Characterization • Water Quality • Drinking Water • Vapor & Air Analysis • Sediment & Ecological • Method Development • Shale Oil & Gas Analysis • Dioxins & Furans • Explosives • PCB Congeners	• Hydrazines/NDMA • Perchlorate • 1,4-Dioxane • Pharmaceutical Manufacturing Industry (PMI) • Method 25D • Alkyl PAHs, Alkanes, Biomarkers • PFC (PFOA) • Organic Acids • Aldehydes • Low-Level Mercury

A list of tests covered under the laboratory's NELAP accreditation can be found in Appendix I. All current certificates and scopes of accreditation are available on the laboratory's website at http://env.lancasterlabs.com/resources/certifications. A complete list of the tests routinely performed by the laboratory can be found in the *Schedule of Services*.

8.2. Analytical Test Methods

Each laboratory is required to establish and maintain analytical procedures for all the methods referenced in standard testing. The sources for these methods include the most recent versions of these compendia:

- Test Methods for Evaluating Solid Waste, SW-846
- Standard Methods for the Examination of Water and Waste
- Code of Federal Regulations, Chapter 40
- EPA 100 through 600 and 1600 series methods
- ASTM

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The test methods used are re-written into a laboratory standard format, which provides consistency in content and allows the analysts to locate the information they need quickly. Procedures are in place to define the format, required approvals, and the control system for these method documents. The format requirements include:

- Uniquely assigned method number, which is used extensively for scheduling and documentation purposes.
- Reference to the original source of the method (e.g. SW-846)
- Scope
- Basic Principles
- Apparatus and Reagents
- Personnel Training and Qualifications
- Safety and Waste Disposal
- Detailed procedure (including any method modifications)
- Calculations
- QA/Quality Control
- Revision Log
- Approval signatures from technical management and QA personnel

Analytical methods are maintained as controlled documents to ensure that analysts are always working with the most current version and are reviewed periodically for accuracy.

8.3. Client Supplied Methods

Most of the client-supplied method requirements presented to us involve achieving specific quality control criteria or limits of quantitation using standard EPA methods. These requirements are communicated to the appropriate technical groups prior to the project start up. Each technical group evaluates the scope of work and the requirements to ensure the criteria can be met using the standard EPA method. The data is monitored to ensure the criteria are met throughout the project. A client service representative notifies the client if there is a more appropriate method available or if the client's criteria cannot be achieved on a certain sample matrix (i.e., due to matrix or dilutions).

Occasionally, we are asked to transfer a non-standardized method from a client into our lab or to develop a new method, when one is not available. In the case of a method transfer, we set up the client's method and perform some initial evaluation. After the initial evaluation, we may make recommendations on how to improve method performance. If the method appears to be adequate, we determine linearity, specificity, precision, accuracy, LOD, and LOQ by performing calibrations, analyzing method blanks, and carrying out method detection limit and quad studies.

In the case of method development, we work with the client and/or data user to determine the level of validation required ensuring that the method meets its intended purpose. In addition to the elements above, we also determine standard and sample stability and robustness depending on the scope of the project. Typically, a standard operating procedure is written and submitted to the client with the results of the validation. These steps are completed prior to analysis of field samples. Data related to the set up of the method are archived.

8.4. Method Validation

Before new or revised analytical methods are authorized for routine use in the laboratory, validation data is required to demonstrate that the method as performed in our laboratory and analysts performing it are capable of meeting data quality objectives for precision and accuracy. A procedure is in place to outline this process.

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Many methods published by USEPA include instructions for performing an initial demonstration of capability, which typically consist of determining the method detection limit and analyzing fortified samples in quadruplicate. This demonstration is performed and compared to acceptance limits for precision, accuracy, and detection limits, when available.

Methods that do not include specific validation requirements are validated by analyzing fortified samples or standard reference materials in replicate. The results of these analyses are used to assess accuracy and precision. Results of validation studies are documented and subject to review and approval.

8.5. Procedural Deviations

Analysts are required to follow a documented method for all tests performed. Procedures are in place to ensure that deviations from analytical methods are documented, approved, and justified in an appropriate and consistent manner (Note: Deviation from the OH EPA approved SOPs is not permitted). We classify method deviations as either being a planned deviation or an unplanned deviation. In general, the following information is captured to document both types of situations:

- Description of the deviation
- Reason or justification for the deviation
- Impact the deviation had on the testing
- Signature/date of analyst performing the test
- Signature/date of Quality Assurance and Laboratory Management approving the deviation
- Signature/date of client approval, if necessary

Deviations to written procedures are documented in raw data records or through the ICAR (Investigation and Corrective Action Report) system. Both types of documentation require management and QA review and approval.

9. INTERNAL QUALITY CONTROL CHECKS

9.1. Laboratory Quality Control Samples and Acceptance Criteria

Quality control (QC) samples are analyzed with each batch of samples to demonstrate that all aspects of the analysis are in control within established limits of precision and accuracy. Management is responsible for ensuring that QC is analyzed as required in the procedure on written methods, each analytical method specifies (or cross-references another procedure) the type of QC sample, frequency of analysis, acceptance criteria for QC sample results, and corrective action to be taken if QC sample results fall outside of the acceptable range.

QA staff, at the direction of the technical department, must program the LIMS with the acceptance criteria for each QC type (other than blanks). The acceptance criteria are based on statistically generated limits from historical laboratory data, on method defined limits, government agency recommendations, or on client/project specific limits.

These limits are used to flag samples that are out-of specification.

The types of QC samples and the information each provides are discussed in the following paragraphs.

Quality control checks used for microbiological tests can be found in Appendix K.

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9.1.1. Blanks - A blank is a designated sample designed to monitor for sample contamination during the analysis process. A volume of reagent laboratory water is typically used to monitor water sample analysis, while solid sample analysis blanks consist of a purified solid matrix or just the reagents used in the test. The blank and field samples are treated with the same reagents, internal standards, and surrogate standards and carried through the entire analytical procedure. Ideally, blanks demonstrate that no artifacts were introduced during the analysis process. The specific acceptance criteria for each test are given in the analytical method and are usually based on the required reporting limit.

9.1.2. Surrogates - Surrogates are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the analytical method, surrogates are spiked into all the field and QC samples to monitor analytical efficiency by measuring recovery on an individual sample basis. The percent recovery is determined and compared to the acceptance criteria. Acceptance criteria limits are set as required by the method or based on a statistical determination from laboratory data.

9.1.3. Matrix Spikes - A matrix spike sample is created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. Blanks are not used to for matrix spike QC. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the accuracy of the method in light of the matrix analyzed. Matrix effects can cause results to be outside of the acceptance criteria. The acceptance criteria are given in the analytical method and limits are set as required by the method or based on a statistical determination from laboratory data.

9.1.4. Laboratory Control Samples - Laboratory control samples (LCS) are samples of known composition that are analyzed with each batch of samples to demonstrate laboratory accuracy. Laboratory fortified blank (LFB) is another term used to describe a LCS. The samples either naturally contain the analytes of interest or are clean samples fortified with known concentrations. Percent recovery is calculated and compared to acceptance criteria, which are set as required by the method or based on a statistical determination from laboratory data.

9.1.5. Duplicates and Matrix Spike Duplicates and Laboratory Control Sample Duplicates - A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test. To compare the values for each compound, the relative percent difference (RPD) is calculated by dividing the difference between the numbers by their average. Precision for analytes that are not typically found in environmental samples (i.e., organic contaminants) is determined by analyzing a pair of matrix spike duplicates, defined as two spiked samples and comparing the RPD for the spiked compounds. The acceptance criteria are described as a maximum for the RPD value, which are set as required by the method or based on a statistical determination from laboratory data.

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9.1.6. Internal Standards - Internal standards are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the method, internal standards are added to every field and QC sample after extraction but prior to analysis. Comparison of the peak areas of the internal standards is used for quantitation of target analytes. Internal standard peak area and retention time also provide a check for changes in the instrument response. The acceptance criteria are stipulated in the analytical method.

9.1.7. Serial Dilutions - A serial dilution is the dilution of a sample with sufficiently high concentration by a factor of five to check for the influence of interferents. This QC check is performed for inorganics analyzed by ICP or ICP-MS. When corrected by the dilution factor, the diluted sample result must agree with the original sample within specified limits.

9.1.8 Interelement Correction Standard – Analyzed to verify interelement and background correction factors. A solution containing both interfering and analyte elements of known concentration is analyzed at the beginning and end of each analytical run or a minimum of twice per 8 hours.

9.1.9. Second Source Check - A second source check is analyzed using either the LCS and/or an ICV (Initial Calibration Verification). The second source is a standard that is made from a solution or neat purchased from a different vendor than that used for the calibration standards. For some organic custom mixes, the same vendor but a different lot and preparation is used. This ensures that potential problems with a vendor supply would be evident in the analysis. Some areas of the lab use the continuing calibration verification standards as a second source from the initial calibration.

9.2. Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for the required QC samples and the corrective action required when a QC result fails to meet the acceptance criteria. A summary is provided in Appendix J.

The QC acceptance criteria are available to analysts in the laboratory. If the method reference requires the use of specific limits then the laboratory uses the published limits that are documented as part of the analytical method. Many methods require that each laboratory determine their own acceptance criteria based on statistical data obtained from performance of the method. In these cases, the limits are available to the analysts and are entered into the LIMS described below. Statistically determined acceptance criteria are subject to change as the laboratory recalculates its control limits. Due to their dynamic nature, acceptance criteria are not included in this manual.

The results of all quality control samples are entered into the computer in the same way as the results of client samples. The LIMS compares the individual values with the acceptance limits (statistically determined or method specified) and identifies quality control sample results that are out of specification. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This includes, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a comment stating the observed deviation, and reanalysis of the samples in the batch.

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Each month, a summary of all QC entries (except blanks and surrogates) is generated from the LIMS. This summary is reviewed by QA staff and evaluated for changes in data that may indicate that an analysis is trending towards an out-of-control situation. The technical department is notified if a trend is observed.

The laboratory allows for marginal exceedances based on the number of analytes in the LCS. The exceedances are carefully monitored so that any systemic problems would be identified and corrective action taken. If the LCS is being reported based on the marginal exceedance allowance, a comment is added to the analytical report. Note: The use of marginal exceedance is not allowed for OH VAP work.

9.3. Quality Control Charts

Quality control results entered into the computer are used to generate control charts that are plotted via computer and can be accessed at any time by all employees. The system charts results from blanks, surrogates, matrix spike/matrix spike duplicates, duplicates, and laboratory control samples/laboratory control samples duplicate. These charts provide a graphical method for monitoring precision and bias over time. They can be used to detect quality problems by observation of patterns. The computerized quality control system is used to report QC data to clients and to collect data for assessment of precision and accuracy statistical limits.

9.4. Measurement Uncertainty

(ISO 17025) “All uncertainty components which are of importance in a given situation shall be taken into account using appropriate methods of analysis” (5.4.6.3). This means the laboratory must determine the uncertainty contribution of all steps in the testing process such as equipment, calibration, standards, reagents, preparation, cleanups, etc. Since, in most methods, the laboratory control sample (LCS) goes through the entire process of preparation to analysis; all factors that would contribute to uncertainty is evident through the LCS results. LCSs are performed with every batch of samples where appropriate for the method.

Measurement uncertainty is calculated as two times the standard deviation of the LCS recoveries for the group and date range of data points selected for all applicable methods. This is reported as a percentage.

Tests that do not have LCSs (e.g. TCLP and paint filter test), are evaluated on a case-by-case basis by taking into account the uncertainty of each of the steps taken to perform the test.

Reports for uncertainty are generated and submitted to QA on an annual basis. It is not necessary to apply or report the uncertainty determination with sample results. When a client requests the measurement uncertainty it is applied by multiplying the determined analyte concentration by the uncertainty percentage.

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10. ASSURING QUALITY OF TEST RESULTS

10.1. Data Management

At a minimum, data management is initiated when the laboratory receives the samples from the client. More often the process begins with client communication of their needs and requirements for a specific project and/or testing. The CSRs are responsible for entering the information in the sample set up function of the LIMS. Upon receipt of the samples the unique tracking number is generated based on this information. At this point, computer technology becomes an integral part of tracking the samples through laboratory operations. The flow of data from the time samples enter the laboratory until the data is reported is summarized in the following table:

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Sample and Data Flow

Action	Personnel Involved
Sample received at Lancaster Labs • Unpacked and reconciled against the client paper work or COC • SA Documentation log completed	Sample Administration
Sample is entered into the LIMS • Lab ID number assigned • Analyses entered • Chain of custody started • Storage location assigned • Electronic record of sample number • Labels generated • Acknowledgement printed (record of samples received and analysis entered)	Sample Administration
Sample stored in assigned location (refrigerator, freezer, etc.) • Electronic record of sample #, bottle code, and location	Sample Support
Acknowledgment sent to client (when requested)	Sample Administration
Sample removed from storage for analysis • Electronic requisition of sample number by bottle code • Necessary aliquot taken • Sample returned to storage	Technical Personnel
Analysis is performed according to selected analytical method • Raw data recorded • Reviewed • Transferred to computer by analyst* (This is tracked by the unique sample number and batch number.)	Technical Personnel
Computer performs calculations as programmed according to methods	Data Processing
Second analyst or supervisor verifies raw data	Technical Personnel
Generation/release of reports (automated through LIMS)	Billing and Reporting Group
Data package deliverables are assembled	Data Package Group
Electronic Data Deliverables (EDDs) are generated	EDD Group
Data packages are reviewed prior to sending to client	QA, Data Package Personnel, and Laboratory Management
Data packages are scanned Hard copy of batch raw data is archived Electronic files are backed up and archived	Data Package Personnel, Office Services, Computer Services

*Analyses requiring the analyst's interpretation may involve manual data reduction before entry into the computer.

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10.2. Data Documentation

Analytical data generated in the laboratory is collected from the instruments or associated data system or is manually documented in bound notebooks. Analysts review data as it is generated to determine that the instruments/systems are performing within specifications. If any problems are observed during an analytical run or the testing process, corrective action is taken and documented.

Procedures are in place to ensure that all data is traceable, authentic, and complete. Electronic data records are maintained and tracked through the LIMS, requiring authorized, password protected user access. The following general requirements outline our system for notebook, logbook, and documentation recording:

- Observations, data, and calculations are recorded at the time they are made and are identifiable to the specific task.
- Entries must be legible, signed, and dated. The signature may be a wet or electronic signature.
- Errors are corrected in a manner that does not obliterate the original entry, initialed and dated, and coded with an explanatory identifier. Changes to electronic data are tracked through audit trail functions.
- Blank pages or substantial portions of pages which are left blank are crossed-out to eliminate the possibility of data entry at a later date.
- Notebook pages and instrument printouts are signed/dated to indicate second party data review; this may be a wet or electronic signature.
- At periodic intervals a supervisor or data reviewer checks equipment/instrument logbook entries and temperature recordings for completeness, legibility, and conformance to procedures.
- At a minimum, the following information is recorded as part of data documentation:
    - Date of analysis/operation
    - Signature/date of analyst performing test/operation
    - Identification of client sample(s) and material(s) analyzed
    - Materials, reagents, standards used to perform the testing/operation
    - Method used to perform testing/operation (including version number and/or effective date)
    - Equipment/instrumentation used to perform testing/operation
    - Calculations and how they were derived
    - Departures, planned or unplanned, from the analytical method
    - Signature/date of person reviewing data documentation
- For computer generated data, the following information is recorded:
    - Sample(s) analyzed/operations performed
    - Date of analysis/operation
    - Unique instrument identification
    - Name/date of person operating the instrument
    - Name/date of person reviewing data
    - Any manual notations or interpretations made on instrument printouts are signed, dated, and reviewed

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10.3. Data Calculations

Most instruments either include or are connected to a data system programmed to perform calculations to reduce the raw data to a reportable form. All calculations are maintained in the instrument manuals and/or as part of the analytical method.

In many cases, the data from the local instrument system are uploaded directly to the LIMS for review and reporting. This direct upload eliminates the need to retype data and an associated source of transcription errors from the analytical scheme.

Some instruments report data that require application of additional factors before the data is in final form. For example, an extract concentration may be reported by the instrumental data system, but additional dilution and preparation factors may be needed before the result represents the concentration of analyte in the sample. Analysts input these additional factors into the LIMS, where final calculations are performed.

Analysts manually enter collected data, such as titration data, into the LIMS, which is programmed to perform calculations for final reporting. Documentation of the programming for each calculation performed by the LIMS is maintained.

10.4. Reporting Limits

It is important to ascertain the limit of quantitation (LOQ) that can be achieved by a given method, particularly when the method is commonly used to determine trace levels of analyte. The Environmental Protection Agency has set forth one method for determining method detection limits (MDLs) from which LOQs can be extrapolated which is summarized in a laboratory procedure.

MDLs are verified or determined annually on each instrument and are the basis for the LOQ used in the default reporting format. Because MDLs change each time they are re-evaluated, they are not included in this manual, but are available in each laboratory and available to clients upon request.

The reporting limit used to determine whether a result is significant and reported as detectable is dependent upon agency and client requirements. A variety of formats are available and include use of the MDL, LOQ, method specified limits, and project specific limits. The MDL and LOQ for each analyte are programmed into LIMS for reporting purposes.

Under the DoD program, the laboratory must establish a Detection Limit (DL) and Limit of Detection (LOD). As defined by the DoD program, the DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence. The laboratory determines the DL using the calculated value from the MDL Study. The DL can be derived from pooled MDL values obtained across instruments. The LOD is the smallest amount of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. It is established by spiking a quality system matrix at a concentration of 2-4 times the DL. The LOD must be verified on a quarterly basis or with each batch of samples.

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10.5. Data Review

Final review and verification of the data are performed by designated employees using the sample results, quality control information, method criteria and Project Notes entered into the LIMS. Data are initially evaluated by the analyst and then a second designated employee knowledgeable in the test, other than the employee responsible for performing the test, reviews the data. The reviews include checks for correct transcription, calculations, passing calibrations, compliant quality control results, holding time compliance, and project specific requirements. Any issues or errors identified during this stage are addressed, corrected, and reviewed with the responsible person.

After determining that all necessary requirements for valid data and for the project are met, the reviewer electronically approves the data by changing the LIMS status of the data from "complete" to "verified". The computer is programmed with a list of approved reviewers for each test, and the system is password protected to ensure that only qualified individuals verify the data.

10.6. Data Qualification

Data qualifiers are used to provide additional information about the results reported. The most typical use for data qualifiers is for results that fall below the quantitation limit, in the region where it becomes more difficult to distinguish a positive result from the background instrument signal. The data systems used to generate and report results are programmed to flag values in this range as estimates.

Other qualifiers are applied to advise data users of any validation issues associated with the data. The laboratory makes every effort to meet all of the requirements for generation of data. Occasionally, generation of data that does not meet all the method requirements occurs due to sample matrix or other analytical problems. If the test can not be repeated or reanalysis would not yield better quality data, qualified data is reported. Qualifiers can be in the form of comments on the analytical report or flags applied to the results.

10.7. Data Reporting

When all analyses are completed, reviewed and verified, a report is generated. The client receives a copy of the report containing the results of the analysis, associated QC data, and where necessary, explanatory comments to address non-conformances. To avoid ambiguity in interpreting results, a summary page that contains an explanation of all symbols and units used in reporting data is included with the Analysis Report submitted to clients. Some regulatory agencies also require the laboratory accreditation identification on the Analysis Reports. Where required, this information is added. The current list of agencies can be accessed in the LIMS. Copies of reports and associated supporting raw data are retained in our archives. The report contains the signature of the assigned client service representative who is the key contact for any questions concerning the results. Personnel authorized to review, sign, and release Analysis Reports are noted in the key personnel list provided in Appendix C.

The laboratory offers a variety of data levels and formats, from a basic report of sample and QC results only, to a comprehensive data package of QC/calibration information and raw data. The client and any agency involved direct the selection of report type. A summary of report formats and data packages types is provided in the laboratory *Schedule of Services*. Various electronic formats are also available formatted to client-specified file structure and sent via e-mail, direct upload, web-site access (LLabWeb), or common courier. LLabWeb is used for clients that require secure transfer of electronic data.

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Client confidentiality of LLabWeb data is ensured by the use of a secured firewall internet environment coupled with the use of a user ID and password to gain login access to the system. User accounts are configured to only allow access to specific data associated with the user's business account number.

Amendments to a final report after issue are in the form of an additional document or data transfer and include a reference to the original report. When a completely new final report is required, it is uniquely identified and includes a reference to the original report it replaces.

10.7.1. Reporting the Results

Analytical reports are generated with a cover page that summarizes all samples in that group. This page lists the laboratory assigned sample number and the corresponding client description. The cover page identifies the laboratory contact person's name and phone number if there is a question about the report. Within this package, each page is uniquely identified and paginated. Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAP accreditation and ISO 17025 unless noted otherwise. Ohio EPA VAP requires that a signed, notarized affidavit accompany each analytical report.

10.8. Data Storage, Security, and Archival

The laboratory has documented procedures and instructions for the identification, collection, access, indexing, filing, storage, maintenance, and disposition of data records. Records are in the form of paper records, electronic data files, magnetic tape, and CD-ROMs.

All data records are maintained in a confidential manner in an environment to minimize deterioration or damage and to prevent loss. Some records are stored in off-site facilities, in such a way that they are readily retrievable. Retention time for records is in accordance with specific procedures or instructions. Prior to the destruction of data/records, and if requested by a client or agency, the laboratory will notify the client/agency that their data is scheduled for destruction so arrangements can be made to have the original data sent to the client.

If specified in client contract(s), archived records are transferred according to their instructions in the event of a change in laboratory ownership or if the laboratory goes out of business. If not specified by the client, the sale agreement must require that archived records be maintained as scheduled by the new owners. In the case of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed.

The laboratory maintains all documentation which is necessary for historical reconstruction of data:

- Analysis reports
- Data notebooks
- Data logbooks
- Instrument output
- Correspondence and client files
- Instrument and equipment logbooks
- QA records
- Corporate documents
- Electronic records

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11. AUDITS AND INSPECTIONS

11.1. Internal Quality Assurance Audits

The QA Department, which is independent of laboratory activities, performs routine and on-going system, traceability, and observation audits to objectively review current systems, operations, and procedures as well as automated data integrity audits of electronic data records. The goal of the audits is to ensure that the quality system activities are effective and in compliance with regulatory programs, including NELAP. ISO 17025, DoD, and state agencies, as well as internal policies and procedures. Audits are documented and tracked in a QA database.

Audits are scheduled and conducted following a predefined schedule, based on criticality of operation and prior audit results, with the goal of evaluating systems and technologies across the operation. If warranted, additional audits are performed to follow up on promised corrective action or areas of concern.

Results of an audit are documented in a report format and distributed to applicable management personnel responsible for the area(s) under audit. Management is responsible to address all non-conformances found during an audit.

Audit reports and responses are circulated to Management to communicate the outcome of the audit and the proposed plan(s) for corrective action, if warranted. If any of the audit findings cast doubt on the validity of the results, the clients must be notified within three business days of the investigation.

All records maintained as part of an audit are kept on file for three years.

On an annual basis, an audit of the QA Department is performed as directed by the company Executive Management. The auditors assigned to carry out this operation are qualified staff members independent of the QA Department.

The specific content and findings of internal audits are not shared with clients.

11.2. Review of the Quality Assurance Program

All levels of management are continually updated on the status of quality and compliance by circulation of pertinent documents. Management review is documented by signatures on the route list, along with any comments or request for additional follow-up. The types of documents circulated real-time include:

- Internal, client, and agency audit reports and responses
- Proficiency test results
- Investigation and corrective action reports
- Monthly and quarterly QA status reports

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Executive management reviews the elements of the total QA program on an annual basis to ensure its continuing suitability and effectiveness in meeting the stated objectives outlined in Section 2.4 of this manual. The evaluation entails review of reports to management, all audit findings, client complaints, laboratory investigations, staff adequacy and training, and projected growth in workload. Patterns or trends in any of these areas are reviewed as a means to continually improve the quality system. This review also includes an evaluation of any audit findings resulting from the audit of the QA Department. At the conclusion of this quality system review, executive management determines the need to introduce changes or improvements into the quality systems at the laboratory. The minutes from the meeting and any recommendations for improvement are documented and a copy is forwarded to the QA staff for review and follow-up.

11.3. Good Laboratory Practice Critical Phase Inspections

Any project that is subject to Good Laboratory Practice (GLP) regulations is audited by the QA Department at intervals adequate to ensure the integrity of the study, as required by the regulations. Inspections of a GLP project include direct observation of analysts as they perform various phases of the study. Data documentation is reviewed as part of the inspection. The purpose of this type of audit is to ensure that there are no deviations from written methods, procedures, or study protocols.

Results of inspections are documented in a report format and distributed to applicable management personnel responsible for the area(s) under audit. Management is responsible to address all non-conformances found during an inspection. Inspection reports and responses are circulated to applicable laboratory management and an off-site study director, as applicable, to communicate the outcome of the inspection and the proposed plan(s) for corrective action, if warranted.

All records maintained as part of an inspection are kept on file.

11.4. Client Audits

Because clients place great importance on compliance with applicable regulations, data quality, and project requirements, they may audit our facility as assurance that their objectives are being met. QA, management staff, CSRs, and the analytical laboratories play a key role in these audits. Visits by clients can range anywhere from a tour (to verify laboratory facilities and instrumentation) to an intensive inspection of technical operations, procedures, regulatory compliance, and/or review of specific project(s).

- Audits are scheduled directly with the CSR or QA. The request to audit is communicated to all applicable laboratory departments.
- In accordance with our policy on client confidentiality, a client is permitted to review only data and results that apply to their work, or which have been approved by laboratory management.
- An escort (designated laboratory employee) remains with an auditor at all times.

Responsibilities are assigned to the following groups in regard to client audits:

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11.4.1. QA Department

- Research previous audit reports and laboratory responses to past deficiencies.
- Follow-up with the applicable analytical laboratory areas to ensure action items were completed from the last audit, as necessary.
- Work with client to set audit agenda.
- Function as an escort during the audit
- Answer questions the auditor has in regard to laboratory and quality systems.
- Take notes of areas where corrective action or suggestions are recommended during the audit.
- Communicate audit issues to management at the completion of the audit.
- Respond to client audit reports.
- Ensure follow-up to cited items are performed in a timely manner.

11.4.2. CSRs

- Gather and organize relevant information (e.g., client correspondence, analysis/project requests, copies of analytical data from archives).
- Be knowledgeable about client-specific project requirements and issues.
- Function as an escort during the audit.
- Communicate issues/problems to appropriate personnel.

11.4.3. Laboratories

- Gather and organize laboratory data and documentation in preparation for client review.
- Assure corrective action was implemented from past audit findings, if necessary.
- Be prepared to discuss project data/testing results during the audit.
- Be familiar with client-specific project requirements and be prepared to answer client questions.
- Be familiar with the location of routine laboratory information and equipment (e.g., SOPs, data notebooks, calibration data, etc.).
- Be prepared to answer specific technical questions in regards to laboratory procedures and instrumentation within the area.
- Functions as an audit escort within the department during the audit.
- Laboratory managers may function as an escort during the audit

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11.5. Agency Inspections

It is laboratory policy to cooperate to the fullest extent and maintain cordial relations with all government agencies. The QA Department is assigned the responsibility of hosting and working with agency representatives. Their role includes, escorting the investigator(s); ensuring all questions are answered promptly and accurately; making note of all unresolved issues; informing management of the audit status and outcome; responding to the audit report and ensuring that appropriate corrective action is completed.

Inspections can be performed by investigators or auditors from the EPA, states, third-party accreditation bodies (i.e. A2LA, United States Department of Agriculture (USDA), or other regulatory agencies.

Government agencies have the right to investigate and inspect the laboratory during normal business hours and permission to inspect is granted by Executive Management.

Designated members of the QA Department are primary contacts for announced inspections. The QA Manager is the primary contact for all unannounced agency inspections. If the QA Manager is unavailable, Executive Management is notified, in addition to a member of the QA Department. The QA Manager, or their designee, must obtain evidence of the investigator's authority either in the form of a letter or examination/explanation of credentials.

Inspections include the examination of records or the inspection of facilities. Investigators are usually concerned only with the records relating to their responsibilities. As a general rule, they are given copies of records and documents, if requested. All copied records taken by an investigator must be stamped as being confidential material. The laboratory must have a record of all items taken by an investigator.

Investigators must be escorted through the laboratory. The laboratory is not obligated to show an investigator the following types of information: sales, financial or pricing information, or any personnel data other than training or qualification documentation. On a case-by-case basis, internal QA audit reports and investigation reports are made available for agency review. Any questions or concerns about a request made by an investigator in regard to recording devices or photographs must be reviewed with legal counsel.

The laboratory personnel are not permitted to sign affidavits. If an affidavit is presented during an inspection, all personnel are directed not to sign it, read it, nor listen to it being read. The only document that is acceptable to sign is an acknowledgement that an inspection report has been received. If there is any doubt as to what should be signed, legal counsel must be consulted.

11.6. Proficiency Testing

Many of the organizations that certify our laboratory to perform various analyses require proof of our competency. Laboratory performance is checked regularly by participation in a variety of proficiency testing programs. When available, blind samples are obtained from vendors that are accredited to provide PT samples for NELAP for all test and matrices routinely tested at the laboratory. In addition, some individual certification programs require analysis of specific sets of proficiency samples, and the laboratory also chooses to participate in a double blind program.

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Generally, the proficiency test programs consist of samples or ampulated spiking solutions used to fortify laboratory samples. The laboratories analyze the samples in the same manner as a client sample and the data is sent to the agency or vendor for evaluation. After the study results are returned to the laboratory, any data falling outside the acceptance criteria is investigated and corrective action is implemented, if needed. Results are circulated to management and communicated to the analyst. No proficiency testing samples or portion of a proficiency test sample are sent to another laboratory for analysis.

Double blind samples are submitted to the laboratories by the Client Services Department using a fictitious client name so that the analysts are not aware that the samples are proficiency tests. The samples are submitted quarterly and include a cross-section of organic and inorganic tests. The acceptance criteria for these double blind samples are developed statistically using data from participating laboratories, providing a source of inter-laboratory comparison. Results are reviewed, investigated as needed, and circulated to management.

If a trend in PT failures is identified, additional blind samples are ordered for that specific test as corrective action.

Clients routinely submit blind and double blind samples to evaluate the laboratory's performance. If a report is issued to the laboratory, it is handled in the same manner as a scheduled PT study evaluation and follow-up.

12. CORRECTIVE AND PREVENTIVE ACTION

12.1. Laboratory Investigations and Corrective Action

Due to the technical nature of laboratory work and the encompassing nature of our QA program, a wide variety of laboratory issues can require investigations, documentation, and corrective action. Prompt investigation and implementation of corrective action ensure that only data of known quality are reported and prevent the reoccurrence of errors. The following list provides "examples" of the type of issues that warrant investigation:

- Out-of-specification QC results
- Failed performance evaluation samples
- Reporting incorrect results
- Contamination issues
- Client technical complaints
- Procedural errors
- Missed holding times
- Systematic problems that compromise the accuracy or compliance of the data generated
- Problems with instrumentation and equipment which could compromise the data generated

These investigations must include the following:

- Identification of the problem
- Steps taken to investigate the problem
- Explanation of probable root cause(s) of the problem
- Steps taken to prevent future occurrence
- Determination of samples or systems affected by the problem

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Management is informed of problem situations and the QA Department tracks documentation and the status of the investigation activities. Technical management and/or QA may issue a stop work notice if issues indicate the potential for problems on a broad scale. The goal is to identify root cause, have the corrective action implemented promptly, and to the degree appropriate for the magnitude and risk of the problem. Corrective action issues are subject to follow up by the QA Department. Tracking and trending of laboratory issues is performed by the QA Department and reported to management on a monthly and quarterly basis.

12.2. Investigation Processes

All results from quality control (QC) samples are logged into the computerized quality control system, which is programmed to alert analysts to unacceptable results. Analysts are required to review the results and determine the source of the problem. The source of the problem and proposed corrective action must be documented. Corrective action may include, but is not limited to, re-analysis, re-extraction or re-digestion, instrument maintenance, or re-calibration. If these actions do not yield compliant data within the required hold time, a Nonconformance Form is initiated to document actions and communication with the client. The original form is archived with the associated raw data. Nonconformance Forms are reviewed by the technical department's management, or designee. A copy of the form is reviewed by QA.

Missed holding times are investigated and documented according to a procedure specific to this issue. A standard form is used for documenting this type of incident and signed by a representative of all areas involved, in addition to management and QA. Clients are informed of any problems involving holding time.

Other types of problems having the potential for impact on the quality of data are investigated and documented using a form titled Investigation and Corrective Action Report (ICAR). This process was developed to ensure that laboratory problems are investigated, evaluated for root cause, documented, and corrective action is put into place to prevent reoccurrence. Any employee can initiate an ICAR to document a laboratory problem. Once initiated, the QA Department is notified to assign a unique tracking number and the due date for the investigation. The QA Department reviews and approves the completed ICAR then monitors the corrective action.

If a laboratory error is identified from the outcome of the investigation that impacts client data, the client must be immediately notified in writing of the situation. If the root cause of the problem has affected any other client sample results, all affected clients are notified immediately of the problem.

12.3. Client Feedback

The laboratory is in the business of providing high quality analytical testing services. The data that we supply to our clients must be technically complete, accurate, and compliant with applicable regulations. Complaints can be received via letter, phone call, e-mail, or face-to-face meeting.

When a complaint is received, it is our responsibility to determine, to the best of our ability, the extent of the issue and what data is in question. The person receiving the complaint documents this information and promptly forwards it to the appropriate management personnel where the work in question was performed. If a transcription or calculation error is discovered, the final report and/or data must be regenerated with the correct value(s).

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The Client Service Representative is responsible for entering client concerns into the LIMS and an automated summary report is sent to QA on a weekly basis for review. In some cases, an investigation is initiated to address and document the situation.

On an annual basis, the Client Services and Business Development Groups send a client satisfaction survey to all clients. The results of these surveys are compiled and used to identify areas of improvement for the laboratory.

12.4. Preventive Actions

All employees are empowered and encouraged to use the concept of Preventive Action to avoid a problematic situation. The company supports, embraces and drives the process for continuous quality improvement by several means, such as: Ethics Committee and the Suggestion Box (accessible to all employees on the company's Intranet 'LabLinks'), and training classes that include "Making Quality a Science" and Ethics. If an employee identifies a potential problem or an area of concern or it should be brought to the attention of his/her supervisor, Human Resources or the Ethics Officer. Employees are also encouraged to communicate to their supervisor any area(s) or operation(s) that they believe could be streamlined, make their job easier, would provide a quality improvement, or could provide a cost savings to the company.

Various training courses are provided to all employees to assist with building quality and efficiency into their daily jobs. They stress a proactive approach/environment to problem solving and to review quality systems and operational efficiencies.

- "Making Quality a Science" is an introductory total quality management (TQM) course required for all employees to teach why quality is important and to explain the laboratory's quality philosophy and processes, and how to apply quality thinking and techniques on the job. Topics discussed include: communication, teamwork, serving the client, measurement, quality tools, and continuous process improvement. To foster continuous improvements of laboratory systems, process improvement teams are formed, as needed, if an employee needs help in solving a problem or addressing an issue. The goal of these groups is to have representation from various areas of the laboratory work together to look at a problem, evaluate the need for a temporary fix, brainstorm root causes, plan process improvement, implement the process improvement, evaluate and follow-up to the corrective action.

- "Putting our Values to Work" is a seminar required for all employees to teach the laboratory's Statement of Values by examining how it translates to our everyday jobs and ethical decision making. Topics discussed include: Statement of Values, ethical paradigms, and ethical decision making. Mandatory ethics training refresher seminars are offered on an annual basis.

- The laboratory has an Ethics Committee that meets on a regular basis to discuss and handle ethical issues or situations that cause concern or make employees feel uncomfortable. The mission of this group is to promote sharing of concerns on ethical issues; encourage and maintain commitment among employees to our core ethical values; and to maintain an environment that ensures open access to committee members and all levels of management and the confidential handling of ethical issues.

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- The laboratory also utilizes a formal program to encourage preventive action through development of lean processes. The goal of this program is to optimize processes to ensure efficiency and operational improvements while maintaining compliance. The efficiency gains are inherently coupled with minimizing errors and rework. Teams of employees learn the tools and techniques to evaluate a process, identify potential sources of errors, delays or problems in an operation, determine system changes that will minimize these and work to implement the improvements. Each project includes thorough documentation of the evaluation, measurement, and implementation phases. The process is continually monitored to ensure that the anticipated results are sustained.

- The Quality Assurance Group prepares monthly and quarterly program status reports for management. The reports include a variety of metrics and graphs which are used to evaluate trends in laboratory performance across all quality and compliance areas. Management responds to any negative trends by developing a corrective action plan.

13. SERVICE TO CLIENTS

13.1. Service to Clients

We value our client relationships and support these partnerships through the following principles:

- Honesty and Fairness – Our corporate culture is founded on the principles of professionalism and high ethical standards in dealing with our clients. This may mean declining to provide the service requested (if we are convinced that to do so would be meaningless) or it may mean referring clients outside of our Lab if we believe that another company can better meet their needs.

- Complete Service – We will give our clients full value on every service provided. We will provide detailed information on our methods, procedures, and QA programs if requested, and take a personal interest and initiative in helping solve our client's problems within the area of our professional expertise.

- Trustworthiness – All data and information developed for a client will be held confidential and not disclosed to a third party except on written request of the client. If information is subpoenaed, we must, by law, release it, but the client will be informed of the release.

- Commitment to Quality – We constantly strive to improve our service in quality, flexibility, and dependability, to keep our competitive edge. We will achieve this through: meeting the requirements of those we serve, staying apprised of regulatory and industry expectations, and providing prompt responses to client concerns.

- Basics of Superlative Service – Our focus is on our client's success. Through proactive collaborative communication, our leadership ensures we understand our client's expectations and strives to exceed them. We foster a service culture in our training, reward and recognition, and performance management process so each employee takes ownership to deliver superlative service to our clients. Feedback from clients, whether positive or negative, is an important part of our continuous improvement system. Ways in which feedback is gathered can include, but is not limited to, customer satisfaction surveys, client audits, and the customer complaint system, which is described within section 12.3.

We also view our fellow employees as our clients since they frequently receive the results of our labor. Meeting the requirements of the next employee in the workflow process is just as important as meeting the needs of an external client.

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13.2. Review of Work Requests, Tenders, and Contracts

The laboratory places great importance on understanding client requirements for a project. We ensure, to the best of our ability, that client/project requirements are identified. Project evaluation can be achieved in various ways, including the review of analytical methods, protocols, business contracts, and quality agreements. Project kick-off meetings can also be arranged through the Business Development and/or the Environmental Project Management Group. These meetings allow the client and key technical personnel to discuss project issues and requirements prior to project initiation. The project review encompasses our Project Cycle process and individual topics to be evaluated for a project include, but are not limited to: scope of testing; required accreditations (i.e. individual state agencies, NELAP, DoD, and ISO17025) held by the laboratory; appropriate and current testing methods; ability to meet project required reporting limits and QC (if applicable); inconsistencies clarified; and nonstandard work requests. Any differences between laboratory processes and the project requirements are discussed and addressed with the client and the laboratory staff before the project is accepted and samples arrive. Testing that cannot be performed at the laboratory may be subcontracted to another laboratory (see 13.4).

A key client contact, the CSR is assigned to oversee the project. Communication between the client and laboratory staff is available and is coordinated through the CSR.

As a project continues, the CSRs provide continuous communication and status reports (if requested) about the project to the client. The CSR relays any project changes or modifications to the technical groups. If the client submits revised project documents (QAPPs, etc.) then the Project Cycle review process is repeated. The CSR also communicates any issues encountered by the technical laboratories back to the client and vice-versa.

13.3. Timely Delivery

Evaluating laboratory capacity and ability to perform specific projects is a joint responsibility between the Technical Director, Business Development, and the laboratory managers. We recognize that one of the most important aspects of the service we offer is turnaround time.

Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in the laboratory area creating operation flexibility for routine work. Larger projects are reviewed against capacity estimates before bids are submitted to ensure that the client's schedule is met. Turnaround time is continually measured.

Regularly scheduled meetings are held with technical and support management, and project management personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Management receives a daily report of the status of all samples in the lab, including those with priority status or those that have exceeded a preset turnaround time. This is of inestimable value in planning and organizing the workload through efficient scheduling.

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Any changes to the established timeline by the client or the laboratory must be communicated to the client or laboratory as soon as possible. Upon communication of changes, a new timeline is established and agreed upon by both parties. If a client requires a change in the scope of the project (e.g., number of samples submitted, change in analyses, revised protocol) the laboratory must be informed in writing and a new timeline and cost estimate is be provided.

13.4. Subcontracting

The laboratory may subcontract tests to other laboratories if the requested testing is not routinely performed in our laboratory. To a lesser extent, samples may need to be subcontracted to an overflow laboratory to ensure hold times and/or turn-around-times (TAT) are met.

Testing is only subcontracted with the client's knowledge and approval. The CSR must notify the client in writing when any of their requested analyses will be subcontracted to another lab. Client approval must be obtained in writing before samples are shipped.

Subcontract laboratories are selected based on their qualifications and accreditations. The subcontractor is requested to sign a statement that they warrant all testing procedures they perform and that they are solely liable and responsible for the accuracy of tests performed. If projects require a specific agency certification (i.e. individual state agencies, National Environmental Laboratory Accreditation Program (NELAP), Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP), and ISO17025), only an appropriately accredited laboratory is used. The client may also have a list of laboratories to be used for subcontracting. In these cases, the evaluation of the subcontract laboratory is made by the client.

Data obtained from subcontract laboratories is clearly marked as such when reported by the laboratory. The data are submitted to the client in the format obtained from the subcontractor.

13.5. Use of NELAP and A2LA logo

It is not laboratory policy to use these logos on any company letterhead, including analytical reports.

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Procedure Cross Reference List

NOTE: SOPs and Forms are indicated in the table with the unique Document Control Database number starting with "90…". The topic of the document is given in parentheses.

Section #	Title	Procedure(s)
1	Introduction	
1.1.	Mission Statement	Employee Handbook
1.2.	Quality Policy	9007879 (Statement form) Employee Handbook
1.3.	Statement of Values	Employee Handbook
1.5.	Certifications, Accreditations, and Registrations	9007852 (Cert Summary form)
2	Organization and Personnel	
2.1.1	Business Continuity and Contingency Plans	9017347 (Incident Response Plan) 9017681 (Preparedness …Policy 0010) 9017358 (Archiving SOP) 9021762 (Deputies form)
2.2.	Organizational Structure	Organization Charts
2.3.	Management Responsibilities	PQDs (job descriptions) PMDs (individual job plans)
2.4.	Overview of the Quality Assurance Program	Dept 4052 SOP Series
2.5.	Quality Assurance Responsibilities	Dept 4052 SOP Series
2.6.	Communication of Quality Issues to Management	9020717 (QA Reports)
2.7.	Personnel Qualifications and Responsibilities	9017379 (Employee Training) PQDs (job descriptions) PMDs (individual job plans) Task Specific Training
2.8.	Relationship of Functional Groups and the Quality Assurance Program	Quality Orientation TQM Training PMDs (individual job plans) Dept 4052 SOP Series 9017338 (Project Cycle)
2.9.	Balancing Laboratory Capacity and Workload	PMDs (individual job plans) LIMS reports for mgt
2.10.	Identification of Approved Signatories	9017322 (Date Entry, Verification and Reporting)
2.11.	Personnel Training	9017379 (Employee Training) 9015390 (DOCs) PQDs (job descriptions) PMDs (individual job plans) Task Specific Training
2.12.	Regulatory Training	9022322 (GLP)

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Section #	Title	Procedure(s)
2.13.	Employee Safety	Analytical Methods Chemical Hygiene Plan 9017681 (Preparedness …Policy 0010) Dept 6098 SOP Series PMDs (individual job plans)
2.14.	Client Services/Project Management Responsibilities	Dept 4039 SOP Series 9017338 (Project Cycle)
2.15.	Confidentiality	Employee Handbook 9017360 (E-mail System) 9022134 (Client and Agency Audits)
2.16.	Business Conduct	Employee Handbook
2.17.	Operational Integrity	9017675 (Manual Integration Policy 0001) 9017333 (Chromatographic Integration) 9017679 (Ethics Policy 0007) 9007879 (Quality Statement form)
3	Buildings and Facilities	
3.1.	Facility	Floor Plans
3.2.	Security	9017366 (Building Security)
3.3.	Disaster Recovery	9017347 (Incident Response Plan)
3.4.	Environmental Monitoring	9017311 (VOA Storage) 9021509 (ETM)
3.5.	Water Systems	9017368 (Reagent Water)
3.6.	Housekeeping/Cleaning	9017373 (Housekeeping)
3.7.	Insect & Rodent Control	9017367 (Insect & Rodent Control)
3.8.	Emergency Power Supply	9017347 (Incident Response Plan)
3.9.	Facility Changes	9017364 (Facility Change Control) 9028515 (Change Control)
4	Document Control	
4.1.	Hierarchy of Internal Operating Procedures	9017356 (Writing SOPs)
4.2.	Document Approval, Issue, Control, and Maintenance	9017357 (Document Control) 9017329 (Method Validation)
4.3.	Client-Supplied Methods and Documentation	9021833 Analytical Decision Making) 9022599 (QA review of QAPPs) 9017338 (Project Cycle) 9015436 Auditing Paperwork)
4.4.	Laboratory Notebooks, Logbooks, and Forms	9017357 (Document Control) 9021767 (Notebooks)

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Section #	Title	Procedure(s)
4.5.	Control of External Documents	9017357 (Document Control) Departmental "Controlled Documents" forms
5	Sample Handling	
5.1.	Sample Collection	Dept 4031 SOP Series
5.2.	Sample Receipt and Entry	Dept 6042 SOP Series
5.3.	Sample Identification and Tracking	Dept 6042 SOP Series 9017318 (LSAR)
5.4.	Sample Storage	Dept 6055 SOP Series
5.5.	Sample Return/Disposal	9015512 (Sample Discard) 9017352 (Hazardous Wastes - Lab) 9017756 (Hazardous Wastes – Storage)
5.6.	Legal Chain of Custody	9017335 (Legal COC)
5.7.	Representativeness of Samples	Analytical Methods 9017334 (Representative Solid Samples)
6	Technical Requirements - Traceability of Measurements	
6.1.	Reagents and Solvents	9017328 (Reagents and Standards) Analytical Methods
6.3.	Calibration Standards	9017328 (Reagents and Standards) Analytical Methods
6.4.	Equipment and Instrumentation	9017325 (Inst. & Equip M&C) 9015389 (Balance, Syringe, Pipette Verification) Departmental Technical Procedures
6.5.	Computerized Systems and Computer Software	9028515 (Change Control) 9017361 (Network Accounts) 9017360 (E-mail System) 9017710 (Computer Backup) Employee Handbook 9017712 (Computer Viruses)
6.6.	Change Control	9028515 (Change Control)
6.7.	Labware Cleaning	Departmental Procedures
7	Purchasing Equipment and Supplies	
7.1	Procurement	9021705 (Procurement) 9018236 (Receipt of Lab Supplies)
7.2	Supplier Evaluation	9021705 (Procurement) 9017310 (Subcontracting) 9017328 (Reagents and Standards) 9015516 Preservative Checks)

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Section #	Title	Procedure(s)
8	Analytical Methods	
8.1.	Scope of Testing	Schedule of Services
8.2.	Analytical Test Methods	9017329 (Method Validation) 9023483 Writing Procedure Guidance form)
8.3.	Client Supplied Methods	9017329 (Method Validation)
8.4.	Method Validation	9017329 (Method Validation)
8.5.	Procedural Deviations	9017331 (ICARs)
9	Internal Quality Control Checks	
9.1.	Laboratory Quality Control Samples and Acceptance Criteria	9017313 (QC Limits) Analytical Methods
9.2.	Quality Control Sample Frequency and Corrective Action	9017315 (Noncompliant Data) Analytical Methods
9.3.	Quality Control Charts	9018253 (End of Month QC Reports)
9.4.	Measurement Uncertainty	9017313 (QC Limits)
10	Assuring Quality of Test Results	
10.1.	Data Management	9021767 (Notebooks)
10.2.	Data Documentation	9021767 (Notebooks) 9017322 (Date Entry, Verification and Reporting) 9007879 (Statement form)
10.3.	Data Calculations	9017322 (Date Entry, Verification and Reporting) Analytical Methods
10.4.	Reporting Limits	9017309 (MDLs & LOQs)
10.5.	Data Review	9021767 (Notebooks) 9017322 (Date Entry, Verification and Reporting)
10.6.	Data Qualification	9017315 (Noncompliant Data)
10.7.	Data Reporting	9017322 (Date Entry, Verification and Reporting) 9017330 (MCL Exceedance)
10.8.	Data Storage, Security, and Archival	9017358 (Data Archiving) 9017710 (Computer Backup)
11	Audits and Inspections	
11.1.	Internal Quality Assurance Audits	9020535 (Internal Audits) 9022322 (GLP) 9008821 IInternal Audit Checklist form)
11.2.	Review of the Quality Assurance Program	9020535 (Internal Audits) 9020717 (QA Reports)
11.3.	Good Laboratory Practice Critical Phase Inspections	9022322 (GLP)
11.4.	Client Audits	Employee Handbook 9022134 (Client and Agency Audits)

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Section #	Title	Procedure(s)
11.5.	Agency Inspections	Employee Handbook 9022134 (Client and Agency Audits)
11.6.	Proficiency Testing	9017321 (PT Program) 9018237 (PT Entry)
12	Corrective and Preventive Action	
12.1.	Laboratory Investigations and Corrective Action	9017315 (Noncompliant Data) 9017331 (ICARs) 9017332 (Client Complaints)
12.2.	Investigation Processes	9017326 Missed Hold Procedure) 9007810 (Missed Hold form) 9017331 (ICARs)
12.3.	Client Feedback	9017332 (Client Complaints) Annual Client Survey
12.4.	Preventive Actions	Corporate Training Lean Projects 9017338 (Project Cycle) 9028515 (Change Control) 9020535 (Internal Audits)
13	Service to Clients	
13.1.	Service to Clients	Employee Handbook Ethics Statement 9007879 (Statement form) TQM Training
13.2.	Review of Work Requests, Tenders, and Contracts	9015436 (Client Paperwork) 9017338 (Project Cycle) 9018254 (QAPP Review)
13.3.	Timely Delivery	9015434 (Tracking Rush Samples) 9015437 (Scheduling Rush Samples) Departmental LIMS reports
13.4.	Subcontracting	9017310 Subcontracting) 9017338 (Project Cycle) 9018248 (QA Approval of Subcontractors)

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Eurofins Document Reference	1-P-QM-GDL-9015379	**Revision**	3
Effective Date	Aug 8, 2014	**Status**	Effective
Historical/Local Document Number	DOD - Environmental Quality Policy Manual Appendix B		
Local Document Level	Level 1		
Local Document Type	POL - Policy		
Local Document Category	ES - Environmental Sciences		

Prepared by	Christiane Sweigart
Reviewed and Approved by	Duane Luckenbill;Review;Tuesday, July 29, 2014 10:47:11 AM EDT Robert Strocko;Review;Wednesday, July 30, 2014 1:31:56 PM EDT Dorothy Love;Approval;Wednesday, July 30, 2014 2:07:59 PM EDT

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Agency	Parameter	Applicable Matrices	Lab ID No. Certificate No
Federal Programs:			
American Association for Laboratory Accreditation (A2LA)	Organics, inorganics, dioxin per ISO 17025 and DoD QSM 4.2	Nonpotable water, solid and hazardous waste, air, tissue and tobacco	0001.01
USDA Quarantine Soil Permit	All	All	P330-13-00350
State Programs:			
State of Alaska, Department of Environmental Conservation	Organics, inorganics, UST analysis	Nonpotable water, solid and hazardous waste	UST-061
State of Arizona, Department of Health Services	Dioxins	Potable water, nonpotable water, solid and hazardous waste	AZ0780
State of Arkansas, Department of Environmental Quality	Organics, inorganics, dioxin	Nonpotable water, solid and hazardous waste	88-0660
State of California, Department of Health ELAP	Organics, inorganics	Potable water, nonpotable water, solid and hazardous waste	2792
State of California, Department of Health NELAC	Dioxin and NDMA	Potable water, nonpotable water, hazardous waste	10276CA
State of Colorado, Department of Public Health and Environment	Organics, inorganics, dioxin	Potable water	None
State of Connecticut, Department of Public Health	Organics, inorganics, dioxin, micro	Potable water, nonpotable water, solid and hazardous waste	PH-0746
State of Delaware, Health and Social Services	Organics, inorganics, dioxin, micro	Potable water	None
*State of Florida, Department of Health	Organics, inorganics, dioxin, micro	Air and emissions, potable water, nonpotable water, solid and chemical materials	E87997
*State of Illinois, Environmental Protection Agency	Organics, inorganics, dioxin	Nonpotable water, solid and chemical materials	200027 003345
State of Iowa, Department of Natural Resources	Organics, inorganics, UST analysis	Nonpotable water, solid and hazardous waste	361
*State of Kansas, Department of Health and Environment	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and chemical materials	E-10151
Commonwealth of Kentucky, Department of Environmental Protection, Division of Water	Organics, inorganics, dioxin	Potable water	90088
*Commonwealth of Kentucky, Department for Environmental Protection – UST Branch	Metals only	Nonpotable water, solids	89
,,* State of Louisiana, Department of Environmental Quality	Organics, inorganics, dioxin	Air emissions, nonpotable water, solid chemical materials, biological tissue	Lab ID:02055 AI No.:30729
State of Maryland, Department of the Environment	Organics, inorganics, dioxin, micro	Potable water	100
Commonwealth of Massachusetts, Department of Environmental Protection	Organics, inorganics	Nonpotable water	M-PA009

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Agency	Parameter	Applicable Matrices	Lab ID No. Certificate No.
State of Michigan, Department of Environmental Quality	Organics, inorganics, dioxin	Potable water	9930
State of Missouri, Department of Natural Resources	Organics	Potable water	450
State of Montana, Department of Public Health and Human Services	Organics, inorganics, dioxin	Potable water	CERT0098
*State of Nevada, Division of Environmental Protection	Organics, inorganics, dioxin	Nonpotable water, solid and chemical materials	PA00009
*State of New Hampshire, Department of Environmental Services	Organics, inorganics, micro	Potable water, nonpotable water, solid and chemical materials	2730
*State of New Jersey, Department of Environmental Protection (NJDEP)	Organics, inorganics, dioxin, micro	Air and emissions (direct accreditation), potable water, nonpotable water, solid and chemical materials,	PA011
*State of New York, Department of Health	Organics, inorganics, dioxin	Air, nonpotable water, potable water, solid and chemical materials	10670
State of North Carolina, Department of the Environment and Natural Resources	Organics, inorganics	Nonpotable water	521
State of North Carolina, Department of Health and Human Services	Organics, micro	Potable water	42705
State of North Dakota, Department of Health	Inorganics	Nonpotable water	R-205
State of Ohio, Environmental Protection Agency (Voluntary Action Program)	Organics, inorganics	Nonpotable water, solid and hazardous waste	CL0070
State of Oklahoma, Department of Environmental Quality	Organics, inorganics, dioxin	Nonpotable water, solid and hazardous waste	9804
*State of Oregon, Public Health Laboratory	Organics, inorganics, dioxin	Air, nonpotable water, solid and chemical materials	PA200001
*Commonwealth of Pennsylvania, Department of Environmental Protection (Bureau of Laboratories)	Organics, inorganics, dioxin, micro	Potable water, nonpotable water, solid and chemical materials	36-00037 013
State of Rhode Island, Department of Health	Organics, inorganics	Potable water, nonpotable water	LAO00338
State of South Carolina, Department of Health and Environmental Control	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and hazardous waste	89002 89002002
State of Tennessee, Department of Environment & Conservation	Organics, inorganics, dioxin	Potable water	TN02838
*State of Texas, Commission on Environmental Quality	Organics, inorganics, dioxin	Air and emissions, potable water nonpotable water, solid and chemical materials, biological tissue (direct accreditation)	T104704194-14-13
*State of Utah, Department of Health	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and hazardous material	PA00009

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eurofins Lancaster Laboratories Environmental	Document Title: Certifications, Accreditations, Registrations and Contracts		
	Eurofins Document Reference: 1-P-QM-FOR-9007852	Revision: 22	Historical Reference: Form 2528
	Effective date: Jun 23, 2014	Status: Effective	

Agency	Parameter	Applicable Matrices	Lab ID No. Certificate No.
State of Vermont, Department of Health Laboratory	Organics, inorganics, dioxin, micro	Potable water	VT 36037
Commonwealth of Virginia, Department of General Services	Organics, inorganics, micro	Potable water	00187 2417
[3] Commonwealth of Virginia, VELAP	Organics, inorganics, dioxin, micro	Air, Potable water, nonpotable water, solid and chemical materials	460182 2754
State of Washington, Department of Ecology	Organics, inorganics, dioxin	Air, Potable water, Nonpotable water, solid and chemical materials	C457
State of West Virginia, Department of Health and Human Resources	Organics, inorganics	Potable water	9906C
State of West Virginia, Department of Environmental Protection	Organics, inorganics, dioxin, micro	Nonpotable water, solid and chemical materials, hazardous waste	055
State of Wisconsin, Department of Natural Resources	Organics, inorganics, dioxin	Nonpotable water, solid and hazardous waste	998035060
State of Wyoming and all Tribal Public Water Systems in Region 8	Organics, inorganics, dioxin, micro	Potable water	8TMS-L

[1]NELAP Primary AB: Air and Emissions
[2]NELAP Primary AB: Potable Water, Nonpotable water, solid and chemical materials
[3]NELAP Secondary AB
[4]Approval for UST work by A2LA
[5] NELAP Primary AB: Biological Tissue

NOTE: This list accurately reflects the certifications, accreditations, registrations, and contracts held at the time of publication and is subject to change. Check with your account manager on the status of any certification needed for a specific project.

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Prepared by	Christiane Sweigart
Reviewed and Approved by	Duane Luckenbill;Review;Tuesday, September 29, 2015 8:51:39 PM EDT Dorothy Love;Approval;Wednesday, October 14, 2015 10:25:01 AM EDT

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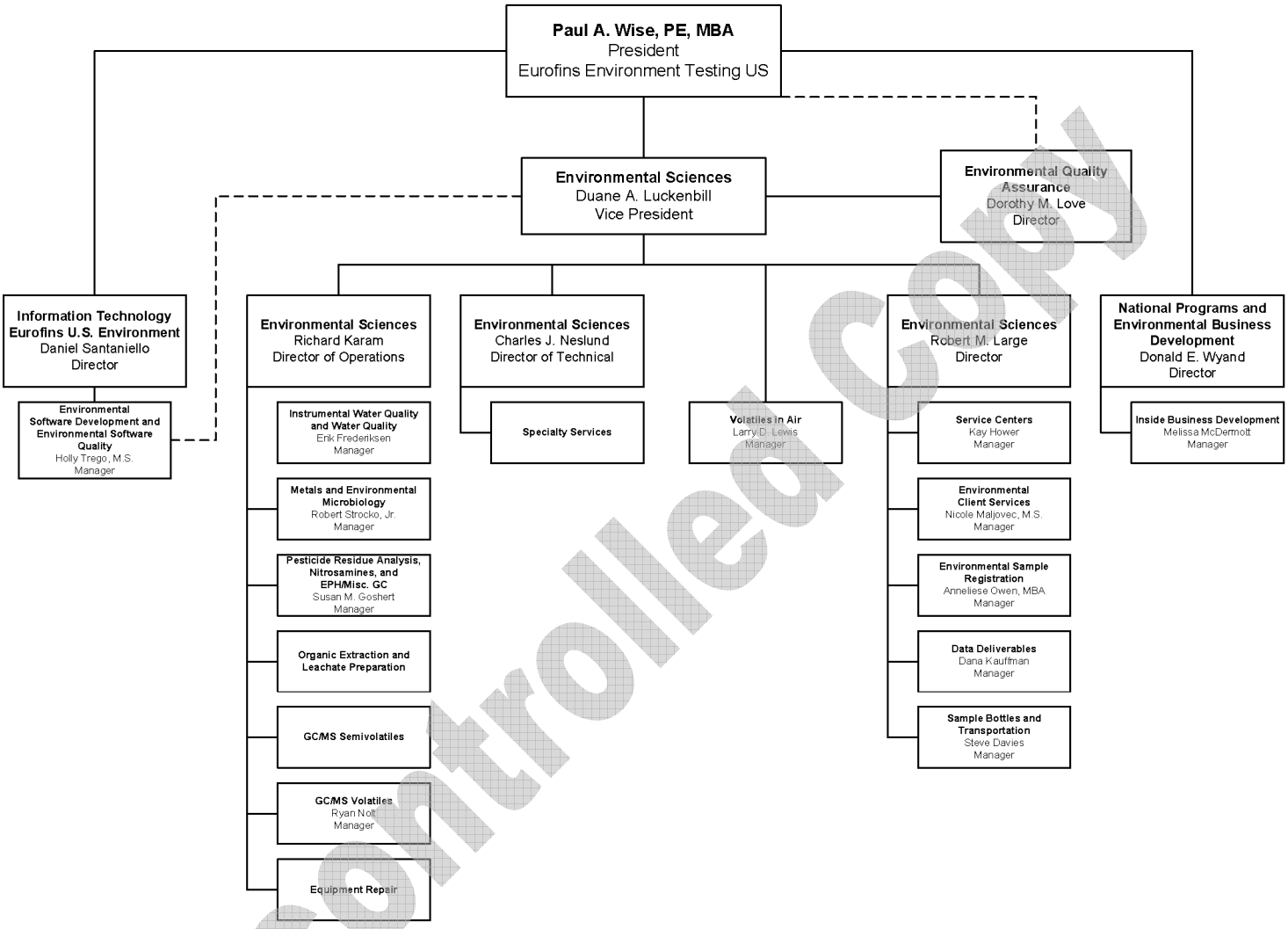

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Name	Degree	Title
Quality Assurance		
Dorothy Love*	B.S.	Director Scientific Support
Barbara Reedy*	B.S.	Senior Specialist
Christiane Sweigart	B.S.	Senior Specialist
Kathryn Brungard*		Senior Specialist
Environmental Sciences		
Duane Luckenbill	B.S.	Vice President
Donald Wyand	B.S.	Director Sales
Robert Large*	B.S.	Director Operations Support
Richard Karam*	B.S.	Director Scientific
Charles Neslund*	B.S.	Director Scientific
Allon Hull	B.S.	Sr Account Manager
Christine Jampo	M.S.	Sr Account Manager
David Velasquez		Sr Account Manager
Irene Dodd*	M.S.	Operations Sup Pr Specialist I
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Jenifer Lewis	B.S.	Pr Account Manager
Jeremy Young	B.S.	Sr Account Manager
Joseph Garzio	M.S.	Sr Account Manager
Kevin Moran	M.B.A.	Sr Account Manager
Laura Caulfield	B.S.	Operations Support Spec I
Laura Jovanovic	B.A.	Pr Account Manager
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Angela Miller*	B.S.	Operations Support Spec I
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Deanna Wyand	B.S.	Specialist I
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Katherine Klinefelter*	M.S.	Operations Sup Pr Specialist I
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Lynn Frederiksen*	B.S.	Operations Sup Pr Specialist I
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Megan Moeller*	B.S.	Operations Support Sr Spec I
Melanie Duszynski*		Operations Support Spec I
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Stacy Butt*	B.S.	Operations Support Spec I

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Name	Degree	Title
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Teresa Cunningham*	B.S.	Operations Sup Pr Specialist I
Additional support personnel in this group: 1		
Data Deliverables		
Dana Kauffman*		Manager
F. Bradley Ayars		Principal Scientist GL
Grace Salm		Specialist I
Audrey McClune		Specialist I
Betty Umble		Specialist I
Grace Salm		Specialist I
Jessica Baron		Specialist I
Judi Brown		Specialist I
Kathy Fair		Specialist I
Lydia Steinke	B.S.	Specialist I
M Susan Kreider		Specialist II
Patricia Madrigal-Kauffman	A.S.	Specialist I
Tina McNeil		Specialist I
Tracy Pang-Ward		Specialist I
Additional support personnel in this group: 5		
Service Centers		
Kay Hower*	B.A.	Manager Operations Support
Larry Starkey		Sr Project Manager GL
Ana Spencer*	B.S.	Project Manager
Cassandre Revell*	B.S.	Project Manager
Karen Lopez		Project Manager
Stefanie Mielnicki*	B.S.	Project Manager
Stephen Gordon*	B.S.	Project Manager
Additional support personnel in this group: 2		
Environmental Microbiology		
Robert Strocko*	B.S.	Manager
Hannah Cottman	B.S.	Scientist
Extractable Petroleum Hydrocarbons (EPH)/Miscellaneous GC		
Susan Goshert*	B.S.	Manager
Michele Hamilton*	B.S.	Senior Scientist Group Leader
Christine Dolman	B.S.	Scientist
Heather Williams	B.S.	Senior Scientist
Nicholas Rossi	B.S.	Senior Scientist
Tracy Cole*		Senior Specialist
Tyler Griffin	B.S.	Scientist
Additional support personnel in this group: 1		
Field Sampling		
Samuel Huber	B.S.	Manager
Jeffrey Allen		Courier/Sample Support Spe GL
Timothy Hauck		Courier/Sample Support Spec

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Name	Degree	Title
GC/MS Semivolatiles		
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Rachel Cochis*	B.A.	Senior Specialist Group Leader
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Beth Rubino	B.S.	Senior Specialist
Brian Graham	B.A.	Senior Scientist
Catherine Bachman	B.S.	Scientist
Holly Ziegler	B.S.	Senior Scientist
Joseph Gambler	B.S.	Principal Scientist
Linda Hartenstine	B.A.	Senior Scientist
Mark Ratcliff*	B.A.	Senior Specialist
Matthew Barton*	B.S.	Senior Specialist
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GC/MS Volatiles		
Ryan Nolt	B.S.	Manager
Kathrine Muramatsu	B.S.	Senior Scientist Group Leader
Kenneth Boley*	B.S.	Senior Scientist Group Leader
Roy Mellott	B.S.	Senior Scientist Group Leader
Amanda Richards		Scientist
Angela Sneeringer	B.S.	Senior Scientist
Anita Dale		Scientist
Brett Kenyon	B.S.	Scientist
Chad Moline*	B.S.	Senior Specialist
Chelsea Stong	B.S.	Senior Specialist
Christine Dulaney*	B.S.	Senior Specialist
Christopher Torres	B.S.	Scientist
Daniel Heller	B.S.E.	Senior Scientist
Jason Long	B.S.	Senior Scientist
Jeremy Giffin	B.S.	Scientist
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Kevin Sposito	B.S.	Senior Scientist
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Sara Johnson	B.S.	Senior Scientist
Sarah Guill	B.S.	Scientist
Stephanie Selis	B.S.	Senior Scientist
Additional support personnel in this group: 6		

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Instrumental Water Quality		
Erik Frederiksen*	B.A.	Manager
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Joseph McKenzie		Scientist
Sandra Miller		Scientist
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Metals		
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Choon Tian	B.A.	Scientist
Damary Valentin		Scientist
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Jennifer Moyer	B.S.	Senior Specialist
Katlin Cataldi	B.S.	Scientist
Parker Lindstrom	B.S.	Senior Scientist
Suzanne Will	B.S.	Scientist
Tara Snyder	B.S.	Scientist
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Organic Extraction		
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Wanda Oswald		Senior Scientist Group Leader
Darin Wagner	B.A.	Scientist
David Hershey		Scientist
David Schrum		Technician II
Heidi Roberts*	B.S.	Senior Scientist
Jessica Velez	B.S.	Scientist
JoElla Rice		Technician II
Joseph Feister		Senior Scientist Group Leader
Justin Bukeavich		Technician
Kailah Ortiz		Technician
Robert Vincent	B.S.	Principal Scientist
Ryan Schafran	B.S.	Scientist
Shawn McMullen	B.A.	Scientist
Additional support personnel in this group: 20		

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Pesticide Residue Analysis		
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Jessica Miller	B.S.	Senior Scientist
Lisa Reinert	B.S.	Scientist
Monica Souders	B.S.	Scientist
Richard Shober	B.S.	Principal Scientist
Valerie Tomayko*	B.S.	Pr Scientific Sup Spec I
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Specialty Services Group		
Charles Neslund*	B.S.	Director
Christine Ratcliff	B.S.	Pr Scientific Sup Spec I GL
Brett Weidman	B.S.	Scientist
Deborah Zimmerman		Scientist
Ginelle McQuaid		Scientist
Joseph Anderson	B.S.	Senior Scientist
Meng Yu	M.S.	Principal Scientist
Michael Ziegler	B.S.	Senior Scientist
Michele Smith*	B.S.	Senior Specialist
Paul Cormier	B.A.	Pr Scientific Sup Spec I
Robert Brown		Principal Scientist
Timothy Trees	A.S.	Principal Scientist
Additional support personnel in this group: 3		
Volatiles in Air		
Larry Lewis	B.S.	Manager Scientific
Jeffrey Smith	B.A.	Senior Scientist Group Leader
Jacob Bailey	B.S.	Scientist
Additional support personnel in this group: 1		
Water Quality		
Erik Frederiksen*	B.A.	Manager Scientific
Kenneth Bell*	B.S.	Principal Scientist GL
Hannah Royer	B.A.	Scientist
Michele Graham	B.S.	Scientist
Michelle Lalli		Scientist
Robert Heisey*	B.A.	Senior Specialist
Susan Engle		Scientist
Susan Hibner	B.S.	Scientist
Yolunder Bunch		Scientist
Additional support personnel in this group: 6		

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Environmental Software Development		
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Andrew Strebel		IT Development Pr Spec II
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Catherine Holt	B.S.	IT Development Pr Spec II
Chadwick Hershey	B.S.	IT Development Sr Specialist
Christopher Stauffer	B.S.	IT Development Sr Specialist
Diana Holmes	M.S.	IT Development Sr Specialist
Eric Walker		IT Development Specialist
John Riggs	B.S.	IT Development Sr Spec GL
Joshua Peters	B.S.	IT Development Specialist
Tiffany Betz	B.S.	IT Development Pr Spec II
Timothy Weaver	B.A.	IT Development Sr Specialist
Environmental Sample Administration		
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Carolyn Cyms	B.S.	Senior Specialist Group Leader
Tamara Helsel		Senior Specialist Group Leader
Christine Knoedler	B.A.	Scientific Support Spec I
Deborah Neslund		Specialist II
Katherine Metzger	B.A.	Scientific Support Spec I
Katie Hartlove		Scientific Support Spec I
Kristin Zeigler	B.S.	Scientific Support Spec I
Additional support personnel in this group: 5		
Equipment Maintenance & Repair		
Robert Allison		Facilities Specialist I
Training		
Beth DiPaolo	M.A.	Vice President of PSS & Recruiting/Organizational Development
Kimberly Davies	M.B.A.	Director
Lindsay Deibler-Wallace	M.S.	Senior Specialist Group Leader
Barbara Weaver	M.S.	Pr Scientific Sup Spec I
Harry Ward	PHD	Pr Scientific Sup Spec I
Julia Matesich	B.S.	Scientific Support Spec I
Michael Salgado	B.S.	Senior Specialist
Sample Bottles		
Steven Davies	B.S.	Manager
Karen Guito		Courier/Sample Support Spec
Samantha DeFalcis		Courier/Sample Support Spec
Sandra Muckle		Courier/Sample Support Spec
Additional support personnel in this group: 3		

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Sample Support		
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Lisa Cooke		Scientist
Stephanie Sanchez		Scientist
Additional support personnel in this group: 10		
Transportation		
Steven Davies	B.S.	Manager Operations Support
Christopher Winters		Courier/Sample Support Spec
L Kenneth Miller		Courier/Sample Support Spec
Leon Wolf		Courier/Sample Support Spec
Timothy Miller		Courier/Sample Support Spec
Additional support personnel in this group: 17		
Safety		
Rachel Brady	B.S.	Senior Specialist Group Leader
Beth Rich		Operations Support Sr Spec I
Stephen Nowakowski	B.S.	Senior Specialist
Additional support personnel in this group: 7		

*Denotes those employees who are authorized to release Analysis Reports.

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Eurofins Document Reference	1-P-QM-GDL-9015381	**Revision**	3
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Historical/Local Document Number	DOD - Environmental Quality Policy Manual Appendix D		
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Local Document Type	POL - Policy		
Local Document Category	ES - Environmental Sciences		

Prepared by	Christiane Sweigart
Reviewed and Approved by	Duane Luckenbill;Review;Tuesday, July 29, 2014 11:12:48 AM EDT Robert Strocko;Review;Wednesday, July 30, 2014 1:27:29 PM EDT Dorothy Love;Approval;Wednesday, July 30, 2014 2:11:21 PM EDT

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Joseph D. Anderson, B.S., Senior Chemist, Specialty Services Group

Education:

B.S. General Science, Pennsylvania State University (2004)

Professional Experience:

ALSI, GC GC/MS Analyst (2004-2010)

Responsibilities included preparing, running, and reviewing samples according to client and industry methods using various instrumentations including GC and GC/MS; performing analysis for various departments as determined by work volume and staffing needs; reviewing and reporting data within client specified criteria

With Lancaster Laboratories since 2010

Senior Chemist, Flexible Staffing (2010)

Responsibilities included preparing, running, and reviewing samples according to client, compendia, and industry methods using various wet chemistry techniques and instrumentation, which may include but is not limited to, gas chromatography, liquid chromatography, IC, and TOC instrumentation; performing analysis for various departments as determined by work volume and staffing needs

Senior Chemist, Specialty Services Group (2012)

Responsibilities include maintaining instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; diagnosing complex problems and offering solutions with a high degree of independence; suggesting and implementing improvements to maximize quality and productivity; acting as technical resource for internal problems and projects; assisting in "brainstorming" client problems and projects; training new employees in all aspects of instrumentation; researching new and emerging technologies

F. Bradley Ayars, Principal Specialist Group Leader, Data Deliverables

Continuing Education:

Environmental Law & Policy, Franklin & Marshall College (1991)

Professional Experience:

With Eurofins Lancaster Laboratories since 1988

Client Services Specialist (1992)

Environmental Project Management (1994)

Senior Specialist Coordinator, Electronic Data Deliverables (1997)

Responsibilities included supervising EDD staff; developing and maintaining EDD formats; overchecking lab data for EDDs; primary contact for EDD issues

Senior Specialist Group Leader, Electronic Data Deliverables (2005)

Responsibilities included supervising EDD staff; developing and maintaining EDD formats; overchecking lab data for EDDs; primary contact for EDD issues

Principal Specialist Group Leader, Electronic Data Deliverables (2014)

Responsibilities include supervising EDD staff; developing and maintaining EDD formats; overchecking lab data for EDDs; primary contact for EDD issues

Matthew Rusty E. Barton, B.S., Senior Specialist, GC/MS Semivolatiles

Education:

B.S. Biochemistry, East Stroudsburg University (1991)

Professional Experience:

With Lancaster Laboratories since 1991

Senior Chemist (1998)

Senior Chemist/Coordinator (1999)

Responsibilities included: supervise personnel; schedule lab work; perform purge and trap gas chromatography testing; operate O.I. 4560/4551, Tekmar 3000, Archon 5100, and HP5890 Series II OC instruments; review and approve data; and developing and evaluating new methods.

Senior Chemist, Nitrosamines (2003)

Responsibilities included: Analysis of nitrites in tobacco samples

Senior Chemist, EPH/Misc. GC (2004)

Responsibilities include: Analysis of environmental samples for diesel range organics via gas chromatography

Senior Specialist, GC/MS Semivolatiles (2008)

Responsibilities include: audit and upload of departmental data

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Marie D. Beamenderfer, B.S., Senior Chemist, GC Volatiles

Education:

B.S. Biology, The Pennsylvania State University (2006)

Professional Experience:

With Eurofins Lancaster Laboratories since 2006

Chemist, GC Volatiles (2006)

Responsibilities included maintaining GC instrumentation; calibrating instruments as needed; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision; training new employees; tracking inventory of instrument parts and standards and entering them into the standards database as received; verifying data on an as needed basis

Senior Chemist, GC Volatiles (2012)

Responsibilities include maintaining GC instrumentation; calibrating instruments as needed analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client an/or regulatory requirements; performing all duties with minimal supervision; training new employees; tracking inventory of instrument parts and standards and entering them into the standards database as received; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in “brainstorming” client problems and projects; completing assigned projects on time; verifying data on an as needed basis

Kenneth A. Bell, B.S., Principal Chemist Group Leader, Water Quality

Education:

B.S. Chemistry, Millersville University (1997)

Professional Experience:

Johnsons Chemical, Laboratory Assistant (1989-1992)

Responsibilities included collecting samples and performing testing on raw material

With Eurofins Lancaster Laboratories since 1994

Senior Laboratory Technician, Water Quality (1994)

Responsibilities included routinely performing analytical testing using wet chemistry methods

Chemist/Coordinator, Water Quality (1994)

Responsibilities included performing wet chemistry analyses, sample verification, and coordinating workflow

Senior Chemist/Coordinator, Water Quality (1994)

Responsibilities included coordinating workflow, performing sample verification, back-up report signing, training new employees, revising standard operating procedures, writing annual job plans and reviews

Senior Chemist Group Leader, Water Quality (2005)

Responsibilities included coordinating workflow, performing sample verification, back-up report signing, training new employees, revising standard operating procedures, writing annual job plans and reviews

Principal Chemist Group Leader, Water Quality (2014)

Responsibilities include coordinating workflow, performing sample verification, back-up report signing, training new employees, revising standard operating procedures, writing annual job plans and reviews

Holly Berry, B.S., Senior Chemist, GC/MS Semivolatiles

Education:

B.S. Forensic Chemistry, Buffalo State College (SUNY) (2006)

Professional Experience:

New York State Police, Toxicology Intern (2005-2006)

Responsibilities included performing analysis of alternative medicines using FPIA, SPE, GC/NPD, and GC/MS

With Lancaster Laboratories since 2006

Chemist, GC/MS Volatiles (2006)

Responsibilities included analyzing soils and waters for VOAs using purge and trap and GC/MS instrumentation

Senior Chemist, GC/MS Volatiles (2010)

Responsibilities included analyzing performing GC/MS analysis of water and soil samples along with other matrices by various analytical methods such as EPA 8260B and CLP; evaluating analytical data generated; calibrating and troubleshooting GC/MS instrumentation; assisting other employees with any questions that may arise and helping to train new employees

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Senior Chemist, GC/MS Semivolatiles (2011)

Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instruments daily; analyzing quality control and client samples; reviewing and assembling this data in an efficient manner with a high degree of quality to meet client requirements; working on special assignments; running 8270C, 625, THPA, and TEL methods

Memberships and Appointments:

Emergency Response Team (Hazmat technician) – LLI (2006-2011)

Tiffany D. Betz, B.S., Principal Specialist, Environmental Software Development

Education:

B.S. Computer Science, Millersville University (2001)

Continuing Education:

Oracle Exam #1Z0-007, Introduction to Oracle 9i: SQL (May 17, 2004)

Oracle Exam #1Z0-147, Oracle 9i: Program with PL/SQL (August 4, 2004)

Professional Experience:

With Eurofins Lancaster Laboratories since 2000

Specialist, Computer Applications Development (2000)

Responsibilities included performing computer applications development and maintenance.

Senior Specialist, Computer Applications Development (2006)

Responsibilities included performing computer applications development and maintenance.

Principal Specialist, Environmental Software Development (2012)

Responsibilities include analyzing, designing, developing, documenting, validating, and deploying custom software in a regulated environment; conforming to FDA guidelines and CFR Part 11 in all duties; strictly adhering to Lancaster Laboratories Software Development Lifecycle (SDLC) policies and procedures; preparing and executing software test plans for custom developed Laboratory Information Management System (LIMS) and other software in accordance with internal procedures; spending a large portion of time writing documentation in support of various software development stages and in accordance with SDLC procedures; spending some portion of time supporting and assisting users with new software applications; at times, conducting formal training sessions with a small group of users to familiarize them with a new computer system

Kenneth L. Boley, Jr., B.S., Senior Chemist Group Leader, GC/MS Volatiles

Education:

B.S. Chemistry, Messiah College (1995)

Professional Experience:

Heritage Custom Kitchens, Inc., Face Frame Assembler (1997–2001)

Responsibilities included reading and interpreting job orders; overseeing daily production of department; performing various manufacturing duties daily; member of the safety committee, first aid team, and security team

With Lancaster Laboratories since 2001

Chemist, GC/MS Volatiles (2001)

Responsibilities included analyzing samples and QC by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers; following methods and SOPs

Senior Chemist, GC/MS Volatiles (2005)

Responsibilities included performing routine and non-routine analyses; diagnosing and solving technical problems; maintaining and troubleshooting instrumentation; writing and revising SOPs; training new analysts; auditing and uploading data as work load deems necessary

Senior Chemist Group Leader, GC/MS Volatiles (2009)

Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing corrective action and system improvements when necessary; performing all duties with minimal supervision; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in “brainstorming” client problems and projects; completing assigned projects on time; researching new and emerging technologies; producing written and oral reports on research activities; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow

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Nancy J. Bornholm, B.S., Principal Specialist, Environmental Client Services

Education:

B.S. Chemistry (magna cum laude), Muhlenberg College (1981)

Continuing Education:

Instrumental Analysis of Paints and Polymers, FBI Academy (1984)
Analytical Chemistry of Contaminants in Surface and Groundwater, ACS Short Course (1986)

Professional Experience:

University of Connecticut Health Center, Laboratory Technician (1977-1980)
Institute for Cancer Research, Research Technician (1981)
Baltimore City Crime Laboratory, Mobile Crime Unit Trainee (1981-1982)
Maryland State Police Crime Laboratory, Forensic Chemist III (1982-1985)
With Lancaster Laboratories since 1985
Senior Specialist, Environmental Client Services (1987)
Responsibilities included project management; audit sample entries; answer client questions; communicate client requirements to lab areas; and schedule sample submissions and provide sampling containers
Principal Specialist, Environmental Client Services (2004)
Responsibilities include performing project management for large clients/projects; auditing sample entries for accuracy; providing price quotes; answering client questions; understanding and communicating client requirements to lab personnel; scheduling sample submissions; ordering sampling containers and providing pre-printed COCs; serving as a technical resource to both internal and external clients and notifying management of any client issues

Awards, Citations, Honorary Societies, and Publications:

Quarterly Impact Award (2008)
Superlative Service President's Award (2008)

Marianne L. Bragg, B.S., Principal Specialist, Environmental Business Development

Education:

B.S. Biology, Millersville University (1987)

Professional Experience:

With Lancaster Laboratories since 1985
Coordinator
Group Leader (1990)
Principal Specialist (1994)
Responsibilities included: advise clients on testing; provide price quotes and proposals; answer client questions; schedule sample submissions and provide sampling containers; communicate client requirements to lab areas; and assist with client visits to the lab.
Principal Specialist/Coordinator, Environmental Business Development (2002)
In addition to the responsibilities listed above, manage workload and workflow among business development staff.
Principal Specialist/Group Leader, Environmental Business Development (2005)
In addition to the responsibilities listed above, manage workload and workflow among business development staff.
Principal Specialist, Environmental Business Development (2007)
Responsibilities include: advise clients on testing; provide price quotes and proposals; answer client questions; schedule sample submissions and provide sampling containers; communicate client requirements to lab areas; and assist with client visits to the lab.

Marla S. Brewer, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Industrial Hygiene, Purdue University (2000)

Continuing Education:

OSHA 8-Hour (2000)
Comprehensive GC/MS Seminar, Restek (2002)
Practical Process Improvement Facilitator Training (2010)

Professional Experience:

ALCOA, Industrial Hygiene Intern (1999)
Responsibilities included performing air sampling for a variety of substances; conducting noise survey including area and personal sampling; testing plant environment for heat stress and evaluated reports; assisting in formulation of written program
BP-Amoco Refinery/Orr Professional Services, Industrial Hygiene Technician (2000)
Responsibilities included performing air sampling to reevaluate Benzene Exposure Surveillance Program; conducting noise surveys including area and personal monitoring to reevaluate Hearing Conservation Program

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With Eurofins Lancaster Laboratories since 2000
- Senior Technician, Volatiles by GC (2000)
  - Responsibilities included performing prescreen analysis, sample prep, GC maintenance, and data review
- Chemist, GC/MS Volatiles (2001)
  - Responsibilities included analyzing samples and QC by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers
- Senior Specialist, GC/MS Volatiles (2006)
  - Responsibilities include performing GC/MS volatile data interpretation; reviewing and approving data; signing reports; analyzing samples; generating raw data; sample verification; SOP revisions and updates

Jamie L. Brillhart, B.S., Senior Chemist, Pesticide Residue Analysis

Education:

B.S. Physical Science, York College of Pennsylvania (2003)

Professional Experience:

B-H Laboratories Inc./Analytical Laboratory Services Inc., Inorganic Laboratory Technician/Inorganic Chemist (2003-2005)
- Responsibilities included performing wet chemistry testing on drinking waters and waste water; being responsible for analyses included fluoride, cyanide, phosphorus, nitrate/nitrite, cadmium reduction, and grease and oil testing when needed; prepping and analyzing for mercury on a mercury analyzer; analyzing for various metals on a graphite furnace; prepping leachates; prepping standards as needed

Hercon Laboratories, Inc., QC Analyst I (2005-2007)
- Responsibilities included performing Quality Control Testing on Transdermal Systems; performing assays, dissolutions, degradation, residual solvents, and raw material testing; prepping necessary standards and performing instrument maintenance as needed

With Lancaster Laboratories since 2007
- Chemist, Pesticide Residue Analysis (2007)
  - Responsibilities included analyzing soils for PPL Pesticides using 5890 and 6890 GCs with ECD detectors; performing instrument maintenance; prepping standards; auditing calibrations as necessary; being able to analyze for OPPAs, ACMOs, EDBs, PCBs, and Herbicides as needed
- Senior Chemist, Pesticide Residue Analysis (2011)
  - Responsibilities include analyzing soils for PPL Pesticides using 5890 and 6890 GCs with ECD detectors; performing instrument maintenance; prepping standards; auditing calibrations as necessary; being able to analyze for OPPAs, ACMOs, EDBs, PCBs, and Herbicides as needed

Robert Brown, Principal Chemist, Specialty Services Group

Education:

Attended 2.5 years at Pennsylvania State University towards B.S. in Microbiology (1988)
Completed 20 credits towards B.S. in Environmental Biology, Millersville University (1993)

Professional Experience:

With Lancaster Laboratories since 1988
- Chemist (1993)
- Senior Chemist (1997)
  - Responsibilities included performing extractable petroleum testing; operating multiple Hewlett-Packard gas chromatograph (GC) instruments; data interpretation and entry; developing and evaluating new methods
- Principal Chemist (2004)
  - Responsibilities included performing extractable petroleum testing; operating multiple Hewlett-Packard gas chromatograph (GC) instruments; data interpretation and entry; developing and evaluating new methods; serving as primary technical contact for client service representatives and their clients
- Principal Chemist Group Leader, EPH/Misc. GC (2005)
  - Responsibilities included performing extractable petroleum testing; operating multiple Hewlett-Packard gas chromatograph (GC) instruments; data interpretation and entry; developing and evaluating new methods; serving as primary technical contact for client service representatives and their clients
- Principal Chemist, Specialty Services Group (2011)
  - Responsibilities include: acting as technical resource within the environmental division; developing and validating analytical protocols; troubleshooting and solving analytical chemistry problems; optimizing instrument configuration and performance; evaluating and interpreting analytical results; writing SOPs; assisting in responding to and eliminating ICARs, assisting in optimizing procedures in prep lab; communicating effectively within department; performing routine work as required

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Kathryn A. Brungard, Senior Specialist, Environmental Quality Assurance

Continuing Education:

Clinical Laboratory Science, Temple University (1984-1988)

Professional Experience:

Environmental Partners, Inc., Environmental Technician/Health and Safety Coordinator (2003-2005)

Responsibilities included determining personnel health and safety risks on each work site and determining appropriate measures to be taken for personal protection; maintaining and servicing sampling equipment; calibrating meters and analytical equipment; collecting and processing representative samples at each monitoring site following state mandated procedures; routinely measuring field water and soil quality parameters; performing product recovery as part of site remedial measures; evaluating and reporting upon trends and/or results that were out-of-range

Maxwell House Coffee/Kraft Foods, Quality Assurance Technician (2004-2005)

Responsibilities included conducting hourly audits on operating production lines which included weight of product, oxygen content, density, caffeine level by HPLC, moisture content, inspection for foreign or incidental materials, and packaging compliance; performing weekly water testing for level of chlorine and microbial contamination; producing result spreadsheets and accurate logs; notifying upper management of all results in a timely manner

Columbia Analytical Services, Inc, Quality Assurance Program Manager (2005-2009)

Responsibilities included being responsible for the overall coordination of the NELAP certified environmental laboratory program; monitoring laboratory quality systems through audits; identifying potential problem areas, recommending corrective actions, and providing technical assistance and training as necessary; informing management of potential problems and recommending remedial measures in a timely basis both orally and by written communication; maintaining performance evaluation records; maintaining accreditations for regulatory agencies and client programs; providing audit responses and initiating changes in procedures; maintaining the calibration of all weights, balances, and thermometers

With Eurofins Lancaster Laboratories since 2010

Senior Specialist, Environmental Quality Assurance (2010)

Responsibilities include ensuring quality of data being produced in the laboratories by performing data review, auditing laboratories, and reviewing written procedures; ensuring laboratory adherence to government regulations and client requirements; reviewing client and government documents for requirements outside our usual laboratory practices; setting up and testing new analysis in the laboratory sample management system as required by the departments

Memberships and Appointments:

Florida Society of Environmental Analysts (2005-2009)

Florida A. Cimino, B.S., Senior Chemist, Volatiles in Air

Education:

B.S. Chemistry, Shippensburg University (2004)

Professional Experience:

With Lancaster Laboratories since 2005

Chemist, Flexible Staffing (2005)

Responsibilities included preparing, running, and reviewing samples according to client, compendia, and industry methods using various wet chemistry techniques and instrumentation including, but not limited to, gas chromatography, liquid chromatography, IC and TOC instrumentation; performing analysis for various departments as determined by work volume and staffing needs

Senior Chemist, Flexible Staffing (2008)

Responsibilities included preparing, running, and reviewing samples according to client, compendia, and industry methods using various wet chemistry techniques and instrumentation including, but not limited to, gas chromatography, liquid chromatography, IC and TOC instrumentation; performing analysis for various departments as determined by work volume and staffing needs

Senior Chemist, Volatiles in Air (2010)

Responsibilities include maintaining instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; diagnosing complex problems and offering solutions with a high degree of independence; suggesting and implementing improvements to maximize quality and productivity; acting as technical resource for internal problems and projects; assisting in "brainstorming" client problems and projects; training new employees in all aspects of instrumentation; researching new and emerging technologies

Awards, Citations, Honorary Societies, and Publications:

Girl Scout Gold Award (2000)

Who's Who Among College Students (2001-2004)

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Mark A. Clark, B.S., Principal Chemist, GC/MS Semivolatiles

Education:

B.S. Biochemistry, Millersville University (1986)

Professional Experience:

With Eurofins Lancaster Laboratories since 1985

Associate Chemist, Water Quality (1985)

Responsibilities included performing wet chemistry analyses; operated departmental instrumentation including TOC,TOX, Technicon, IC

Chemist, Water Quality (1987)

Responsibilities included coordinating, performing, and verifying 24/48 hour hold time analyses; performing wet chemistry analyses

Senior Chemist, Expresslab (1989)

Responsibilities included performing rush analyses operating AA, GC, IR; analyses included BTEX, Petroleum Hydrocarbons by IR, Metals by AA

Senior Chemist, Food Chemistry (1993)

Responsibilities included operating department instrumentation including Fatty Acid Profile by GC, assorted analyses by HPLC including Artificial Sweeteners, Vitamins D, E, etc.

Principal Chemist, GC/MS Semivolatiles (2001)

Responsibilities included performing PAH by HPLC analysis and assisting with GC/MS operations on third shift

Principal Chemist, GC/MS Semivolatiles (2012)

Responsibilities include performing GC/MS semivolatiles testing; operating GC/MS instruments; performing data Interpretation and entry; calibrating and repairing instruments

Rachel R. Cochis, B.A., Principal Specialist Group Leader, GC/MS Semivolatiles

Education:

B.A. Science, Pennsylvania State University (1992)

Continuing Education:

Introduction to Mass Spec Interpretation, Hewlett-Packard (1995)

Gas Chromatography Principles & Practices (1994)

Professional Experience:

With Eurofins Lancaster Laboratories since 1993

Chemist (1994), GC/MS Semivolatiles (1993)

Responsibilities included performing semvolatiles analysis on water and soil samples

Senior Chemist Coordinator, GC/MS Semivolatiles (1996)

Responsibilities included scheduling lab work; performing data interpretation and entry; reviewing and approving data; revising and updating SOPs and analytical methods; monitoring turnaround time; communicating client requirements to lab areas

Senior Specialist Group Leader, GC/MS Semivolatiles (2005)

Responsibilities included scheduling lab work; performing data interpretation and entry; reviewing and approving data; revising and updating SOPs and analytical methods; monitoring turnaround time; communicating client requirements to lab areas

Principal Specialist Group Leader, GC/MS Semivolatiles (2013)

Responsibilities include scheduling lab work; performing data interpretation and entry; reviewing and approving data; revising and updating SOPs and analytical methods; monitoring turnaround time; communicating client requirements to lab areas

Tracy A. Cole, Senior Specialist, EPH/Miscellaneous GC

Continuing Education:

Gas Chromatography: Principles and Practice, LLU (1997)

Professional Experience:

With Lancaster Laboratories since 1991

Laboratory Technician, Volatiles in Air (1991)

Responsibilities included preparing samples and standards; washing glassware; loading samples on instruments

Senior Technician, Volatiles in Air and EPH/Miscellaneous GC (1994)

Responsibilities included analyzing routine samples and QC by Gas Chromatography for DRO and miscellaneous organic compounds; preparing direct injection samples for analysis; preparing standards; reviewing chromatography data and uploading to the LIMS

Chemist, EPH/Miscellaneous GC (1999)

Responsibilities included analyzing routine and nonroutine samples and QC by Gas Chromatography for various organic analyses including DRO, TPH, and other petroleum related methods and miscellaneous organic compounds by direct injection; reviewing chromatography data and uploading to the LIMS; performing instrument maintenance; calibrating instruments for various methods

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Senior Specialist, EPH/Miscellaneous GC (2008)
Responsibilities include reviewing/verifying data for technical correctness including raw chromatography data, initial calibrations, and analytical reports; ensuring that method and project requirements were followed and entry into the LIMS is correct; acting as a technical resource for the department; assisting in reviewing/writing SOPs and other technical documents

Paul R. Cormier, B.A., Principal Specialist, Specialty Services Group

Education:
B.S. Microbiology, Virginia Tech (1984)
B.A. Chemistry, Virginia Tech (1984)

Continuing Education:
Hewlett-Packard GC/MS Advance Operations/System Manager Course (1990)
Mass Spectral Interpretation, Finnigan MAT Institute (1991)
Technical Training, OI Analytical (1995)

Professional Experiences:
Environmental Testing & Certification (1985-1989)
Analytikem, Inc. (1989-1990)
With Lancaster Laboratories since 1990
Senior Chemist (1990)
Responsibilities included: operate GC/MS instruments; data interpretation; review and approve data; repairing instruments; and train other analysts.
Senior Specialist (2005)
Responsibilities included: operate GC/MS instruments; data interpretation; review and approve data; repairing instruments; and train other analysts.
Principal Specialist, GC/MS Volatiles (2006)
Responsibilities include: operate GC/MS instruments; data interpretation; review and approve data; repairing instruments; and train other analysts.
Principal Specialist, Specialty Services Group (2010)
Responsibilities include acting as technical resource within the environmental division; developing and validating analytical protocols; troubleshooting and solving analytical chemistry problems; optimizing instrument configuration and performance; evaluating and interpreting analytical results; writing SOPs; assisting in responding to and eliminating ICARs, assisting in optimizing procedures in prep lab; communicating effectively within department; performing routine work as required

Memberships & Appointments:
American Chemical Society

Teresa L. Cunningham, B.S., Principal Specialist, Environmental Client Services and Inside Business Development

Education:
B.S. Biology, St. Joseph's University (1999)

Continuing Education:
Chemical Monitoring Assistance Program, Pennsylvania Rural Water Association (2000)
How to Deliver Exceptional Customer Service, Fred Pryor Seminars (2000)
Organizational Behavior, Penn State University (2005)

Professional Experience:
With Eurofins Lancaster Laboratories since 1999
Specialist, Environmental Client Services (1999-2000)
Senior Specialist, Environmental Client Services (2001)
Senior Specialist Coordinator, Environmental Client Services (2001)
Responsibilities included serving as project manager for clients with petroleum-related testing accounts; coordinating client requests with laboratory groups to ensure that the client's needs are met; scheduling bottle shipments and sample pickups; preparing quotations; coordinating staff
Senior Specialist Group Leader, Environmental Client Services (2005)
Responsibilities included serving as project manager for clients with petroleum-related testing accounts; coordinating client requests with laboratory groups to ensure that the client's needs are met; scheduling bottle shipments and sample pickups; preparing quotations; coordinating staff
Manager, Environmental Client Services (2006)
Responsibilities included overseeing implementation of new projects; coordinating client requests with laboratory groups to ensure that the client's needs are met; coordinating staff
Principal Specialist, Environmental Client Services and Inside Business Development (2008)
Responsibilities include performing project management; training new client service representatives; auditing sample entry; answering client questions; communicating client requirements to lab areas

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Carolyn M. Cyms, B.S., Senior Specialist Group Leader, Environmental Sample Administration

Education:

B.S. Secondary Education/Chemistry, Bloomsburg University of Pennsylvania (1993)
Post Baccalaureate Certificate, Biology and MS Math, Millersville University (2002)

Continuing Education:

Accounting I, HACC (1996)
Introduction to the Internet, PC Focus (1996)
Self-Discipline & Emotional Control, Franklin-Covey (1997)
Child Growth & Development, HACC (1998)
Cell Biology, Millersville University (2000)
Botany; Genetics; Zoology; Biochemistry; Ecology, and Ecology Lab, Millersville University (2001)
Immunology; Animal Behavior; Teaching Biological Issues; Entomology, Millersville University (2002)
Introduction to Computer Programming, Millersville University (2003)

Professional Experience:

Lancaster Theological Seminary, Field Education Assistant-Special Project Coordinator (1996-1999)
Responsibilities included assisting with mailings, organization of the field education program; creating and preparing a student field education manual for the ministerial studies program; acting as liaison between Field Ed Professor, Field Ed sites, and students; preparing all written correspondences for the field ed office; organizing and preparing materials for meetings; tracking student progress through the program; assisting with other special projects requiring computer skills of PageMaker, WordPerfect, Quattro Pro, and Envoy

Self-Employed, Tutor (1994-2005)
Responsibilities included tutoring HACC students in Introduction to Chemistry, Chemistry, Biology, and Algebra

Millersville University – Biology Department, Assistant (2003)
Responsibilities included preparing Power Point presentations for a stream restoration monitoring program; photographing various stages of the project

With Lancaster Laboratories since 1994

Administrator III, Environmental Sample Administration (1994)
Responsibilities included receiving samples, entering samples, auditing, filing, noting discrepancies, and unpacking samples

Administrator III/Coordinator, Environmental Sample Administration (1995)
Responsibilities included relaying technical/client information when it became available; answering questions from clients/technical areas when CSR was unavailable; coordinating/prioritizing entry; supervising and evaluating work of 2nd Shift Environmental Entry Staff; training new personnel in the entry/interpretation process; preparing Job Plans on an as-needed basis

Specialist I, Environmental Sample Administration (1996)
Responsibilities included receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis

Senior Specialist, Environmental Sample Administration (2000)
Responsibilities included receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis; training; preparing resource materials; working on special projects as needed

Senior Specialist Coordinator, Environmental Sample Administration (2004)
Responsibilities included receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis; training; preparing resource materials; working on special projects as needed

Senior Specialist Group Leader, Environmental Sample Administration (2005)
Responsibilities include receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis; training; preparing resource materials; working on special projects as needed

Awards, Citations, Honorary Societies & Publications:

Residential Life Award of Merit (1990)
Bloomsburg University Dean's List 6 of 8 semesters, graduated cum laude (1990-1993)
Kappa Delta Phi (National Co-Ed Honor Society) (1994)
Spirit of LLI (2001)

Memberships & Appointments:

Elizabethtown Fire Company (1993-present)
Safety Committee (1994-1998)
Alpha Phi Omega (National Co-Ed Service Fraternity) (1991-1993)
NSTA (2000-2008)
Kappa Delta Phi (1994, 2001-2003)

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Kimberly A. Davies, M.B.A., Director, Divisional Support Services

Education:

B.S. Biology, Shippensburg University of Pennsylvania (1991)
M.B.A., Pennsylvania State University (1999)

Professional Experience:

Polybac Corporation, Technical Services (1991-1992)
Upper Saucon Township Wastewater Treatment Plant, Technician (1992-1993)
With Eurofins Lancaster Laboratories since 1993
- Client Services Senior Specialist (1996)
- Senior Specialist/Coordinator, Pharmaceutical Project Management (1998)
- Principal Specialist/Coordinator, Pharmaceutical Project Management (2000)
- Group Leader, Pharmaceutical Project Management and Data Support (2001)
  - Responsibilities included managing pharmaceutical project management and data support staff; facilitating group meetings to communicate with staff; supporting company and division policies and provide information to department; supporting employee development and acknowledge innovative ideas; promoting group and department teamwork and collaboration
- Manager (previously titled Group Leader), Pharmaceutical Project Management (2003)
  - Responsibilities included managing pharmaceutical project management staff; facilitating group meetings to communicate with staff; supporting company and division policies and provide information to department; supporting employee development and acknowledge innovative ideas; promoting group and department teamwork and collaboration
- Manager, Flexible Staffing (2005)
  - Responsibilities included managing labor resources across departments and divisions, coordinating continuous improvement activities including Management Operating System (MOS) audits, new management MOS training, and MOS tool maintenance
- Manager, Flexible Staffing and Technical Training (2006)
  - Responsibilities included managing labor resources across departments and divisions, coordinating continuous improvement activities including Management Operating System (MOS) audits, new management MOS training, and MOS tool maintenance; managing the technical training staff responsible for designing and facilitating technical training
- Manager, PPI Process and Flexible Staffing (2008)
  - Responsibilities included managing labor resources across departments and divisions, coordinating continuous improvement activities including Management Operating System (MOS) audits, new management MOS training, and MOS tool maintenance; managing the technical training staff responsible for designing and facilitating technical training; qualified Practical Process Improvement process manager responsible for facilitating PPI project team training and PPI efforts within LLI
- Director, Divisional Support Services (2012)
  - Responsibilities include managing Billing and Reporting, Office Services, Shipping & Receiving, Purchasing and Flexible Staffing; moving labor resources across departments and divisions, coordinating continuous improvement activities through Practical Process Improvement and the Management Operating System; managing the technical training staff responsible for designing and facilitating technical training; qualified Practical Process Improvement process manager and PPI Master Facilitator

Steven C. Davies, B.S., Manager, Transportation and Sample Bottles

Education:

B.S. Elementary Education, Lancaster Bible College (1987)

Professional Experience:

With Lancaster Laboratories since 1990
- Transportation Coordinator (1991)
- Transportation Group Leader (1994)
- Transportation and Sample Bottles Group Leader (1998)
  - Responsibilities included supervise personnel; schedule lab work; manage financial resources; answer client questions; communicate client requirements to lab areas; and schedule sample submissions and provide sampling containers.
- Transportation and Sample Bottles Manager (2005)
  - Responsibilities include supervise personnel; schedule lab work; manage financial resources; answer client questions; communicate client requirements to lab areas; and schedule sample submissions and provide sampling containers.

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Beth E. DiPaolo, M.A., SPHR, Vice President of PSS & Recruiting/Organizational Development

Education:

- B.S. Business Management, Human Resources, State University of New York, Empire State College (2007)
- M.A. Human and Organizational Systems, Fielding Graduate University (2010)
- Certified as Senior Professional in Human Resources, SHRM, HRCI
- Certifications for Leader Instructor/Consulting in: Working with Emotional Intelligence, Seven Habits of Highly Effective People, Social Styles Facilitation, Contributing Team Member, Signature Service Client Service Training, Targeted Selection Interviewing, Achieve Global Leadership Series, and Speed of Trust

Professional Experience:

- People Unlimited (1985-1987)
  - Responsibilities included recruitment, supervision, sales, and client service for temporary and permanent placement service
- With Lancaster Laboratories Human Resources Department since 1987
  - Recruiting Specialist (1987)
  - Senior Recruiting Specialist (1990)
  - Senior Recruiting Coordinator (1991)
  - Recruiting & Training Group Leader (1992)
  - Manager of Recruiting, Training, Organizational Development (2001)
  - Director of Recruiting, Training, and Organizational Development (2005)
  - Director, Professional Scientific Staffing, Recruiting, and Organizational Development (2005)
  - Managing Director, Professional Scientific Staffing, Recruiting, and Organizational Development (2007)
    - Responsibilities included managing operations including client service, business development, recruiting, and training of PSS internationally; providing strategic senior leadership in accordance with vision, values, and strategic goals of company for PSS, recruiting, and organizational development
  - Vice President of PSS & Recruiting/Organizational Development (2012)
    - Responsibilities include managing operations including client service, business development, recruiting, and training of PSS internationally; providing strategic senior leadership in accordance with vision, values, and strategic goals of company for PSS, recruiting, and organizational development

Awards, Citations, Honorary Societies, and Publications:

- Society for Human Resource Management, Pennsylvania Chapter
  - Past President of LCAHRM, SHRM Lancaster Chapter
  - Outstanding Member of the Year (1996)
  - Two Superior Merit Awards during Presidency

Memberships and Appointments:

- American Society for Training and Development
- Society for Human Resource Management

Irene Lynn Dodd, M.B.A., Principal Specialist, Environmental Business Development

Education:

- B.A. Chemistry, Washington & Jefferson College (1988)
- M.B.A. Pennsylvania State University (1993)

Continuing Education:

- Mass Spectral Interpretation Course (1991)
- High Impact Communication Skills (1992)
- GC Troubleshooting Course (1993)
- Selected courses at Millersville University (1996)
- Effective Technical Communication (2000)
- Business Writing for Results (2002)
- Signature Service (2002)
- The Counselor Salesperson (2004)
- Pennsylvania Chamber Annual Environmental Laws and Regulations Conference (2004, 2005, 2006, 2007)
- Conceptual Selling (2009)
- Intermediate II and Advanced Excel (2011)

Professional Experience:

- Stauffer Chemical Company, Food Chemist (1987-1988)
- With Lancaster Laboratories since 1988
  - Chemist (1991)
  - Senior Chemist (1995)
  - Senior Specialist (1997)
  - Principal Specialist, Environmental Business Development (2003)
    - Responsibilities include: project management; review and approve data; consult with clients regarding testing needs; work with external auditors; assist with client visits to the lab, advise clients on testing; provide price quotes; monitoring turnaround time; audit sample entry; answer client questions; communicate client requirements to lab areas; provide status reports, including results, to clients; provide sampling containers; schedule sample submissions

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Memberships and Appointments:

American Chemical Society
National Society of Collegiate Journalists
American Business Women's Association
President (1998-1999); Vice President (1994-1995, 1997-1998); Secretary (2000-2001); Newsletter Chair (1993-1994, 2001-2003); Business Associate Night Chair (2000); Woman of the Year (1999, 2004); Thelma Farley Memorial Award (1995); Hospitality Chair (2003-2004) with Wheatland Conestoga Chapter
Vice President of Communications (2006-2007, 2007-2008) and Formation committee (2006-2007); Woman of the Year (2007) for Lancaster Area Express Network; Regional and National Newsletter Award Winner (2008)
Girl Scouts in the Heart of Pennsylvania
Leader (2008-Present); Outstanding Leader of the Year 2012

Christine M. Dulaney, B.A., Senior Specialist, GC/MS Volatiles

Education:

B.A. Biology, Meredith College (1984)

Continuing Education:

Waters Fundamentals of HPLC, Compuchem Laboratories (1989)

Professional Experience:

Compuchem Laboratories (1984-1998)
Extraction Technician (1984-1986)
Responsibilities included performing extraction of various environmental matrices for pesticide GC analysis and semivolatile GC/MS analysis; extracting quarterly PE samples
GC Technician (1986-1989)
Responsibilities included performing analysis of environmental extracts for pesticides, PAHs, and volatile organic compounds using GC, HPLC, and purge and trap, respectively; performing routine instrument maintenance
Senior Chemist, Pesticide Review (1990-1995, 1996-1998)
Responsibilities included performing qualitative and quantitative review of pesticide, PAH, and volatile organic data; reviewing instrument maintenance and standard logbooks
With Eurofins Lancaster Laboratories since 1998
Chemist, Pesticide Residue (1998)
Responsibilities included reviewing GC pesticide residue data packages; responding to client inquiries and ICARs
Project Management Specialist, Pharmaceutical Client Services (2003)
Responsibilities included managing details of various pharmaceutical client accounts using the laboratory information management system; acting as liaison between the client and internal laboratory personnel
Senior Specialist, GC/MS Volatiles (2005)
Responsibilities include auditing data for various GC and GC/MS volatile analyses; verifying data within the laboratory information management system, communicating and following up on outstanding data issues

Eric L. Eby, B.S., Senior Chemist, Metals

Education:

B.S. Biology, Millersville University (1988)

Continuing Education:

OSHA 40-hour Hazardous Waste Management, Phoenix Safety Associates (1991)
DX500 Maintenance and Troubleshooting, Dionex (1996)
The Chemistry Behind the Techniques, EAS, Inc. (1996)
Cleaning Validation Strategies, Applied Analytical Industries, Inc. (1997)
Gas Chromatography Practical Theory and Applications, Lancaster Laboratories (1998)

Professional Experience:

With Lancaster Laboratories since 1988
Associate Chemist (1993)
Responsibilities included environmental wet chemistry testing and field sampling.
Chemist (1997)
Senior Chemist, Pharmaceutical Raw Materials (1998)
Responsibilities included IC, TOC analysis, IC maintenance, USP purified water testing, raw materials testing, USP <661> container closure testing.
Senior Chemist, Pharmaceutical Product Testing (2000)
Responsibilities included pharmaceutical product testing per client specific methods, IC and HPLC maintenance.
Senior Chemist, Metals (2005)
Responsibilities include ICP analysis for environmental testing and ICP instrument maintenance.

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Erik J. Frederiksen, B.A., Manager, Water Quality and Instrumental Water Quality

Education:

B.A. Chemistry, University of Virginia (1990)

Continuing Education:

Infrared Spectral Interpretation (1993)

Professional Experience:

With Lancaster Laboratories since 1990

Chemist/Coordinator (1993)

Group Leader (1994)

Responsibilities included supervising personnel; managing laboratory operations; project management; managing financial resources; reviewing and approving data

Manager, Water Quality and Instrument Water Quality (2005)

Responsibilities include supervising personnel; managing laboratory operations; project management; managing financial resources; reviewing and approving data

Lynn Frederiksen, B.S., Principal Specialist Group Leader, Environmental Client Services

Education:

B.S. Conservation and Resource Development, University of Maryland (1981)

Professional Experience:

University of Missouri, Senior Research Lab Technician (1982 – 1984)

GPU Nuclear Corporation, Data Analyst (1985 – 1989)

With Lancaster Laboratories since 1989

Senior Specialist (1989)/Team Leader, Environmental Client Services (2006)

Responsibilities included: consult with clients regarding testing needs; revise and update SOPs; provide price quotes; audit sample entry; answer client questions; communicate client requirements to lab areas; provide status reports, including results, to clients; schedule sample submissions and provide sampling containers; assist Group Leader with training of new employees and delegating new projects.

Senior Specialist Group Leader, Environmental Client Services (2007)

Responsibilities included: managing a team of client service representatives, training of new employees, setting up and delegating new projects, serving as primary project manager for several large petroleum clients and consultants.

Principal Specialist Group Leader, Environmental Client Services (2011)

Responsibilities include serving as the primary contact or back-up with the laboratory for a number of assigned clients requiring specialized testing or complex projects; understanding and communicating technical information and client requirements to laboratory personnel, helping to ensure that requirements are met; leading broad-based complex projects to a satisfactory conclusion according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; advising and training other members of the department; serving as a technical resource both internally and externally; proactively assisting Outside Business Development with client visits, presentations, and internal audits for assigned clients; participating on PPI teams

Joseph M. Gambler, B.S., Senior Chemist, GC/MS Semivolatiles

Education:

B.S. Chemistry, Millersville University (1996)

Professional Experience:

Wyeth, Biological Manufacturing Technician (1996)

With Lancaster Laboratories since 1996

Senior Chemist, GC/MS Semivolatiles (1996)

Responsibilities include training new hires; maintaining GC/MS systems; preparing standards/stocks/spikes; maintaining Helium supply system; performing data interpretation; ordering supplies; auditing; cross trained in Pesticides Department

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William E. Gambler, B.S., Senior Specialist, Safety

Education:

B.S. Occupational Safety and Environmental Health, Millersville University (2011)

Continuing Education:

Principles and Practices of Bio Safety, American Biological Safety Association (2012)
Radiation Safety Officer, Dade Moeller Training Academy (2012)
Certified Safety Committee Training, High Safety Consulting Services (2013)
Hazardous Material Technician Training, High Safety Consulting Services (2013)
Visible Emissions Evaluation Program, Penn State University (2013)
First Aid, CPR, and AED, Respond First Aid Systems (2013)
Basic IATA/49CFR Dangerous Goods Training, Dangerous Goods International Training Center (2013)

Professional Experience:

With Eurofins Lancaster Laboratories since 2011
- Specialist, Environmental Health and Safety, Human Resources (2011)
  - Responsibilities included managing employee health programs; maintaining current and developing new safety programs; managing environmental compliance program
- Senior Specialist, Safety (2013)
  - Responsibilities include managing employee health programs; maintaining current and developing new safety programs; managing environmental compliance program

Memberships and Appointments:

Lancaster County Industrial Safety Council (2011-present)
Board of Certified Safety Professionals (GSP designation) (2011-present)

Matthew R. Gehman, B.S., Principal Specialist Group Leader, Environmental Health and Safety Officer, Human Resources

Education:

B.S. Occupational Safety and Environmental Health, Millersville University (2002)

Continuing Education:

24-Hour Emergency Response (HAZWOPER), Lancaster Laboratories (2004)
8-Hour Emergency Response Refresher, High Safety Consulting (2013)
IATA/DOT 49 CFR, DGI Training Center (2013)
American Heart Association First Aid, CPR, AED certified, Respond First Aid (2013)
Advanced RCRA, Environmental Resource Center (2004)
In-depth Environmental Compliance, PA Chamber (2005)
In-depth Environmental Compliance, PA Chamber (2006)
National Incident Command System, Command School, Inc. (2006)
Life Safety Code, NFPA (2006)
International Conference on Biocontainment Facilities, Tradeline (2006)
In-depth Environmental Compliance, PA Chamber (2007)
Principals of Biosafety, ABSA (2010)
Potent Compound Boot Camp, SafeBridge Consulting (2012)

Professional Experience:

With Eurofins Lancaster Laboratories since 2004
- Senior EHS Specialist, Environmental Health and Safety, Human Resources (2004-2007)
  - Responsibilities included employee health program administration; maintaining current and developing new safety programs; managing environmental compliance program
- Senior Specialist, Environmental Health and Safety Officer, Human Resources (2007)
  - Responsibilities included managing employee health programs; maintaining current and developing new safety programs; managing environmental compliance program
- Principal Specialist Group Leader, Environmental Health and Safety Officer, Human Resources (2011)
  - Responsibilities include managing employee health programs; maintaining current and developing new safety programs; managing environmental compliance program

Memberships and Appointments:

Central PA section of American Industrial Hygiene Association (AIHA)
- Member (2004-present)

VFW, Post 7362
- Member (2004-present)

American Biological Safety Association (ABSA)
- Member (2007-present)

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Susan M. Goshert, B.S., Manager, EPH/Miscellaneous GC, Pesticide Residue Analysis, Nitrosamines

Education:

B.S. Chemistry, Juniata College (1988)

Continuing Education:

Advanced Aquarius Report Training, Hewlett-Packard (1989)
How to Handle People with Tact and Skill, Harrisburg Area Community College (1992)
Positive Attitude and Peak Performance, Harrisburg Area Community College (1992)

Professional Experience:

With Lancaster Laboratories since 1988
- Chemist (1990)
- Senior Chemist Coordinator (1997)
  - Responsibilities included supervising personnel; reviewing and approving data; monitoring turnaround time
- Senior Specialist Group Leader, EPH/Misc. GC (2005)
  - Responsibilities included supervising personnel; reviewing and approving data; monitoring turnaround time
- Principal Specialist Group Leader, GC/MS Volatiles (2008)
  - Responsibilities included supervising personnel; reviewing and approving data; monitoring turnaround time
- Manager, EPH/Miscellaneous GC, Pesticide Residue Analysis, Nitrosamines (2012)
  - Responsibilities include supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs

Brian K. Graham, B.A., Senior Chemist, GC/MS Semivolatiles

Education:

B.A. Mathematics, Millersville University (1996)

Professional Experience:

With Lancaster Laboratories since 1989
- Chemist, GC/MS Semivolatiles (1989-2006)
- Senior Chemist, GC/MS Semivolatiles (2006)
  - Responsibilities include maintaining GC/MS Instrumentation; tuning and calibrating GC/MS; analyzing samples by GC/MS; reviewing and assembling all supporting GC/MS data; preparing standards for calibrations; training new analysts

Nina C. Haller, Senior Specialist Group Leader, Metals

Continuing Education:

State Dairy Lab Cert., State of PA (1993)
Butterfat Testing License, State of PA (1995)
Seminar ICP/ICPMS, Fisons Instruments (1995)
Three-day ICP Trace Training Course, Thermo Jarrell Ash, MA (1996)

Professional Experience:

Hazelton Research Products, Lab Technician (1981-1984)
- Responsibilities included rabbit production facility, removal of ovaries, care, and maintenance

With Lancaster Laboratories since 1987
- Technical Associate, Foods (1987)
  - Responsibilities included coordinating Listeria Testing Program; performing data entry and verification
- Chemist, Metals (1993)
  - Responsibilities included performing daily tracking of rushes; operating and maintaining ICP instrumentation; reviewing and verifying of ICP data, data package review
- Specialist Group Leader, Metals (2003)
  - Responsibilities included overseeing the ICP/ICPMS personnel and instrumentation workflow; verifying ICP/ICPMS/GFAA/Hg data
- Senior Specialist Group Leader, Metals (2006)
  - Responsibilities included overseeing the ICP/ICPMS personnel and instrumentation workflow; verifying ICP/ICPMS/GFAA/Hg data
- Senior Specialist Group Leader, Metals (2007)
  - Responsibilities include overseeing metals instrument and verification personnel and instrumentation workflow; verifying metals data

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Michele D. Hamilton, B.S., Senior Chemist Group Leader, EPH/Misc. GC

Education:

B.S. Chemistry, Temple University (1990)

Continuing Education:

Gas Chromatography: Practical Theory and Applications for LL (1993)
Practice of Modern HPLC, LC Resources (1996)

Professional Experience:

With Eurofins Lancaster Laboratories since 1991
- Senior Chemist (1997)
- Senior Chemist Coordinator (2000)
  - Responsibilities included supervising personnel; coaching and developing new employees; sample tracking; reviewing rush request; communicating client requirements; operating GC and HPLC instruments; data interpretation and entry; calibrating; repairing instruments and verifying data
- Senior Chemist Group Leader, Pesticide Residue Analysis (2005)
  - Responsibilities included supervising personnel; coaching and developing new employees; sample tracking; reviewing rush request; communicating client requirements; operating GC and HPLC instruments; data interpretation and entry; calibrating; repairing instruments and verifying data
- Senior Chemist Group Leader, EPH Misc. GC (2011)
  - Responsibilities include supervising personnel; coaching and developing new employees; sample tracking; reviewing rush request; communicating client requirements; operating GC instruments; data interpretation and entry; calibrating; repairing instruments and verifying data

Linda M. Hartenstine, B.A., Senior Chemist, GC/MS Semivolatiles

Education:

B.A. Chemistry, Millersville University (1994)

Professional Experience:

With Lancaster Laboratories since 1994
- Associate Chemist (1994)
- Chemist (1997)
- Senior Chemist, GC/MS Semivolatiles (1998)
  - Responsibilities include performing GC/MS semivolatiles testing; operating GC/MS instruments; data interpretation; developing and evaluating new methods; calibrating and repairing instruments; preparing standards; revising and updating SOPs and analytical methods; training other analysts

Robert G. Heisey, Jr., B.A., Senior Specialist, Water Quality

Education:

B.A. Chemistry, Millersville State College (1972)

Professional Experience:

RCA Corp., Engineering Technician (1972-1987)
With Lancaster Laboratories since 1988
- Chemist Coordinator (1989)
- Senior Chemist Coordinator (1997)
  - Responsibilities included: supervise personnel; schedule lab work; review and approve data; develop and evaluate new methods; prepare test standards.
- Senior Chemist Group Leader (2005)
  - Responsibilities included: supervise personnel; schedule lab work; review and approve data; develop and evaluate new methods; prepare test standards.
- Senior Specialist, Water Quality (2006)
  - Responsibilities include: review and approve data; develop and evaluate new methods; prepare test standards; order laboratory supplies; maintain department's chemical inventory.

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Daniel H. Heller, B.A., Senior Chemist, GC/MS Volatiles

Education:

A.S.T. Machine Technology, Stevens State College (1998)
B.A. Secondary Education Biology, Millersville University (2003)

Professional Experience:

Tyco Electronics, Machinist B (1998-2004)
Responsibilities included machining various materials using various machines
Columbia Junior/Senior High School, Teacher (2005)
Responsibilities included teaching 9th and 10th grade biology
Penn State Cooperative Extension, Biologist (2005-2006)
Responsibilities included treating and surveying mosquito populations
With Lancaster Laboratories since 2006
Chemist, GC/MS Volatiles (2006)
Responsibilities included evaluating water samples for volatiles using GC/MS instrumentation
Senior Chemist, GC/MS Volatiles (2012)
Responsibilities include evaluating water samples for volatiles using GC/MS instrumentation

Tamara J. Helsel, Senior Specialist Group Leader, Environmental Sample Administration

Professional Experience:

Willow Valley Retirement Communities, Certified Nursing Assistant (2000-2001)
Responsibilities included assisting nursing home residents with their daily activities and personal hygiene
Bayada Nurses, Certified Nursing Assistant (2000-2001)
Responsibilities included assisting people with disabilities in their homes with their personal hygiene and daily activities
With Eurofins Lancaster Laboratories since 2001
Senior Administrator, Environmental Sample Administration (2001)
Responsibilities included performing sample receipt, interpretation, and entry
Specialist, Environmental Sample Administration (2001)
Responsibilities included performing sample receipt, interpretation, and entry
Senior Specialist, Environmental Sample Administration (2007)
Responsibilities included performing sample receipt, interpretation, and entry
Senior Specialist Group Leader, Environmental Sample Administration (2013)
Responsibilities include performing sample receipt, interpretation, and entry

Memberships and Appointments:

Lancaster Laboratories Safety Committee (2003-2007)

Chadwick J. Hershey, B.S., Senior Specialist, Environmental Software Development

Education:

B.A. Economics, Millersville University (2001)
B.S. Computer Science, Millersville University (2001)

Continuing Education:

Mastering Microsoft Visual Basic 6 Development, IntelliMark (2001)
Oracle Exam #120-007, Introduction to Oracle 9i: SQL (2004)

Professional Experience:

With Eurofins Lancaster Laboratories since 1999
Intern, Computer Applications Development (1999-2001)
Responsibilities included maintaining and developing departmental computer systems
Specialist, Computer Applications Development (2001)
Responsibilities included maintaining and developing departmental computer systems
Senior Specialist, Environmental Software Development (2006)
Responsibilities include maintaining and developing departmental computer systems

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Diana G. Holmes, M.S., Senior Specialist, Environmental Software Development

Education:

B.A. Physics, Cornell University (1983)
M.S. Computer Science, Rensselaer Polytechnic Institute (1985)

Professional Experience:

AT&T Bell Laboratories, Technical Staff Member (1985-1986)
Responsibilities included developing software for testing software
Prime Computer, Software Engineer II (1986-1988)
Responsibilities included designing, implementing, and testing software for PRIMOS and mini-supercomputers
Banyan Systems, Principal Software Engineer (1988-1999)
Responsibilities included developing, enhancing, and maintaining suite of services for VINES mail service; worked with 3rd party developers; third line customer support
Progressive Systems/Cobalt Networks, Senior Software Engineer (1999-2000)
Responsibilities included managing and leading software releases; designed and implemented software features; third line customer support
Sun Microsystems, Project Manager (2000-2005)
Responsibilities included project manager for Linux Operation System releases
Innovative Emergency Management, Inc., Applications Systems Engineer (2005-2006)
Responsibilities included providing system administration support, development of software tools for deployment
Pennington Biomedical Research Center, IT Applications Developer III (2006-2013)
Responsibilities included analyzing, designing, developing, executing, documenting, and supporting software applications for the Basic Science labs
With Eurofins Lancaster Laboratories since 2013
Senior Specialist, Environmental Software Development (2013)
Responsibilities include providing technical support for maintenance of installed software applications and assistance with development, installation, and maintenance of new applications for general use; assistance in development, implementation, and maintenance of software intended to improve quality and efficiency of work performed

Catherine M. Holt, B.S., Principal Specialist, Environmental Software Development

Education:

B.A. Mathematics, Franklin & Marshall College (1984)
B.S. Computer Science, Millersville University (1987)

Continuing Education:

Novell Network Seminar, Novell (1989)
Clarion Database Management Seminar, Clarion Software (1991)
Operations Process Optimization, Penn State University (1992)
Fast Track to Powerbuilder Seminar, Actium (1997)
Mastering Visual Basic 6 Development, Microsoft Corporation (1999)
Introduction to Oracle9I: SQL, Online Testing (2004)
Programming with the Microsoft .NET framework using Microsoft Visual Studio 2005 (2008)
Windows Forms 3.5 Programming for Experienced VB .NET Programmers (2010)

Professional Experience:

R.R. Donnelley & Sons Company, Technician (1985-1987)
Responsibilities included scanning and developing photographs for use in catalogs
Shared Medical Systems, Programmer (1987-1989)
Responsibilities included customizing and installing software at hospitals
With Eurofins Lancaster Laboratories since 1989
Principal Specialist, Computer Applications Development (1989)
Responsibilities included developing and maintaining computer systems/programs for laboratory use
Principal Specialist/Coordinator, Computer Applications Development (1995)
Responsibilities included supervising personnel; developing and maintaining computer systems/programs for lab use; communicating with clients about disk requirements
Principal Specialist, Environmental Software Development (1997)
Responsibilities include developing and maintaining computer systems in VB6 and VB.net for use within Parallax shell

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John P. Hook, B.S., Senior Chemist, Metals

Education:

B.S. General Science, Pennsylvania State University (2002)

Continuing Education:

ICP/ICP-MS Seminar, Perkin-Elmer (2003)
ICP-MS Seminar, Agilent (2004)
ICP-MS training, Perkin-Elmer (2005)
PPI Team Training, Lancaster Laboratories (2008)
Facilitator Training, ThermoFisher Scientific (2009)

Professional Experience:

Sony Technology Corporation, Manufacturing Staff (2002-2003)
Responsibilities included assembly, final inspection, and packaging of television sets
ALCOA Primary Metals, Laboratory Technician (2003)
Responsibilities included observation and maintenance of aluminum production pilot test operation; analysis of product
With Lancaster Laboratories since 2003
Chemist, Metals (2003)
Senior Chemist, Metals (2006)
Responsibilities include performing setup, analysis, and review of ICP, ICP-MS runs; maintenance and troubleshooting of ICP, ICP-MS instruments; yearly, quarterly and start-up ICP instrument qualifications including IECs, IDLs, MDLs, and LDRs; maintaining adequate laboratory supply inventory; disposing of acid waste; writing SOPs

Kay G. Hower, B.S., Principal Specialist Group Leader, Bay Area Service Center

Education:

B.S. Animal Science, University of Delaware (1988)

Professional Experience:

U.S. Fish and Wildlife Service, Research Assistant (1990-1991)
RMC Environmental Services, Biological Technician (1992-1994)
Lancaster Laboratories
Senior Specialist, Project Manager, Environmental Client Services (1994-2001)
Responsibilities included managing client projects; auditing sample entry; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions and providing sampling containers.
Principal Specialist, Environmental Business Development (2001-2007)
Responsibilities included providing price quotes and proposals; advising clients on testing; assisting on client visits/audits; answering client questions; communicating client requirements to lab areas
Principal Specialist, Pharmaceutical Client Services (2007-2008)
Responsibilities included acting as the pharmaceutical client liaison within the laboratory by communicating client's requirements to the technical staff by maintaining project-related documentation, communicating desired turnaround times, and managing information flow; other duties include facilitating and organizing client audits, visits, and conference calls; monitoring ongoing projects and providing status updates as needed; auditing client sample paperwork and resolving discrepancies; overseeing the general administration of pharmaceutical projects (issuing quotations, answering billing and reporting questions, and scheduling sample pickups)
Urological Associates of Lancaster, Surgical Coordinator (2010-2012)
Responsibilities included coordinating surgical procedures for seven urologists at four facilities; meeting with patients to explain procedure details including pre-hospital testing, day-of timeline and post-op appointments and testing; obtaining insurance authorizations
With Lancaster Laboratories since 2012
Principal Specialist Group Leader, Bay Area Service Center (2012)
Responsibilities include serving as the primary contact with the laboratory for a number of assigned clients; communicating technical information and conveying client requirements to laboratory personnel, ensuring that those requirements are met; managing large/complex projects according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow

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Samuel A. Huber, B.S., Manager, Physical Services/Equipment Maintenance & Repair

Education:

B.S. Biology, Lebanon Valley College (1988)
Certificate of Business Administration, Penn State University (1995)

Continuing Education:

24-hour HAZWOPER (spill response) (1995-2004)
40-hour HAZWOPER (2005-present)
DOT/IATA training (2004-2010)
Incident Command System IS-00100 (2006)
National Incident Management System IS-00700 (2006)
Total Productive Maintenance (2007)
Basic Electricity for the Non-Electrician (2009)
Air Conditioning and Refrigeration (2010)
OSHA Asbestos 2- Hour Awareness Training (2012)
Applied Structural Drying (4-Hours) (2012)
Siemens APOGEE Workstation Operations (2012)
NFMT (National Facilities Management & Technology) – annual conference attendance (2008-present)
I2SL (International Institute for Sustainable Laboratories) – annual conference attendance (2012)

Professional Experience:

With Eurofins Lancaster Laboratories since 1988
Environmental department responsibilities (1988-2007)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; supervising method development
Manager, Physical Services/Equipment Maintenance & Repair (2007- present)
Responsibilities include overseeing facilities staff and operation of physical plant and grounds; growth planning; overseeing security functions

Awards, Citations, Honorary Societies & Publications:

Dawson-Grundmann Innovation Award, Lancaster Laboratories (1999)
Design and oversee installation of bulk solvent delivery system for organic extractions; annual savings in waste reduction and labor costs of greater than $12,000
Organizing the Laboratory to Efficiently and Accurately Process Soil Samples, Pittcon poster session (2006)
NFPA Industrial Fire Protection Section Member (2009-present)
NFMT (National Facilities Management & Technology) Member (2010-present)
I2SL (International Institute for Sustainable Laboratories) Member (2012-present)
AFE (Association for Facilities Engineering) Member (2012-present)
LCISC (Lancaster County Industrial Safety Council) Member (2009-present)

Sara E. Johnson, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Chemistry, Biochemistry option, Millersville University (2006)

Professional Experience:

With Lancaster Laboratories since 2006
Chemist, Flexible Staffing (2006)
Responsibilities included flexing to various departments as needed and performing analysis ranging from GC/MS to SDS-PAGE Electrophoresis with colloidal blue or silver staining
Chemist, GC/MS Volatiles (2008)
Responsibilities included performing GC/MS analysis of water and soil samples along with other matrices by various analytical methods such as EPA 624, 8260B, and CLP; evaluating analytical data generated; calibrating and troubleshooting GC/MS instrumentation
Senior Chemist, GC/MS Volatiles (2010)
Responsibilities include performing GC/MS analysis of water and soil samples along with other matrices by various analytical methods such as EPA 624, 8260B, and CLP; evaluating analytical data generated; calibrating and troubleshooting GC/MS instrumentation; assisting other employees with any questions that may arise and helping to train new employees

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Richard H. Karam, B.A., Director of Operations, Eurofins Lancaster Laboratories Environmental

Education:

B.A. Environmental Studies, Green Mountain College (2000)

Professional Experience:

Severn Trent Laboratories

Analytical Chemist (2000-2005)

Responsibilities included analyzing environmental samples for various general chemistry parameters, metals by ICP/ICPMS, pesticides/PCBs/herbicides by GC, and semivolatiles by GC/MS

Project Manager (2005-2006)

Responsibilities included managing environmental projects; writing case narratives; project set up

With Eurofins Lancaster Laboratories since 2006

Group Leader, GC/MS Semivolatiles (2006)

Responsibilities included coordinating production in GC/MS Semivolatiles; reviewing and signing reports

Manager, GC/MS Semivolatiles (2007)

Responsibilities included ensuring the accuracy and acceptability of all data generated by the GC/MS Semivolatiles group; coordinating daily prioritization of workload and monitoring the holding time and turnaround time status of samples; responding to client questions regarding GC/MS Semivolatiles data and methods and communicating technical issues or concerns about samples to project managers for clarification or resolution with the client

Manager, Organic Extraction/Leachate Preparation/GC/MS Volatiles/GC/MS Semivolatiles (2008)

Responsibilities included ensuring the accuracy and acceptability of all data generated by the groups; coordinating daily prioritization of workload and monitoring the holding time and turnaround time status of samples; responding to client questions regarding data and methods and communicating technical issues or concerns about samples to project managers for clarification or resolution with the client

Director, Eurofins Lancaster Laboratories Environmental (2014)

Responsibilities include leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Dana M. Kauffman, Manager, Sample Support and Data Deliverables

Continuing Education:

Introduction to Electronics, Lancaster County Career & Technology Center, Brownstown (1994)
AC/DC Electronics, Lancaster County Career & Technology Center (1995)
Entry Level Management (1997)
Gas Chromatography: Principles and Practices, Lancaster Labs University (2003)
Practical Process Improvement Facilitator Training (2009)
Practical Process Improvement Process Manager Training (2011)

Professional Experience:

With Lancaster Laboratories since 1994

Lab Technician (1995)
Senior Technician (1996)
Sample Support Coordinator (1997)
Group Leader, Sample Support (1999); Group Leader, Volatiles by GC (2002)

Responsibilities included supervising personnel; managing laboratory operations; project management; sample preparation; developing and evaluating new methods; reagent preparation; revising and updating SOPs; ordering supplies; training other analysts; running the automated storage and retrieval system; lab cleaning and maintenance; monitoring laboratory activities; performing internal audits; enforcing regulatory compliance requirements; maintaining required certifications; communicating client requirements to lab areas

Manager, Sample Support and Data Deliverables (2005)

Responsibilities include overseeing all upfront sample handling requirements including storage, preservation, homogenization, moisture determination, volatile prescreen, and volatile soil prep; supervising group leader personnel; project management; revising and updating SOPs; performing internal audits; enforcing regulatory compliance requirements; maintaining required certifications; communicating client requirements to lab areas; data package and EDD TAT monitoring; overseeing all data package processes including data assembly, review, and processing; Practical Process Improvement (PPI) process manager responsible for facilitating PPI project team training and PPI efforts within LLI

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Katherine A. Klinefelter, M.S., Principal Specialist, Environmental Client Services

Education:

B.S. Chemistry, Rutgers University (1983)
M.S. Physiology, Rutgers University (1985)

Continuing Education:

Additional graduate work in Physiology, Rutgers University (1985-1989)
Practical Process Improvement (Team Member Training), Lancaster Labs University (2009)

Professional Experience:

Rutgers University, Research and Teaching Assistant (1984-1989)
M. S. Hershey Medical Center of Penn State University, Senior Research Technician (1990-1993)
With Lancaster Laboratories since 1993
- Environmental Project Management
- Senior Specialist, Environmental Client Services (1993)
- Senior Specialist/Coordinator, Environmental Client Services (1996)
- Senior Specialist, Environmental Client Services (2000)
- Principal Specialist, Environmental Client Services (2007)
  - Responsibilities include project management; training new client service representatives; auditing sample entry; answering client questions; communicating client requirements to lab areas

Awards, Citations, Honorary Societies & Publications:

Dean's Graduate Student Dissertation Research Award, Rutgers University
Dean's Graduate Student Travel Award, Rutgers University
Steinetz Memorial Fund Award, Department of Biological Sciences, Rutgers University
10 abstracts and 3 scientific papers on membrane transport physiology
4 presentations on membrane transport physiology
Quarterly Impact Award for Practical Process Improvement (2009)

Wendy A. Kozma, B.S., Principal Specialist Group Leader, Environmental Client Services

Education:

B.S. Environmental Science, Allegheny College (1991)

Professional Experience:

Roy F. Weston, Inc. (1992-1993)
With Lancaster Laboratories since 1993
- Senior Specialist, Environmental Client Services (1996)
  - Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers
- Principal Specialist, Environmental Client Services (2004)
  - Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers
- Principal Specialist Group Leader, Environmental Client Services (2006)
  - Responsibilities include performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers

Rachel L. Kreamer, B.S., Manager, Environmental Client Services

Education:

B.S. Biology, Eastern Mennonite College (1980)

Continuing Education:

Financial Accounting, Penn State (2005)
Behavioral Science in Business, Penn State (2006)
Price and Markets, Penn State (2006)

Professional Experience:

With Lancaster Laboratories since 1987
- Client Services Specialist, Environmental Client Services (1990)
- Environmental Project Manager, Environmental Client Services (1994)
- Coordinator, Environmental Client Services (1996)
- Group Leader, Environmental Client Services (1996)
  - Responsibilities included supervising personnel; training; revising and updating SOPs; monitoring turnaround time

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Manager, Environmental Client Services (2005)
Responsibilities included supervising personnel; training; revising and updating SOPs; monitoring turnaround time
Manager, Pharmaceutical Client Services (2005)
Responsibilities included supervising personnel; revising and updating SOPs; training
Director, Professional Scientific Staffing – VA (2007)
Responsibilities included managing all aspects of the PSS group in VA
Director, Bay Area Service Center (2008)
Responsibilities included managing all aspects of the Bay Area Service Center
Manager, Environmental Client Services and Bay Area Service Center (2009)
Responsibilities include managing all aspects of the environmental client services group and Bay Area Service Center

Awards, Citations, Honorary Societies & Publications:
Senior Leadership Group Achievement Award (1996)

M. Susan Kreider, Senior Specialist, Data Deliverables

Continuing Education:
Chemistry and Psychology courses, F&M College

Professional Experience:
General Cigar Co., R&D Center, Laboratory Technician (1963-1966)
Responsibilities included testing tobacco products; smoke analysis; nicotine and tar analysis; preparing samples for gas chromatography
Company F. Weaver, Inc., Laboratory Technician (1966-1967)
Responsibilities included performing microbiological testing of food products, both raw materials and finished products; training factory employees in sterile food handling
Microbiological Associates, Inc., Stock Line/Sterile Technician (1968-1969)
Responsibilities included performing cancer research; dissection of animal and human tissue for cell line production; freezing of live cells; all phases of sterile lab work
Warner Lambert Co., Assistant Microbiologist/Organic Chemistry Technician (1970-1975)
Responsibilities included performing microbiological and chemical testing of raw material and finished products
Julia Winifred & Co. (Jacks III), Sales Clerk (1982-1983)
Responsibilities included retail sales; preparing windows and displays in store
With Lancaster Laboratories since 1983
Laboratory Technician, ExpressLAB (1983)
Responsibilities included performing sample prep and analyses
Senior Technician, ExpressLAB (1986)
Responsibilities included performing sample prep and analyses
Chemist, ExpressLAB (1988)
Responsibilities included performing sample prep and analyses
Specialist, Pesticide Residue Analysis (1998)
Responsibilities included performing sample prep and analyses
Specialist, EPH/Misc. GC (2003)
Responsibilities included performing sample prep and analyses
Specialist, Data Deliverables (2005)
Responsibilities included validating and sending data deliverables
Senior Specialist, Data Deliverables (2006)
Responsibilities include validating and sending data deliverables

Robert M. Large, B.S., Director, Environmental Client Services/Inside Business Development/Sample Administration/Data Deliverables/Sample Support/Bay Area Service Center

Education:
B.S. Zoology, Pennsylvania State University (1973)

Continuing Education:
Chromatography/Mass Spectral Interpretation, Finnigan MAT Institute (1981)
Foundations of Management, Gilbert Associates (1982)
M.B.A. Program, St. Joseph's University (1984-1987)
How to Market Professional Services, ACIL (1990)

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Professional Experience:

Gilbert Associates, Inc., Program Manager (1977-1984)
Spotts, Stevens, & McCoy, Director of Client Services (1984-1990)
With Lancaster Laboratories since 1990
Marketing Specialist, Environmental Client Services (1990)
Group Leader, Environmental Client Services (1994)
Manager, Environmental Client Services (1995)
Responsibilities included: supervise personnel; project management; various office tasks; interpret QC implications to data quality; and advise clients on testing. Set up and managed the Bay Area Service Center in Richmond, CA (2001). Manage Environmental Sample Administration (2002). Manage Inside Business Development (2003).
Director, Environmental Client Services/Business Development/Sample Administration/Bay Area Service Center (2005)
Responsibilities include: supervise personnel; project management; various office tasks; interpret QC implications to data quality; and advise clients on testing. Set up and managed the Bay Area Service Center in Richmond, CA (2001). Manage Environmental Sample Administration (2002). Manage Inside Business Development (2003). Assisted setting up Professional Scientific Staffing (PSS) for a major biotech client (2004). Manage Data Deliverables and Sample Support (2010).

Kerri E. Legerlotz, Senior Chemist, GC/MS Volatiles

Education:

B.S. Chemistry, Houghton College (2005)

Professional Experience:

Pfizer, Chemist (2005-2006)
Responsibilities included performing raw material, finished product, and stability testing; wet chemistry, pH, viscosity, IR, Karl Fischer, specific gravity
With Lancaster Laboratories since 2006
Chemist, GC/MS Volatiles (2006)
Responsibilities included testing for volatile compounds using GC/MS by purge and trap; preparing working standards from neat compounds
Senior Chemist, GC/MS Volatiles (2013)
Responsibilities include analyzing water and soil samples by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers; troubleshooting problems on GC/MS, purge and traps, and autosamplers; formulating and diluting analytical reference materials

Parker D. Lindstrom, B.S., Senior Chemist, Metals

Education:

B.S. Chemical Oceanography, Millersville University (2002)

Continuing Education:

Comprehensive Gas Chromatography Seminar, RESTEK (2002)
Comprehensive GC/MS Seminar, RESTEK (2002)
Statistics at Lancaster Laboratories, LLU (2005)
24-hour HAZWOPER, LLU (2006)

Professional Experience:

Fred Fiorentino, Assistant Laborer (1997-2002
Responsibilities included roofing, painting, general construction, clean-up, installation of windows, doors, stairs, decking
Dr. Kerper, Office Assistant (2000-2002)
Responsibilities included filing, cataloging children's books
Millersville University IMC/IMS, Media/Education Assistant (2000-2002)
Responsibilities included assisting teachers in creating media for the classroom, editing video and audio projects
With Lancaster Laboratories since 2002
Associate Chemist/Senior Chemist, GC/MS Volatiles (2002)
Responsibilities included running purge and trap and GC/MS to analyze samples and QC for VOCs; performing purge and trap and GC/MS maintenance
Senior Chemist, Metals (2006)
Responsibilities included running ICP/MS; verifying samples; performing maintenance; prepping samples; general troubleshooting for metals department; installation, maintenance and operation of CVAF low level Mercury; providing general computer help to Computer Services department
Senior Chemist Metrology, Metals (2009)
Responsibilities include helping the instrument (Metrology) group maintain and qualify HPLCs, GCs, and other pharmaceutical instruments; helping with other qualifications as needed (hoods, storage units, etc); for a short time in 2009 verifying data in Water Quality department

Memberships and Appointments:

Emergency Response Team (Spill Team), Lancaster Laboratories (2006)

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Jason M. Long, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Chemistry, Shippensburg University (2004)

Professional Experience:

EA Engineering Science & Technology, Lab Tech (2004)

Responsibilities included setting up and running tests in toxicology lab; cleaning glassware used in performing tests; titrating for alkalinity and pH of water samples

With Lancaster Laboratories since 2004

Chemist, GC/MS Volatiles (2004)

Responsibilities included analyzing water and soil samples by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers

Senior Chemist, GC/MS Volatiles (2007)

Responsibilities include analyzing water and soil samples by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers; troubleshooting problems on GC/MS, purge and traps, and autosamplers

Lyssa M. Longenecker, B.S., Senior Specialist, Environmental Client Services

Education:

B.S. Biology, Millersville University of PA (2010)

Professional Experience:

With Eurofins Lancaster Laboratories since 2011

Specialist, Environmental Client Services (2011)

Responsibilities included serving as the primary laboratory contact to clients; communicating technical information to the client in a comprehensible manner; deciphering the clients' testing needs; conveying the clients' requirements to the laboratory; ensuring clients' requirements and needs are met

Senior Specialist, Environmental Client Services (2014)

Responsibilities include serving as the primary laboratory contact to clients; communicating technical information to the client in a comprehensible manner; deciphering the clients' testing needs; conveying the clients' requirements to the laboratory; ensuring clients' requirements and needs are met

Dorothy M. Love, B.S., Manager, Environmental Quality Assurance

Education:

B.S. Environmental Health, Indiana University of Pennsylvania (1981)

Professional Experience:

Sun Transport, Inc., Safety Assistant (1980-1981)
Texas A & M University, Research Assistant (1982-1984)
Texas Water Commission, Chemist (1984-1986)
GHR Analytical, Chemist (1986-1987)
Clean Harbors, Inc., Senior Chemist (1987-1989)
With Eurofins Lancaster Laboratories since 1989

Senior Specialist (1989)
Senior QA Specialist (1998) Coordinator (2000)
Principal Specialist/Coordinator, Quality Assurance (2003)

Responsibilities included supervising personnel; training other QA staff; revised and updated analytical methods; monitored laboratory activities and corrective action for quality issues; performed internal audits; worked with external auditors; reviewed lab data and procedures; enforced regulatory compliance requirements; reviewed/wrote client/lab Quality Assurance Project Plans (QAPP)

Principal Specialist Group Leader, Quality Assurance (2005)

Responsibilities included supervising personnel; training other QA staff; revised and updated analytical methods; monitored laboratory activities and corrective action for quality issues; performed internal audits; worked with external auditors; reviewed lab data and procedures; enforced regulatory compliance requirements; reviewed/wrote client/lab Quality Assurance Project Plans (QAPP)

Manager, Environmental Quality Assurance (2013)

Responsibilities include supervising the Environmental QA department; monitoring regulatory activities; reviewing procedures and data; interacting with clients and agencies; performing regulatory and client document review; enforcing regulatory compliance; quality improvement; staff training; QA policy development and maintenance

Memberships and Appointments:

Society of Women Environmental Professionals (SWEP (2007-present)
TNI Quality Systems Committee (2009-present)
NJ Environmental Laboratory Advisory Committee (2012-present)

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Natalie R. Luciano, B.A., Senior Specialist, Environmental Client Services

Education:

B.A. Biology, Bridgewater College (2006)

Continuing Education:

Safe Drinking Water Regulations Revisions, PaAAEL & PA DEP (2010)
PA Regulatory Update Bureau of Safe Drinking Water, PaAAEL (2013)
PA DEP Regulatory Update, PA DEP (2013)

Professional Experience:

With Eurofins Lancaster Laboratories since 2007
- Specialist, Environmental Client Services (2007)
  - Responsibilities included performing project management; serving as the primary contact for external clients; communicating client requirements to laboratory areas; auditing entries and reviewing sample data
- Senior Specialist, Environmental Client Services (2013)
  - Responsibilities include performing project management; serving as the primary contact for external clients; communicating client requirements to laboratory areas; auditing entries and reviewing sample data

Duane A. Luckenbill, B.S., Vice President, Eurofins Lancaster Laboratories Environmental

Education:

B.S. Chemistry, Clarion University of PA (1989)

Continuing Education:

Introduction to Mass Spectral Interpretation, Hewlett-Packard (1995)
Technical Training, OI Analytical (1995)

Professional Experience:

ATEC Associates, Inc., GC/MS Analyst (1989)
With Eurofins Lancaster Laboratories since 1989
- Chemist (1991)
- Chemist/Coordinator (1993)
- Group Leader (1997)
- Manager (2001)
  - Responsibilities included client satisfaction, safety and quality systems administration, and all aspects of financial, personnel, and operations management of the GC/MS Volatiles and GC/MS Semivolatiles groups
- Director, Environmental Sciences (2005)
  - Responsibilities included client satisfaction, safety and quality systems administration, and all aspects of financial, personnel, and operations management of the GC/MS Volatiles, GC/MS Semivolatiles, Volatiles in Air, Organic Extraction, Leachate Preparation, Field Sampling, Pesticide Residue Analysis, Volatiles by GC, and EPH/Miscellaneous GC groups
- Vice President, Eurofins Lancaster Laboratories Environmental (2013)
  - Responsibilities include all aspects of financial, personnel, and operations management of all Technical areas, Environmental Quality and Compliance, Computer Application/Development, and Environmental Support Services while continually focusing on client satisfaction, safety, and quality systems administration; collaborating with other Eurofins US environmental companies to expand national testing capabilities and grow market share in the US

Awards, Citations, Honorary Societies & Publications:

Undergraduate Award in Analytical Chemistry, American Chemical Society (1988)
Department of Chemistry Competitive Award, Clarion University (1988-1989)
Outstanding Senior Chemistry Award, American Institute of Chemists Foundation (1989)
Senior College Award for Chemistry, Society for Analytical Chemists of Pittsburgh (1989)
One publication on mass spectrometry

Nicole L. Maljovec, M.S., Principal Specialist Group Leader, Environmental Client Services

Education:

B.S. Chemistry, St. Bonaventure University (2004)
M.S. Adolescence Education, D'Youville College (2005)

Professional Experience:

CYTEC Industries, Industrial Hygiene Internship (2003-2004)
- Responsibilities included performing air monitoring and sampling; complying with OSHA standards; assisting R/D lab with the identification of unknown chemicals and wastes

Niagara Wheatfield, Environmental Science Teacher (2005-2006)
- Responsibilities included teaching chemistry, chemistry lab, and environmental science; developing special education plans to assist students with learning disabilities

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With Lancaster Laboratories since 2006

Specialist, Environmental Client Services (2006)

Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers

Senior Specialist Group Leader, Environmental Client Services (2007)

Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers; managing a team of client service representatives and administrative assistants, training of new employees, setting up and delegating new projects, serving as primary project manager for several large clients and consultants

Principal Specialist Group Leader, Environmental Client Services (2012)

Responsibilities include serving as the primary contact or back-up with the laboratory for a number of assigned clients requiring specialized testing or complex projects; understanding and communicating technical information and client requirements to laboratory personnel, helping to ensure that requirements are met; leading broad-based complex projects to a satisfactory conclusion according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; advising and training other members of the department; serving as a technical resource both internally and externally; proactively assisting Outside Business Development with client visits, presentations, and internal audits for assigned clients; participating on PPI teams

Melissa McDermott, B.A., Principal Specialist, Environmental Business Development

Education:

B.A. Biology, Millersville University (1992)
Elementary Education Certification, PA (May 2009)
Middle School Science Certification, PA (July 2009)

Continuing Education:

Gas Chromatography Principles and Practices (1995)
Conflict Resolution and Confrontation Skills Seminar (1996)
Coaching Skills for Supervisors Seminar (1996)
Waste Testing and Quality Assurance Symposium (1996)
Entry Level Management (1997)
How to Deliver Exceptional Customer Service Seminar (1997)
Statistics at Lancaster Laboratories (2006)

Professional Experience:

With Eurofins Lancaster Laboratories since 1992

Chemist, EPH/Misc. GC (1993)

Responsibilities included performing analysis of environmental samples for metals by AA flame and cold vapor generation; assembling client data packages

Chemist Coordinator, EPH/Misc. GC (1996)

Responsibilities included coordinating rush work; communicating with client service representatives regarding sample status; answering client questions; generating employee job plans; conducting employee evaluations

Senior Chemist, EPH/Misc. GC (1997)

Responsibilities included performing analysis of environmental samples for DRO and interpretive TPH analyses; verifying analyses performed by other analysts; preparing standards; revising departmental SOPs; method development; reviewing data packages

Senior Specialist, Environmental Client Services (1997)

Responsibilities included auditing sample entry; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions and providing sampling containers

Senior Chemist, EPH/Misc. GC (2002)

Responsibilities included reviewing and approving data; writing departmental methods; reviewing and approving data packages; acting as technical resource within department; answering client questions; monitoring and performing QA metrics

Senior Specialist, Environmental Client Services (2007)

Responsibilities included acting as technical resource between client services and laboratories; scheduling sample submissions and providing sampling containers; communicating client requirements to lab areas

Senior Chemist, EPH/Misc. GC (2009)

Responsibilities included reviewing and approving data; writing departmental methods; reviewing and approving data packages; acting as technical resource within department; answering client questions; monitoring and performing QA metrics

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Senior Chemist Group Leader, Pesticides (2011)

Responsibilities included performing routine and non routine instrumental analyses of QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds in accordance with departmental methods and standard operating procedures (SOPs); assisting in implementing special client requests; identifying and offering solutions to correct instrument problems and causes of QC problems; reviewing data for accuracy and completeness (for both routine and non routine analyses, reports, or data packages); serving as a technical resource for the department; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow

Principal Specialist, Environmental Business Development (2014)

Responsibilities include using company literature, verbal discussions, formal written quotes, proposals, tours, and audits to independently secure new business consistent with operational capabilities and business plan goals; collaborating efforts and activities with those of Outside Sales account managers as needed; focusing on proposal writing for major national accounts; attending face-to-face sales meetings with selected national accounts as needed and maintaining responsibility for their maintenance and growth

Roy R. Mellott Jr., B.S., Senior Chemist Group Leader, GC/MS Volatiles

Education:

B.S. Biology, Millersville University (1993)

Continuing Education:

Hazardous Waste Disposal, LLU (1996)
GC: Principles & Practices, LLU (1997)
GC/MS: Applications/Troubleshooting Seminar, ECS/MDL Systems, Inc. (1999)
Introduction to Interpretation of Mass Spectra, LLU (2005)
Interpretation of Mass Spectra, Intermediate, LLU (2005)
Role of the Leader 1 – Giving Recognition, LLU (2007)
Role of the Leader 2 – Clarifying Performance Expectations, LLU (2007)
Role of the Leader 3 – Developing Others, LLU (2007)
Role of the Leader 4 – Providing Constructive Feedback, LLU (2007)
PPI Team Training, LLU (2010)
PPI Facilitator Workshop, LLU (2010)
Targeted Selection, LLU (2010)
Role of the Leader Building Team Pride and Purpose, LLU (2011)
Role of the Leader Resolving Conflicts with Your Peers, LLU (2011)

Professional Experience:

With Eurofins Lancaster Laboratories since 1995

Senior Lab Tech I, GC/MS Volatiles (1995)

Responsibilities included requisitioning samples; performing sample storage, prescreening, discard, hazardous waste disposal; tracking down missing samples by various means

Chemist/Auditor, GC/MS Volatiles (1996)

Responsibilities included performing analysis of waters, soils, and other matrices for VOCs via various analytical methods; evaluation of analytical data; calibrating and trouble shooting various GC/MS equipment; evaluation/review of analyst-generated data; corresponding with analysts about possible trends (whether analyst- or system-related) in generated data; evaluation/review of corrections of problems with generated data

Senior Chemist, GC/MS Volatiles (2002)

Responsibilities included performing analysis of waters, soils, and other matrices for VOCs via various analytical methods; evaluation of analytical data; setting up, calibrating, and trouble shooting various GC/MS equipment; evaluation/review of analyst-generated data; corresponding with analysts about possible trends (whether analyst- or system-related) in generated data; evaluation/review of corrections of problems with generated data; updating/correcting SOPs and laboratory and analytical procedures; preparation, tracking and documentation of analytical standards used in the laboratory; training of new employees to the department

Senior Chemist Group Leader, GC/MS Volatiles (2005)

Responsibilities include performing analysis of waters, soils, and other matrices for VOCs via various analytical methods; evaluation of analytical data; setting up, calibrating, and trouble shooting various GC/MS equipment; evaluation/review of analyst-generated data; corresponding with analysts about possible trends (whether analyst- or system-related) in generated data; evaluation/review of corrections of problems with generated data; updating/correcting SOPs and laboratory and analytical procedures; preparation, tracking and documentation of analytical standards used in the laboratory; training of new employees to the department

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Memberships & Appointments:
- Nature Conservancy (1998-present)
- Eurofins Lancaster Laboratories
  - Ethics Committee (1999-2003)
- Lancaster Herpetological Society
  - Treasurer (2005-present)
- HabitatMT (2011-present)

Jessica L. Miller, B.S., Senior Chemist, Pesticide Residue Analysis

Education:
- B.S. Chemistry, Cedar Crest College (2011)

Continuing Education:

Gas Chromatography Principles and Practice (2011)

Professional Experience:
- With Eurofins Lancaster Laboratories since 2011
  - Chemist, Pesticide Residue Analysis (2011)
    - Responsibilities included performing pesticide residue analysis; prescreening samples; calibrating, reviewing, and uploading data
  - Senior Chemist, Pesticide Residue Analysis (2014)
    - Responsibilities include performing pesticide residue analysis; prescreening samples; calibrating, reviewing, and uploading data

Memberships and Appointments:
- Psi Chi
  - Member (2009)
- Gamma Sigma Epsilon
  - Member (2011)

Megan A. Moeller, B.S., Senior Specialist, Environmental Client Services

Education:
- B.S. Environmental Science, University of Delaware (1999)

Professional Experience:
- With Lancaster Laboratories since 1999
  - Sample Administration/Client Service Specialist, Environmental Client Services (2003)
    - Responsibilities included Interpretation and entry of incoming samples. Route samples to the correct locations. Assist Client Service representatives with auditing, reviewing reports, and reviewing invoices.
  - Specialist, Environmental Client Services (2004-2006)
    - Responsibilities included managing projects, prepare quotations, audit sample entries, answer client questions, communicate client requirements to lab areas, schedule sample submissions, and provide sample containers.
  - Senior Specialist, Environmental Client Services (2006)
    - Responsibilities include managing projects, prepare quotations, audit sample entries, answer client questions, communicate client requirements to lab areas, schedule sample submissions, and provide sample containers.

Chad A. Moline, B.S., Senior Chemist, GC/MS Semivolatiles

Education:
- B.S. Environmental Studies, Slippery Rock University (1998)
- Teaching Certification, Secondary Education, Millersville University (2003)

Professional Experience:
- Centre Analytical Laboratories, Lab Technician (1999-2000)
  - Responsibilities included running various wet chemistry analyses
- Lancaster Laboratories, Chemist/Senior Chemist (2000-2005)
  - Responsibilities included maintaining GC/MS instrumentation
- Warwick School District, Science Teacher (2005-2006)
  - Responsibilities included teaching chemistry and physics to 8th grade students
- Conestoga Valley School District, Science Teacher (2006-2007)
  - Responsibilities included teaching chemistry and earth science to 8th grade students
- With Eurofins Lancaster Laboratories since 2007
  - Senior Chemist Group Leader, GC/MS Semivolatiles (2007)
    - Responsibilities included monitoring workflow; meeting client turnaround times
  - Senior Chemist (2012)
    - Responsibilities include maintaining and operating GC/MS instrumentation

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Jeffrey S. Moyer, B.S., Senior Specialist Group Leader, Sample Bottles

Education:

B.S. Environmental Resource Management, Penn State University (1977)

Professional Experience:

Joseph A. Kodak, Carpenter's Helper (1977-1978)
Responsibilities included performing construction

BP Oil, Inc., Operations Supervisor (1978-1979)
Responsibilities included working on special projects in the regional operations office

Koch Hydrocarbon Company, Terminal Manager (1979-1997)
Responsibilities included managing the operation of a 24 hr/day, 365 day/year propane storage facility; coordinating inventory storage, product quality control, maintenance, safety, and personnel staffing and training; additional responsibilities included facility upgrades and expansion projects

With Lancaster Laboratories since 1997

Specialist, Environmental Sample Administration (1997)
Responsibilities included entering environmental samples for analysis; coordinating projects with client services; updating standard forms; filing client bottle orders; tracking change forms and forwarding updated info to SA department; tracking short hold/rush list; processing gold forms

Specialist, Environmental Client Services (1999)
Responsibilities included acting as technical resource for clients and SA entry; preparing quotes for clients; preparing bottle orders; scheduling sample pickups; auditing acknowledgements and client paperwork; troubleshooting client problems; updating standard forms; processing bottle orders, lab reports, acknowledgements, and COCs; handling reprint requests; preparing SDG reports

Senior Specialist Group Leader, Sample Bottles (2004)
Responsibilities include managing bottles department; coordinating projects with client services; updating bottle code and preservation sheets; updating SOPs; working with purchasing to ensure inventory levels are adequate; backing up transportation coordination

Jennifer L. Moyer, B.S., Senior Specialist, Metals

Education:

B.S. Chemistry, Lock Haven University (2000)

Professional Experience:

Lock Haven University, Lab Tech (1996-1998)
Responsibilities included setting up labs; stocking and setting up stock rooms; helping professors with projects

Croda Inc., Process Development Chemist (1998-2000)
Responsibilities included developing and improving procedures on existing products

With Lancaster Laboratories since 2000

Chemist, Metals (2000)
Responsibilities included running and maintaining ICP instruments

Chemist, Metals (2002)
Responsibilities included running and maintaining Graphite Furnace Atomic Absorption instruments

Group Leader/Specialist, Metals (2003)
Responsibilities included overseeing Graphite Furnace Atomic Absorption and Mercury analysts

Senior Specialist, Metals (2007)
Responsibilities include verifying ICP, GFAA, Mercury, and ICP-MS

Kathrine K. Muramatsu, B.S., Senior Chemist Group Leader, GC/MS Volatiles

Education:

B.S. Chemistry, University of Colorado (2005)

Continuing Education:

Forensic Science and DNA Testing Certification (2006)
24-Hour Emergency Response (HAZWOPER), Lancaster Laboratories (2009)
American Heart Association (AHA)/American Red Cross certified, Lancaster Laboratories (2009)

Professional Experience:

With Eurofins Lancaster Laboratories since 2007

Chemist, Analytical Chemistry, Professional Scientific Staffing – CO (2007)
Responsibilities included ensuring compliance with cGMPs; performing analysis of system water, clean in place (CIP) samples, clean out of place (COP) samples, and other sample types; methods used were total organic carbon (TOC), pH, conductivity, Limulus Amebocyte Lysate (LAL), and UV spectroscopy

Chemist, GC/MS Volatiles (2007)
Responsibilities included analyzing environmental samples of various sample matrices using purge and trap GC/MS; generating and reviewing raw data; performing instrument maintenance as needed

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Chemist Group Leader, GC/MS Volatiles (2009)
Responsibilities included supervising and mentoring personnel; coordinating daily workload through prioritizing and scheduling; processing monthly metrics for the department; verifying sample data; analyzing environmental samples of various sample matrices using purge and trap GC/MS; generating and reviewing raw data; performing instrument maintenance as needed
Senior Chemist Group Leader, GC/MS Volatiles (2014)
Responsibilities include supervising and mentoring personnel; coordinating daily workload through prioritizing and scheduling; processing monthly metrics for the department; verifying sample data; analyzing environmental samples of various sample matrices using purge and trap GC/MS; generating and reviewing raw data; performing instrument maintenance as needed

Awards, Citations, Honorary Societies, and Publications

Dean's List (2002)
Colorado Scholars (2002-2005)
Superlative Service Award (2010)
Two publications in the Journal of Organic Chemistry

Memberships and Appointments:

American Chemical Society

Charles J. Neslund, B.S., Technical Director, Volatiles in Air and Specialty Services Group, Eurofins Lancaster Laboratories Environmental

Education:

B.S. Chemistry, University of Pittsburgh (1982)

Continuing Education:

Graduate studies in organic chemistry, University of Pittsburgh (1983)

Professional Experience:

Lancaster Laboratories (1984-1996)
Chemist (1986)
Group Leader (1987)
Chemist (1991)
OI Analytical, Sales Representative (1996)
With Eurofins Lancaster Laboratories since 1997
Group Leader, GC/MS Semivolatiles (1997)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; data interpretation; reviewing and approving data; developing and evaluating new methods; consulting with clients regarding testing needs; revising and updating SOPs and analytical methods
Manager, GC/MS Semivolatiles and Volatiles in Air (2005)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; data interpretation; reviewing and approving data; developing and evaluating new methods; consulting with clients regarding testing needs; revising and updating SOPs and analytical methods
Manager, Volatiles in Air and Specialty Services Group (2007)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; data interpretation; reviewing and approving data; developing and evaluating new methods; consulting with clients regarding testing needs; revising and updating SOPs and analytical methods; marketing specialty services capabilities; conducting technical presentations
Technical Director, Volatiles in Air and Specialty Services Group, Eurofins Lancaster Laboratories Environmental (2014)
Responsibilities include leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Awards, Citations, Honorary Societies & Publications:

Dawson-Grundmann Innovation Award (1995)

Memberships & Appointments:

American Chemical Society (ACS)
Chromatography Forum of the Delaware Valley (CFDV)
Past member of Executive Committee of the Chromatography Forum of the Delaware Valley
Air & Waste Management Association (A&WMA)
Society of Environmental Toxicology and Chemistry (SETAC)
Sediment Management Workgroup (SMWG)

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Deborah A. Neslund, Senior Specialist, Environmental Sample Administration

Professional Experience:

- Lancaster General Hospital, Phlebotomist (1976-1977)
- Fairfax Hospital, LPN (1978)
- Lancaster General Hospital, Phlebotomist/EKG Technician (1980-1986)
- With Eurofins Lancaster Laboratories since 1986
  - Senior Specialist Coordinator, Environmental Sample Administration (1986)
    - Responsibilities included supervising personnel; directed flow of samples to include prioritization to meet hold times and standards set for rush and other samples; developed and improved systems for efficiency within SA; represented SA in communications with Technical Groups, Client Services, and other support areas; logged-in samples
  - Senior Specialist Group Leader, Environmental Sample Administration (2005)
    - Responsibilities included supervising personnel; directed flow of samples to include prioritization to meet hold times and standards set for rush and other samples; developed and improved systems for efficiency within SA; represented SA in communications with Technical Groups, Client Services, and other support areas; logged-in samples
  - Senior Specialist (2013)
    - Responsibilities include directing flow of samples to include prioritization to meet hold times and standards set for rush and other samples; developing and improving systems for efficiency within SA; representing SA in communications with Technical Groups, Client Services, and other support areas; logging-in samples

Ryan V. Nolt, B.S., Manager, GC/MS Volatiles

Education:

- B.S. Chemistry, Millersville University (1997)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1996
  - Clerk II, Sample Support (1996)
    - Responsibilities included performing ASRS operations, preserving incoming samples, homogenizing samples, packing bottle orders, and performing sample discard
  - Senior Technician, ExpressLAB (1997)
    - Responsibilities included performing sample dilutions, preparing standards, prepping samples, and setting up new instruments
  - Chemist, GC/MS Volatiles (1998)
    - Responsibilities included performing purge and trap and GC/MS maintenance; tuning and calibrating GC/MS system; analyzing samples; reviewing, working up, and assembling all supporting data; and preparing new standards
  - Senior Chemist Coordinator, GC/MS Volatiles (2000)
    - Responsibilities included performing routine and non-routine laboratory analysis; diagnosing and solving technical problems; implementing improvements to maximize quality; maintaining and troubleshooting instruments; writing and revising SOPs; validating new methods and equipment; assigning new work to instrument groups and monitoring productivity; training new analysts
  - Principal Chemist Group Leader, GC/MS Volatiles (2005)
    - Responsibilities included performing routine and non-routine laboratory analysis; diagnosing and solving technical problems; implementing improvements to maximize quality; maintaining and troubleshooting instruments; writing and revising SOPs; validating new methods and equipment; assigning new work to instrument groups and monitoring productivity; training new analysts
  - Manager, GC/MS Volatiles (2014)
    - Responsibilities include performing a variety of technical and administrative tasks to develop, evaluate, and supervise staff; planning and monitoring work flow; designing, implementing, and utilizing departmental operations systems; promoting safety; remaining current on technical developments in the area of GC/MS volatiles; communicating with clients; maintaining a strong commitment to quality

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Anneliese H. Owen, M.B.A., Manager, Environmental Sample Administration

Education:

B.S. Molecular and Cell Biology, Pennsylvania State University (1986)
M.B.A. Pennsylvania State University (1993)

Professional Experience:

With Lancaster Laboratories since 1986
- Coordinator (1987)
- Client Services Specialist (1988)
- Business Development Specialist (1990)
- Group Leader, Environmental Sample Administration (1992)
  - Responsibilities included: supervise personnel; manage laboratory operations and financial resources; sample interpretation and entry; and monitor corrective action for quality issues.
- Manager, Environmental Sample Administration (2005)
  - Responsibilities include: supervise personnel; manage laboratory operations and financial resources; sample interpretation and entry; and monitor corrective action for quality issues.

Linda C. Pape, B.A., Senior Chemist, GC/MS Volatiles

Education:

B.A. Business Administration, Milsaps College (1985)

Professional Experience:

Rite Aid Pharmacy, Store Manager (1985-1989)
- Responsibilities included being responsible for overall maintenance and security of merchandise, store, and property; ordering and display of all merchandise; auditing daily cash and inventory reports; scheduling employees; payroll accounting; training of new and prospective personnel

With Lancaster Laboratories since 1993
- Chemist, Volatiles by GC (1993)
  - Responsibilities included analyzing client-submitted samples and their associated quality control samples by purge-and-trap gas chromatography; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality
- Chemist, Water Quality (2000)
  - In addition to responsibilities listed above performed CN distillation, PO_4 digestion, and phenol distillation during a 3-month time frame
- Senior Chemist, Volatiles by GC (2007)
  - Responsibilities included analyzing client-submitted samples and their associated quality control samples by purge-and-trap gas chromatography; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; performing final review (verification) of data for clients (adding appropriate comments as necessary); evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality; training new employees in Volatiles by GC soils
- Senior Chemist, Volatiles by GC/MS (2008)
  - Responsibilities included analyzing client-submitted samples and their associated quality control samples by purge-and-trap gas chromatography/mass spectrometry; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; performing final review (verification) of data for clients (adding appropriate comments as necessary); evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality; training new employees
- Senior Chemist, GC/MS Volatiles (2009)
  - Responsibilities include analyzing client-submitted samples and their associated quality control samples; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; performing final review (verification) of data for clients (adding appropriate comments as necessary); evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality; training new employees

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Cassandre L. Pelto, B.S., Project Manager, Fort Collins Service Center

Education:

B.S. Biology, University of Central Florida (2008)

Professional Experience:

Environmental Research and Design, Laboratory Technician (2005-2008)

Responsibilities included performing following tests: Color, pH, Alkalinity, Spec. Conductivity, Turbidity, Metals Digestion, TN/TP Digestion, Chloride, Fluoride and Hardness

Environmental Research and Design, Microbiologist/Assistant Laboratory Manager (2008-2010)

Responsibilities included performing tests and QC on Fecal Coliform, E. Coli, and Total Coliform by MF and MTF (MPN); assisted Lab Manager with data entry, QC checks and inspections

Environmental Research and Design, Laboratory Manager (2010-2014)

Responsibilities included personnel Training, Liaison for Inspections, QC Review, Data Entry, Sample receiving, Client Project Management, Inorganic Analysis: Metals, Nutrients, Oil and Grease, Hardness, etc.

With Eurofins Lancaster Laboratories since 2014

Project Manager, Fort Collins Service Center (2014)

Responsibilities include serving as the primary contact for a number of assigned clients; understanding technical information and communicating client requirements to laboratory personnel, helping to ensure that requirements are met; managing large/complex projects according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; training subordinates; delegating routine tasks; resolving issues when problems arise; participating in departmental process improvement

Memberships and Appointments:

Florida Society of Environmental Analysts

Member (2010-2014)

James H. Place, B.S., Senior Chemist, Pesticide Residue Analysis

Education:

B.S. Physical Science, York College of Pennsylvania (1997)

Professional Experience:

AMZ Corporation, Laboratory Technician (1998-2000)

Responsibilities included performing analysis and maintenance of chemical compositions pertaining to electroplating baths

Nichia America Co., Laboratory Technician (2000-2001)

Responsibilities included performing analysis of phosphorus for composition of pigments; performing sample screening and AA analysis

AMZ Corporation, Laboratory Technician (2001-2003)

Responsibilities included performing analysis and maintenance of chemical compositions pertaining to electroplating baths; conducting inventory and ordering chemicals

With Lancaster Laboratories since 2003

Chemist, Pesticide Residue Analysis (2003)

Responsibilities include performing routine and non-routine instrumental analyses of QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds in accordance with departmental methods and SOPs; achieving quality results within the time-frame expected by our clients with minimal daily supervision; maintaining the GCs or HPLCs used for routine analyses; identifying and correcting common instrument or QC problems

Senior Chemist, Pesticide Residue Analysis (2008)

Responsibilities include performing routine and non-routine instrumental analyses of QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds in accordance with departmental methods and SOPs; assisting in implementing special client requests; identifying and offering solutions to correct instrument problems and causes of QC problems; reviewing data for accuracy and completeness (for both routine and non-routine analyses, reports, or data packages); serving as a technical resource for the department

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Christine M. Ratcliff, B.S., Principal Specialist, Volatiles in Air

Education:

B.S. Chemistry, Shippensburg University (1988)

Continuing Education:

Mass Spectral Interpretation, Finnigan MAT Institute (1990)

Professional Experience:

With Lancaster Laboratories since 1988

Chemist (1991)

Coordinator (1994)

Group Leader (1996)

Senior Chemist/Coordinator (1997)

Senior Chemist (2002)

Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data

Senior Specialist, GC/MS Semivolatiles (2005)

Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data

Principal Specialist, GC/MS Semivolatiles (2009)

Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of GC/MS semivolatiles data in a timely manner

Principal Specialist, Volatiles in Air (2009)

Responsibilities include reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of Volatiles in Air, GC/MS semivolatiles, and GC/MS volatiles data in a timely manner

Principal Specialist, Volatiles in Air (2009)

Responsibilities include reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of Volatiles in Air, GC/MS semivolatiles, GC/MS volatiles, and dioxans and furans data in a timely manner

Mark A. Ratcliff, B.A., Senior Specialist, GC/MS Semivolatiles

Education:

B.A. Physics, Franklin & Marshall College (1988)

Continuing Education:

Finnegan Mass Spectral Interpretation Course (1991)

Professional Experience:

With Lancaster Laboratories since 1989

Chemist (1992)

Senior Chemist (1996)

Responsibilities included: perform GC/MS semivolatiles testing; operate GC/MS instruments; data interpretation; calibrating and repairing instruments; prepare standards; revise and update SOPs; and train other analysts.

Senior Specialist, GC/MS Semivolatiles (2005)

Responsibilities include: perform GC/MS semivolatiles testing; operate GC/MS instruments; data interpretation; calibrating and repairing instruments; prepare standards; revise and update SOPs; and train other analysts.

Barbara F. Reedy, B.S., Senior Specialist, Environmental Quality Assurance

Education:

B.S. Environmental Biology, Millersville University (1993)

Continuing Education:

Environmental GC Analysis Seminar, Restek (2001)

The Internet Audit A Quality Tool, PaAAEL (2001)

Advanced Gas Chromatography Mass Spectroscopy Seminar, PaAAEL (2002)

LC/MS/MS System Seminar, Applied Biosystems (2006)

Introduction to Root Cause Analysis, Patton Professional (2007)

When to Initiate Corrective Action, Patton Professional (2007)

Practical Process Improvement Training in the role of Team Member (2008)

GC Pesticide/PCB's Analysis Training Seminar (2008)

NY/PAAAEL Annual Meeting - Internal & Electronic Audits: Satisfying Regulatory Requirements, Corrective and Preventive Actions, Ethics and Data Integrity Training (2009)

Environmental Laboratory Assessment Basic Assessor Training – TNI Standard 2009 (2012)

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Professional Experience:

Department of Environmental Resources, Division of Rivers and Wetlands, Scientific Intern (1993)

Responsibilities included reviewing wetland permits applications; inspecting and photographing wetland mitigation sites; determining hydrology, soil type, and the consistency of the mitigation with the approved project plans; researching records of the sites

With Eurofins Lancaster Laboratories since 1993

Associate Chemist/Chemist, Volatiles by GC (1993)

Responsibilities included calibrating Capillary, VOA, BTEX, and FID instruments; performing routine maintenance; interpreting, reviewing, and uploading data

Senior Chemist, Volatiles by GC (1999)

Responsibilities included being primary verifier for the majority of data for Volatiles by GC for the ELCD/PID and FID for both waters and soils; signing of analytical reports; generating statistically determined QC windows; training new analysts to review and upload data into the LIMS

Senior Specialist, Environmental Quality Assurance (2001)

Responsibilities include ensuring quality of data being produced in the laboratories by performing data review, auditing laboratories, and reviewing written procedures; ensuring laboratory adherence to government regulations and client requirements; reviewing client and government documents for requirements outside our usual laboratory practices; setup and testing new analysis in the laboratory sample management system as required by the departments; maintaining documentation of agency certifications

Memberships & Appointments:

Pennsylvania Association of Accredited Laboratories (2013-present)

Beth A. Rich, Senior Specialist, Safety

Professional Experience:

With Eurofins Lancaster Laboratories since 1998

Senior Administrator, Human Resources (1998)

Responsibilities included entering and maintaining employee information in system; photocopying, filing, maintaining personnel files; tracking mid-year and annual job plan completion; following up on exit interviews and other HR admin and support

Specialist, Human Resources (2005)

Responsibilities included maintaining a high level of human resource generalist knowledge to support all personnel in the HR department and to serve all employees

Senior Specialist, Human Resources (2010)

Responsibilities included maintaining a high level of human resource generalist knowledge to support all personnel in the HR department and to serve all employees

Senior Specialist, Safety (2013)

Responsibilities include managing worker's compensation and return to work programs; coordinating annual health screenings, flu shots, and blood bank donations; setting up new site worker's compensation systems as needed; filing incident reports and tracking recordable incidents; coordinating special medical programs as needed

John R. Riggs, Jr., B.S., Senior Specialist Group Leader, Environmental Software Development

Education:

B.S. Professional Studies (Computer Science/Mathematic), Misericordia University (1994)

Continuing Education:

Masters Business Administration, Elizabethtown College (Expected graduation date: 2015)

Professional Experience:

Nissin Foods, Inc., Distribution Supervisor/IT Engineer (1994-1998)

Responsibilities included acting as a liaison between local and corporate management teams; supervised the activities of multiple teams of material handlers engaged in receiving, storing, and shipping finished goods; ensured the accuracy of orders and inventory to meet customer demand; maintained documentation and prepared reports which reflected the effectiveness and efficiency of department activities; Implemented warehouse safety procedures and hold regular safety meetings; established and recommended changes to policies to improve the organization; supported and maintained Novell servers and backups; administered user accounts and email; configured new desktop machines and maintained existing work stations

AVAR, Project Manager/Lead Developer (1998-2014)

Responsibilities included directing the planning, design, production and management of applications and data centers; lead a development team in creating software applications to provide business solutions; acted as a point of contact for vendors, business units, and Information Technology partners during integration of projects, administering schedules and communicating risks; conducted meetings, helping to facilitate communication and maximize productivity; coordinated the work of multiple teams to support applications for data management systems; oversaw creation and maintenance of all unit and system testing plans; supervised the generation of documentation and technical guides for end users; prepared and deliver end-user training

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With Eurofins Lancaster Laboratories since 2014
Senior Specialist Group Leader, Environmental Software Development (2014)
Responsibilities include providing technical support for maintenance of installed software applications and assisting with the development, installation, and maintenance of new applications for general use; assisting in development, implementation, and maintenance of software intended to improve the quality and efficiency of work performed

Heidi L. Roberts, B.S., Senior Chemist, Organic Extraction

Education:
B.S. Environmental Science/Biology, Kutztown University (1996)

Continuing Education:
P.E. Spectroscopy Seminar, Perkin Elmer (1998)
Statistics, LLU (1999)
Pharm. Calc. Class, LLU (1999)
LLI Leadership Training (2000)
Practical Process Improvement Team Member Training (2008)
Practical Process Improvement Facilitator Training (2010)

Professional Experience:
M.J. Reider Associates, Lab Technician (1996-1997)
Responsibilities included organics prep/method development for HEM/various wet chemistry analyses.
With Lancaster Laboratories since 1997
Chemist, Metals (1998)
Responsibilities included performing metals analyses, maintenance of instruments, verification of analyses, analyzed GMP samples, administered quad studies, MDL studies, IDL studies.
Coordinator, Metals (1999)
Responsibilities included coordination of GFAA/FAA/Hg group, verification of analyses, instrument maintenance and operation, updating of SOPs, training records, quad studies, MDLs, and IDLs, performed GMP analyses.
Coordinator/Specialist, Environmental Client Services (2001)
Responsibilities included supervising Commercial Account Team and administrators, handle miscellaneous and homeowner calls, prepare bottle orders, audit sample paperwork, monitor sample progress, and handle client concerns.
Group Leader/Senior Specialist, Environmental Client Services (2005)
Responsibilities included supervising Account Management Team and administrator, work with team members on continual process improvement, manage several large client accounts, prepare bottle orders, audit sample paperwork, monitor sample progress, and handle client concerns.
Senior Chemist, Organic Extraction (2007)
Responsibilities include performing non-routine extractions, scheduling prep work, verification of prepped batches, processing MOS reports, managing projects for tobacco analyses, point person for project rollouts.

Awards, Citations, Honorary Societies, and Publications:
Senior Leadership Group Award, Lancaster Laboratories (2001, 2005, 2007)
Superlative Service Award, Lancaster Laboratories (2004, 2010)

Memberships and Appointments:
Ethics Committee, Lancaster Laboratories (1998)
MOS Process Improvement Team, Lancaster Laboratories (2005)

Nicholas R. Rossi, M.S., Senior Chemist, EPH/Misc. GC

Education:
B.S. Biology, Messiah College (2005)
M.S. Environmental Pollution Control, Penn State Harrisburg (2011)

Professional Experience:
Vermont Agency of Agriculture, Laboratory Technician/Sample Collector (2004-2005)
Responsibilities included collecting water samples from agricultural sites and extracting samples in the lab
With Eurofins Lancaster Laboratories since 2005
Chemist, GC/MS Volatiles (2005)
Responsibilities included organizing batches of samples, sample preparation, analyzing soil and water samples for volatile organic compounds using purge and trap GC-MS, instrument maintenance, and performing a level II audit on data prior to verification; processing plan improvement (PPI) team to reduce the amount of errors in the prescreen department; evaluating the process, implementing changes, and tracking results

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Chemist, EPH/Misc. GC (2011)

Responsibilities included analyzing routine and non-routine samples and their associated quality control samples by gas chromatography; reviewing and reporting the corresponding data; maintaining, optimizing, and calibrating equipment (functions are to be performed in an efficient manner with a high degree of accuracy and quality); assisting in organization of related departmental work and in sample preparation (as required) to consistently meet client turnaround time requirements

Senior Chemist, EPH/Misc. GC (2013)

Responsibilities include performing routine and non-routine instrumental analyses of QC and clients' samples for total petroleum hydrocarbons, diesel range organics, and other miscellaneous organic compounds in accordance with departmental methods and SOPs; assisting in implementing special client requests; identifying and offering solutions to correct instrument problems and causes for QC problems; reviewing data for accuracy and completeness for routine and non-routine analyses, reports, or data packages; serving as a technical resource for the department

Memberships and Appointments:

American Chemical Society (2010)
Pennsylvania Department of Environmental Professionals (2011)

Robin C. Runkle, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Chemistry, State University of New York at Oneonta (1988)

Continuing Education:

Introduction to Mass Spectral Interpretation, Finnigan Mat (1991)
Gas Chromatography: Practical Theory and Applications for LL (1993)
HP5890 GC Troubleshooting and Maintenance, Hewlett-Packard (1993)
Technical Training, OI Analytical (1995)

Professional Experience:

With Lancaster Laboratories since 1989

Senior Chemist (1993)

Responsibilities included: sample preparation; perform GC/MS volatile testing; operate GC/MS instruments; data interpretation; review and approve data; developing and evaluating new methods; calibrating and repairing instruments; prepare standards; reagent preparation; revise and update SOPs and analytical methods; order supplies; train other analysts; and prepare and test trip blank water.

Senior Specialist, GC/MS Volatiles (2005)

Responsibilities include: data review and verification, review and sign reports, respond to and work on client inquiries and ATF requests.

Stephanie A. Selis, B.S.E., Senior Chemist, GC/MS Volatiles

Education:

B.S.E. Biology, Chemistry Minor, Millersville University (1996)

Professional Experience:

Access I, Access II, PC Focus (1997)
Emergency Evacuation Coordinator (1998)
Gas Chromatography Principles and Practices, Lancaster Laboratories University (1998)
GC/MS Theories and Applications, MDL Systems (1999)
Statistics, Lancaster Laboratories University (2000)
Enlightened Leadership: Getting to the Heart of Change, Lancaster Laboratories University (2000)
Building Relationship Versatility: Social Styles at Work, Lancaster Laboratories University (2000)
Leadership at Lancaster Laboratories, Lancaster Laboratories University (2000)
Introduction to Interpretation of Mass Spectra, Lancaster Laboratories University (2005)

Professional Experience:

With Lancaster Laboratories since 1996

Chemist (1996)

Senior Chemist, Volatiles by GC (2000)

Responsibilities included performing sample analysis, troubleshooting, and maintenance; calibrating the system; establishing QC windows for soil analysis; writing SOPs; performing data entry; preparing standards; performing sample verification; training analysts

Senior Chemist, GC/MS Volatiles (2005)

Responsibilities include performing sample analysis; auditing maintenance notebooks; performing troubleshooting, maintenance, and system calibration; preparing standards; performing sample verification; training analysts

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Richard A. Shober, B.S., Principal Chemist, Pesticide Residue Analysis

Education:

B.S. Chemistry, Muhlenberg College (1984)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Allied Analytical (1985)
ACS Short Course, Analytical Chemistry of Contaminants in Surface and Groundwater (1986)
Gas Chromatography: Practical Theory & Application, Lancaster Laboratories (1994)
Mass Spectral Interpretation, Hewlett-Packard (1995)
Comprehensive HPLC, RESTEK (2010)

Professional Experience:

With Lancaster Laboratories since 1984
Principal Chemist, Pesticide Residue Analysis (1999)
Responsibilities include performing pesticide residue testing; operating gas chromatography instruments; interpreting data; repairing instruments; developing new methods for and operating LC/MS/MS; developing and maintaining computer systems/programs for lab use

Awards, Citations, Honorary Societies & Publications:

Poster paper on computer applications for analytical chemistry
Poster paper on tobacco specific nitrosamine analysis

Biographical Listings:

Who's Who in Environmental Science

Susan B. Shorter, B.S. CTFL, Principal Specialist, Environmental Software Development

Education:

B.S. Chemistry and Mathematics, Cedar Crest College (1986)
ISTQB Software Testing – Foundations Certification, Certificate #05-CTFL-00172-USA (2005)

Continuing Education:

Introduction to DOS, HACC-Lancaster Campus (09/18/1992)
How to Handle People with Tact and Skill, HACC (06/14/1993)
Challenges Facing Drinking Water Laboratories: ICR, Methods, Quality, and Certification, EPA and Western Michigan University (08/30-31/1994)
How to Evaluate Data from a QA/QC Perspective, EPA (07/07/1997)
Systematic Software Testing, Software Quality Engineering (June 2004)
Software Testing Foundations, Software Quality Engineering (May 2005)

Professional Experience:

With Eurofins Lancaster Laboratories since 1988
Associate Chemist (1988)
Responsibilities included setting up ICP, maintaining ICP, reviewing data from the instrument, reviewing daily oos sheets
Chemist I, Coordinator added 10/1991 (1990)
Responsibilities included setting up ICP, maintaining ICP, reviewing data from the instrument, reviewing daily oos sheets, plus verifying sample analyses, training new employees, maintaining instrumental SOPs
Specialist, Quality Assurance (1991)
Responsibilities included QA coordination for various environmental analytical departments, reviewing data packages, submitting blind and PT samples to ESD, maintaining state certifications, GLP, working with state, agency, and client auditors, technical resource for SDWA
Senior Specialist (previously known as Specialist II), Quality Assurance (1993)
Responsibilities included QA coordination for various environmental analytical departments, reviewing data packages, submitting blind and PT samples to ESD, maintaining state certifications, GLP, working with state, agency, and client auditors, technical resource for SDWA, document review, QAPP generation
Senior Chemist, GC/MS Volatiles (1999)
Responsibilities included auditing GC/MS volatile data, performing QA tasks (filing SOPs, maintaining training records, etc.), auditing MDLs and Quad studies
Senior Specialist, Computer Applications Development (2002)
Responsibilities included writing and executing Test Plans for software quality support; completing documentation as required by policies and procedures for software validation
Senior Specialist, Computer Systems (2007)
Responsibilities included writing and executing Test Plans for software quality support; completing documentation as required by policies and procedures for software validation
Principal Specialist, Environmental Software Development (2013)
Responsibilities include writing and executing Test Plans for software quality support; completing documentation as required by policies and procedures for software validation

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Memberships & Appointments:

Society of Applied Spectroscopy (1990-1993)
Pennsylvania Association Accredited Environmental Laboratories (PA AAEL) (1992-2004)
Director (1998-2003)
Secretary/Treasurer (1998-2003)

Jeffrey B. Smith, B.A., Senior Chemist Group Leader, Volatiles in Air

Education:

B.A. Biology, University of Delaware (1991)

Professional Experience:

Roy F. Weston, Inc., Chemist (1991-1997)
Merck, Chemist (1997-2000)
With Lancaster Laboratories since 2001
Senior Chemist, GC/MS Semivolatiles (2001)
Responsibilities included performing GC/MS analysis of semivolatile organics
Senior Chemist Group Leader, Volatiles in Air (2005)
Responsibilities include tracking of all incoming work and scheduling analysts; tracking all incoming summa orders and assigning to analyst; main CSR contact for group; instrument troubleshooting and maintenance; auditing and certifying data as needed

Michele J. Smith, B.S., Senior Specialist, Specialty Services Group

Education:

B.S. Chemistry, St. Mary's College, Notre Dame, Indiana (1998)
22 credits master's study with Penn State University (2000-2002)

Continuing Education:

Gas Chromatography Principles and Practices, Lancaster Laboratories University (1999)
Statistics, Lancaster Laboratories University (2000)

Professional Experience:

St. Mary's College, Laboratory Teaching Assistant (1996-1998)
Responsibilities included: assisted professor in the laboratory—responsible for experiment demonstrations, answered student's questions, and graded lab reports.
With Lancaster Laboratories since 1998
Chemist (1998)
Responsibilities included: maintain GC/MS instrumentation, tune and calibrate GC/MS, analyze samples by GC/MS, review and assemble all supporting GC/MS data, review daily QC outliers.
Senior Chemist (2001)
Responsibilities included: maintain GC/MS instrumentation, tune and calibrate GC/MS, analyze samples by GC/MS, review and assemble all supporting GC/MS data, perform technical audit of GC/MS and HPLC, sign analysis reports, track samples to meet turn around time.
Senior Chemist Coordinator (2004)
Responsibilities included: maintain GC/MS instrumentation, tune and calibrate GC/MS, analyze samples by GC/MS, review and assemble all supporting GC/MS data, perform technical audit of GC/MS and HPLC, sign analysis reports, track samples to meet turn around time.
Senior Specialist Group Leader, GC/MS Semivolatiles (2005)
Responsibilities included: review and assemble GC/MS data, perform technical audit of GC/MS and HPLC, sign analysis reports, schedule and track samples to meet turn around time.
Senior Specialist, Environmental Client Services (2008)
Responsibilities included auditing sample paperwork; setting up standard forms; generating bottle orders; preparing quotes
Senior Specialist, Specialty Services Group (2011)
Responsibilities include maintaining instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; diagnosing complex problems and offering solutions with a high degree of independence; suggesting and implementing improvements to maximize quality and productivity; acting as technical resource for internal problems and projects; assisting in "brainstorming" client problems and projects; training new employees in all aspects of instrumentation; researching new and emerging technologies

Memberships and Appointments:

American Chemical Society (1998-2002)

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Tara M. Spaide, Senior Specialist, Environmental Client Services

Continuing Education:

Algebra and Analytical Geometry, Pennsylvania State University (1993)
Chemistry, Pennsylvania State University (1993)

Professional Experience:

With Lancaster Laboratories since 1986
- Senior Specialist Coordinator, Organic Extraction (1997)
  - Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations; reviewing and approving data; and revising and updating analytical methods
- Senior Chemist Coordinator, Organic Extraction (2003)
  - Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations; reviewing and approving data; and revising and updating analytical methods
- Senior Chemist Group Leader, Organic Extraction (2005)
  - Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations; reviewing and approving data; and revising and updating analytical methods
- Senior Specialist, Environmental Client Services (2007)
  - Responsibilities include auditing sample paperwork; setting up standard forms; generating bottle orders; preparing quotes

Chelsea B. Stong, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Biology, Eastern University (2007)

Professional Experience:

With Lancaster Laboratories since 2006
- Laboratory Technician, GC/MS Volatiles (2006)
  - Responsibilities included scanning samples into LIMS; prepping samples for analysis
- Chemist, GC/MS Volatiles (2007)
  - Responsibilities included analyzing water and soil samples using a GC/MS; prepping samples for analysis; working up raw data
- Senior Chemist, GC/MS Volatiles (2012)
  - Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client an/or regulatory requirements; performing all duties with minimal supervision; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in “brainstorming” client problems and projects; completing assigned projects on time; researching new and emerging technologies; producing written and oral reports on research activities

Andrew J. Strebel, Principal Chemist, GC/MS Semivolatiles

Continuing Education:

Advanced Aquarius Programmers Course, Hewlett-Packard (1989)
Environmental Applications of GC/MS, Indiana University (1989)
Environmental GC-MS (DOS) Operation, Hewlett-Packard (1995)
Unix Module 1, Albright College (1995)
Unix Module 2, Albright College (1995)
Unix Shell Scripts, Albright College (1995)
Unix AWK Programming, Albright College (1995)
Target Training, Thru-Put Systems, Inc. (1995)
Report Writer Training, Thru-Put Systems, Inc. (1998)
HP-UX System Administration for HP 9000s, Hewlett Packard (1998)
HP-UX Troubleshooting for HP 9000s, Hewlett Packard (1998)
GC/MS Training Course, MDL Systems (1999)
LC/MS/MS 101 Training Course, Basic Mass Spec Solutions, Inc. (2001)

Professional Experience:

With Lancaster Laboratories since 1986
- Technical Specialist (1991)
- Chemist (1994)
- Senior Chemist (1997)
- Principal Chemist, GC/MS Semivolatiles (2001)
  - Responsibilities include: perform routine semivolatile testing; operate GC/MS semivolatile instruments; data interpretation; review and approve data; developing and evaluating new methods; calibrating and repairing instruments; prepare standards; revise and update SOPs and analytical methods; train other analysts; develop and maintain computer systems/programs for lab use; and computer validation testing.

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Robert Strocko, Jr., B.S., Manager, Metals and Microbiology

Education:

B.S. Biology, York College of Pennsylvania (1988)

Continuing Education:

Thermo Jarrel l ASA ICP Course, Thermo Jarrell ASA (1993)

Professional Experience:

Springettsbury Waste Water Treatment Facility, Chemistry Technician (1986-1988)

Responsibilities included running NPDES tests on wastewater, % solids, NH4, pH, BOD, suspended solids, coliform, dissolved solids, temperature, and Hexa-Chrome testing

Penn Dairies, Laboratory Technician (1988-1989)

Responsibilities included testing raw milk for coliform bacteria for acceptance; performing milk-fat percent solids on milk products; calculating sugar content in sweetened milk

Pennsylvania Department of Environmental Resources, Chemistry Technician (1989-1992)

Responsibilities included receiving samples; logging data for analysis to computer; handling field sampling questions; operating flame AA; shipping cooler to field samples

With Eurofins Lancaster Laboratories since 1992

Chemist, Metals (1992)

Responsibilities included setting up, pouring, and running samples on ICP; reviewing and verifying ICP data; performing instrument maintenance; calculating IDLs, MDLs, and linear ranges; writing SOPs

Chemist/Coordinator, Metals (1996)

Responsibilities included overseeing prep room personnel and work flow; scheduling work flow through prep room; writing job plans and job reviews; ordering standards and reagents; overchecking notebooks

Manager, Metals (1998)

Responsibilities include overseeing technical areas in ICP, low-level mercury, ICP-MS, and mercury; writing SOPs, ICARs, etc.; writing job plans and job reviews; handling technical questions for clients/client services; verifying ICP/ICP-MS/Hg data

Manager, Metals Analysis and Microbiology (2013)

Responsibilities included overseeing technical areas in ICP, low-level mercury, ICP-MS, and mercury; writing SOPs, ICARs, etc.; writing job plans and job reviews; handling technical questions for clients/client services; verifying ICP/ICP-MS/Hg data

Manager, Metals Analysis and Microbiology (2014)

Responsibilities include included overseeing technical areas in ICP, low-level mercury, ICP-MS, and mercury; writing SOPs, ICARs, etc.; writing job plans and job reviews; handling technical questions for clients/client services; verifying ICP/ICP-MS/Hg data; overseeing technical area in Microbiology; tests include Colilert (presence/absence), Colilert (Q-tray), Heterotrophic Plate Count (HPC), Fecal Coliform by Membrane Filtration, Yeast and Mold, Hydrocarbon degraders; overseeing writing of SOPs, responding to ICARs; writing job plans and job reviews; handling technical questions for clients/client services; verifying data

Christiane S. Sweigart, B.S., Senior Specialist, Environmental Quality Assurance

Education:

B.S. Science, Elizabethtown College (1985)

Medical/Technology Degree, St. Joseph School of Medical Technology (1985)

Continuing Education:

The Principals of Gas Chromatography (1993)

Statistics Course (1993)

Creative Training Techniques Conference (1997)

SEDD/ADR Implementation Workshop (2008)

ERPTOOLSX (Environmental Resources Planning Tools) (2010)

PPI (Practical Process Improvement) - Facilitator Training (2011)

Professional Experience:

With Eurofins Lancaster Laboratories since 1985

Chemist, GC/MS (1985)

Responsibilities included GC/MS operation targeting VOA and BNA compounds, instrument maintenance, sample handling, and data handling (interpretation and documentation)

Chemist, GC/VOA (1986)

Responsibilities included GC operation targeting both aromatic and halogenated compounds, FID operation, instrument maintenance, sample handling, and data handling (interpretation and documentation); training others on FID methods, development of training/reference manual for FID, development of internal Operating Manual, standard documentation, definition and maintenance of statistically defined windows, and temporary coordinator in Department 4025

Chemist Coordinator, GC/VOA (1993)

Responsibilities included coordination of sample analysis and data management; job plans and feedback for several personnel; communication both internal and external, and data handling (interpretation and documentation; and combination of existing department with another (personnel, instrumentation, and sample volume)

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Senior Specialist, Human Resources (1997)
Responsibilities included recruiting, training, and professional development
Senior Specialist, Electronic Data Deliverables (2001)
Responsibilities included EDD generation, EDD content review, and communication (internal and external)
Senior Specialist, Environmental Quality Assurance (2013)
Responsibilities include ensuring quality of operations and data being produced in the laboratories; ensuring laboratory adherence to government regulations and client requirements; independently performing complex work and special projects in addition to routine and non-routine duties

Awards, Citations, Honorary Societies & Publications:

Recognition for the implementation of a revamped New Hire Orientation (1999)
Recognition for the development and presentation of the Ethic's Refresher (2001)

Memberships & Appointments:

LCAHRM (1997-2001)

Lawrence M. Taylor, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Chemistry, Shippensburg University (1989)

Continuing Education:

QA Report Operator Training Course, Finnigan Mat Institute (1990)
Technical Training, OI Analytical (1995)
Mass Spectral Interpretation Course, Hewlett-Packard (1995)
Archon Training Course, PTS (1997)

Professional Experience:

With Lancaster Laboratories since 1989
Senior Chemist (1992)
Responsibilities included GC/MS volatile data interpretation; review and approve data; verify sample results, and sign reports.
Senior Specialist, GC/MS Volatiles (2005)
Responsibilities include GC/MS volatile data interpretation; review and approve data; verify sample results, and sign reports.

Valerie L. Tomayko, B.S., Principal Specialist, Pesticide Residue Analysis

Education:

A.S. Chemical Engineering Technology, Pennsylvania State University (1977)
B.S. Human Resource Management, Geneva College (1993)

Professional Experience:

Hercules Inc., Laboratory Technician (1977-1983)
Antech Ltd., Associate Chemist, (1985-1989)
Quanterra (formerly Wadsworth/Alert), Chemist, (1989-1997)
UEC (United States Steel Engineering Consultants), Chemist (1997)
With Lancaster Laboratories since 1997
Senior Chemist, Pesticide Residue Analysis (1997)
Responsibilities included: data interpretation; review and approve data; review data packages; and generate statistical QC limits for Pesticide Residue Analysis and Extractable Petroleum Hydrocarbons/MBC GC and Nitrosamines departments.
Senior Chemist Coordinator, Pesticide Residue Analysis (2001)
Responsibilities included: Monitor turnaround time and status of samples and packages; coordinate work flow; track employees' progress; assist in implementing procedures/protocols for meeting QA requirements, data package requirements, and special client or project-specific requests. In addition to data interpretation; review and approve data; review data packages; and generate statistical QC limits for Pesticide Residue Analysis and Extractable Petroleum Hydrocarbons/MBC GC and Nitrosamines departments.
Senior Specialist Group Leader, Pesticide Residue Analysis (2005)
Responsibilities included: Monitor turnaround time and status of samples and packages; coordinate work flow; track employees' progress; assist in implementing procedures/protocols for meeting QA requirements, data package requirements, and special client or project-specific requests. In addition to data interpretation; review and approve data; review data packages; and generate statistical QC limits for Pesticide Residue Analysis and Extractable Petroleum Hydrocarbons/MBC GC and Nitrosamines departments.
Senior Specialist Group Leader, Volatiles by GC (2006)
Responsibilities included: Monitor turnaround time and status of samples; coordinate work flow; track employees' progress; assist in implementing procedures/protocols for meeting QA requirements, data package requirements, and special client or project-specific requests. In addition to data interpretation; review and approve data; review data packages; and generate statistical QC limits for GC Volatile analysis.

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Principal Specialist, Pesticide Residue Analysis (2011)

Responsibilities include reviewing laboratory data for technical compliance to methods, SOPs, client protocols, and regulatory agency requirements; overchecking and verifying data from the analysts performing instrumental analyses, including QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds; reviewing data for accuracy and completeness (for routine and non-routine analyses, analytical reports, and/or data packages); assisting in implementing special client requests that impact data processing and reporting; identifying and offering solutions to correct problems related to data processing and reporting; serving as a technical resource for the department with regard to QA/QC procedures and issues

Luz C. Torres, B.S., Senior Specialist Group Leader, Data Deliverables

Education:

B.S. Secretarial Sciences, Catholic University of Puerto Rico (1982)

Continuing Education:

English as a Second Language, Spanish American Civic Association (1988)
Computer Literacy, Spanish American Civic Association (1989)

Professional Experience:

Dr. Jose Moro, Pediatrician, Administrative Secretary (1976-1986)

Responsibilities included customer service, answering phone, collecting payment, billing medical insurance, dictation, transcription, writing letters, filing, archiving, account receivables, ordering supplies.

With Lancaster Laboratories since 1988

Laboratory Assistant, Water Quality (1988)

Responsibilities included washing glassware, assisting technical staff by performing Odor and TDS analyses.

Clerk II, Data Deliverables (1991)

Responsibilities included data package assembly, tracking/preparing/sending QC summary reports, processing and sending data packages, generating and sending Lotus Text file disks, and DP content review.

Administrator I, II, III, Data Deliverables (1992)

Responsibilities included DP assembly, DP content review, review of analytical data, DP processing and sending, training new hires and current staff learning new tasks, DP corrections follow up.

Specialist Coordinator, Data Deliverables (1996)

Responsibilities included technical data review, package correction and problems investigation, Package TAT monitoring, oversee data package assembly, content review, and data package processing, documentation of departmental procedures, maintenance of database, interviewing, supervision of personnel

Senior Specialist Coordinator, Data Deliverables (2003)

Responsibilities included QA review, interviewing, supervision of personnel including writing job plan and performance evaluation, package correction and problems investigation, package TAT monitoring, documentation of departmental procedures, training new hires and cross-training employee from other areas, maintenance of method summary database, oversee data package assembly, content review, and data package processing.

Senior Specialist Group Leader, Data Deliverables (2005)

Responsibilities include QA review, interviewing, supervision of personnel including writing job plan and performance evaluation, package correction and problems investigation, package TAT monitoring, documentation of departmental procedures, training new hires and cross-training employee from other areas, maintenance of method summary database, oversee data package review and data package processing.

Timothy J. Trees, A.A.S., Principal Chemist, Specialty Services Group

Education:

Certificate, N.Y.S. Water/Wastewater Treatment Operations, Columbia Greene Community College (1985)
A.A.S. Environmental Control of Hazardous Waste/Water Quality, Ulster County Community College (1988)

Continuing Education:

Water Treatment Operations, NYS License Board (1984)
Wastewater Treatment Operations, NYS License Board (1986)
Varian AA Course (1992)
Service Operations Process Optimization, Pennsylvania State University (1992)
Hitachi GFAA Workshop, Hitachi, CT (1994)
24-hour HAZWOPER (spill response) (1995)
Atomic Spectroscopy Workshop, Perkin-Elmer (1997)

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Professional Experience:

York Wastewater Management (1985-1986)
Rider Engineering (1986-1988)
With Eurofins Lancaster Laboratories since 1988

Senior Technician, Metals (1988)
Responsibilities included: operation, maintenance, and sample preparation of mercury cold vapor and hydride generation instrumentation for the determination of mercury, arsenic, and selenium; data entry; troubleshooting instruments; repair of instrumentations' electronic system.

Chemist I, Metals (1990)
Responsibilities included: operation and maintenance of graphite furnace instrumentation; verification of mercury cold vapor and hydride generation data; coaching and training of personnel in the operation of mercury and hydride instrumentation; troubleshooting and repair of instrumentations' mechanical and electronic system.

Chemist I/Coordinator, Metals (1992)
Responsibilities included: operation and maintenance of graphite furnace instrumentation; ICP operation; verification of mercury cold vapor and hydride generation data; coaching and training of personnel in the operation of mercury, hydride, and graphite furnace instrumentation; troubleshooting and repair of instrumentations' mechanical and electronic system; systems operation optimization to increase production; scheduling of personnel for department operation; job plan and review with employees.

Chemist II/Coordinator, Metals (1993)
Responsibilities included: coaching and training of personnel in the operation of mercury, hydride, and graphite furnace instrumentation; assist clients with data interpretation and process improvement; ICP operation; verification of graphite furnace, mercury cold vapor, and hydride generation data; data package review; troubleshooting and repair of instrumentations' mechanical and electronic systems; system operations optimization to increase production; scheduling of personnel for department operation; job plan and review with employees.

Senior Chemist/Coordinator, Metals (1994)
Responsibilities included: operation, maintenance, repair, and troubleshooting of department graphite furnaces; flame atomic absorption, mercury cold vapor, hydride generation, and Inductively Coupled Plasma Instrumentation as well as computer systems used in the operation with these instruments; data qualification, interpretation, and verification of department workload; assist clients with interpretation of data, cause and effect; coaching and training of department personnel in areas of sample preparation, instrument setup, maintenance, and analysis using these instruments; job plan, review, and evaluation with employees; ordering of supplies; maintained operation of Metals Atomic Absorption for the department; method development for both environmental and pharmaceutical divisions for graphite furnace and ICP work; Set up and maintain, all SOPs and documentation for computer systems and instrumentation to comply with GMP regulations; data package review for metals analysis; review and verification of ICP data as needed.

Principal Chemist/Coordinator, Metals (1996)
Responsibilities included: operation, maintenance, repair, and troubleshooting of department graphite furnaces; flame atomic absorption, mercury cold vapor, hydride generation, and Inductively Coupled Plasma Instrumentation as well as computer systems used in the operation with these instruments; data qualification, interpretation, and verification of department workload; assist clients with interpretation of data, cause and effect; coaching and training of department personnel in areas of sample preparation, instrument setup, maintenance, and analysis using these instruments; job plan, review, and evaluation with employees; ordering of supplies; maintained operation of Metals Atomic Absorption for the department; method development for both environmental and pharmaceutical divisions for graphite furnace and ICP work; Set up and maintain, all SOPs and documentation for computer systems and instrumentation to comply with GMP regulations; data package review for metals analysis; review and verification of ICP data as needed.

Senior Chemist, GC/MS Semivolatiles (1998)
Responsibilities included: operation, maintenance, and troubleshooting of GC/MS instrumentation; HP5890, 6890 GC, 5971, 5972, 5973 Mass Spec; review and data interpretation of various analyses including but not limited to, 8270C, Appendix IX, 625, CLP 3/90, and 2/88; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures.

Principal Chemist, GC/MS Semivolatiles (2001)
Responsibilities included: operation, maintenance, and troubleshooting of GC/MS instrumentation; HP5890, 6890 GC, 5971,5972, 5973 Mass Spec; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including but not limited to 8270C, Appendix IX, 625, CLP 3/90 and 2/88; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; analysis and troubleshooting of HPLC and analysis of PAHs; coaching and training of analysts to assist with troubleshooting; working in Pharmaceutical Method Development and Validation, operating LC/MS, LC/MS/MS, and GC/MS instrumentation, and performing instrument qualifications since June 2003

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Principal Chemist, Flexible Staffing (2006)

Responsibilities included working in GC/MS Volatiles in Air department; operation, maintenance, and troubleshooting GC/MS instrumentation; HP5890, 6890 GC, 5971, 5972, 5973 Mass Spec; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including but not limited to TO-15 and TO-14; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; ability to operate a variety of instrumentation and data systems

Principal Chemist, GC/MS Semivolatiles (2007)

Responsibilities included operating, performing maintenance on, and troubleshooting GC/MS instrumentation; HP5890, 6890 GC, 5971,5972, 5973, 5975 Mass Spec; setting up and performing method development of Thermo Fisher TRACE GC and DSQ II MS; performing method development using both EI and CI mode of analysis; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including, but not limited to, 8270C, Appendix IX, 625, CLP 3/90 and 2/88; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; analysis and troubleshooting of HPLC and analysis of PAHs; coaching and training of analysts to assist with troubleshooting; Including working in GC/MS Volatiles in Air department; operation, maintenance, and troubleshooting GC/MS instrumentation; HP5890, 6890 GC, 5971, 5972, 5973 Mass Spec; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including but not limited to TO-15 and TO-14; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; ability to operate a variety of instrumentation and data systems

Principal Chemist, Specialty Services Group (2011)

Responsibilities include acting as technical resource within the environmental division; developing and validating analytical protocols; troubleshooting and solving analytical chemistry problems; optimizing instrument configuration and performance; evaluating and interpreting analytical results; writing SOPs; assisting in responding to and eliminating ICARs, assisting in optimizing procedures in prep lab; communicating effectively within department; performing routine work as required. Maintain and operation of Thermo Fisher Scientific TSQ Quantum XLS MS/MS as well as TSQ8000 MS/MS with a Trace 1310 GC; developing methods utilizing GC triple Quad technology in a variety of matrices; utilizing various extraction technologies such as QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) to effectively extract and cleanup sample matrices

Holly L. Trego, M.S., Manager, Computer Applications Development

Education:

B.S. Computer Science, Millersville University (1998)

M.S. Computer Science, Pennsylvania State University (2004)

Professional Experience:

Millersville University (1994-1998)

Computer Programmer

Responsibilities included organizing meetings with staff of Academic Advising and students; maintained statistics on students grades in the Undeclared program using SAS; created reports in Cobol to report on the statistics; organized summer orientation for the Undeclared program.

Internet Programmer

Responsibilities included creating and maintaining various interactive web pages to allow students to view information; developed web site for students to vote on what classes departments should offer.

With Lancaster Laboratories since 1996

Senior Specialist, Computer Applications Development (1996)

Responsibilities included write Visual Basic code to general client reports; design Powerbuilder System with customized macros which processes analytical data; develop data acquisition software with SQL*Loader.

Senior Specialist/Group Leader, Computer Applications Development (2005)

Responsibilities included managing environmental application development projects, maintenance of existing applications.

Manager, Computer Applications Development (2007)

Responsibilities include managing environmental application development projects, maintenance of existing applications.

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Dennis Urban, M.S., Principal Specialist, Training

Education:

B.A. Chemistry, Millersville University (1972)
M.S. Chemistry, St. Joseph's University (1976)
M.S. Applied Statistics, Villanova University (1998)

Continuing Education:

Waters HPLC Training Course, Techniques, Instrument Maintenance, and Service, Waters Associates (1979)
Technicon Autoanalyzer Techniques, Technicon (1982)
Fundamentals of Gas Chromatography, Perkin-Elmer Corporation
FTIR Spectrometry, Theory, Techniques, and Application, Analect Instruments (1983)
FTIR Spectrometry, Pittsburgh Conference (1985)
Infrared Spectroscopy II: Instrumentation, Polymer Spectra, Sample Handling, and Computer Assisted Spectroscopy, Bowdoin College (1985)
Infrared Spectroscopy I: Interpretation of Spectra, Bowdoin College (1986)
Theoretical and Applied Statistics, RCA (1987)
Purge and Trap Training Course: Theory, Operation, and Maintenance, Tekmar Company (1990)
Chemometrics for Chemists, Spectros Associates (1993)
Statistically Sound Procedures for Calculating MDLs and PQLs from Calibration Data, Pittsburgh Conference (1995)
Design and Analysis of Experiments, Institute for Professional Education (1996)
Experimental Design for Productivity & Quality in R & D, ACS Shore Course (1998)

Professional Experience:

RCA, Chemistry and Physics Laboratory, Associate Engineering Technician (1972-1977)
Wyeth Labs, Analytical Quality Control Laboratory, Control Analyst (1977-1979)
Responsibilities included performing the necessary chemical and physical testing of all raw materials used in the manufacturing facility; techniques used were GC, IR, UV/VIS, AA, and wet chemical methods
Wyeth Labs, Drug in Feed Group, Chemist (1979-1980)
Responsibilities included developing and validating HPLC methods for analyzing the drug content in various animal feed matrices used in toxicology studies; conducted stability studies of drug in feed mixtures
RCA, Member, Technical Staff (1980-1987)
Responsibilities included method development and analytical support and troubleshooting to the manufacturing particle size analysis, and classical wet chemical methods
With Eurofins Lancaster Laboratories since 1987
Principal Chemist (1997)
Responsibilities included methods development and validation; instrument maintenance, troubleshooting and repair; and analyst training
Principal Specialist, Training (2000)
Responsibilities include developing, designing, and presenting in-house technical training programs, consulting with laboratory personnel and management on the proper use of appropriate statistical procedures and in the interpretation of statistical results

Memberships & Appointments:

American Chemical Society
American Statistical Association

Nicole M. Veety, B.S., Senior Chemist Group Leader, Instrumental Water Quality

Education:

AA Psychology, Harrisburg Area Community College (1997)
B.S. Psychobiology, Lebanon Valley College (2000)

Professional Experience:

With Eurofins Lancaster Laboratories since 2000
Senior Technician, Instrumental Water Quality (2000)
Responsibilities included various prep analyses, data entry, TOC and TOX analyses.
Chemist, Instrumental Water Quality (2003)
Responsibilities included performing various analyses, verification, and review and revise SOPs.
Senior Chemist, Instrumental Water Quality (2006)
Responsibilities include performing various analyses, method development, verification, and review and revise SOPs.
Senior Chemist Group Leader, Instrumental Water Quality (2009)
Responsibilities include performing various analyses, method development, verification, and review and revise SOPs; acting as a technical resource, trainer, and troubleshooter; making recommendations for operational and/or technical improvements; coaching and developing direct reports; planning and monitoring workflow.

Awards, Citations, Honorary Societies, and Publications:

Phi Theta Kappa National Honor Society (Alpha Nu Omega) (1996-2000)

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Robert Todd Vincent, B.S., Principal Chemist, Organic Extraction

Education:

B.S. Chemistry, West Virginia Wesleyan College (2001)

Professional Experience:

With Lancaster Laboratories since 2001

Chemist, EPH/Misc. GC (2001)

Responsibilities included analyzing samples; performing equipment repair; GC method development

Chemist, Organic Extraction (2005)

Responsibilities included performing method development; equipment repair

Senior Chemist, Organic Extraction (2007)

Responsibilities included performing method development; equipment repair; vendor relations; technology evaluation

Principal Chemist, Organic Extraction (2011)

Responsibilities include performing high level, difficult preps (with minimal supervision or guidance) following standard operating procedures (SOPs); self train in new techniques; entering information into computer; training new or existing employees in extraction techniques or use of equipment; using knowledge to actively improve current processes; developing, enhancing, and validating new extraction methods; keeping work area clean and organized; preparing spikes; repairing equipment; updating departmental SOPs and training manual; disposing of wastes in approved manner; assisting in incident prevention and remediation when necessary

Harry D. Ward, Ph.D., Principal Specialist Group Leader, Training

Education:

B.S. Chemistry, Muhlenberg College (1980)

Ph.D. Organic Chemistry, University of Delaware (1985)

Professional Experience:

Armstrong World Industries, Inc., Research Scientist (1985-2003)

Responsibilities included performing research and development related to flooring

With Eurofins Lancaster Laboratories since 2003

Senior Chemist, Pharmaceutical Product Testing (2003)

Responsibilities included performing pharmaceutical product testing

Senior Chemist, Method Development & Validation (2005)

Responsibilities included performing pharmaceutical method development and validation

Senior Training Specialist, Human Resources (2006)

Responsibilities included design and delivery of core and elective technical training

Principal Training Specialist, Human Resources (2008)

Responsibilities included design and delivery of core and elective technical training

Principal Specialist Group Leader, Training (2011)

Responsibilities include managing the resources of the technical training group; designing and delivering core and elective technical training

Barbara J. Weaver, M.S., CIH, Principal Specialist, Training and Development, Human Resources

Education:

B.S. Chemistry, Elizabethtown College (1971)

M.S. Analytical Chemistry, Illinois Institute of Technology (2001)

Certifications:

CIH - American Board of Industrial Hygiene - Certified in the comprehensive practice of industrial hygiene (1983), Certification #2719

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Continuing Education:

Business Law, Elizabethtown College (1979)
NIOSH Course #553 "Industrial Hygiene Sampling, Decision Making, Monitoring and Record Keeping, Sampling Strategies" (1979)
Industrial Toxicology, 5-Day Workshop, Thomas Jefferson University (1980)
Special Topics: Environmental Analytical Chemistry, Graduate Work, Villanova University (1981)
"Comprehensive Industrial Hygiene Review", University of Cincinnati, NIOSH Education Resource Center (1983)
Environmental Health, Graduate Work, West Chester University (1985)
Chemical Hygiene - The OSHA Laboratory Standard, NEAIHA PDC (1990)
Health and Safety Management for Hazardous Waste Professionals, AIHA PDC #11 (1990)
Financial Accounting, Penn State (1990)
NIOSH Course #582 "Sample and Analysis of Airborne Asbestos Dust", NIOSH Education Resource Center, Cincinnati (1992)
Survey of Management, Penn State University (1993)
Laboratory Safety and Health, American Chemical Society (1994)
24-hour HAZWOPER (spill response) and Refreshers (1995-present)
Health, Safety, and Environmental Auditing, Johns Hopkins (1995)
Managing Ionizing Radiation Programs for Industrial Hygienists, AIHA (1996)
Radiation Safety Officer Training, Radiation Safety Associates, MA (1997)
Presenting Data and Information, Edward R. Tufte, Graphic Press LLC (2005)
IATA/FIATA Dangerous Goods, IATA (2007)
GC/MS Training Seminar, Restek (2008)
IATA Dangerous Goods Refresher Training, DGI (2009)
Exposure Assessment Strategies and Statistics, 4.6 CEUs, AIHA (2009)
Practical Process Improvement, Training in the Role of Facilitator (2010)
DOT (49CFR) Shipper Course, DGI (2011)
8-hr HAZWOPER refresher (2011)
IATA Acceptance Training, all inclusive (2011)

Professional Experience:

Warner Lambert, Inc., Quality Control Chemist (1970-1973)
Responsibilities included performing USP/NF and client-specific raw materials and product testing; conducting specific project assignments such as documentation of product-specific alcohol denaturing at supplier's site; pre-market new product quality control testing; serving on panels for testing fragrance and color

Hershey Medical Center, Junior Research Technician (1973-1974)
Responsibilities included developing rubidium-crystal FID-GC (nitrogen sensitive) methods for the low level detection of barbiturates in solution and in blood extracts; performing analysis of blood and spiked blood from rat and monkey; performing analysis of a specific liver enzyme; using preparative fix-angle ultracentrifuge in sample preparation; developing electron microscopy photographs for liver cell mitochondria study

Elizabethtown College, Laboratory Instructor (1977-1978)
Responsibilities included preparing materials for freshman chemistry laboratories; providing basic laboratory instruction for freshmen; conducting research on the separation of linoleic and linolenic acids (omega-3 and omega-6 fatty acids in olive oil) using spinning band distillation; testing flame-retardant cellulose insulation to determine the flame-retardant formulation for industrial client

With Lancaster Laboratories since 1978

Chemist, Air Quality/Industrial Hygiene (1978)
Responsibilities included performing air and miscellaneous chemical analysis using gas chromatography, colorimetric analysis, UV-Vis, spectrophotometry, fiber-counting using phase contrast microscopy, and infrared analysis

Program Manager, Air Quality/Industrial Hygiene (1978)
Responsibilities for the Air Quality and Miscellaneous Chemistry Group included conducting NIOSH, OSHA, and EPA air sampling and analysis; industrial hygiene (air quality and employee exposure in the workplace) consulting services; responsibilities for laboratory work included method development for analysis of pharmaceutical active compounds in air; method development for the FID-GC analysis of cholesterol and fatty acid profiles; infra-red and gas chromatography methods; forensic sample analysis and expert witness testimony; USP/NF testing, some ASTM testing, analytical microscopy using phase contrast, fluorescence and light microscopy; preparing and/or submitting PAT and QA test samples and blanks for analysis; business development, technical writing, proposal, pricing and quote development, and client services for QA/IH; managing the industrial hygiene field sampling/consultation and industrial hygiene/miscellaneous chemistry (client special projects) lab group; maintaining DEA registration; serving as laboratory director for the AIHA analytical laboratory certification for more than 10 years

Marketing and Technical Services Specialist, Business Development (1987)
Responsibilities included inside and external business development including client visits and trade shows; serving as client services/account representative for air quality, foods, and pharmaceutical sciences; creating and tracking quotes and responses to requests for bids and proposals; continued to serve as laboratory director for the AIHA analytical laboratory certification

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Principal Specialist reporting to Vice President, Environmental and Pharmaceutical Sciences (1987)
Responsibilities included technical writing, special projects, and performing Graphite Furnace Atomic Absorption for Pb and Cu in water; pesticides data entry verification; coordinating, developing, and providing technical and EHS training; providing technical support to the EHS staff; serving as interim EHS officer and the EHS liaison with our parent company; serving as Lancaster Radiation Safety Officer during the period in which Lancaster held a site NRC license; serving as a permanent member of the safety committee representing EHS training
Principal Specialist, Training & Development, Human Resources (1991)
Responsibilities include coordinating, developing, and providing technical training and environmental health and safety (EHS) training; soliciting and managing grants for training programs; providing coordination for the external and continuing education programs; providing technical support for the EHS staff and continuing to represent EHS training on the safety committee

Awards, Citations, Honorary Societies & Publications:

1 publication on microscopy
1 publication on NMR and Copper-histidine
Book Review - Review of *Guidelines for Laboratory Design: Health and Safety Aspect,* ***The Synergist*** March 2002
Acknowledged in two EPA publications: Pb-Based Paint Laboratory Operations Guidelines: Analysis of Pb in Paint, Dust and Soil (EPA 747-R-92-006 May 1993) and Environmental Management Guide for Small Laboratories (EPA 233-B-98-001 July 1998)
Biographical Listings: *Who's Who in the East*, under Barbara J. Felty; *Who's Who in the Safety Profession*

Memberships and Appointments:

American Board of Industrial Hygiene (1984-present)
American Industrial Hygiene Association (AIHA) (1980-present)
Sampling and Laboratory Analysis Committee (2001-present)
Communication and Training Methods Committee (2006-present)
AIHA - Central Pennsylvania Section, Charter Member (1981-present)
Treasurer (1981-1984, 2008-present), President-elect (1985-1986, 2002-2005), President (1986-1987, 2005-2006), Secretary (2007-2008), Membership Director (1988-1993), Director (2000-2002)
American Chemical Society (1985-present)
Chemical Health and Safety Section, Membership Committee (1992-1993)
Lancaster County Industrial Safety Council (Director 1988-1990)
Leadership Lancaster (1995)
Mentor (1999-2002), Marketing Committee (1999-2000)
Johns Hopkins NIOSH Education Resource Center Continuing Education Advisory Committee (1996-2006)
Penn State University–Lancaster Center Advisory Committee (2002–2006)
Chromatography Forum, Delaware Valley (2002-present/lifetime member)

Timothy S. Weaver, B.A., Senior Specialist, Environmental Software Development

Education:

B.A. Mathematics, Franklin & Marshall College (1996)

Professional Experience:

With Eurofins Lancaster Laboratories since 1996
Computer Specialist, Volatiles by GC (1996)
Responsibilities included programming, maintenance, and updates
Computer Specialist, Environmental Sciences (1997)
Responsibilities included disk format programming initially, followed by pesticides system and database maintenance and programming
Specialist, Computer Applications Development (2002)
Responsibilities included pesticides system and database maintenance and programming; invoice print server maintenance; LLENS program administration
Senior Specialist, Environmental Software Development (2008)
Responsibilities include pesticides system and database maintenance and programming; invoice print server maintenance; LLENS program administration

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Heather E. Williams, B.S., Senior Chemist, EPH/Miscellaneous GC

Education:

B.S. Forensic and Investigative Science, West Virginia University (2004)

Continuing Education:

Principles of Gas Chromatography, LLU (2007)

Professional Experience:

With Lancaster Laboratories since 2006

Chemist, EPH/Miscellaneous GC (2006)

Responsibilities included analyzing routine samples and their associated QC by gas chromatography for extractable petroleum products such as DRO, TPH, and other related materials; reviewing, calculating, and reporting the corresponding data and results; maintaining, optimizing, and calibrating Gas Chromatographs in an efficient and accurate manner; assisting in organization of department work, track samples, and prepare samples and standards to consistently meet turn around time requirements

Senior Chemist, EPH/Miscellaneous GC (2008)

Responsibilities include analyzing routine samples and their associated QC by gas chromatography for extractable petroleum products such as DRO, TPH and other related materials; reviewing, interpreting, calculating, and reporting the corresponding data and results; maintaining, optimizing, and calibrating Gas Chromatographs in an efficient and accurate manner; assisting in organization of department work, tracking samples; preparing samples and standards to consistently meet turn around time requirements; verifying sample data; corresponding with client service representatives regarding client inquiries and providing answers and solutions when problems arise; SOP writing and revising as new methods are developed; assisting with new instrument installation and set-up; participating in practical process improvements as a member of a team

Bret M. Winey, B.S., Senior Specialist, Environmental Software Development

Education:

B.S. Computer Science, Millersville University (2005)

Professional Experience:

Penn State University, College of Medicine, Programmer/Analyst (2009-2011)

Responsibilities included developing systems responsible for collecting and analyzing medical research data

Weidenhammer Systems Corp., Programmer/Analyst (2011-2012)

Responsibilities included maintaining and implementing functionality on clients' websites, using specification gathered directly from the respective client

Donegal Mutual Insurance Company, Inc., Programmer (2012-2013)

Responsibilities included maintaining existing web presentation and provide aid during transition to new website design

With Eurofins Lancaster Laboratories since 2013

Senior Specialist, Environmental Software Development (2013)

Responsibilities include providing technical support for maintenance of installed software applications and assisting with the development, installation, and maintenance of new applications for general use; assisting in development, implementation, and maintenance of software intended to improve the quality and efficiency of work performed

Donald E. Wyand, B.S., Director, Environmental Business Development/Sales

Education:

B.S. Chemistry, Lebanon Valley College (1989)

Continuing Education:

Graduate Chemistry, Villanova University

Professional Experience:

With Lancaster Laboratories since 1989

Client Services Specialist (1990)

Business Development Specialist (1993)

Principal Specialist/Account Manager (1995)

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Principal Specialist/Sales (1998) Principal Specialist/Coordinator/Sales, Environmental Sciences (2001)

Responsibilities included: National Account Manager; project management; evaluating new methods; consult with clients regarding testing needs; develop long-term, mutually beneficial relationships with new and existing clients by maximizing our clients' efficiency and effectiveness in managing analytical projects; present relevant market information to senior management and technical operations staff to develop new services for our clients; organize and manage National Account teams; prepare, organize, and manage project planning for target accounts; present Lancaster Labs' capabilities through formal presentations, personal account visits, and marketing campaigns; develop and maintain marketing programs within assigned geographic territory; maintain and communicate knowledge of regulatory issues, analytical methodology, and industry requirements to new and existing clients; prepare proposals and quotations; advise clients on testing; communicate client requirements to lab areas; perform technical presentation to inform our clients of new environmental regulations; and lead client teams to offer analytical solutions to client problems.

Principal Specialist/Group Leader/Sales (2005)

Responsibilities included: National Account Manager; project management; evaluating new methods; consult with clients regarding testing needs; develop long-term, mutually beneficial relationships with new and existing clients by maximizing our clients' efficiency and effectiveness in managing analytical projects; present relevant market information to senior management and technical operations staff to develop new services for our clients; organize and manage National Account teams; prepare, organize, and manage project planning for target accounts; present Lancaster Labs' capabilities through formal presentations, personal account visits, and marketing campaigns; develop and maintain marketing programs within assigned geographic territory; maintain and communicate knowledge of regulatory issues, analytical methodology, and industry requirements to new and existing clients; prepare proposals and quotations; advise clients on testing; communicate client requirements to lab areas; perform technical presentation to inform our clients of new environmental regulations; and lead client teams to offer analytical solutions to client problems.

Director, Environmental Business Development/Sales (2006)

Responsibilities include: National Account Manager; project management; evaluating new methods; consult with clients regarding testing needs; develop long-term, mutually beneficial relationships with new and existing clients by maximizing our clients' efficiency and effectiveness in managing analytical projects; present relevant market information to senior management and technical operations staff to develop new services for our clients; organize and manage National Account teams; prepare, organize, and manage project planning for target accounts; present Lancaster Labs' capabilities through formal presentations, personal account visits, and marketing campaigns; develop and maintain marketing programs within assigned geographic territory; maintain and communicate knowledge of regulatory issues, analytical methodology, and industry requirements to new and existing clients; prepare proposals and quotations; advise clients on testing; communicate client requirements to lab areas; perform technical presentation to inform our clients of new environmental regulations; and lead client teams to offer analytical solutions to client problems.

Memberships & Appointments:

American Chemical Society
Society of American Military Engineers
Society of Environmental Toxicology and Chemistry

Meng Yu, M.S., Principal Chemist, Specialty Services Group

Education:

B.S. Chemical Engineering, Zhejiang University of Technology (1986)
Post Graduate, Biogeography and Environmental Assessment, University of Saarland (1995)
M.S. Chemistry, Catholic University of Leuven (1999)

Professional Experience:

Setsco Service Ltd, Executive Chemist (1999-2002)

Responsibilities performing EPA and USDA method development and validation for water, soil, food, and pharmaceutical materials using USP, BP, and AOAC methods; performing pesticide residue analysis using all kinds of GC

Cantest Ltd, Research Chemist (2002-2008)

Responsibilities included performing bioanalytical and food safety method development and validation; performing pesticide and drug residue method validation as per USDA, EPA, CFIA methods; UPLCMSMS, LCMSMS, LCMS and GCMS operation and maintenance

Pharmanet Inc. HSP Laboratory, Research Scientist (2008-2010)

Responsibilities included performing bioanalytical method development and validation for plasma, urine, tissue, etc.; performing LCMSMS operation, tuning, and maintenance

With Lancaster Laboratories since 2010

Principal Chemist, Specialty Services Group (2010)

Responsibilities include developing and validating new testing methods; operating and maintaining LCMSMS instruments; performing sample analyses

Memberships and Appointments:

ASMS (2010)

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Michael A. Ziegler, B.S., Senior Chemist, Volatiles in Air

Education:

B.S. Molecular Biology, Clarion University of PA (2002)

Professional Experience:

With Eurofins Lancaster Laboratories since 2006

Chemist, GC/MS Volatiles (2006)

Responsibilities included maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision

Chemist, Volatiles in Air (2010)

Responsibilities included maintaining GC and/or GC/MS instrumentation and calibrating GC and/or GC/MS instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality to meet client requirements; performing various Airlab duties associated with sample prep and sample flow (these include, but are not limited to, sample retrieval and entry, Nitrogen tank replacement, summa can cleaning, summa/FC requests, and sample pressurization/prescreen)

Senior Chemist, Volatiles in Air (2014)

Responsibilities include maintaining GC and/or GC/MS instrumentation and calibrating GC and/or GC/MS instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality to meet client requirements; performing various Airlab duties associated with sample prep and sample flow (these include, but are not limited to, sample retrieval and entry, Nitrogen tank replacement, summa can cleaning, summa/FC requests, and sample pressurization/prescreen)

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Eurofins Document Reference	1-P-QM-GDL-9015382	**Revision**	4
Effective Date	Aug 8, 2014	**Status**	Effective
Historical/Local Document Number	DOD - Environmental Quality Policy Manual Appendix E		
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Local Document Category	ES - Environmental Sciences		

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Reviewed and Approved by	Duane Luckenbill;Review;Tuesday, July 29, 2014 11:10:44 AM EDT Robert Strocko;Review;Wednesday, July 30, 2014 1:00:17 PM EDT Dorothy Love;Approval;Wednesday, July 30, 2014 2:21:13 PM EDT

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Document Title	Document ID	Historical Document ID	Document Owner
Level 1			
Organizational Charts Personnel to Sign Reports	1-P-QM-GDL-9015380	DOD - Environmental Quality Policy Manual Appendix C	4052 - Environmental Quality Assurance
Personnel Qualifications and Responsibilities	1-P-QM-GDL-9015381	DOD - Environmental Quality Policy Manual Appendix D	4052 - Environmental Quality Assurance
SOPs and Analytical Methods	1-P-QM-GDL-9015382	DOD - Environmental Quality Policy Manual Appendix E	4052 - Environmental Quality Assurance
Instrument and Equipment List	1-P-QM-GDL-9015383	DOD - Environmental Quality Policy Manual Appendix F	4052 - Environmental Quality Assurance
Preventative Maintenance Schedules	1-P-QM-GDL-9015384	DOD - Environmental Quality Policy Manual Appendix G	4052 - Environmental Quality Assurance
Calibration Schedules	1-P-QM-GDL-9015385	DOD - Environmental Quality Policy Manual Appendix H	4052 - Environmental Quality Assurance
NELAP Scope of Testing	1-P-QM-GDL-9015386	DOD - Environmental Quality Policy Manual Appendix I	4052 - Environmental Quality Assurance
Quality Control Types, Frequency, and Corrective Action	1-P-QM-GDL-9015387	DOD - Environmental Quality Policy Manual Appendix J	4052 - Environmental Quality Assurance
Microbiological Testing	1-P-QM-GDL-9015388	DOD - Environmental Quality Policy Manual Appendix K	4052 - Environmental Quality Assurance
Manual Integration	1-P-QM-GDL-9017675	Policy 0001	4052 - Environmental Quality Assurance
Laboratory Ethics and Data Integrity Policy	1-P-QM-GDL-9017679	Policy 0007	4052 - Environmental Quality Assurance
Chemical Hygiene Plan	1-P-QM-GDL-9015198	Chemical Hygiene Plan	6098 - Safety
Preparedness, Prevention, and Contingency Plan	1-P-QM-GDL-9017681	Policy 0010	6098 - Safety
Exposure Control Plan for Bloodborne Pathogens	1-P-QM-GDL-9017682	Policy 0011	6098 - Safety
Level 2			
Balance, Syringe, Pipette Verification	1-P-QM-QMA-9015389	DOD - LOM-SOP-ES-235	4052 - Environmental Quality Assurance
Bay Area Service Center Dangerous Goods Shipping Procedure	1-P-QM-QMA-9017337	LOM-SOP-ES-237	50 - Bay Area Service Center
Change Control Procedures for ELLE	1-P-QM-QMA-9028515	N/A	4052 - Environmental Quality Assurance
Chromatography Integration and Documentation	1-P-QM-QMA-9017333	LOM-SOP-ES-232	4052 - Environmental Quality Assurance
Chromatography Integration and Documentation for OH VAP	1-P-QM-QMA-9022815	LOM-SOP-ES-232 (OH VAP)	4052 - Environmental Quality Assurance
Communicating Maximum Contaminant Level (MCL) Exceedances	1-P-QM-QMA-9017330	LOM-SOP-ES-227	4039 - Environmental Client Services and Inside Business Development
Compliance with Environmental GLP Regulations	1-P-QM-QMA-9022322	LOM-SOP-LAB-204 and LOM-SOP-LAB-224	4052 - Environmental Quality Assurance
Data Entry, Verification and Reporting	1-P-QM-QMA-9017322	LOM-SOP-ES-218	4052 - Environmental Quality Assurance

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Document Title	Document ID	Historical Document ID	Document Owner
Level 2 (continued)			
Demonstrations of Capability	1-P-QM-QMA-9015390	DOD - LOM-SOP-ES-238	4052 - Environmental Quality Assurance
Determining Method Detection Limits and Limits of Quantitation	1-P-QM-QMA-9017309	LOM-SOP-ES-203	4052 - Environmental Quality Assurance
Documentation for the Parallax Analysis Definition Function	1-P-QM-QMA-9017323	LOM-SOP-ES-219	4052 - Environmental Quality Assurance
Environmental Project Cycle	1-P-QM-QMA-9017338	LOM-SOP-ES-239	4052 - Environmental Quality Assurance
Establishing Control Limits	1-P-QM-QMA-9017313	LOM-SOP-ES-207	4052 - Environmental Quality Assurance
Forensic Laboratory Services	1-P-QM-QMA-9017307	LOM-SOP-ES-201	4052 - Environmental Quality Assurance
Guidelines for Analytical Decision Making in Environmental Testing	1-P-QM-QMA-9021833	LOM-SOP-LAB-226	4052 - Environmental Quality Assurance
Guidelines for Writing Technical Reports	1-P-QM-QMA-9017308	LOM-SOP-ES-202	4052 - Environmental Quality Assurance
Handling of Client Technical Complaints (Investigations and Response)	1-P-QM-QMA-9017332	LOM-SOP-ES-231	4052 - Environmental Quality Assurance
HP-UX Target 3.5 Data System Accounts and Electronic Signature Security	1-P-QM-QMA-9017336	LOM-SOP-ES-236	4052 - Environmental Quality Assurance
Instrument and Equipment Maintenance and Calibration	1-P-QM-QMA-9017325	LOM-SOP-ES-222	4052 - Environmental Quality Assurance
Investigation and Corrective Action of Noncompliant Data	1-P-QM-QMA-9017315	LOM-SOP-ES-209	4052 - Environmental Quality Assurance
Investigation and Corrective Action Reporting for Laboratory Problems	1-P-QM-QMA-9017331	LOM-SOP-ES-230	4052 - Environmental Quality Assurance
Laboratory Notebooks, Logbooks, and Documentation for Environmental Testing	1-P-QM-QMA-9021767	LOM-SOP-LAB-220	4052 - Environmental Quality Assurance
Laboratory Sample Analysis Record (LSAR) Documentation	1-P-QM-QMA-9017318	LOM-SOP-ES-212	4052 - Environmental Quality Assurance
Legal Chain-of-Custody Documentation	1-P-QM-QMA-9017335	LOM-SOP-ES-234	4052 - Environmental Quality Assurance
Missed Holding Time Reports	1-P-QM-QMA-9017326	LOM-SOP-ES-223	4052 - Environmental Quality Assurance
Monitoring of the Volatile Organics Analysis (VOA) Storage Areas for Contamination	1-P-QM-QMA-9017311	LOM-SOP-ES-205	4052 - Environmental Quality Assurance
Monitoring Temperatures in Refrigerators, Freezers, Incubators, and Ovens Using the Andover System	1-P-QM-QMA-9017316	LOM-SOP-ES-210	4052 - Environmental Quality Assurance
Monitoring Temperatures in Refrigerators, Freezers, Incubators, and Ovens Using the ETM	1-P-QM-QMA-9021509	N/A	4052 - Environmental Quality Assurance
Obtaining a Representative Environmental Solid Sample Aliquot	1-P-QM-QMA-9017334	LOM-SOP-ES-233	4052 - Environmental Quality Assurance
Procurement of Environmental Laboratory Supplies	1-P-QM-QMA-9021705	LOM-SOP-LAB-218	4052 - Environmental Quality Assurance
Proficiency Test Samples	1-P-QM-QMA-9017321	LOM-SOP-ES-216	4052 - Environmental Quality Assurance
Quarantine Soils Procedures	1-P-QM-QMA-9017317	LOM-SOP-ES-211	4052 - Environmental Quality Assurance
Reagents and Standards	1-P-QM-QMA-9017328	LOM-SOP-ES-225	4052 - Environmental Quality Assurance

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Document Title	Document ID	Historical Document ID	Department Owner
Level 2 (continued)			
Sample Requisition	1-P-QM-QMA-9017312	LOM-SOP-ES-206	4052 - Environmental Quality Assurance
Subcontracting Analytical Testing	1-P-QM-QMA-9017310	LOM-SOP-ES-204	4052 - Environmental Quality Assurance
Thermometer Use and Calibration	1-P-QM-QMA-9017314	LOM-SOP-ES-208	4052 - Environmental Quality Assurance
Validation and Authorization of Analytical Methods	1-P-QM-QMA-9017329	LOM-SOP-ES-226	4052 - Environmental Quality Assurance
Automated External Defibrillator (AED) Program	1-P-QM-QMA-9017350	LOM-SOP-HS-215	6098 - Safety
Biosafety Manual	1-P-QM-QMA-9024252	N/A	6098 - Safety
Disposal of Regulated Medical Waste	1-P-QM-QMA-9017349	LOM-SOP-HS-214	6098 - Safety
Emergency Evacuation Plan	1-P-QM-QMA-9017343	LOM-SOP-HS-208	6098 - Safety
Environmental Hazardous Sample Communication Procedure	1-P-QM-QMA-9017346	LOM-SOP-HS-211	6098 - Safety
Environmental, Health, and Safety (EHS) Assessments	1-P-QM-QMA-9017344	LOM-SOP-HS-209	6098 - Safety
Fall Protection Plan	1-P-QM-QMA-9017354	LOM-SOP-HS-221	6098 - Safety
Fleet Safety Plan	1-P-QM-QMA-9021826	N/A	6098 - Safety
Hot Work Permit Program	1-P-QM-QMA-9017345	LOM-SOP-HS-210	6098 - Safety
Incident Response Plan	1-P-QM-QMA-9017347	LOM-SOP-HS-212	6098 - Safety
Inspection of Facility Emergency Equipment	1-P-QM-QMA-9017353	LOM-SOP-HS-220	6098 - Safety
Lockout/Tagout	1-P-QM-QMA-9017342	LOM-SOP-HS-207	6098 - Safety
Management of Hazardous Wastes in the Laboratory	1-P-QM-QMA-9017352	LOM-SOP-HS-219	6098 - Safety
Pharmaceutical Sample Handling	1-P-QM-QMA-9017351	LOM-SOP-HS-218	6098 - Safety
Radiation Safety Program	1-P-QM-QMA-9017348	LOM-SOP-HS-213	6098 - Safety
Reporting Work Related Incidents	1-P-QM-QMA-9017340	LOM-SOP-HS-203	6098 - Safety
Respiratory Protection Program	1-P-QM-QMA-9017341	LOM-SOP-HS-204	6098 - Safety
Safety Glasses	1-P-QM-QMA-9017339	LOM-SOP-HS-202	6098 - Safety
Spill Prevention, Control, and Countermeasure Plan	1-P-QM-QMA-9017355	LOM-SOP-HS-222	6098 - Safety
Building Security	1-P-QM-QMA-9017366	LOM-SOP-LAB-212	6043 - Physical Services
Data and Record Storage, Security, Retention, Archival, and Disposal	1-P-QM-QMA-9017358	LOM-SOP-LAB-203	6047 - Office Services
Document Control	1-P-QM-QMA-9017357	LOM-SOP-LAB-202	6047 - Office Services

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Document Title	Document ID	Historical Document ID	Department Owner
Level 2 (continued)			
E-Mail System	1-P-QM-QMA-9017360	LOM-SOP-LAB-205	9013 - Information Technology
Employee Training Program	1-P-QM-QMA-9017379	LOM-SOP-LAB-231	6047 - Office Services
Environmental Health and Safety Training	1-P-QM-QMA-9017378	LOM-SOP-LAB-230	6054 - Training
EtQ System User Account Maintenance	1-P-QM-QMA-9017380	LOM-SOP-LAB-232	6047 - Office Services
Eurofins North America E-Mail and Archiving	1-P-QM-QMA-9020074	NA	9013 - Information Technology
Facilities Operation Manual	1-P-QM-QMA-9017374	LOM-SOP-LAB-223	6043 - Physical Services
Facility Change Control Procedure	1-P-QM-QMA-9017364	LOM-SOP-LAB-209	6043 - Physical Services
Insect and Rodent Control	1-P-QM-QMA-9017367	LOM-SOP-LAB-213	6043 - Physical Services
Laboratory Housekeeping and Cleaning	1-P-QM-QMA-9017373	LOM-SOP-LAB-221	6043 - Physical Services
Position Qualification Descriptions (PQDs) and Essential Job Functions (EJFs)	1-P-QM-QMA-9017376	LOM-SOP-LAB-225	6056 - Recruiting
Review of Legal Matters	1-P-QM-QMA-9017371	LOM-SOP-LAB-219	20 - Bio/Pharmaceutical Sciences
Review of Legal Matters	1-P-QM-QMA-9017371	LOM-SOP-LAB-219	40 - Environmental Sciences
Use and Maintenance of Reagent Water Supply	1-P-QM-QMA-9017368	LOM-SOP-LAB-214	4052 - Environmental Quality Assurance
Utilizing the Services and Support of the Computer Systems Group	1-P-QM-QMA-9017362	LOM-SOP-LAB-207	9013 - Information Technology
Windows Network and Computer Accounts	1-P-QM-QMA-9017361	LOM-SOP-LAB-206	9013 - Information Technology
Writing and Reviewing Lancaster Laboratories Policies and Operating Procedures	1-P-QM-QMA-9017356	LOM-SOP-LAB-201	6047 - Office Services
Level 3 – Environmental Microbiology			
Quanti-Tray X Sealer	1-P-QM-PRO-9017534	OMC-PM-078	3002 - Environmental Microbiology
Quality Control/Quality Assurance Procedure for Environmental Microbiology	1-P-QM-PRO-9018209	SOP-PM-041	3002 - Environmental Microbiology
2% Brilliant Green Bile Broth (for Coliform Test Dept. 02)	1-P-QM-WI -9018027	SOP-PM-001, Media 400	3002 - Environmental Microbiology
EC Medium – for Dept. 02	1-P-QM-WI -9018028	SOP-PM-001, Media 401	3002 - Environmental Microbiology
Free Chlorine Residual Data Records (Optional Total Chlorine Reading)	1-P-QM-WI -9011681	Analysis 0308	3002 - Environmental Microbiology
Heterotrophic Plate Count Testing for Environmental Solid and Liquid Samples Pour Plate Method SM 9215B-1994	1-P-QM-WI -9011658	Analysis 0307, 4196, 12833	3002 - Environmental Microbiology
Hydrocarbon Degrading Plate Count Study Waters and Solids	1-P-QM-WI -9013997	Analysis 6157, 6158	3002 - Environmental Microbiology
Lauryl Sulfate Tryptose Broth (1x LST) Single Strength – for Dept. 02	1-P-QM-WI -9018025	SOP-PM-001, Media 398	3002 - Environmental Microbiology
Lauryl Sulfate Tryptose Double Strength (2x LST) – for Dept. 02	1-P-QM-WI -9018026	SOP-PM-001, Media 399	3002 - Environmental Microbiology

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Document Title	Document ID	Historical Document ID	Department Owner
Level 3 – Environmental Microbiology (continued)			
M-FC (for Dept. 02)	1-P-QM-WI -9018024	SOP-PM-001, Media 397	3002 - Environmental Microbiology
Modification DPD Free Chlorine Residual In Water (Presence/Absence)	1-P-QM-WI -9011686	Analysis 0416	3002 - Environmental Microbiology
Modification Fecal Coliform by Membrane Filtration	1-P-QM-WI -9011598	Analysis 0199, 11028	3002 - Environmental Microbiology
MS/Agar Noble Base (for HC degrading PC study)	1-P-QM-WI -9018021	SOP-PM-001, Media 390	3002 - Environmental Microbiology
MS/Agar Noble Medium (for HC degrading PC study for Dept. 02)	1-P-QM-WI -9018022	SOP-PM-001, Media 391	3002 - Environmental Microbiology
Total Coliform and E. coli Analysis Potable Water (Presence/Absence), 6477 Swimming Pool Samples, 6479 Potable Water (Quantitative), 8161	1-P-QM-WI -9014018	Analysis 6477, 6479, 8161	3002 - Environmental Microbiology
Tryptic Soy Broth (TSB) for Dept. 02 Sterility Checks	1-P-QM-WI -9018035	SOP-PM-001, Media 409	3002 - Environmental Microbiology
Tryptic Soy Broth (TSB)—for Dept. 02	1-P-QM-WI -9018023	SOP-PM-001, Media 396	3002 - Environmental Microbiology
Level 3 – Environmental Sciences			
Glassware Cleaning	1-P-QM-PRO-9015465	DOD - SOP-MS-001	4021 - GC/MS Volatiles
Preparation and Testing of Trip Blanks for GC/MS Volatile Analyses	1-P-QM-PRO-9015466	DOD - SOP-MS-002	4021 - GC/MS Volatiles
GC/MS Instrumentation Maintenance	1-P-QM-PRO-9015467	DOD - SOP-MS-004	4021 - GC/MS Volatiles
Preservation and Residual Chloride Checks of Samples for GC/MS Volatile Water Analysis	1-P-QM-PRO-9015468	DOD - SOP-MS-005	4021 - GC/MS Volatiles
GC/MS Volatile Standards Traceability	1-P-QM-PRO-9015469	DOD - SOP-MS-006	4021 - GC/MS Volatiles
Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles	1-P-QM-PRO-9015470	DOD - SOP-MS-007	4021 - GC/MS Volatiles
GC/MS Volatiles Audit Process	1-P-QM-PRO-9015471	DOD - SOP-MS-012	4021 - GC/MS Volatiles
Preparation and Testing of Storage Blanks for GC/MS Volatile Analysis	1-P-QM-PRO-9015473	DOD - SOP-MS-015	4021 - GC/MS Volatiles
Use of 40-mL Vials for Volatile Organic Analyses	1-P-QM-PRO-9015474	DOD - SOP-MS-016	4021 - GC/MS Volatiles
Level II Review of GS/MS Volatiles	1-P-QM-PRO-9017810	SOP-MS-017	4021 - GC/MS Volatiles
Volatile Compounds in Aqueous and Solid Samples by SW-846 8260B for OH VAP	1-P-QM-WI -9012739	Analysis 10237, 10335 OH VAP	4021 - GC/MS Volatiles
Volatile Organics Tentatively Identified Compound Method (Interpretive)	1-P-QM-WI -9012746	Analysis 0882, 0884, 12027	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by GC/MS in Soils and Solids by Method 8260B	1-P-QM-WI -9012764	Analysis 10237, 10607, 10949, 10950, 10951	4021 - GC/MS Volatiles
The Determination of 1,2,3- Trichloropropane by Gas Chromatography/ Mass Spectrometry (GC/MS) using Isotope Dilution and Selective Ion Monitoring (SIM)	1-P-QM-WI -9012867	Analysis 11017	4021 - GC/MS Volatiles
Targeted Library Search by GC/MS	1-P-QM-WI -9013053	Analysis 11660	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by GC/MS in Soils and Solids by Method 8260C	1-P-QM-WI -9013077	Analysis 11995	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Waters and Wastewaters by Method 8260C	1-P-QM-WI -9013078	Analysis 11996, 11997, 13130	4021 - GC/MS Volatiles

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The Determination of Vinyl Chloride, Trichloroethene and Tetrachloroethene by Gas Chromatography /Mass Spectrometry (GC/MS) using Selective Ion Monitoring (SIM)	1-P-QM-WI -9013082	Analysis 12030	4021 - GC/MS Volatiles
The Determination of Vinyl Chloride and Carbon Disulfide by Gas Chromatography/Mass Spectrometry (GC/MS) using Selective Ion Monitoring (SIM)	1-P-QM-WI -9013992	Analysis 6008	4021 - GC/MS Volatiles
The Determination of Ethylene Oxide and Crotonaldehyde by Gas Chromatography/Mass Spectrometry (GC/MS) in Water and Soil by SW-846 Method 8260B	1-P-QM-WI -9014003	Analysis 6372, 6377	4021 - GC/MS Volatiles
Preparation of Oil Samples	1-P-QM-WI -9015068	Analysis DOD - 0373	4021 - GC/MS Volatiles
The Determination of 1,4-Dioxane by Gas Chromatography/Mass Spectrometry (GC/MS) using Isotope Dilution and Selective Ion Monitoring (SIM)	1-P-QM-WI -9015075	Analysis DOD - 0527, 10326	4021 - GC/MS Volatiles
Volatile Organics Tentatively Identified Compound Method	1-P-QM-WI -9015084	Analysis DOD - 0890, 0880, 12028	4021 - GC/MS Volatiles
Waters for Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry using EPA Method 624	1-P-QM-WI -9015097	Analysis DOD - 10371	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Waters and Wastewaters by Method 6200B	1-P-QM-WI -9015099	Analysis 10460	4021 - GC/MS Volatiles
The Determination of Volatile Organic Compounds in Wastewater by Isotope Dilution and Gas Chromatography/Mass Spectrometry (GC/MS)	1-P-QM-WI -9015136	Analysis 2394, 2417	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Waters and Wastewaters by Method 8260B	1-P-QM-WI -9015141	Analysis DOD - 2898, 10335, 10903, 10904, 10905, 10943, 10945	4021 - GC/MS Volatiles
Toxicity Characteristic Leachate Procedure (TCLP); Analysis of Zero Headspace Extractions (ZHE) of Solid Waste, Soils, and other Matrices for Volatile Target Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique	1-P-QM-WI -9015142	Analysis DOD - 3636	4021 - GC/MS Volatiles
Waters for Purgeable Organic Compounds by Capillary Column Gas Chromatography Mass Spectrometry	1-P-QM-WI -9015143	Analysis DOD - 3648	4021 - GC/MS Volatiles
Low Concentration Waters for Volatile Organic Analysis	1-P-QM-WI -9015153	Analysis DOD - 4914	4021 - GC/MS Volatiles
Fixed-Volume Hand-Held	1-P-QM-PRO-9015403	DOD - MC-IO-003	4022 - Metals
Bottletop Dispensers	1-P-QM-PRO-9015404	DOD - MC-IO-019	4022 - Metals
Glassware Cleaning	1-P-QM-PRO-9015463	DOD - SOP-IO-013	4022 - Metals
Metals Use of the LLENS System	1-P-QM-PRO-9015464	DOD - SOP-IO-036	4022 - Metals
Mercury in Aqueous and Solid Samples by SW-846 Method 7470A (Aqueous) and 7471A (Solid) for OH VAP	1-P-QM-WI -9011649	Analysis 0259, 0159 OH VAP	4022 - Metals
Maintenance and Calibration of HACH Model 2100N Laboratory Turbidimeter	1-P-QM-PRO-9017427	MC-IO-017	4022 - Metals
Mercury in Aqueous and Solid Samples by SW-846 Method 7470A (Aqueous) and 7471A (Solid) for OH VAP	1-P-QM-WI -9011649	Analysis 0259, 0159 OH VAP	4022 - Metals

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Sample Preparation of Soil, Sediment, and Sludge for Total Mercury Analysis by Atomic Absorption Cold Vapor Technique	1-P-QM-WI -9012710	Analysis 0494	4022 - Metals
Langelier Index in Water	1-P-QM-WI -9012744	Analysis 0576	4022 - Metals
Mercury by Cold Vapor Atomic Fluorescence Spectrometry using EPA Method 1631 Revision E	1-P-QM-WI -9013144	Analysis 1573, 1574	4022 - Metals
Preparation of Soil, Sediment, and Sludge for Analysis of Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	1-P-QM-WI -9013404	Analysis 1849	4022 - Metals
Client Specific - 3030 C. Treatment for Acid-Extractable Metals for North Carolina Groundwater Samples	1-P-QM-WI -9013465	Analysis 2812, 10651, 11988, 11989	4022 - Metals
Dilute/Run and AVS/SEM Sample Handling for Metals	1-P-QM-WI -9013476	Analysis 4792	4022 - Metals
Digestion of Non-Aqueous Samples by SW-846 Method 3050B for OH VAP	1-P-QM-WI -9013983	Analysis 5708, 10637, 11026, 11027 OH VAP	4022 - Metals
Sample Preparation of Sediments, Sludges, and Soils for Analysis of Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (5708)	1-P-QM-WI -9013984	Analysis 5708II	4022 - Metals
Digestion of Solid Samples by SW-846 Method 7471A - OH VAP	1-P-QM-WI -9013985	Analysis 5711 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW-846 Method 7470A for OH VAP	1-P-QM-WI -9013986	Analysis 5713 OH VAP	4022 - Metals
Sample Preparation of Potable Water, Groundwater, Surface Water, and Wastewater for Analysis of Total Recoverable Metals by ICP (5716)	1-P-QM-WI -9013987	Analysis 5716	4022 - Metals
Undigested Sample Preparation of Potable Water for Analysis of Total Recoverable Metals by Inductively Coupled Plasma Mass Spectrometry [ICP-MS]	1-P-QM-WI -9013994	Analysis 6051, 5281	4022 - Metals
Sample Preparation of Wastewater for Analysis of Total Recoverable Metals by Inductively Coupled Mass Spectrometer (ICP-MS)	1-P-QM-WI -9013995	Analysis 6052	4022 - Metals
Sample Preparation of Potable Water, Groundwater, Surface Water, and Wastewater for Analysis of Total Recoverable Metals by ICPMS (7050)	1-P-QM-WI -9014042	Analysis 7050	4022 - Metals
Mercury in Aqueous, Solid and Tissue Samples by Cold Vapor AA	1-P-QM-WI -9015067	Analysis DOD - 0259, 0159	4022 - Metals
Digestion of Aqueous Samples by SW-846 Method 7470A, EPA 254.1, CLP2.1, CLP4.0 and CLP 5.2	1-P-QM-WI -9015082	Analysis DOD - 0821, 5713, 5714	4022 - Metals
Sample Preparation of Oils for Analysis of Metals by Inductively Coupled Plasma Spectroscopy	1-P-QM-WI -9015091	Analysis DOD - 1015, 11355	4022 - Metals
Sample Preparation of Waters for Analysis of Total Recoverable Metals by Inductively Coupled Plasma Optical Emission Spectrometry	1-P-QM-WI -9015133	Analysis DOD - 1848, 5720, 10635	4022 - Metals
Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry	1-P-QM-WI -9015159	Analysis DOD - 5705, 10636	4022 - Metals
Sample Prep of Sediments, Sludges, Soils, and Fish Tissue for Analysis of Metals by ICP and ICP-MS	1-P-QM-WI -9015160	Analysis DOD - 5708, 10637	4022 - Metals

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Sample Preparation of Soil, Sediment, Sludge, Oils, and Fish Tissue for Total Mercury Analysis by Atomic Absorption Cold Vapor Technique	1-P-QM-WI -9015161	Analysis DOD - 5711, 10638	4022 - Metals
Sample Preparation of Leachates and Other Wastewater for Analysis of Total Metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)	1-P-QM-WI -9015165	Analysis DOD - 6050, 10639	4022 - Metals
Metals by Inductively Coupled Plasma Atomic Emissions Spectroscopy for SW-846 Methods 6010A/B/C (aqueous, solid, tissue), CLP 2.1(water/solid/tissue), CLP 4.0(water/solid/tissue), CLP 5.2 (water/solid/tissue) and EPA 200.7(aqueous)	1-P-QM-WI -9018442	Analysis 6966, 1643, 6935, 7914, 6946, 6947, 1650, 6949, 6952, 6951, 6953, 1654, 1662, 1656, 1657, 6958, 6960, 1667, 6961,10145, 6955, 6944, 6936, 6969, 7968, …	4022 - Metals
Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A (aqueous, solid, tissue), CLP 5.2 (aqueous, solid, tissue) and EPA 200.8 (aqueous)	1-P-QM-WI -9018443	Analysis 6142, 6123, 6125, 10801, 6126, 6127, 6129, 6128, 6132, 6131, 6133, 6134, 6140, 6136, 6137, 6138, 6143, 6139, 6135, 6124, 6141, 6146, 6144, 6147, 6145, …	4022 - Metals
Trace Metals in Aqueous and Non-Aqueous Samples by Method SW-846 6020 for OH VAP	1-P-QM-WI -9022820	6127, 6027, 6131, 6031, 6137, 6037, 6139, 6039, 6133, 6033, 6125, 6142, 6042, 6128, 6028, 6124, 6024, 6126, 6026, 6145, 6045, 6135, 6035 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW846 Method 3020A/3010A Modified for Analysis by ICP/MS for OH VAP	1-P-QM-WI -9022821	6050 OH VAP	4022 - Metals
Trace Metals in Aqueous and Non-Aqueous Samples by Method SW-846 6010B for OH VAP	1-P-QM-WI -9022822	7066, 6966, 1743, 1643, 7035, 6935, 7046, 6946, 7047, 6947, 1750, 1650, 7049, 6949, 7052, 6952, 7051, 6951, 7053, 6953, 1754, 1654, 1762, 1662, 7058, 6958, 1767, 1667, 7061, 6961, 7055, 6955, 7044, 6944, 7036, 6936, 7022, 6925, 7071, 6971, 7072,... OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW-846 3005A for ICP Analysis – OH VAP	1-P-QM-WI -9024237	Analysis 1848 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW-846 3010A for ICP Analysis – OH VAP	1-P-QM-WI -9024239	Analysis 5705 OH VAP	4022 - Metals
Pesticide Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015407	DOD - MC-OE-004	4024 - Pesticide Residue Analysis
QC Data Acceptability and Corrective Action	1-P-QM-PRO-9015493	DOD - SOP-PP-002	4024 - Pesticide Residue Analysis
Interpretation of Chromatographic Data	1-P-QM-PRO-9015494	DOD - SOP-PP-011	4024 - Pesticide Residue Analysis
Preventative and Corrective GC Maintenance	1-P-QM-PRO-9015495	DOD - SOP-PP-013	4024 - Pesticide Residue Analysis
Monitoring QC Data Acceptance Limits	1-P-QM-PRO-9015496	DOD - SOP-PP-025	4024 - Pesticide Residue Analysis
Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department	1-P-QM-PRO-9015497	DOD - SOP-PP-029	4024 - Pesticide Residue Analysis
Setting Up Single Component Initial Calibrations	1-P-QM-PRO-9015498	DOD - SOP-PP-031	4024 - Pesticide Residue Analysis
Using "Datalog" Software for Data Acquisition of Multicomponent Pesticides/PCBs	1-P-QM-PRO-9015499	DOD - SOP-PP-032	4024 - Pesticide Residue Analysis

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Using "Datalog" Software for Single-component Data Acquisition	1-P-QM-PRO-9015500	DOD - SOP-PP-033	4024 - Pesticide Residue Analysis
Common Equations Used During Chromatographic Analyses	1-P-QM-PRO-9015501	DOD - SOP-PP-040	4024 - Pesticide Residue Analysis
Standards Traceability and Monitoring	1-P-QM-PRO-9018220	SOP-PP-003	4024 - Pesticide Residue Analysis
Standards Preparation, Coding, and Storage	1-P-QM-PRO-9018222	SOP-PP-021	4024 - Pesticide Residue Analysis
Data Audit Procedure for Department 4024	1-P-QM-PRO-9018224	SOP-PP-023	4024 - Pesticide Residue Analysis
Uploading Data to the LIMS	1-P-QM-PRO-9018225	SOP-PP-027	4024 - Pesticide Residue Analysis
Setting Retention Time Windows	1-P-QM-PRO-9018226	SOP-PP-035	4024 - Pesticide Residue Analysis
Creating Calibration Timed Events in Chrom Perfect	1-P-QM-PRO-9018227	SOP-PP-036	4024 - Pesticide Residue Analysis
Setting Up Analysis Numbers in the Departmental Database	1-P-QM-PRO-9018228	SOP-PP-037	4024 - Pesticide Residue Analysis
Prescreening Water and Soil Samples for Pesticides and PCBs	1-P-QM-PRO-9018229	SOP-PP-041	4024 - Pesticide Residue Analysis
Micromass Quattro Micro Tandem Mass Spectrometer with a Waters 2795 HPLC System (LC/MS/MS)	1-P-QM-PRO-9018230	SOP-PP-042	4024 - Pesticide Residue Analysis
PCBs in Oil by SW-846 Method 8082	1-P-QM-WI -9011597	Analysis 0174	4024 - Pesticide Residue Analysis
Medium Level Sonic Probe Extraction Procedure for the Determination of Pesticides and PCBs in a Solid Matrix	1-P-QM-WI -9012745	Analysis 0819M, 11144	4024 - Pesticide Residue Analysis
Liquid/Liquid Extraction Procedure for the Determination of Organophosphorous Pesticides in a Wastewater Matrix	1-P-QM-WI -9012765	Analysis 10240	4024 - Pesticide Residue Analysis
Determination of Picric Acid in Soil Samples by HPLC with UV	1-P-QM-WI -9012797	Analysis 10709	4024 - Pesticide Residue Analysis
Soxhlet Extraction Procedure for the Determination of Polychlorinated Biphenyls (PCBs) in a Solid Matrix	1-P-QM-WI -9013065	Analysis 11696	4024 - Pesticide Residue Analysis
Analysis of Low Level Polychlorinated Biphenyls (PCBs) in Aqueous Samples using Gas Chromatography with Electron Capture Detection (GC-ECD)	1-P-QM-WI -9013081	Analysis 12013	4024 - Pesticide Residue Analysis
Passive In-Situ Chemical Extraction Sampler (PISCES) Procedure for the Determination of Polychlorinated Biphenyls (PCBs)	1-P-QM-WI -9013121	Analysis 12801	4024 - Pesticide Residue Analysis
N-Methylcarbamates by Method 531.1 in Groundwater and Drinking Water using High Performance Liquid Chromatography (HPLC)	1-P-QM-WI -9013126	Analysis 1340	4024 - Pesticide Residue Analysis
N-Methylcarbamate Pesticides by Method 8318 / 8318A in Solids	1-P-QM-WI -9013139	Analysis 1509, 10597	4024 - Pesticide Residue Analysis
Extraction Procedure for the Determination of Carbamate and Urea Pesticides in a Soil or Solid Waste Matrix	1-P-QM-WI -9013140	Analysis 1510, 11143	4024 - Pesticide Residue Analysis
Analysis of Acephate and Methamidophos by 8141A in Aqueous and Solid Samples	1-P-QM-WI -9013395	Analysis 1782, 1785	4024 - Pesticide Residue Analysis
Chlorinated Acids in Water Using GC-ECD by Method 515.1	1-P-QM-WI -9013405	Analysis 1864	4024 - Pesticide Residue Analysis
Analysis of Aqueous Samples for Chlorinated Pesticides and PCBs by Gas Chromatography with an Electron Capture Detector	1-P-QM-WI -9013406	Analysis 1869	4024 - Pesticide Residue Analysis

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Analysis of Aqueous Samples for Nitrogen- and Phosphorus-Containing Pesticides by Gas Chromatography with a Nitrogen-Phosphorus Detector	1-P-QM-WI -9013407	Analysis 1870	4024 - Pesticide Residue Analysis
Analysis of Captan and Captafol by Gas Chromatography with Electron Capture Detection of Waters and Solids Method 8081A	1-P-QM-WI -9013435	Analysis 2257, 2253	4024 - Pesticide Residue Analysis
Picric Acid in Water by Method 8015B Using HPLC with UV Detection	1-P-QM-WI -9013439	Analysis 2265	4024 - Pesticide Residue Analysis
Analysis of Formaldehyde and other Aldehydes in Aqueous and Solid Samples by High Performance Liquid Chromatography (HPLC) Method 8315A	1-P-QM-WI -9013471	Analysis 4144, 4173, 8044, 8045	4024 - Pesticide Residue Analysis
Extraction of Chlorinated Herbicides in a Soil Matrix	1-P-QM-WI -9013472	Analysis 4181	4024 - Pesticide Residue Analysis
Soxhlet Extraction Procedure for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9013991	Analysis 6006SOX	4024 - Pesticide Residue Analysis
Separatory Funnel Extraction Procedure for the Determination of Chlorinated Pesticides; Nitrogen and Phosphorus Containing Pesticides; and PCBs in a Drinking Water Matrix	1-P-QM-WI -9014001	Analysis 6368, 11127	4024 - Pesticide Residue Analysis
Extraction of Chlorinated Acids and Herbicides in Drinking Water by Method 515.1	1-P-QM-WI -9014002	Analysis 6369	4024 - Pesticide Residue Analysis
Analysis of Pesticides and Polychlorinated Biphenyls (PCBs) in Aqueous Samples by Method 608	1-P-QM-WI -9014174	Analysis 7572	4024 - Pesticide Residue Analysis
Microextraction of 1,2-Dibromoethane (EDB), 1,2-Dibromo-3-chloropropane (DBCP), and 1,2,3-Trichloropropane (TCP), in Water	1-P-QM-WI -9014309	Analysis 7786	4024 - Pesticide Residue Analysis
Organic Acids in Water by HPLC/UV Method 8015B/D	1-P-QM-WI -9015063	Analysis 8843, 12737	4024 - Pesticide Residue Analysis
Analysis of Pesticides in Aqueous Samples using GC-ECD	1-P-QM-WI -9015066	Analysis DOD - 0177, 0950, 0180, 1954	4024 - Pesticide Residue Analysis
Waste Dilution Procedure for the Determination of PCBs in Oil	1-P-QM-WI -9015077	Analysis DOD - 0815	4024 - Pesticide Residue Analysis
Extraction of Chlorinated Herbicides in a Water Matrix by SW-846 8151A	1-P-QM-WI -9015078	Analysis DOD - 0816, 11110, 11111	4024 - Pesticide Residue Analysis
Separatory Funnel Extraction Procedure for the Determination of Pesticides and PCBs in a Wastewater Matrix	1-P-QM-WI -9015079	Analysis DOD - 0817, 6654, 10241, 11112, 11113, 11114, 11116, 11117, 11118, 11119, 11120, 11121, 11123, 11126, 11960	4024 - Pesticide Residue Analysis
Waste Dilution Procedure for the Determination of Pesticides and PCBs in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015080	Analysis DOD - 11114DIL	4024 - Pesticide Residue Analysis
Sonic Probe Extraction Procedure for the Determination of Polychlorinated Biphenyls (PCBs) in a Solid Matrix	1-P-QM-WI -9015081	Analysis DOD - 0819, 11128, 11132, 11135	4024 - Pesticide Residue Analysis
Analysis of Chlorinated Herbicides by 8151A in Water	1-P-QM-WI -9015088	Analysis DOD - 0952, 10407	4024 - Pesticide Residue Analysis
Extraction Procedure for the Determination of Formaldehyde and Aldehydes in a Water Matrix	1-P-QM-WI -9015090	Analysis DOD - 1013	4024 - Pesticide Residue Analysis
EDB/DBCP and TCP by Method 504.1 or 8011 in Waters using Microextraction and GC-ECD	1-P-QM-WI -9015094	Analysis DOD - 1034, 7934, 10398	4024 - Pesticide Residue Analysis
Microwave Extraction Procedure for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9015103	Analysis DOD - 10496, 11141	4024 - Pesticide Residue Analysis
Microwave Extraction Procedure for the Determination of PCBs in a Solid Matrix	1-P-QM-WI -9015104	Analysis DOD - 10497, 11140	4024 - Pesticide Residue Analysis

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Analysis of Pesticides in Aqueous Samples using Gas Chromatography with Electron Capture Detection (GC-ECD) by SW-846 Method 8081B	1-P-QM-WI -9015107	Analysis DOD - 10589	4024 - Pesticide Residue Analysis
Analysis of Pesticides by 8081B in Solid Samples using GC-ECD	1-P-QM-WI -9015108	Analysis DOD - 10590	4024 - Pesticide Residue Analysis
Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD	1-P-QM-WI -9015109	Analysis DOD - 10591	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A Using GC-ECD	1-P-QM-WI -9015110	Analysis DOD - 10592, 10885, 12718, 13099	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes	1-P-QM-WI -9015126	Analysis DOD - 0042, 1030, 6011, 7512, 10225, 10736, 10906, 12800	4024 - Pesticide Residue Analysis
Analysis of Pesticides in Solid Samples using Gas Chromatography with Electron Capture Detection (GC-ECD)	1-P-QM-WI -9015128	Analysis DOD - 1363, 1420, 4225, 10738	4024 - Pesticide Residue Analysis
Analysis of Organophosphorous Pesticides in Aqueous Samples by Methods 8141A/8141B/622 using GC-NPD	1-P-QM-WI -9015156	Analysis DOD - 5366, 10410, 10593, 12144	4024 - Pesticide Residue Analysis
Analysis of Organophosphorous Pesticides in Solid Samples by 8141A/8141B using GC-NPD	1-P-QM-WI -9015157	Analysis DOD - 5367, 10408, 10594	4024 - Pesticide Residue Analysis
Analysis of Chlorinated Herbicides by 8151A in Soil	1-P-QM-WI -9015158	Analysis DOD - 5592, 10401	4024 - Pesticide Residue Analysis
Extraction Procedure for the Determination of Formaldehyde and Aldehydes in a Solid Matrix	1-P-QM-WI -9015162	Analysis DOD - 5876, 11139	4024 - Pesticide Residue Analysis
Sonic Probe Extraction for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9015163	Analysis DOD - 11129, 11131, 11134	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) by Method 608 or 8082 in Waters	1-P-QM-WI -9015164	Analysis DOD - 6030, 10227	4024 - Pesticide Residue Analysis
Determination of Perchlorate in Aqueous Samples and Soil Samples by LC/MS/MS, Method 6850	1-P-QM-WI -9015166	Analysis DOD - 6386, 6557	4024 - Pesticide Residue Analysis
Extraction Procedure for Perchlorate in Soil Samples by LC/MS/MS	1-P-QM-WI -9015167	Analysis DOD - 6568	4024 - Pesticide Residue Analysis
Soxhlet Extraction Procedure for the Determination of Triazine Herbicides and Organophosphorous Pesticides in a Solid Matrix	1-P-QM-WI -9015170	Analysis DOD - 6677, 11130, 11133, 11142	4024 - Pesticide Residue Analysis
Extraction of Nitroaromatics and Nitroamines in Water	1-P-QM-WI -9015171	Analysis DOD - 6915, 11122, 11125	4024 - Pesticide Residue Analysis
Nitroaromatics and Nitroamines in Water and Solids by HPLC with UV Detection by Method 8330(A)	1-P-QM-WI -9015172	Analysis DOD - 6916, 6918, 10595, 10596, 10131, 10132	4024 - Pesticide Residue Analysis
Extraction of Nitroaromatics and Nitroamines in Soil	1-P-QM-WI -9015173	Analysis DOD - 6917, 11137, 11138	4024 - Pesticide Residue Analysis
Sonication Extraction of Nitroaromatics and Nitroamines in Soil (DoD)	1-P-QM-WI -9015174	Analysis DOD - 6917DoD	4024 - Pesticide Residue Analysis
Separatory Funnel Extraction of Pesticides and PCBs in Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022427	Analysis 11117, 11118 OH VAP	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) in Aqueous and Non-aqueous Samples by SW-846 Method 8082 for OH VAP	1-P-QM-WI -9022429	Analysis 10225, 10227, 10736 OH VAP	4024 - Pesticide Residue Analysis
Pesticides in Aqueous and Non-aqueous Samples by SW-846 Method 8081A for OH VAP	1-P-QM-WI -9022430	Analysis 0177, 1363, 10738 OH VAP	4024 - Pesticide Residue Analysis
Sonic Probe Extraction of Pesticides and PCBs in Solid Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022432	Analysis 0819, 11134 OH VAP	4024 - Pesticide Residue Analysis
Microwave Extraction of Pesticides and PCBs in Non-aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022433	Analysis 10496, 10497 OH VAP	4024 - Pesticide Residue Analysis

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Microwave Extraction of Pesticides and PCBs in Non-aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022433	Analysis 10496, 10497 OH VAP	4024 - Pesticide Residue Analysis
Determination of Benzene Sulfonic Acid and p-Phenol Sulfonic Acid in Water	1-P-QM-WI -9023254	Analysis 13147	4024 - Pesticide Residue Analysis
EDB, DBCP and TCP by Method 8011 in Solids using Microextraction and GC-ECD	1-P-QM-WI -9025366	Analysis 13214	4024 - Pesticide Residue Analysis
Microextraction of EDB, DBCP, and TCP in Solids by Method 8011	1-P-QM-WI -9025371	Analysis 13218	4024 - Pesticide Residue Analysis
Statistical Calculations Used in the Analysis of Samples by EPA Methodology	1-P-QM-PRO-9015491	DOD - SOP-OR-020	4025 - Volatiles by GC
GC Routine and Nonroutine Maintenance	1-P-QM-PRO-9015492	DOD - SOP-OR-077	4025 - Volatiles by GC
Glassware Cleaning	1-P-QM-PRO-9017814	SOP-OR-070	4025 - Volatiles by GC
Calibrating the 1-uL Standard Delivery Groove on the Archon Model 5100A and O.I. 4660 Autosampler Systems	1-P-QM-PRO-9017815	SOP-OR-075	4025 - Volatiles by GC
Client Specific - Determination of Volatile Gasoline Range Organics in Soil and Water Maine Method	1-P-QM-WI -9012774	Analysis 10438, 10439	4025 - Volatiles by GC
Client Specific - GRO in Water for South Carolina	1-P-QM-WI -9012789	Analysis 10653	4025 - Volatiles by GC
Client Specific - GRO in Soils for South Carolina	1-P-QM-WI -9012790	Analysis 10654	4025 - Volatiles by GC
Client Specific - Method AK101 for the Determination of Gasoline Range Organics (GRO) in Water by Purge and Trap Gas Chromatography for the State of Alaska	1-P-QM-WI -9013129	Analysis 1438, 1440	4025 - Volatiles by GC
Client Specific - Method AK101 for the Determination of Gasoline Range Organics in Soil Analysis for the State of Alaska	1-P-QM-WI -9013134	Analysis 1450, 1451	4025 - Volatiles by GC
Determination of Volatile Gasoline Range Organics in Soil and Water - Northwest GX Method	1-P-QM-WI -9013411	Analysis 2005, 2006, 8273, 8274	4025 - Volatiles by GC
Client Specific - Determination of Volatile Gasoline Range Organics in Soil and Water Oklahoma Method	1-P-QM-WI -9013441	Analysis 2315, 8789	4025 - Volatiles by GC
Purgeable Aromatics in Water Samples by Method 602	1-P-QM-WI -9014655	Analysis 8241	4025 - Volatiles by GC
Client Specific - Determination of Volatile Gasoline Range Organics and Petroleum Volatile Organic Compounds in Water - Wisconsin Method	1-P-QM-WI -9015062	Analysis 8803, 8805, 8806, 8807, 8809, 8810	4025 - Volatiles by GC
Gasoline Range Organics (GRO) in Water Samples Using Purge and Trap Gas Chromatography by SW-846, Method 8015B or SW-846, Method 8015C, Method 8015D	1-P-QM-WI -9015131	Analysis DOD - 1635, 1636, 1728, 1729, 2762, 2763, 8229, 8268, 10598	4025 - Volatiles by GC
Gasoline Range Organics (GRO) in Soils using Purge and Trap Gas Chromatography by SW-846, Method 8015B or SW-846, Method 8015C, or SW-846, Method 8015D	1-P-QM-WI -9015132	Analysis DOD - 1637, 1638, 1700, 1725, 1726, 2765, 2766, 5550, 5551, 10599, 12989	4025 - Volatiles by GC
Purgeable Aromatics in Water Samples	1-P-QM-WI -9015135	Analysis DOD - 2102, 6464, 8806	4025 - Volatiles by GC
Purgeable Aromatics in High-Level Soils	1-P-QM-WI -9015190	Analysis DOD - 8179	4025 - Volatiles by GC
GC/MS Preventative and Corrective Maintenance	1-P-QM-PRO-9015393	DOD - MC-EX-001	4026 - GC/MS Semivolatiles
Semivolatile Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015406	DOD - MC-OE-003	4026 - GC/MS Semivolatiles
Semivolatile Spiking and Calibration Standards	1-P-QM-PRO-9015452	DOD - SOP-EX-001	4026 - GC/MS Semivolatiles

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GC/MS Electronic Data Management and Handling	1-P-QM-PRO-9015453	DOD - SOP-EX-006	4026 - GC/MS Semivolatiles

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Quality Control Spike Mix Verification	1-P-QM-PRO-9015454	DOD - SOP-EX-008	4026 - GC/MS Semivolatiles
GC/MS Audit Process	1-P-QM-PRO-9015455	DOD - SOP-EX-009	4026 - GC/MS Semivolatiles
Semivolatile Run/Injection Log Generation	1-P-QM-PRO-9015456	DOD - SOP-EX-019	4026 - GC/MS Semivolatiles
Monitoring QC Data Acceptance Limits	1-P-QM-PRO-9015457	DOD - SOP-EX-020	4026 - GC/MS Semivolatiles
Pesticide Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023663	N/A	4026 - GC/MS Semivolatiles
Semivolatile Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023664	N/A	4026 - GC/MS Semivolatiles
The Determination of d-Limonene in Plastic by Gas Chromatography/Mass Spectrometry (GC/MS)	1-P-QM-WI -9012761	Analysis 10215	4026 - GC/MS Semivolatiles
Extraction Procedure for the Determination of 2-Chlrorbenzalmalonotrile (CS) and 3-Quinuclidinyl Benzilate (BZ) in Water and Wastewater	1-P-QM-WI -9012779	Analysis 10475	4026 - GC/MS Semivolatiles
Microwave Extraction for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9012780	Analysis 10481, 11598	4026 - GC/MS Semivolatiles
Determination of N-Nitrosodimethylamine (NDMA) in Water and Soil by EPA 1625C	1-P-QM-WI -9012803	Analysis 10962, 11622	4026 - GC/MS Semivolatiles
Solid Phase Extraction Procedure for the Determination of THPA, THPI and PA in a Water Matrix	1-P-QM-WI -9012865	Analysis 11011	4026 - GC/MS Semivolatiles
Liquid/Liquid Extraction Procedure for the Determination of Neutral Extractables in a Wastewater Matrix	1-P-QM-WI -9013043	Analysis 11629	4026 - GC/MS Semivolatiles
Determination of cis-1,2,3,6-Tetrahydrophthalic anhydride (THPA), cis-1,2,3,6-tetrahydrophthalimide (THPI), Phthalic anhydride (PA) in Water/Wastewater by SPE and Soil by Sonic Probe Extraction with analysis by GC/MS	1-P-QM-WI -9013141	Analysis 1542, 2345	4026 - GC/MS Semivolatiles
Analysis of Chlorinated Herbicides in Water by Selective Ion Monitoring Gas Chromatography/Mass Spectroscopy (SIM/GC/MS)	1-P-QM-WI -9013416	Analysis 2026	4026 - GC/MS Semivolatiles
The Determination of Semivolatiles by Large Volume Injection (LVI) Gas Chromatography/Mass Spectrometry (GC/MS)	1-P-QM-WI -9014025	Analysis 6570	4026 - GC/MS Semivolatiles
Determination of Benz(a)pyrene in Smokeless Tobacco by Selective Ion Monitoring Gas Chromatography/Mass Spectrometry (SIM/GC/MS)	1-P-QM-WI -9014169	Analysis 7325, 0089	4026 - GC/MS Semivolatiles
Low-Level Sonication Extraction Procedure for the Determination of Polynuclear Aromatic Hydrocarbons (PAHs) in a Solid Matrix by GC/MS	1-P-QM-WI -9014490	Analysis 7806	4026 - GC/MS Semivolatiles
Extraction Procedure for the Determination of PAHs in an XAD Air Tube Sample by TO-15A	1-P-QM-WI -9014491	Analysis 7806AIR	4026 - GC/MS Semivolatiles
Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9015070	Analysis DOD - 0381, 10478, 10480, 10483, 10486, 10487L	4026 - GC/MS Semivolatiles
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix	1-P-QM-WI -9015071	Analysis DOD - 0381DIL	4026 - GC/MS Semivolatiles
Dioxin Screening of Water and Soils (Screening Procedure for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin by Selective Ion Monitoring Gas	1-P-QM-WI -9015072	Analysis DOD - 0382, 1196	4026 - GC/MS Semivolatiles

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Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by SW-846 Method 3510C	1-P-QM-WI -9015076	Analysis DOD - 0813, 11010, 11015, 10464, 10467, 10476	4026 - GC/MS Semivolatiles
Semivolatile Organics Tentatively Identified Compound Method	1-P-QM-WI -9015083	Analysis DOD - 0885, 0886, 0887, 0893, 7125, 12126	4026 - GC/MS Semivolatiles
Determination of Semivolatile Organic Compounds by Method 8270C	1-P-QM-WI -9015087	Analysis DOD - 0949, 1309, 1476, 1536, 1946, 1947, 1953, 2035, 2395, 4615, 4678, 4688, 6387, 6397, 7804, 7805, 10032, 10723, 10724, 10727, 10728, 11013	4026 - GC/MS Semivolatiles
Analysis of Semivolatile Compounds in Drinking Water by Method 525.2	1-P-QM-WI -9015092	Analysis DOD - 10333	4026 - GC/MS Semivolatiles
Determination of Priority Pollutants by Method 625	1-P-QM-WI -9015093	Analysis DOD - 10334, 2783	4026 - GC/MS Semivolatiles
Liquid/Liquid Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 8270	1-P-QM-WI -9015098	Analysis DOD - 10458	4026 - GC/MS Semivolatiles
Determination of Semivolatile Organic Compounds by Method 8270D	1-P-QM-WI -9015100	Analysis DOD - 10461, 10462, 10726	4026 - GC/MS Semivolatiles
Extraction Procedure for the Determination of Tetraethyl Lead in a Water or Wastewater Matrix	1-P-QM-WI -9015101	Analysis DOD - 10472	4026 - GC/MS Semivolatiles
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Solid Matrix by SIM	1-P-QM-WI -9015102	Analysis DOD - 10479, 10484, 10489	4026 - GC/MS Semivolatiles
Microwave Extraction by Method 3546 for Semivolatiles	1-P-QM-WI -9015105	Analysis DOD - 10498, 10809, 10810, 10811, 10812, 10813, 10814, 11630, 11916	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables by SIM in a Wastewater Matrix	1-P-QM-WI -9015121	Analysis DOD - 11012, 10465, 10466, 10470, 10471, 11912	4026 - GC/MS Semivolatiles
Determination of Tetraethyl Lead (TEL) and Tetramethyl Lead (TML) by GC/MS Analysis	1-P-QM-WI -9015145	Analysis DOD - 4220, 4221	4026 - GC/MS Semivolatiles
CLP Semivolatile Analysis of Waters and Soils by the OLM03.2 and/or the OLM04.3 Statement of Work	1-P-QM-WI -9015146	Analysis DOD - 4372, 4438, 4722, 4723	4026 - GC/MS Semivolatiles
Liquid-Liquid Extraction Procedure for the Determination of Target Compound List Analytes in a Water Matrix	1-P-QM-WI -9015147	Analysis DOD - 4606	4026 - GC/MS Semivolatiles
Low-Level Sonic Probe Extraction Procedure for the Determination of Target Compound List Analytes in a Solid Matrix	1-P-QM-WI -9015148	Analysis DOD - 4607	4026 - GC/MS Semivolatiles
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015150	Analysis DOD - 4731DIL	4026 - GC/MS Semivolatiles
Extraction of Organic Compounds in Drinking Water By Method 525.2	1-P-QM-WI -9015152	Analysis DOD - 4894	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction for the Determination of PAHs in Water by GC/MS Using Method 3510C	1-P-QM-WI -9015185	Analysis DOD - 7807	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 625	1-P-QM-WI -9015188	Analysis DOD - 8108, 10463	4026 - GC/MS Semivolatiles

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Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Complex Matrix	1-P-QM-WI -9015189	Analysis DOD - 8108TJ	4026 - GC/MS Semivolatiles
Semivolatiles by Methods 8270C/D SIM	1-P-QM-WI -9015192	Analysis DOD - 8357, 0038, 0039, 10010, 10137, 10138, 10725, 11915, 11917, 12969, 12970, 12971	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction Semivolatile Organic Compounds in an Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022472	Analysis 10464 OH VAP	4026 - GC/MS Semivolatiles
Semivolatile Organic Compounds in Aqueous and Non-Aqueous Samples by Method SW-846 8270C for OH VAP	1-P-QM-WI -9022474	Analysis 1309, 10725 OH VAP	4026 - GC/MS Semivolatiles
Microwave Extraction of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022475	Analysis 10813 OH VAP	4026 - GC/MS Semivolatiles
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022476	Analysis 0381 10478 OH VAP	4026 - GC/MS Semivolatiles
Adjustable Volume Handheld Pipettes	1-P-QM-PRO-9015395	DOD - MC-IC-001	4027 - Instrumental Water Quality
pH Electrodes and Meters	1-P-QM-PRO-9015396	DOD - MC-IC-003	4027 - Instrumental Water Quality
Maintenance and Calibration of A.I. Scientific AIM600 Digestor	1-P-QM-PRO-9015397	DOD - MC-IC-005	4027 - Instrumental Water Quality
Maintenance of the OI Analytical Model 1030 Total Organic Carbon Analyzer	1-P-QM-PRO-9015398	DOD - MC-IC-006	4027 - Instrumental Water Quality
Maintenance of Continuous Flow Analyzers	1-P-QM-PRO-9015399	DOD - MC-IC-007	4027 - Instrumental Water Quality
Accusterilizer - Steam Sterilizer	1-P-QM-PRO-9015400	DOD - MC-IC-008	4027 - Instrumental Water Quality
Automatic Pipette Dispensers	1-P-QM-PRO-9015401	DOD - MC-IC-009	4027 - Instrumental Water Quality
ICS-1000, ICS 1100, ICS-2000 and ICS-3000 Ion Chromatography Systems	1-P-QM-PRO-9015402	DOD - MC-IC-010	4027 - Instrumental Water Quality
Quality Control for Auto-Analyzer Analyses Performed in Instrumental Water Quality	1-P-QM-PRO-9015459	DOD - SOP-IC-004	4027 - Instrumental Water Quality
Department 4027 Chemical Inventory and Review Procedures	1-P-QM-PRO-9015460	DOD - SOP-IC-016	4027 - Instrumental Water Quality
Maintenance of the OI Analytical Total Organic Carbon Solids Analyzer	1-P-QM-PRO-9015461	DOD - SOP-IC-017	4027 - Instrumental Water Quality
Determination of Low Level Hexavalent Chromium by Ion Chromatography in Solids and Waters by EPA Method 218.7	1-P-QM-PRO-9020768	N/A	4027 - Instrumental Water Quality
Automated Determination of Ammonia Nitrogen in Water and Wastewater Using Segmented Flow Analysis and Gas Diffusion by EPA 350.1	1-P-QM-PRO-9020808	Analysis 12892, 13000	4027 - Instrumental Water Quality
Automated Determination of Total Kjeldahl Nitrogen in Water, Wastewater, and Solids	1-P-QM-WI -9011633	Analysis 0217, 1511, 0223, 4235, 6165	4027 - Instrumental Water Quality
Nitrite Nitrogen in Water and Wastewater (Colorimetric, Automated)	1-P-QM-WI -9011634	Analysis 0219, 5991	4027 - Instrumental Water Quality
Nitrate Nitrogen in Water and Wastewater (Colorimetric, Automated Cadmium Reduction)	1-P-QM-WI -9011635	Analysis 0220, 7882, 5992	4027 - Instrumental Water Quality
Determination of Inorganic Anions by Ion Chromatography	1-P-QM-WI -9011637	Analysis 0224, 0228, 0332, 0368, 1504, 1505, 1506, 7322, 7332, 7333, 7334, 7335, 7336, 7337, 7338	4027 - Instrumental Water Quality
Determination of Total and Soluble Phosphorus in Water, Wastewater, and Soils (Colorimetric,	1-P-QM-WI -9011640	Analysis 0227, 0345, 1546, 5893, 5894	4027 - Instrumental Water Quality

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Ascorbic Acid, Automated)			
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Determination of Total and Amenable Cyanide in Water, Wastewater, and Soils, Free Cyanide in Water and Wastewater, Reactive Cyanide of Solids, and Weak Acid Dissociable Cyanide in Waters and Soils	1-P-QM-WI -9011646	Analysis 0237, 1123, 1549, 5895, 5898, 8255, 0241, 4814, 0961, 0957, 0959	4027 - Instrumental Water Quality
Determination of Total Organic Carbon, Dissolved Organic Carbon, and Inorganic Carbon in Water and Wastewater	1-P-QM-WI -9011651	Analysis 0273, 6090, 7547	4027 - Instrumental Water Quality
Determination of Total Organic Carbon in Water and Wastewater (Quadruplicate Studies)	1-P-QM-WI -9011682	Analysis 0354	4027 - Instrumental Water Quality
Determination of Nitrocellulose in Water and Soil	1-P-QM-WI -9011683	Analysis 0370, 0371, 1105, 1106	4027 - Instrumental Water Quality
Automated Determination of Phenols in Water, Wastewater, and Soils By Automated Flow Analyzer EPA 420.4, EPA 420.2, SW-846, 9066	1-P-QM-WI -9011690	Analysis 0434, 2393, 5912	4027 - Instrumental Water Quality
Phenol Distillation (as Preparation for Analysis on the Flow Analyzer)	1-P-QM-WI -9011693	Analysis 0491, 5911, 8123	4027 - Instrumental Water Quality
Total and Amenable Cyanide Distillation (As Preparation for Analysis on the Automatic Flow Analyzer)	1-P-QM-WI -9011694	Analysis 0492, 1548, 5896, 5897, 8256, 0956, 0958	4027 - Instrumental Water Quality
Total Cyanide Analysis by Massachusetts Contingency Plan (MCP)	1-P-QM-WI -9012873	Analysis 11151	4027 - Instrumental Water Quality
Determination of Total and Available Cyanide in Water using Amperometric Detection by ASTM D 7511-09e2 and Method OIA-1677-09	1-P-QM-WI -9013123	Analysis 12823, 12941, 12999	4027 - Instrumental Water Quality
Reagent Water Extraction (as Preparation for Analysis on the Ion Chromatograph or Autoanalyzer)	1-P-QM-WI -9013127	Analysis 1352, 10129	4027 - Instrumental Water Quality
Total Kjeldahl Nitrogen Digestion of Water and Wastewater (A Preparation for Analysis 0217)	1-P-QM-WI -9013136	Analysis 1460	4027 - Instrumental Water Quality
Total Kjeldahl Nitrogen Digestion of Solids and Soils (a preparation for Analysis #1511)	1-P-QM-WI -9013138	Analysis 1465	4027 - Instrumental Water Quality
Determination of Total Carbon in Water and Wastewater	1-P-QM-WI -9013142	Analysis 1550	4027 - Instrumental Water Quality
Determination of TOC and TC in Solids and Sludges by Combustion	1-P-QM-WI -9013418	Analysis 2079, 0383, 6623, 10065, 11356, 11763	4027 - Instrumental Water Quality
Moisture by Sartorius Moisture Analyzer/Moisture by Mettler Toledo HB43 SM20 2540 G and SOW OLM03.2	1-P-QM-WI -9013422	Analysis 2111, 2118, 2121, 2353	4027 - Instrumental Water Quality
Determination of Hexavalent Chromium by Ion Chromatography in Solids and Waters SW-846 7199 and EPA 218.6	1-P-QM-WI -9013989	Analysis 5892, 6467	4027 - Instrumental Water Quality
Determination of Perchlorate by Ion Chromatography	1-P-QM-WI -9013993	Analysis 6019, 10130, 10147	4027 - Instrumental Water Quality
Weak Acid Dissociable Cyanide Distillation (as Preparation for Analysis on the Flow Analyzer)	1-P-QM-WI -9014171	Analysis 7528, 0960	4027 - Instrumental Water Quality
Digestion of Total and Soluble Phosphorus in Water, Wastewater, and Soils EPA 361.1, SM20 4500 P B, and SM20 4500 P E	1-P-QM-WI -9014675	Analysis 8261, 8262, 8263, 8264, 8895	4027 - Instrumental Water Quality
Client Specific - Determination of Inorganic Anions by Ion Chromatography (Department of Defense)	1-P-QM-WI -9015115	Analysis DOD - 10697, 10698, 10699, 10700, 10701, 10702, 10703	4027 - Instrumental Water Quality
Client Specific - Determination of Total Cyanide in Water, Wastewater, and Soils (Department of Defense) SW-846 9012B, SW-846 9012A	1-P-QM-WI -9015116	Analysis DOD - 10704, 10705	4027 - Instrumental Water Quality
Client Specific - Total Cyanide Distillation (Department of Defense)	1-P-QM-WI -9015117	Analysis DOD - 10706, 10707	4027 - Instrumental Water Quality
Hexavalent Chromium (Cr VI) in Aqueous and Non-aqueous Samples by Method SW-846	1-P-QM-WI -9022443	Analysis 5892, 6467 OH VAP	4027 - Instrumental Water Quality

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7199 for OH VAP			
pH Meters and Probes	1-P-QM-PRO-9015415	DOD - MC-TL-001	4028 - Leachate Preparation
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Calibration of the Leachate Tumblers	1-P-QM-PRO-9015416	DOD - MC-TL-002	4028 - Leachate Preparation
Glassware Cleaning for Leachate Extractions	1-P-QM-PRO-9015525	DOD - SOP-TL-001	4028 - Leachate Preparation
Leachate Blank Evaluations	1-P-QM-PRO-9015526	DOD - SOP-TL-002	4028 - Leachate Preparation
Subsampling and Preservation of Leachates	1-P-QM-PRO-9015527	DOD - SOP-TL-003	4028 - Leachate Preparation
Manually Pressurized Zero Headspace Extractor (ZHE)	1-P-QM-PRO-9015528	DOD - SOP-TL-004	4028 - Leachate Preparation
Procedure for Calculating and Reporting Weighted Average Results for TCLP Extracts	1-P-QM-PRO-9015529	DOD - SOP-TL-005	4028 - Leachate Preparation
Shake Extraction of Solid Waste with Water ASTM Method #D3987-85	1-P-QM-WI -9015074	Analysis DOD - 0447	4028 - Leachate Preparation
Toxicity Characteristic Leaching Procedure TCLP Zero Headspace Leachates, Method 1311	1-P-QM-WI -9015085	Analysis DOD - 0946, 2573, 0075	4028 - Leachate Preparation
Toxicity Characteristic Leaching Procedure TCLP Nonvolatile Leachates	1-P-QM-WI -9015086	Analysis DOD - 0947, 1339	4028 - Leachate Preparation
Waste Extraction Test Leaching Procedure for Volatile and Non-volatile Analytes	1-P-QM-WI -9015129	Analysis DOD - 1435, 1436	4028 - Leachate Preparation
Synthetic Precipitation Leaching Procedure (SPLP) for Nonvolatile Leachates	1-P-QM-WI -9015130	Analysis DOD - 1567	4028 - Leachate Preparation
Food and Tissue Preparation	1-P-QM-WI -9015137	Analysis DOD - 2487	4028 - Leachate Preparation
Cation Exchange Capacity of Soils (Sodium Acetate) by Method 9081	1-P-QM-WI -9015138	Analysis DOD - 2595	4028 - Leachate Preparation
Synthetic Precipitation Leaching Procedure (SPLP) Zero Headspace Leachates	1-P-QM-WI -9015194	Analysis DOD - 8792, 1339	4028 - Leachate Preparation
Spectronic Genesys 2 Spectrophotometer	1-P-QM-PRO-9015417	DOD - MC-WQ-002	4029 - Water Quality
Accumet Model AB30 pH/Ion/Conductivity Meter	1-P-QM-PRO-9015419	DOD - MC-WQ-004	4029 - Water Quality
Equipment Incubators and Refrigerators	1-P-QM-PRO-9015420	DOD - MC-WQ-006	4029 - Water Quality
pH Probes and Meters	1-P-QM-PRO-9015421	DOD - MC-WQ-007	4029 - Water Quality
Equipment Muffle Furnaces and Ovens	1-P-QM-PRO-9015422	DOD - MC-WQ-009	4029 - Water Quality
Calibration of Hach 2100AN Turbidimeter	1-P-QM-PRO-9015423	DOD - MC-WQ-010	4029 - Water Quality
Maintenance of Desiccators	1-P-QM-PRO-9015424	DOD - MC-WQ-012	4029 - Water Quality
Fixed Volume Hand-Held Pipettes	1-P-QM-PRO-9015425	DOD - MC-WQ-013	4029 - Water Quality
Adjustable Volume Handheld Pipettes	1-P-QM-PRO-9015426	DOD - MC-WQ-014	4029 - Water Quality
Hach DR 2800 Spectrophotometer	1-P-QM-PRO-9015427	DOD - MC-WQ-017	4029 - Water Quality
Orion 960 Autotitration System	1-P-QM-PRO-9015428	DOD - MC-WQ-022	4029 - Water Quality
YSI Model 5100 Dissolved Oxygen Meter	1-P-QM-PRO-9015429	DOD - MC-WQ-023	4029 - Water Quality
Maintenance of Hot Plates	1-P-QM-PRO-9015430	DOD - MC-WQ-024	4029 - Water Quality
Standardization of 0.02 and 0.1 Normal Sulfuric Acid	1-P-QM-PRO-9015530	DOD - SOP-WQ-002	4029 - Water Quality
Standardization of 0.02 Normal Sodium Hydroxide	1-P-QM-PRO-9015531	DOD - SOP-WQ-005	4029 - Water Quality
Water Quality Washroom Procedures	1-P-QM-PRO-9015532	DOD - SOP-WQ-006	4029 - Water Quality
Instructions for Collecting Data on the LLENS System	1-P-QM-PRO-9015533	DOD - SOP-WQ-014	4029 - Water Quality
Chemical Review	1-P-QM-PRO-9015534	DOD - SOP-WQ-016	4029 - Water Quality
Quality Control Data for Wet Chemistry	1-P-QM-PRO-9015535	DOD - SOP-WQ-017	4029 - Water Quality
Total Solids by 2540 B-1997, EPA 160.3 or 2540 G-1997	1-P-QM-WI -9011623	Analysis 0203	4029 - Water Quality
Total Fixed Solids Total Volatile Solids by 2540	1-P-QM-WI -9011624	Analysis 0204, 0205	4029 - Water Quality

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E-1997, 160.4 or 2540 G-1997			
Total Suspended Solids by 2540 D-1997 or EPA 160.2	1-P-QM-WI -9011625	Analysis 0206	4029 - Water Quality
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Fixed Suspended Solids (Gravimetric) (#207) Volatile Suspended Solids (Gravimetric) (#208) by SM 2540 E - 1997	1-P-QM-WI -9011626	Analysis 0207, 0208	4029 - Water Quality
Total Dissolved Solids (Calculation)	1-P-QM-WI -9011627	Analysis 0209	4029 - Water Quality
Fixed Dissolved Solids (Calculation)	1-P-QM-WI -9011628	Analysis 0210	4029 - Water Quality
Volatile Dissolved Solids (Calculation)	1-P-QM-WI -9011629	Analysis 0211	4029 - Water Quality
Total Dissolved Solids in Waters (Gravimetric) by 2540 C-1997 or EPA 160.1	1-P-QM-WI -9011630	Analysis 0212	4029 - Water Quality
Settleable Solids by 2540 F-1997, or EPA 160.5	1-P-QM-WI -9011631	Analysis 0215	4029 - Water Quality
Ammonia-Nitrogen for Waters (Titrimetric Distillation Procedure) by 4500-NH3 B/C (Modified)-1997, or EPA 350.2	1-P-QM-WI -9011636	Analysis 0221	4029 - Water Quality
Methylene-Blue-Active Substances (MBAS) by 5540 C-2000 or EPA 425.1	1-P-QM-WI -9011638	Analysis 0225	4029 - Water Quality
Orthophosphate by EPA 365.3, or 4500-P E-1999	1-P-QM-WI -9011639	Analysis 0226	4029 - Water Quality
Sulfite by 4500-SO3 B-2000, or EPA 377.1	1-P-QM-WI -9011641	Analysis 0229	4029 - Water Quality
Colorimetric Sulfide in Waters (#0230), Sulfide as H2S (#10293 Calculation), Dissolved Sulfide in Waters (#10499) by 4500-S2 B/C/D-2000, 4500-S2 F-2000, or EPA 376.2	1-P-QM-WI -9011642	Analysis 0230, 10293, 10499	4029 - Water Quality
Chemical Oxygen Demand (COD) (Dichromate Reflux Method) (Titrimetric, Mid-Level)	1-P-QM-WI -9011644	Analysis 0234	4029 - Water Quality
Biochemical Oxygen Demand Determination in Waters by SM 5210 B-2001 or EPA 405.1	1-P-QM-WI -9011645	Analysis 0235	4029 - Water Quality
Free Carbon Dioxide (Calculation)	1-P-QM-WI -9011647	Analysis 0238	4029 - Water Quality
Chlorine Residual by 4500 Cl F-2000, or EPA 330.4	1-P-QM-WI -9011648	Analysis 0240	4029 - Water Quality
Hexavalent Chromium (Colorimetric) by SW-846 7196A	1-P-QM-WI -9011652	Analysis 0276, 10330	4029 - Water Quality
Color by 2120 B-2001, or EPA 110.2	1-P-QM-WI -9011653	Analysis 0277	4029 - Water Quality
Turbidity (Nephelometric)	1-P-QM-WI -9011654	Analysis 0279	4029 - Water Quality
pH (SW) (Electrometric)	1-P-QM-WI -9011685	Analysis 0394, 0496	4029 - Water Quality
Hexavalent Chromium in Solids (Alkaline Digestion and Analysis Methods)	1-P-QM-WI -9011687	Analysis 0425, 7825, 2432	4029 - Water Quality
Dissolved Oxygen (Membrane Electrode) by 4500 O G-2001 or EPA 360.1	1-P-QM-WI -9011688	Analysis 0428	4029 - Water Quality
Determination of Flash Point for Liquids and Solids	1-P-QM-WI -9011689	Analysis 0430	4029 - Water Quality
Acidity to pH 3.7 and pH 8.3 (Titrimetric) by EPA 305.2	1-P-QM-WI -9011691	Analysis 0475, 0476	4029 - Water Quality
Soluble Biochemical Oxygen Demand Determination in Waters by Incubation by 5210 B Modified-2001 or EPA 405.1	1-P-QM-WI -9012740	Analysis 0541	4029 - Water Quality
Ignitability of Solids	1-P-QM-WI -9012741	Analysis 0542	4029 - Water Quality
Dissolved Silica (Colorimetric) by SM4500SiO2 C-1997 or EPA 370.1	1-P-QM-WI -9012742	Analysis 0559	4029 - Water Quality
Ammonia-Nitrogen for Soils (Tritrimetric Distillation Procedure) by 4500-NH3 B/C (Modified)-1997, or EPA 350.2 (Modified)	1-P-QM-WI -9012743	Analysis 0573	4029 - Water Quality
Ammonia Nitrogen by Ion-Selective Electrode Method (ISE) in Solids by EPA 350.3 (Modified) and SM 4500-NH3B-1997	1-P-QM-WI -9012763	Analysis 10222, 10696	4029 - Water Quality

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Total Suspended Solids in Waters (Gravimetric) by SM 2540 D - 1997	1-P-QM-WI -9012778	Analysis 10457	4029 - Water Quality
Hexavalent Chromium (Colorimetric) in Waters by MCP	1-P-QM-WI -9012870	Analysis 11145	4029 - Water Quality
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Hexavalent Chromium in Solids by MCP (Alkaline Digestion and Analysis Methods)	1-P-QM-WI -9012871	Analysis 11146	4029 - Water Quality
Reactivity	1-P-QM-WI -9013027	Analysis 1121	4029 - Water Quality
Reactive Sulfide	1-P-QM-WI -9013032	Analysis 1122	4029 - Water Quality
Chloride (Titrimetric Determination) by SM 4500-Cl C-1997	1-P-QM-WI -9013035	Analysis 1124	4029 - Water Quality
Sulfate (turbidimetric) in Waters	1-P-QM-WI -9013037	Analysis 1125	4029 - Water Quality
Analysis of Conductivity, Alkalinity, pH, Temperature of pH, Fluoride, Turbidity, Total Hardness, Carbonate, Bicarbonate, and Ammonia by Either Man-Tech Multi-Parameter System or Manual Technique	1-P-QM-WI -9013112	Analysis 12145, 12146, 12147, 12148, 12149, 12150, 12151, 12152, 12677, 12678, 12679	4029 - Water Quality
Specific Conductance (Solids) by SW-846 9050 (Modified), EPA 120.1 (Modified) or 2510B-1997	1-P-QM-WI -9013113	Analysis 1215	4029 - Water Quality
Sulfide Titration for Water by 4500 S2 F-2000, EPA 376.1, or SW-846 Method 9034	1-P-QM-WI -9013125	Analysis 1333	4029 - Water Quality
Carbonaceous Biochemical Oxygen Demand Determination in Waters by SM 5210 B-2001	1-P-QM-WI -9013128	Analysis 1364	4029 - Water Quality
pH (CLP) (Electrometric)	1-P-QM-WI -9013130	Analysis 1441	4029 - Water Quality
#1443 Specific Gravity by SM 2710 F #6569 Bulk Density by ASTM E868-82 Sec 9.9 Modified	1-P-QM-WI -9013131	Analysis 1443, 6569	4029 - Water Quality
Low-Level Hexavalent Chromium (colorimetric) by 3500-Cr B-2009	1-P-QM-WI -9013132	Analysis 1446	4029 - Water Quality
Bellack Distillation for Fluoride in Waters and Solids by SM 4500 F B–1997 or EPA 340.1 Procedure 6.1	1-P-QM-WI -9013133	Analysis 1448	4029 - Water Quality
Chemical Oxygen Demand (COD) in Waters (Dichromate Reflux Method) (Titrimetric, Low-Level)	1-P-QM-WI -9013143	Analysis 1553	4029 - Water Quality
Acid Volatile Sulfide in Solids	1-P-QM-WI -9013392	Analysis 1630	4029 - Water Quality
Paint Filter Liquids Test (Free Liquids Test)	1-P-QM-WI -9013402	Analysis 1820	4029 - Water Quality
Oxidation-Reduction Potential	1-P-QM-WI -9013403	Analysis 1821	4029 - Water Quality
Hexavalent Chromium in Solids by CTRCP (Alkaline Digestion and Analysis Methods)	1-P-QM-WI -9013409	Analysis 1962, 7825	4029 - Water Quality
Hexavalent Chromium (Colorimetric) in Waters by CTRCP	1-P-QM-WI -9013410	Analysis 1968	4029 - Water Quality
Percent Solids for GC/MS	1-P-QM-WI -9013444	Analysis 2365	4029 - Water Quality
n-Hexane Extractable Material (HEM) in Solids and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM)	1-P-QM-WI -9013456	Analysis 2562, 6598	4029 - Water Quality
Chemical Oxygen Demand (COD) (Dichromatic Reflux Method) (Colorimetric)	1-P-QM-WI -9013470	Analysis 4001	4029 - Water Quality
Total Acidity for Wastewater by SM 2310 B-1997 or EPA 305.1	1-P-QM-WI -9013474	Analysis 4530	4029 - Water Quality
Total Dissolved Solids by 2540 C	1-P-QM-WI -9014026	Analysis 6649	4029 - Water Quality
Moisture (Gravimetric), Total Residue (#0521), Volatile Residue (#0522), Total Fixed Residue/Ash (#1029) by SM 2540 G-1997 or SM 2540 E-1997	1-P-QM-WI -9014030	Analysis 6866, 0521, 0522, 1029	4029 - Water Quality
Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D422	1-P-QM-WI -9014165	Analysis 7103, 11601, 11604	4029 - Water Quality

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Hexane Extractable Material (HEM) and Silica Gel Treated Hexane Extractable Materials (SGT-HEM) in Waters by EPA Method 1664A and EPA Method 1664B	1-P-QM-WI -9014492	Analysis 8079, 8078, 0612	4029 - Water Quality
Ferrous Iron By Method 3500-Fe B (Modified) - 1997	1-P-QM-WI -9015060	Analysis 8344, 10328	4029 - Water Quality
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Client Specific - Hexavalent Chromium in Waters (Colorimetric) (Department of Defense)	1-P-QM-WI -9015113	Analysis DOD - 10678	4029 - Water Quality
Client Specific - Hexavalent Chromium in Solids by Alkaline Digestion and Analysis Methods (Department of Defense)	1-P-QM-WI -9015114	Analysis DOD - 10679, 7825	4029 - Water Quality
Digestion Procedure for the Determination of Hexavalent Chromium (Cr VI) Digestion of Non-aqueous Samples by Method SW-846 3060A for OH VAP	1-P-QM-WI -9022448	Analysis 7825 OH VAP	4029 - Water Quality
Calibration of Pressure Gauges	1-P-QM-PRO-9015391	DOD - MC-AL-002	4030 - Volatiles in Air
Routine Instrument Maintenance for Volatiles in Air by GC and GC/MS	1-P-QM-PRO-9015392	DOD - MC-AL-003	4030 - Volatiles in Air
Cleaning and Handling of Summa Canisters	1-P-QM-PRO-9015431	DOD - SOP-AL-001	4030 - Volatiles in Air
Cleaning and Handling of Flow Controllers	1-P-QM-PRO-9015432	DOD - SOP-AL-002	4030 - Volatiles in Air
Volatiles in Air Audit Process	1-P-QM-PRO-9015433	DOD - SOP-AL-003	4030 - Volatiles in Air
Procedure for Compositing Samples from a Tedlar Bag	1-P-QM-PRO-9017689	SOP-AL-004	4030 - Volatiles in Air
Preparing Summa Can Order	1-P-QM-PRO-9017690	SOP-AL-005	4030 - Volatiles in Air
Oxygen and Carbon Dioxide in Air	1-P-QM-WI -9011592	Analysis 0034	4030 - Volatiles in Air
Volatiles in Air Tentatively Identified Compound Method (Interpretive)	1-P-QM-WI -9012747	Analysis 0888	4030 - Volatiles in Air
Helium as a Tracer Gas	1-P-QM-WI -9012770	Analysis 10341	4030 - Volatiles in Air
The Automated Determination of Volatile Organic Compounds in Air Collected in Specially Treated Canisters Using Cryogenic Preconcentration and Gas Chromatography with Mass Selective Detection Using NJDEP Modified Low Level Method TO-15	1-P-QM-WI -9012799	Analysis 10734	4030 - Volatiles in Air
Analysis of Air for Selected Volatile Organic Compounds by Gas Chromatography with Flame Ionization Detector and Photoionization Detector for Louisiana RECAP Vapor Evaluation	1-P-QM-WI -9014029	Analysis 6820	4030 - Volatiles in Air
Volatiles in Air Tentatively Identified Compound Method	1-P-QM-WI -9014034	Analysis 6900	4030 - Volatiles in Air
The Determination of Volatile Organic Compounds in Air Collected in Summa Canisters or Tedlar Bags Using Cryogenic Preconcentration and GC/MS Detection Using EPA Method TO-14 or TO-15	1-P-QM-WI -9015155	Analysis DOD - 5265, 5298, 0015, 0037, 7199, 7869	4030 - Volatiles in Air
Analysis of Air for Selected Volatile Organic Compounds by Gas Chromatography with Flame Ionization Detector and Photo Using EPA Method 18 and 25	1-P-QM-WI -9015177	Analysis DOD - 7090	4030 - Volatiles in Air
SIM Analysis of Low-Level Volatile Organic Compounds in Air Collected in Specially Treated Canisters or Tedlar Bags Using Cryogenic Preconcentration and Gas Chromatography with SIM Mass Selective Detection Using EPA Method TO-15	1-P-QM-WI -9015182	Analysis DOD - 7345	4030 - Volatiles in Air
Collecting Water Samples for Regulatory Purposes	1-P-QM-PRO-9015458	DOD - SOP-FS-012	4031 - Field Sampling
Calibration, Operation and Maintenance of pH Probes and Meters	1-P-QM-PRO-9017426	MC-FS-002	4031 - Field Sampling

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Wastewater Field Sampling Procedures	1-P-QM-PRO-9017757	SOP-FS-002	4031 - Field Sampling
Soil Sampling Procedures	1-P-QM-PRO-9017758	SOP-FS-003	4031 - Field Sampling
Collecting Potable Water Samples	1-P-QM-PRO-9017759	SOP-FS-004	4031 - Field Sampling
Groundwater Monitoring Sampling Procedure	1-P-QM-PRO-9017760	SOP-FS-006	4031 - Field Sampling
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Direct Field Readings Using Orion Model 1230 Multi-Parameter Meter	1-P-QM-PRO-9017761	SOP-FS-008	4031 - Field Sampling
Symphony Multi-Parameter Meter	1-P-QM-PRO-9017762	SOP-FS-009	4031 - Field Sampling
Low Level Mercury Sampling	1-P-QM-PRO-9017763	SOP-FS-010	4031 - Field Sampling
Performing Free Chlorine Residual Readings	1-P-QM-PRO-9017764	SOP-FS-011	4031 - Field Sampling
Sampling Swimming Pool Water	1-P-QM-PRO-9018291	SOP-TR-003	4031 - Field Sampling
Maintenance and Troubleshooting Procedures for GC-FID Instrumentation	1-P-QM-PRO-9015447	DOD - SOP-EP-006	4032 - EPH/Misc. GC
Common Equations Used During Chromatographic Analyses	1-P-QM-PRO-9015448	DOD - SOP-EP-008	4032 - EPH/Misc. GC
QC Data Acceptability and Corrective Action	1-P-QM-PRO-9015449	DOD - SOP-EP-009	4032 - EPH/Misc. GC
Monitoring QC Data Acceptance Limits	1-P-QM-PRO-9015450	DOD - SOP-EP-010	4032 - EPH/Misc. GC
Interpretation and Integration of Chromatographic Data	1-P-QM-PRO-9015451	DOD - SOP-EP-011	4032 - EPH/Misc. GC
Using "Range Compound Analysis" Software for Range Data Acquisition	1-P-QM-PRO-9017817	SOP-OR-082	4032 - EPH/Misc. GC
GC Routine and Nonroutine Maintenance for Instrumentation Used for VPH Analysis	1-P-QM-PRO-9023979	N/A	4032 - EPH/Misc. GC
Extraction of Solids/Soils for Analysis of Alcohols by Method 8015B	1-P-QM-WI -9011684	Analysis 0380	4032 - EPH/Misc. GC
Silica Gel Fractionation for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9012711	Analysis 0497	4032 - EPH/Misc. GC
CCWE Water Miscible Solvents	1-P-QM-WI -9012748	Analysis 0969	4032 - EPH/Misc. GC
Determination of Terphenyls by Method 8015B in Water and Solids Using GC-FID	1-P-QM-WI -9012769	Analysis 10318, 10319	4032 - EPH/Misc. GC
Hydrocarbon Oil Index by ISO Method 9377-2:2000	1-P-QM-WI -9012775	Analysis 10441	4032 - EPH/Misc. GC
Separatory Funnel Extraction of Hydrocarbon Oil Index in Waters	1-P-QM-WI -9012776	Analysis 10442	4032 - EPH/Misc. GC
Client Specific - Method for the Determination of Extractable Petroleum Hydrocarbons by New Jersey Protocol (NJEPH) using GC-FID	1-P-QM-WI -9012863	Analysis 10967, 10973	4032 - EPH/Misc. GC
Client Specific - Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Solid Matrix by New Jersey Protocol	1-P-QM-WI -9012864	Analysis 10979, 11990	4032 - EPH/Misc. GC
Extraction Procedure for Wisconsin DRO Soils and Solid Waste	1-P-QM-WI -9012868	Analysis 11029	4032 - EPH/Misc. GC
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Maine Methodology	1-P-QM-WI -9013014	Analysis 11165	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Wisconsin Protocol	1-P-QM-WI -9013015	Analysis 11166	4032 - EPH/Misc. GC
Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Oklahoma Methodology	1-P-QM-WI -9013016	Analysis 11168	4032 - EPH/Misc. GC
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or	1-P-QM-WI -9013017	Analysis 11170	4032 - EPH/Misc. GC

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Wastewater Matrix by FL-PRO			
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Montana Protocol	1-P-QM-WI -9013018	Analysis 11174, 11243	4032 - EPH/Misc. GC

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Client Specific - Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water Matrix by Washington Methodology	1-P-QM-WI -9013019	Analysis 11175	4032 - EPH/Misc. GC
Extraction Procedure for the Determination of Total Petroleum Hydrocarbons in a Water or Wastewater Matrix by Connecticut Methodology	1-P-QM-WI -9013020	Analysis 11178	4032 - EPH/Misc. GC
Client Specific - Separatory Funnel Extract Procedure for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Water or Wastewater Matrix by Tennessee Methodology	1-P-QM-WI -9013021	Analysis 11179	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water Matrix by Alaska 102/103	1-P-QM-WI -9013022	Analysis 11184, 11185, 11242, 13027, 13030	4032 - EPH/Misc. GC
Client Specific - Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by Texas Methodology	1-P-QM-WI -9013023	Analysis 11192	4032 - EPH/Misc. GC
Client Specific - Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix Oklahoma Methodology	1-P-QM-WI -9013024	Analysis 11206	4032 - EPH/Misc. GC
Client Specific - Sonication Extraction Procedure for the Determination of Diesel Range Organics in Soil or Solid Matrix California Methodology	1-P-QM-WI -9013025	Analysis 11207, 11214	4032 - EPH/Misc. GC
Sonic Probe Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in Soil or Solid Matrix Florida Methodology	1-P-QM-WI -9013026	Analysis 11208	4032 - EPH/Misc. GC
Client Specific - Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Montana Protocol	1-P-QM-WI -9013028	Analysis 11212	4032 - EPH/Misc. GC
Client Specific - Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Washington Protocol	1-P-QM-WI -9013029	Analysis 11213	4032 - EPH/Misc. GC
Client Specific - Sonic Probe Extraction for the Determination of Extractable Total Petroleum Hydrocarbons in Soil or Solid Matrix Connecticut Methology	1-P-QM-WI -9013030	Analysis 11216	4032 - EPH/Misc. GC
Sonic Probe Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in Soil or Solid Matrix Tennessee Methodology	1-P-QM-WI -9013031	Analysis 11217	4032 - EPH/Misc. GC
Client Specific - Extraction Procedure for the Determination ofTotal Petroleum Hydrocarbons in a Soil or Solid Matrix by Texas Methodology	1-P-QM-WI -9013033	Analysis 11230, 11244	4032 - EPH/Misc. GC
Total Saturated Hydrocarbons by Method 8015C in Waters and Solids using GC/FID	1-P-QM-WI -9013038	Analysis 11507, 11554	4032 - EPH/Misc. GC
Extraction of Soils/Solids for Glycol Analysis	1-P-QM-WI -9013039	Analysis 11551	4032 - EPH/Misc. GC
Alumina Column Cleanup of Solids	1-P-QM-WI -9013040	Analysis 11599, 11600	4032 - EPH/Misc. GC
Waste Dilution for the Determination of Saturated Hydrocarbons in an Oil Matrix	1-P-QM-WI -9013051	Analysis 11657	4032 - EPH/Misc. GC
10g Silica Gel Cleanup for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9013055	Analysis 11681	4032 - EPH/Misc. GC
Microextraction by Method 3511 for the Determination of Diesel Range Organics in Water	1-P-QM-WI -9013110	Analysis 12059, 12866, 12895, 12896, 12897, 12898	4032 - EPH/Misc. GC

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Client Specific - Total Extractable Hydrocarbons (TEH) by Method 8015B Modified Using GC-FID	1-P-QM-WI -9013137	Analysis 1464, 1469, 10007	4032 - EPH/Misc. GC
Analysis of DRO/RRO by Alaska 102/103 in Waters and Soils	1-P-QM-WI -9013394	Analysis 1738, 1741, 1742, 2238, 2244, 2245, 2923	4032 - EPH/Misc. GC
Qualitative/Quantitative GC Fingerprint by 8015B Mod/ 8015C Mod/ or 8015D Mod	1-P-QM-WI -9013412	Analysis 2012, 2535	4032 - EPH/Misc. GC
Determination of Petroleum Range Organics in Waters and Solids using FL-PRO	1-P-QM-WI -9013420	Analysis 0347, 0359, 2099, 2100	4032 - EPH/Misc. GC
Method for the Determination of Extractable Petroleum Hydrocarbons by GC/FID using OA-2 Iowa/Missouri Protocol for Waters and Soils	1-P-QM-WI -9013421	Analysis 2110, 2112	4032 - EPH/Misc. GC
Separatory Funnel Extraction Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	1-P-QM-WI -9013424	Analysis 2135, 11197, 12007, 12119, 12120, 12907, 12916, 12924	4032 - EPH/Misc. GC
Client Specific - Microwave Extraction for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Solid Matrix by Massachusetts Protocol	1-P-QM-WI -9013429	Analysis 2168, 11235	4032 - EPH/Misc. GC
Quick Silica Gel Cleanup for Hydrocarbons by GC in Solid and Water Matrices	1-P-QM-WI -9013430	Analysis 2176	4032 - EPH/Misc. GC
Client Specific - TNRCC TX Method 1005 - Total Petroleum Hydrocarbons (Gasoline Range, Diesel Range, and Extended Range Organics)	1-P-QM-WI -9013442	Analysis 2318, 2321	4032 - EPH/Misc. GC
PMI Volatile Organic Compounds by Direct Injection GC/FID	1-P-QM-WI -9013445	Analysis 2366, 2380	4032 - EPH/Misc. GC
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by California Methodology	1-P-QM-WI -9013446	Analysis 2376, 11169, 11180, 11187, 11188, 11198, 11199	4032 - EPH/Misc. GC
TPH by CT ETPH	1-P-QM-WI -9013462	Analysis 2768, 2769	4032 - EPH/Misc. GC
Client Specific - TPH by TN EPH in Water and Soil using GC/FID	1-P-QM-WI -9013463	Analysis 2784, 2785	4032 - EPH/Misc. GC
Client Specific - Method for the Determination of Extractable Petroleum Hydrocarbons by Massachusetts Protocol (MAEPH)	1-P-QM-WI -9013971	Analysis 5331, 5332, 5944, 5949, 5968, 5969	4032 - EPH/Misc. GC
VPH in Waters and Solids Using GC-FID by Method ECY 97-602 WA VPH	1-P-QM-WI -9013982	Analysis 5665, 5666	4032 - EPH/Misc. GC
EPH in Waters and Solids Using GC-FID by Method ECY97-602 WA EPH	1-P-QM-WI -9013990	Analysis 5979, 5970	4032 - EPH/Misc. GC
Client Specific - TNRCC TX Method 1006 Characterization of C6-C35 Petroleum Hydrocarbons in Environmental Samples	1-P-QM-WI -9013996	Analysis 6091, 6104	4032 - EPH/Misc. GC
Determination of the Volatile Organic Concentration of Waste Samples by FID and ELCD	1-P-QM-WI -9014040	Analysis 7001	4032 - EPH/Misc. GC
Sonic Probe Extraction for TPH in Solids by Washington DX	1-P-QM-WI -9014041	Analysis 7024, 11234, 12008, 12117, 12118	4032 - EPH/Misc. GC
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Massachusetts or New Jersey Protocol	1-P-QM-WI -9014170	Analysis 7326, 10980, 11200 MA/LA/NJ	4032 - EPH/Misc. GC
Analysis for TPH-DRO (Diesel Range Organics) in Soils or Waters by Wisconsin DRO Methodology	1-P-QM-WI -9014172	Analysis 7553, 7554	4032 - EPH/Misc. GC
TPH DRO (Diesel Range Organics) by Oklahoma DEQ Method	1-P-QM-WI -9014308	Analysis 7784, 7785, 10024, 10027	4032 - EPH/Misc. GC
TPH by NWTPH-Dx (modified) in Waters using GC-FID	1-P-QM-WI -9015026	Analysis 8271, 2211, 12005	4032 - EPH/Misc. GC

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TPH by NWTPH-Dx (modified) in Soils using GC-FID	1-P-QM-WI -9015027	Analysis 8272, 2214, 12006	4032 - EPH/Misc. GC
Analysis of Glycols in Waters by Method 8015B or 8015C	1-P-QM-WI -9015028	Analysis 8278, 11099, 12926	4032 - EPH/Misc. GC
Analysis of Glycols in Soils by Method 8015B	1-P-QM-WI -9015029	Analysis 8283	4032 - EPH/Misc. GC
Method for the Determination of Fractionated Extractable Petroleum Hydrocarbons using LA RECAP Ranges	1-P-QM-WI -9015030	Analysis 8323, 8324, 6976, 7062	4032 - EPH/Misc. GC
Client Specific - MA VPH Analysis of Water and Soil Samples	1-P-QM-WI -9015061	Analysis 8754, 8765, 5869, 5988, 6629, 6630, 10886, 10889	4032 - EPH/Misc. GC
TPH-DRO by 8015C/8015D in Water using GC-FID (Diesel Range Organics)	1-P-QM-WI -9015111	Analysis DOD - 10600	4032 - EPH/Misc. GC
TPH-DRO by 8015C/8015D in Solids using GC-FID (Diesel Range Organics)	1-P-QM-WI -9015112	Analysis DOD - 10601, 12838	4032 - EPH/Misc. GC
Microwave Extraction for the Determination of Diesel Range Organics (DRO) and Saturated Hydrocarbons in a Solid Matrix	1-P-QM-WI -9015120	Analysis DOD - 10942, 11509	4032 - EPH/Misc. GC
Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix by Alaska Methodology	1-P-QM-WI -9015123	Analysis DOD - 11222, 11223, 11239, 11248	4032 - EPH/Misc. GC
Sonic Disruption Extraction Procedure for the Determination of GC Fingerprint on Petroleum Products in Soil or Solid Matrix	1-P-QM-WI -9015151	Analysis DOD - 4833, 11227	4032 - EPH/Misc. GC
TPH by GC-FID and TPH by Custom 8015B	1-P-QM-WI -9015154	Analysis DOD - 5256, 5260, 8734, 8735	4032 - EPH/Misc. GC
Water Miscible Solvents by Method 8015B/8015C/8015D Using GC-FID	1-P-QM-WI -9015169	Analysis DOD - 6624, 10501, 10603, 10604	4032 - EPH/Misc. GC
Separatory Funnel Extraction Method 3510C for DRO in Water or Wastewater	1-P-QM-WI -9015175	Analysis DOD - 7003, 10304, 11164, 11167, 11171, 11172, 11176, 11177, 11181, 11183, 11189, 11190, 11191, 11195, 11196, 11201, 11203, 11596, 12820, 12906, 12915, 12923, 13095	4032 - EPH/Misc. GC
Sonication Extraction Method 3550C for DRO in Soils or Solids	1-P-QM-WI -9015176	Analysis DOD - 7004, 10303, 11204, 11205, 11209, 11215, 11218, 11219, 11225, 11228, 11229, 11233, 11236, 11237, 11238, 13097	4032 - EPH/Misc. GC
Volatile Hydrocarbons in Water by Method RSK-175 Modified and SW-846 8015 Using Headspace Sampling Techniques and GC-FID	1-P-QM-WI -9015178	Analysis DOD - 7105, 10602	4032 - EPH/Misc. GC
Analysis of Total Petroleum Hydrocarbons with Ranges by GC-FID, Based on Method 8015B	1-P-QM-WI -9015186	Analysis DOD - 8093, 8107, 2500, 2516, 2729, 2740, 0071, 0072, 0965, 1020, 6631, 6635, 10199, 10365	4032 - EPH/Misc. GC
Determination of Carbon Dioxide in Water Using Headspace Sampling Techniques and Gas Chromatography with Thermal Conductivity Detection (GC-TCD)	1-P-QM-WI -9015187	Analysis DOD - 8097	4032 - EPH/Misc. GC
TPH-DRO by 8015B in Solids using GC-FID (Diesel Range Organics)	1-P-QM-WI -9015191	Analysis DOD - 1104, 2222, 5868, 6901, 6902, 8270, 8345, 10941, 12831	4032 - EPH/Misc. GC

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TPH-DRO by 8015B in Water using GC-FID (Diesel Range Organics)	1-P-QM-WI -9020088	1070, 1737, 2216, 2251, 5867, 6609, 6610, 6884, 6885, 6912, 6913, 8269, 8349, 11918, 12680, 12816	4032 - EPH/Misc. GC
Silica Gel Column Cleanup for Hydrocarbons by GC in Aqueous Matrices	1-P-QM-WI -9020897	Analysis 12894	4032 - EPH/Misc. GC
Analysis of DRO/TPH by 8015B or NWTPH-Dx (Modified) in Waters using Microextraction and GC-FID	1-P-QM-WI -9020899	Analysis 12858, 12872, 12879	4032 - EPH/Misc. GC
Analysis of DRO by 8015B and TPH by NWTPH-DX (Modified) in Water using Mini-Extraction and GC-FID	1-P-QM-WI -9021423	Analysis 12899, 12908, 12917	4032 - EPH/Misc. GC
3 g Silica Gel Column Cleanup for DRO	1-P-QM-WI -9021425	Analysis 12932	4032 - EPH/Misc. GC
Determination of Diesel and Residual Range Organics using Alaska 102/103 Small Volume (SV) Protocols in Aqueous Samples	1-P-QM-WI -9021778	Analysis 13025, 13028	4032 - EPH/Misc. GC
TPH-DX with Fuel Identification in Waters and Solids by NWTPH-DX	1-P-QM-WI -9023949	Analysis 12071, 12082, 12093, 12094	4032 - EPH/Misc. GC
TPH-DRO by 8015C South Carolina Methodology Using GC-FID	1-P-QM-WI -9024963	Analysis 13094, 13096	4032 - EPH/Misc. GC
Extraction of Nicotine from Tobacco Products Using the Centers for Disease Control Protocol	1-P-QM-WI -9011593	Analysis 0088	4035 - Nitrosamines
CDC Tobacco Moisture	1-P-QM-WI -9011594	Analysis 0091	4035 - Nitrosamines
Analysis of Nicotine in Tobacco by GC/FID for Smokeless Tobacco Products Using the CDC Method	1-P-QM-WI -9011595	Analysis 0097	4035 - Nitrosamines
Nitrite in Tobacco Prep	1-P-QM-WI -9013438	Analysis 2264	4035 - Nitrosamines
Nitrite Nitrogen Analysis in Tobacco	1-P-QM-WI -9013440	Analysis 2266	4035 - Nitrosamines
Extraction of Tobacco Specific N-Nitrosamines in Tobacco Filler	1-P-QM-WI -9013443	Analysis 2326LC	4035 - Nitrosamines
Nitrate in Tobacco Prep	1-P-QM-WI -9013457	Analysis 2610	4035 - Nitrosamines
Nitrate Nitrogen in Tobacco (Colorimetric, Automated Cadmium Reduction)	1-P-QM-WI -9013464	Analysis 2808	4035 - Nitrosamines
Tobacco Drying and Grinding	1-P-QM-WI -9013801	Analysis 4998	4035 - Nitrosamines
Analysis of Tobacco Specific Nitrosamines (TSNA) in Tobacco Leaf by LC/MS/MS	1-P-QM-WI -9013802	Analysis 5102	4035 - Nitrosamines
Extraction of Nicotine from Tobacco and Tobacco Products	1-P-QM-WI -9014031	Analysis 6870	4035 - Nitrosamines
Analysis of Nicotine in Tobacco by GC/FID Following Coresta 62	1-P-QM-WI -9014032	Analysis 6878	4035 - Nitrosamines
Extraction of Tobacco for Benzo[a]Pyrene	1-P-QM-WI -9014033	Analysis 6883	4035 - Nitrosamines
Column Cleanup of Tobacco for TSNAs	1-P-QM-WI -9014036	Analysis 6962	4035 - Nitrosamines
Ultrasonic Processor Maintenance and Tuning	1-P-QM-PRO-9015405	DOD - MC-OE-002	4036 - Organic Extraction
Semivolatile Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015406	DOD - MC-OE-003	4036 - Organic Extraction
Pesticide Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015407	DOD - MC-OE-004	4036 - Organic Extraction
Steam Bath and N-Evap Usage, Calibration and Maintenance	1-P-QM-PRO-9015408	DOD - MC-OE-007	4036 - Organic Extraction
Refrigerated Recirculators	1-P-QM-PRO-9015409	DOD - MC-OE-008	4036 - Organic Extraction
Electrothermal Heating Mantles	1-P-QM-PRO-9015410	DOD - MC-OE-009	4036 - Organic Extraction
N-Evap	1-P-QM-PRO-9015411	DOD - MC-OE-010	4036 - Organic Extraction
Glassware Cleaning for Organic Extractions	1-P-QM-PRO-9015475	DOD - SOP-OE-001	4036 - Organic Extraction
Solvent and Reagent Lot Testing for Organic	1-P-QM-PRO-9015476	DOD - SOP-OE-002	4036 - Organic Extraction

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Extractions			
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Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)	1-P-QM-PRO-9015477	DOD - SOP-OE-004	4036 - Organic Extraction
pH Meters and Electrodes	1-P-QM-PRO-9015478	DOD - SOP-OE-005	4036 - Organic Extraction
Procedure for Containment and Clean Up of Hazardous Materials Spills in Organic Prep Lab	1-P-QM-PRO-9015479	DOD - SOP-OE-006	4036 - Organic Extraction
Determining QC Sample Volume for Organic Extractions	1-P-QM-PRO-9015480	DOD - SOP-OE-007	4036 - Organic Extraction
Scheduling Extraction Batches	1-P-QM-PRO-9015481	DOD - SOP-OE-008	4036 - Organic Extraction
Spike Solution Testing and Approval	1-P-QM-PRO-9015482	DOD - SOP-OE-009	4036 - Organic Extraction
Ultrasonic Probe Horn Cleaning	1-P-QM-PRO-9015483	DOD - SOP-OE-010	4036 - Organic Extraction
Routine Maintenance of Miele Glass Washers	1-P-QM-PRO-9015484	DOD - SOP-OE-011	4036 - Organic Extraction
Pesticide Extract Concentration Using a Zymark TurboVap II Concentration Workstation	1-P-QM-PRO-9015485	DOD - SOP-OE-012	4036 - Organic Extraction
Maintenance of Accelerated Solvent Extractor (ASE) and the Pressurized Solvent Extractor (PSE)	1-P-QM-PRO-9015486	DOD - SOP-OE-013	4036 - Organic Extraction
Glassware Cleaning using Automatic Washers for non-Organic Extraction Glassware	1-P-QM-PRO-9015487	DOD - SOP-OE-014	4036 - Organic Extraction
Semivolatile Extract Concentration Using a Zymark TurboVap II Concentration Workstation	1-P-QM-PRO-9015488	DOD - SOP-OE-015	4036 - Organic Extraction
Concentration Using a TurboVap LV Concentration Workstation	1-P-QM-PRO-9015489	DOD - SOP-OE-016	4036 - Organic Extraction
Organic Extraction Standards Storage and Handling	1-P-QM-PRO-9015490	DOD - SOP-OE-017	4036 - Organic Extraction
Maintenance and Calibration of the Microwave Accelerated Reaction System	1-P-QM-PRO-9017428	MC-OE-013	4036 - Organic Extraction
Pesticide Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023663	N/A	4036 - Organic Extraction
Semivolatile Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023664	N/A	4036 - Organic Extraction
Pesticides and Polychlorinated Biphenyls (PCBs) Cleanup Procedures for OH VAP	1-P-QM-PRO-9024148	N/A	4036 - Organic Extraction
Silica Gel Fractionation for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9012711	Analysis 0497	4036 - Organic Extraction
Medium Level Sonic Probe Extraction Procedure for the Determination of Pesticides and PCBs in a Solid Matrix	1-P-QM-WI -9012745	Analysis 0819M, 11144	4036 - Organic Extraction
Liquid/Liquid Extraction Procedure for the Determination of Organophosphorous Pesticides in a Wastewater Matrix	1-P-QM-WI -9012765	Analysis 10240	4036 - Organic Extraction
Separatory Funnel Extraction of Hydrocarbon Oil Index in Waters	1-P-QM-WI -9012776	Analysis 10442	4036 - Organic Extraction
Extraction Procedure for the Determination of 2-Chlorbenzalmalonotrile (CS) and 3-Quinuclidinyl Benzilate (BZ) in Water and Wastewater	1-P-QM-WI -9012779	Analysis 10475	4036 - Organic Extraction
Microwave Extraction for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9012780	Analysis 10481, 11598	4036 - Organic Extraction
Client Specific - Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Solid Matrix by New Jersey Protocol	1-P-QM-WI -9012864	Analysis 10979, 11990	4036 - Organic Extraction
Solid Phase Extraction Procedure for the Determination of THPA, THPI and PA in a Water Matrix	1-P-QM-WI -9012865	Analysis 11011	4036 - Organic Extraction
Extraction Procedure for Wisconsin DRO Soils	1-P-QM-WI -9012868	Analysis 11029	4036 - Organic Extraction

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Client Specific - Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Maine Methodology	1-P-QM-WI -9013014	Analysis 11165	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Wisconsin Protocol	1-P-QM-WI -9013015	Analysis 11166	4036 - Organic Extraction
Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Oklahoma Methodology	1-P-QM-WI -9013016	Analysis 11168	4036 - Organic Extraction
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by FL-PRO	1-P-QM-WI -9013017	Analysis 11170	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Montana Protocol	1-P-QM-WI -9013018	Analysis 11174, 11243	4036 - Organic Extraction
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water Matrix by Washington Methodology	1-P-QM-WI -9013019	Analysis 11175	4036 - Organic Extraction
Extraction Procedure for the Determination of Total Petroleum Hydrocarbons in a Water or Wastewater Matrix by Connecticut Methodology	1-P-QM-WI -9013020	Analysis 11178	4036 - Organic Extraction
Client Specific - Separatory Funnel Extract Procedure for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Water or Wastewater Matrix by Tennessee Methodology	1-P-QM-WI -9013021	Analysis 11179	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water Matrix by Alaska 102/103	1-P-QM-WI -9013022	Analysis 11184, 11185, 11242, 13027, 13030	4036 - Organic Extraction
Client Specific - Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by Texas Methodology	1-P-QM-WI -9013023	Analysis 11192	4036 - Organic Extraction
Client Specific - Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix Oklahoma Methodology	1-P-QM-WI -9013024	Analysis 11206	4036 - Organic Extraction
Client Specific - Sonication Extraction Procedure for the Determination of Diesel Range Organics in Soil or Solid Matrix California Methodology	1-P-QM-WI -9013025	Analysis 11207, 11214	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in Soil or Solid Matrix Florida Methodology	1-P-QM-WI -9013026	Analysis 11208	4036 - Organic Extraction
Client Specific - Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Montana Protocol	1-P-QM-WI -9013028	Analysis 11212	4036 - Organic Extraction
Client Specific - Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Washington Protocol	1-P-QM-WI -9013029	Analysis 11213	4036 - Organic Extraction

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Client Specific - Sonic Probe Extraction for the Determination of Extractable Total Petroleum Hydrocarbons in Soil or Solid Matrix Connecticut Methodology	1-P-QM-WI -9013030	Analysis 11216	4036 - Organic Extraction
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Sonic Probe Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in Soil or Solid Matrix Tennessee Methodology	1-P-QM-WI -9013031	Analysis 11217	4036 - Organic Extraction
Client Specific - Extraction Procedure for the Determination of Total Petroleum Hydrocarbons in a Soil or Solid Matrix by Texas Methodology	1-P-QM-WI -9013033	Analysis 11230, 11244	4036 - Organic Extraction
Alumina Column Cleanup of Solids	1-P-QM-WI -9013040	Analysis 11599, 11600	4036 - Organic Extraction
Liquid/Liquid Extraction Procedure for the Determination of Neutral Extractables in a Wastewater Matrix	1-P-QM-WI -9013043	Analysis 11629	4036 - Organic Extraction
Waste Dilution for the Determination of Saturated Hydrocarbons in an Oil Matrix	1-P-QM-WI -9013051	Analysis 11657	4036 - Organic Extraction
10g Silica Gel Cleanup for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9013055	Analysis 11681	4036 - Organic Extraction
Soxhlet Extraction Procedure for the Determination of Polychlorinated Biphenyls (PCBs) in a Solid Matrix	1-P-QM-WI -9013065	Analysis 11696	4036 - Organic Extraction
Microextraction by Method 3511 for the Determination of Diesel Range Organics in Water	1-P-QM-WI -9013110	Analysis 12059, 12866, 12895, 12896, 12897, 12898	4036 - Organic Extraction
Passive In-Situ Chemical Extraction Sampler (PISCES) Procedure for the Determination of Polychlorinated Biphenyls (PCBs)	1-P-QM-WI -9013121	Analysis 12801	4036 - Organic Extraction
Extraction Procedure for the Determination of Carbamate and Urea Pesticides in a Soil or Solid Waste Matrix	1-P-QM-WI -9013140	Analysis 1510, 11143	4036 - Organic Extraction
Separatory Funnel Extraction Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	1-P-QM-WI -9013424	Analysis 2135, 11197, 12007, 12119, 12120, 12907, 12916, 12924	4036 - Organic Extraction
Client Specific - Microwave Extraction for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Solid Matrix by Massachusetts Protocol	1-P-QM-WI -9013429	Analysis 2168, 11235	4036 - Organic Extraction
Quick Silica Gel Cleanup for Hydrocarbons by GC in Solid and Water Matrices	1-P-QM-WI -9013430	Analysis 2176	4036 - Organic Extraction
Client Specific - Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by California Methodology	1-P-QM-WI -9013446	Analysis 2376, 11169, 11180, 11187, 11188, 11198, 11199	4036 - Organic Extraction
Extraction of Chlorinated Herbicides in a Soil Matrix	1-P-QM-WI -9013472	Analysis 4181	4036 - Organic Extraction
Soxhlet Extraction Procedure for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9013991	Analysis 6006SOX	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Chlorinated Pesticides; Nitrogen and Phosphorus Containing Pesticides; and PCBs in a Drinking Water Matrix	1-P-QM-WI -9014001	Analysis 6368, 11127	4036 - Organic Extraction
Extraction of Chlorinated Acids and Herbicides in Drinking Water by Method 515.1	1-P-QM-WI -9014002	Analysis 6369	4036 - Organic Extraction
Sonic Probe Extraction for TPH in Solids by Washington DX	1-P-QM-WI -9014041	Analysis 7024, 11234, 12008, 12117, 12118	4036 - Organic Extraction
Client Specific - Separatory Funnel Extraction Procedure for the Determination of	1-P-QM-WI -9014170	Analysis 7326, 10980, 11200 MA/LA/NJ	4036 - Organic Extraction

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Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Massachusetts or New Jersey Protocol			
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Microextraction of 1,2-Dibromoethane (EDB), 1,2-Dibromo-3-chloropropane (DBCP), and 1,2,3-Trichloropropane (TCP), in Water	1-P-QM-WI -9014309	Analysis 7786	4036 - Organic Extraction
Low-Level Sonication Extraction Procedure for the Determination of Polynuclear Aromatic Hydrocarbons (PAHs) in a Solid Matrix by GC/MS	1-P-QM-WI -9014490	Analysis 7806	4036 - Organic Extraction
Extraction Procedure for the Determination of PAHs in an XAD Air Tube Sample by TO-15A	1-P-QM-WI -9014491	Analysis 7806AIR	4036 - Organic Extraction
Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9015070	Analysis DOD - 0381, 10478, 10480, 10483, 10486, 10487L	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix	1-P-QM-WI -9015071	Analysis DOD - 0381DIL	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by SW-846 Method 3510C	1-P-QM-WI -9015076	Analysis DOD - 0813, 11010, 11015, 10464, 10467, 10476	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of PCBs in Oil	1-P-QM-WI -9015077	Analysis DOD - 0815	4036 - Organic Extraction
Extraction of Chlorinated Herbicides in a Water Matrix by SW-846 8151A	1-P-QM-WI -9015078	Analysis DOD - 0816, 11110, 11111	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Pesticides and PCBs in a Wastewater Matrix	1-P-QM-WI -9015079	Analysis DOD - 0817, 6654, 10241, 11112, 11113, 11114, 11116, 11117, 11118, 11119, 11120, 11121, 11123, 11126, 11960	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of Pesticides and PCBs in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015080	Analysis DOD - 11114DIL	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Polychlorinated Biphenyls (PCBs) in a Solid Matrix	1-P-QM-WI -9015081	Analysis DOD - 0819, 11128, 11132, 11135	4036 - Organic Extraction
Sampling Equipment Cleaning and Validation for Metals Analysis	1-P-QM-WI -9015089	Analysis DOD - 10068	4036 - Organic Extraction
Extraction Procedure for the Determination of Formaldehyde and Aldehydes in a Water Matrix	1-P-QM-WI -9015090	Analysis DOD - 1013	4036 - Organic Extraction
Liquid/Liquid Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 8270	1-P-QM-WI -9015098	Analysis DOD - 10458	4036 - Organic Extraction
Extraction Procedure for the Determination of Tetraethyl Lead in a Water or Wastewater Matrix	1-P-QM-WI -9015101	Analysis DOD - 10472	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Solid Matrix by SIM	1-P-QM-WI -9015102	Analysis DOD - 10479, 10484, 10489	4036 - Organic Extraction
Microwave Extraction Procedure for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9015103	Analysis DOD - 10496, 11141	4036 - Organic Extraction
Microwave Extraction Procedure for the Determination of PCBs in a Solid Matrix	1-P-QM-WI -9015104	Analysis DOD - 10497, 11140	4036 - Organic Extraction
Microwave Extraction by Method 3546 for Semivolatiles	1-P-QM-WI -9015105	Analysis DOD - 10498, 10809, 10810, 10811, 10812, 10813, 10814, 11630, 11916	4036 - Organic Extraction

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Microwave Extraction for the Determination of Diesel Range Organics (DRO) and Saturated Hydrocarbons in a Solid Matrix	1-P-QM-WI -9015120	Analysis DOD - 10942, 11509	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables by SIM in a Wastewater Matrix	1-P-QM-WI -9015121	Analysis DOD - 11012, 10465, 10466, 10470, 10471, 11912	4036 - Organic Extraction
Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix by Alaska Methodology	1-P-QM-WI -9015123	Analysis DOD - 11222, 11223, 11239, 11248	4036 - Organic Extraction
Soxhlet Extraction Procedure for Extractable Matter in Textiles	1-P-QM-WI -9015134	Analysis DOD - 1948, 1949, 1950, 1951, 1952	4036 - Organic Extraction
Determination of Percentage Fat Using Accelerated Solvent Extraction (ASE)	1-P-QM-WI -9015144	Analysis DOD - 4193ASE	4036 - Organic Extraction
Liquid-Liquid Extraction Procedure for the Determination of Target Compound List Analytes in a Water Matrix	1-P-QM-WI -9015147	Analysis DOD - 4606	4036 - Organic Extraction
Low-Level Sonic Probe Extraction Procedure for the Determination of Target Compound List Analytes in a Solid Matrix	1-P-QM-WI -9015148	Analysis DOD - 4607	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Base Neutrals and Acid Extractables in a Toxicity Characteristic Leachate by SW-846 Method 3510C	1-P-QM-WI -9015149	Analysis DOD - 4731	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015150	Analysis DOD - 4731DIL	4036 - Organic Extraction
Sonic Disruption Extraction Procedure for the Determination of GC Fingerprint on Petroleum Products in Soil or Solid Matrix	1-P-QM-WI -9015151	Analysis DOD - 4833, 11227	4036 - Organic Extraction
Extraction of Organic Compounds in Drinking Water By Method 525.2	1-P-QM-WI -9015152	Analysis DOD - 4894	4036 - Organic Extraction
Extraction Procedure for the Determination of Formaldehyde and Aldehydes in a Solid Matrix	1-P-QM-WI -9015162	Analysis DOD - 5876, 11139	4036 - Organic Extraction
Sonic Probe Extraction for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9015163	Analysis DOD - 11129, 11131, 11134	4036 - Organic Extraction
Extraction Procedure for Perchlorate in Soil Samples by LC/MS/MS	1-P-QM-WI -9015167	Analysis DOD - 6568	4036 - Organic Extraction
Soxhlet Extraction Procedure for the Determination of Triazine Herbicides and Organophosphorous Pesticides in a Solid Matrix	1-P-QM-WI -9015170	Analysis DOD - 6677, 11130, 11133, 11142	4036 - Organic Extraction
Extraction of Nitroaromatics and Nitroamines in Water	1-P-QM-WI -9015171	Analysis DOD - 6915, 11122, 11125	4036 - Organic Extraction
Extraction of Nitroaromatics and Nitroamines in Soil	1-P-QM-WI -9015173	Analysis DOD - 6917, 11137, 11138	4036 - Organic Extraction
Sonication Extraction of Nitroaromatics and Nitroamines in Soil (DoD)	1-P-QM-WI -9015174	Analysis DOD - 6917DoD	4036 - Organic Extraction
Separatory Funnel Extraction Method 3510C for DRO in Water or Wastewater	1-P-QM-WI -9015175	Analysis DOD - 7003, 10304, 11164, 11167, 11171, 11172, 11176, 11177, 11181, 11183, 11189, 11190, 11191, 11195, 11196, 11201, 11203, 11596, 12820, 12906, 12915, 12923, 13095	4036 - Organic Extraction

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Level 3 – Environmental Sciences (continued)			
Sonication Extraction Method 3550C for DRO in Soils or Solids	1-P-QM-WI -9015176	Analysis DOD - 7004, 10303, 11204, 11205, 11209, 11215, 11218, 11219, 11225, 11228, 11229, 11233, 11236, 11237, 11238, 13097	4036 - Organic Extraction
Separatory Funnel Extraction for the Determination of PAHs in Water by GC/MS Using Method 3510C	1-P-QM-WI -9015185	Analysis DOD - 7807	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 625	1-P-QM-WI -9015188	Analysis DOD - 8108, 10463	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Complex Matrix	1-P-QM-WI -9015189	Analysis DOD - 8108TJ	4036 - Organic Extraction
Silica Gel Column Cleanup for Hydrocarbons by GC in Aqueous Matrices	1-P-QM-WI -9020897	Analysis 12894	4036 - Organic Extraction
3 g Silica Gel Column Cleanup for DRO	1-P-QM-WI -9021425	Analysis 12932	4036 - Organic Extraction
Separatory Funnel Extraction of Pesticides and PCBs in Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022427	Analysis 11117, 11118 OH VAP	4036 - Organic Extraction
Sonic Probe Extraction of Pesticides and PCBs in Solid Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022432	Analysis 0819, 11134 OH VAP	4036 - Organic Extraction
Microwave Extraction of Pesticides and PCBs in Non-aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022433	Analysis 10496, 10497 OH VAP	4036 - Organic Extraction
Separatory Funnel Extraction Semivolatile Organic Compounds in an Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022472	Analysis 10464 OH VAP	4036 - Organic Extraction
Microwave Extraction of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022475	Analysis 10813 OH VAP	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022476	Analysis 0381 10478 OH VAP	4036 - Organic Extraction
Microextraction of EDB, DBCP, and TCP in Solids by Method 8011	1-P-QM-WI -9025371	Analysis 13218	4036 - Organic Extraction
DFS HRGC/HRMS Preventative and Corrective Maintenance	1-P-QM-PRO-9015412	DOD - MC-SP-001	4037 - Specialty Services Group
Sample Extract Column Cleanup Procedure for HRMS Analysis	1-P-QM-PRO-9015510	DOD - SOP-SP-003	4037 - Specialty Services Group
Thermo Scientific Trace Ultra Gas Chromatograph Quantum XLS Tandem Mass Spectrometer (GC/MS/MS) Preventative and Corrective Maintenance	1-P-QM-PRO-9017429	MC-SP-002	4037 - Specialty Services Group
Maintenance and Tuning for Thermo Scientific TSQ Quantum Access Tandem Mass Spectrometer with a Thermo Electron Accela HPLC System (LC/MS/MS)	1-P-QM-PRO-9018268	SOP-SP-001	4037 - Specialty Services Group
Processing EPA 1613B PCDD/PCDF High Resolution Mass Spectrometry Data using TargetQuan 2.0	1-P-QM-PRO-9018269	SOP-SP-004	4037 - Specialty Services Group
Standards Management in the High Resolution Mass Spectrometry Laboratory	1-P-QM-PRO-9018270	SOP-SP-005	4037 - Specialty Services Group
Glassware Cleaning for HRMS Extractions	1-P-QM-PRO-9025452	N/A	4037 - Specialty Services Group
Determination of Selected Perfluorinated	1-P-QM-WI -9012802	Analysis 10954	4037 - Specialty Services

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Alkyl Acids (PFAAs) in Aqueous Samples by LC/MS/MS			Group
Document Title	**Document ID**	**Historical Document ID**	**Department Owner**
Level 3 – Environmental Sciences (continued)			
Determination of Perfluorooctanoic Acid (PFOA) in Aqueous Samples by LC/MS/MS	1-P-QM-WI -9012866	Analysis 11016	4037 - Specialty Services Group
Determination of Diuron, Fenuron and Monuron in Water Samples by SPE Extraction and LC/MS/MS	1-P-QM-WI -9013044	Analysis 11639	4037 - Specialty Services Group
Determination of Diuron, Fenuron and Monuron in Soil Samples by LC/MS/MS	1-P-QM-WI -9013054	Analysis 11663	4037 - Specialty Services Group
Determination of Dioxin-like Polychlorinated Biophenyls by HRGC/HRMS	1-P-QM-WI -9013071	Analysis 11773, 12416	4037 - Specialty Services Group
The Determination of Pesticides by Gas Chromatography/Tandem Mass Spectrometry (GC/MS/MS)	1-P-QM-WI -9013072	Analysis 11788	4037 - Specialty Services Group
Extraction of Vegetation utilizing the QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) Technique for Pesticides	1-P-QM-WI -9013073	Analysis 11911	4037 - Specialty Services Group
Determination of Perchlorate in Milk and Milk Powder by LCMSMS	1-P-QM-WI -9013074	Analysis 11962, 11964	4037 - Specialty Services Group
Determination of Glycols in Waters by Direct Injection LC/MS/MS Method	1-P-QM-WI -9013111	Analysis 12060	4037 - Specialty Services Group
Determination of Polychlorinated Biphenyl Congeners by HRGC/HRMS	1-P-QM-WI -9013114	Analysis 12154, 12429	4037 - Specialty Services Group
Determination of Hydrazine, Monomethylhydrazine and 1.1-Dimethylhydrazine in Aqueous Samples by LC/MS/MS Using SW-846 8315A Modified	1-P-QM-WI -9015095	Analysis DOD - 10342	4037 - Specialty Services Group
Determination of Hydrazine, Monomethylhydrazine and 1,1-Dimethylhydrazinein Soil Samples by LC/MS/MS	1-P-QM-WI -9015096	Analysis DOD - 10346	4037 - Specialty Services Group
Separatory Funnel Sample Extraction Procedure for HRMS Analysis in a Water Matrix	1-P-QM-WI -9015118	Analysis DOD - 10914	4037 - Specialty Services Group
Determination of Tetra- Through Octa-Chlorinated Dioxins and Furans using HRGC/HRMS by EPA 1613B or SW-846 8290A	1-P-QM-WI -9015119	Analysis DOD - 10915, 11031, 11645, 11650, 12935, 12936, 12937	4037 - Specialty Services Group
Soxhlet Sample Extraction Procedure for HRMS Analysis in a Solid Matrix	1-P-QM-WI -9015122	Analysis DOD - 11030	4037 - Specialty Services Group
Determination of Endothall in Soil Samples by LCMSMS	1-P-QM-WI -9015125	Analysis DOD - 11688	4037 - Specialty Services Group
Client Specific - Trace Analysis of 16 Phthalates in Cosmetic Products by Gas Chromatography Selective Ion Monitoring Mass Spectroscopy (GC/SIM/MS) (Client Specific Method)	1-P-QM-WI -9017430	NS-37-010	4037 - Specialty Services Group
Client Specific - Analysis of Furan in Tobacco Products by Headspace Gas Chromatography Mass Spectroscopy (HS/GC/MS)	1-P-QM-WI -9020124	NA	4037 - Specialty Services Group
Determination of Hydrazine in Mainstream Smoke via Liquid Chromatography/Tandem Mass Spectrometry	1-P-QM-WI -9020139	NA	4037 - Specialty Services Group
Client Specific - Analysis of Glycerol Monolaurate and Propylene Glycol Monolaurate in BioPolySan by Gas Chromatography Mass Spectroscopy (GC/MS)	1-P-QM-WI -9020891	N/A	4037 - Specialty Services Group
Client Specific – Analysis of Aflatoxin B1 in Tobacco and Tobacco Related Products	1-P-QM-WI -9021796	N/A	4037 - Specialty Services Group

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using LC/MS/MS			
Client Specific - Analysis of Piperonyl Butoxide (PBO) in Wastewater by GC/MS/MS	1-P-QM-WI -9022844	N/A	4037 - Specialty Services Group

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Level 3 – Environmental Sciences (continued)			
Client Specific - Trimethylamine by Headspace Gas Chromatography Mass Spectroscopy (HS GCMS)	1-P-QM-WI -9023280	N/A	4037 - Specialty Services Group
Determination of Multiple Client Specific APIs in Surface Water by LCMSMS	1-P-QM-WI -9023568	N/A	4037 - Specialty Services Group
Processing and Sending Data Packages	1-P-QM-PRO-9015441	DOD - SOP-DP-007	4038 - Data Deliverables
Overchecking the Electronic Data Deliverable	1-P-QM-PRO-9015442	DOD - SOP-DP-009	4038 - Data Deliverables
Preparation of Data Packages on CD ROM	1-P-QM-PRO-9015444	DOD - SOP-DP-014	4038 - Data Deliverables
Archiving Department 4025 Raw Sample Data and Other Miscellaneous Data	1-P-QM-PRO-9015445	DOD - SOP-DP-022	4038 - Data Deliverables
Generation and Content Review of GLP Compliant Data Packages	1-P-QM-PRO-9017747	SOP-DP-034	4038 - Data Deliverables
Assembly and Review of Environmental Data Packages	1-P-QM-PRO-9017748	SOP-DP-037	4038 - Data Deliverables
Tracking and Communicating Rush Results	1-P-QM-PRO-9015434	DOD - SOP-CL-005	4039 - Environmental Client Services and Inside Business Development
Phone Log and Email Documentation	1-P-QM-PRO-9015435	DOD - SOP-CL-006	4039 - Environmental Client Services and Inside Business Development
Auditing Client Paperwork	1-P-QM-PRO-9015436	DOD - SOP-CL-007	4039 - Environmental Client Services and Inside Business Development
Scheduling and Pricing of Rush Samples	1-P-QM-PRO-9015437	DOD - SOP-CL-010	4039 - Environmental Client Services and Inside Business Development
Sample Set-Up Form Creation Guide	1-P-QM-PRO-9015438	DOD - SOP-CL-014	4039 - Environmental Client Services and Inside Business Development
Client Concern and ISPD Code Entry	1-P-QM-PRO-9015439	DOD - SOP-CL-015	4039 - Environmental Client Services and Inside Business Development
Preparing Quotations	1-P-QM-PRO-9017698	SOP-CL-008	4039 - Environmental Client Services and Inside Business Development
Daily or Weekly DEP Reporting	1-P-QM-PRO-9017699	SOP-CL-012	4039 - Environmental Client Services and Inside Business Development
Monthly DEP Reporting	1-P-QM-PRO-9017700	SOP-CL-013	4039 - Environmental Client Services and Inside Business Development
Creating Bottle Orders	1-P-QM-PRO-9017701	SOP-CL-016	4039 - Environmental Client Services and Inside Business Development
Creating Project Information Lists	1-P-QM-PRO-9017702	SOP-CL-017	4039 - Environmental Client Services and Inside Business Development
Client/Prospects Visits	1-P-QM-PRO-9017799	SOP-MK-104	4039 - Environmental Client Services and Inside Business Development
Proposal Preparation	1-P-QM-PRO-9017800	SOP-MK-105	4039 - Environmental Client Services and Inside Business Development
ETM System Probe Calibration	1-P-QM-PRO-9015418	DOD - MC-WQ-003	4052 - Environmental Quality Assurance
Proficiency Test and Double Blind Samples	1-P-QM-PRO-9018237	SOP-QC-003	4052 - Environmental Quality

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			Assurance
Environmental Quality Assurance Approval of Subcontractor Laboratories	1-P-QM-PRO-9018248	SOP-QC-023	4052 - Environmental Quality Assurance
Quality Assurance Review of End-of-Month QC Reports	1-P-QM-PRO-9018253	SOP-QC-028	4052 - Environmental Quality Assurance
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Level 3 – Environmental Sciences (continued)			
Environmental Quality Assurance Functions for GLP Compliance	1-P-QM-PRO-9018256	SOP-QC-032	4052 - Environmental Quality Assurance
Performing Electronic Data Audits using Mint Miner Software	1-P-QM-PRO-9018259	SOP-QC-036	4052 - Environmental Quality Assurance
Maintenance of Environmental Certifications and Accreditations	1-P-QM-PRO-9018261	SOP-QC-039	4052 - Environmental Quality Assurance
Performing Environmental Quality Assurance Audits	1-P-QM-PRO-9020535	N/A	4052 - Environmental Quality Assurance
Preparing Environmental Quality Assurance Reports for Management	1-P-QM-PRO-9020717	N/A	4052 - Environmental Quality Assurance
QA Approval of Environmental Analytical Procedures and Standard Operating Procedures	1-P-QM-PRO-9022099	N/A	4052 - Environmental Quality Assurance
Hosting of Environmental Client and Agency Audits	1-P-QM-PRO-9022134	N/A	4052 - Environmental Quality Assurance
Environmental Quality Assurance Review of Client Project and Bid Documents	1-P-QM-PRO-9022599	N/A	4052 - Environmental Quality Assurance
Introduction to Software Quality	1-P-QM-TMA-9018310	TRN-CS-001	4057 - Environmental Software Quality
Level 3 – Transportation			
What to Do in Case of Vehicular Accident or Breakdown	1-P-QM-PRO-9018292	SOP-TR-010	6041 – Transportation
Sample Pick-Up, Transportation, and Delivery	1-P-QM-PRO-9018293	SOP-TR-018	6041 - Transportation
Transportation Summary SOP	1-P-QM-PRO-9028514	N/A	6041 - Transportation
Level 3 – Environmental Sample Administration			
Environmental Sample Entry	1-P-QM-PRO-9015502	DOD - SOP-SA-101	6042 - Environmental Sample Administration
Sample Receipt at Sample Receipt Desk	1-P-QM-PRO-9015503	DOD - SOP-SA-102	6042 - Environmental Sample Administration
Environmental Sample Receipt and Unpacking	1-P-QM-PRO-9015504	DOD - SOP-SA-103	6042 - Environmental Sample Administration
Filing of Sample Information	1-P-QM-PRO-9015505	DOD - SOP-SA-107	6042 - Environmental Sample Administration
Assigning Sample Delivery Group Numbers and Five-Digit Sample Codes to Sample Groups	1-P-QM-PRO-9015506	DOD - SOP-SA-119	6042 - Environmental Sample Administration
Entry of Environmental Samples Requiring Subcontracting	1-P-QM-PRO-9015507	DOD - SOP-SA-129	6042 - Environmental Sample Administration
Taking the Temperature of Environmental Samples Upon Arrival at the Lab	1-P-QM-PRO-9015508	DOD - SOP-SA-138	6042 - Environmental Sample Administration
Level 3 – Sample Support			
Sample Support Ovens	1-P-QM-PRO-9015413	DOD - MC-SS-001	6055 - Sample Support
Maintenance of Desiccators	1-P-QM-PRO-9015414	DOD - MC-SS-002	6055 - Sample Support
Liquid Sample Preservation	1-P-QM-PRO-9015511	DOD - SOP-SS-002	6055 - Sample Support

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Automated Storage, Retrieval, and Discarding of Samples	1-P-QM-PRO-9015512	DOD - SOP-SS-006	6055 - Sample Support
Homogenization and Subsampling of Solid Waste Samples from Environmental Sources	1-P-QM-PRO-9015513	DOD - SOP-SS-009	6055 - Sample Support

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Level 3 – Sample Support (continued)			
Subsampling for Subcontracted Analyses	1-P-QM-PRO-9015514	DOD - SOP-SS-010	6055 - Sample Support
Hardware Procedures for ASRS	1-P-QM-PRO-9015515	DOD - SOP-SS-015	6055 - Sample Support
Preservation and Bottles Room Preservative Traceability	1-P-QM-PRO-9015516	DOD - SOP-SS-017	6055 - Sample Support
Pipette Dispenser Calibration Procedure	1-P-QM-PRO-9015517	DOD - SOP-SS-018	6055 - Sample Support
Automated Storage and Retrieval System (ASRS) Lockout/Tagout Procedure	1-P-QM-PRO-9015518	DOD - SOP-SS-019	6055 - Sample Support
Outlier Quality Control Data	1-P-QM-PRO-9015519	DOD - SOP-SS-020	6055 - Sample Support
Instructions for Collecting Data on the LLENS System	1-P-QM-PRO-9015520	DOD - SOP-SS-021	6055 - Sample Support
Non-Automated Storage, Retrieval, and Discarding of Samples	1-P-QM-PRO-9015521	DOD - SOP-SS-022	6055 - Sample Support
Prescreening Water and Soil Samples for Volatile Organic Compounds	1-P-QM-PRO-9015522	DOD - SOP-SS-023	6055 - Sample Support
ASRS Emergency Failure Procedure	1-P-QM-PRO-9015523	DOD - SOP-SS-024	6055 - Sample Support
Incremental Sampling of Soil/Solid Samples	1-P-QM-PRO-9015524	DOD - SOP-SS-025	6055 - Sample Support
Glassware Cleaning	1-P-QM-PRO-9018271	SOP-SS-026	6055 - Sample Support
Bulk Solid Sample Preparation by SW-846 5035A for OH VAP	1-P-QM-WI -9012777	Analysis 11967 OH VAP	6055 - Sample Support
Water Content (Moisture) by ASTM D 2216	1-P-QM-WI -9014166	Analysis 7116, 7119	6055 - Sample Support
Moisture (Gravimetric)	1-P-QM-WI -9015065	Analysis DOD - 0111, 6111, 7611, 11624, 12845	6055 - Sample Support
GC/MS - Bulk Solid Matrix Sample Preparation	1-P-QM-WI -9015069	Analysis DOD - 0374, 6646, 10445, 11966, 11967	6055 - Sample Support
Preparation of Vials for Field Preservation of Soils for Volatile Analysis	1-P-QM-WI -9015073	Analysis DOD - 0388, 6119, 6169, 6647, 0405, 1169, 6171, 6172, 6173, 6645, 2392, 6176, 7579, 0069, 11014, 11764	6055 - Sample Support
Preparation of Soil and Solid Samples for GC Volatile Analyses	1-P-QM-WI -9015124	Analysis DOD - 1150, 6170, 11968, 11969	6055 - Sample Support
Tobacco Moisture	1-P-QM-WI -9015168	Analysis DOD - 6611	6055 - Sample Support
Total Residue by SM 2540G-1997	1-P-QM-WI -9015183	Analysis DOD - 7400	6055 - Sample Support
Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035	1-P-QM-WI -9015193	Analysis DOD - 8389, 8390, 6130, 6117, 6174, 7578, 7320	6055 - Sample Support
Preparation of Solid Samples by SW-846 Method 5035A (Field Preserved and EnCores) for OH VAP	1-P-QM-WI -9022845	Analysis 2392, 6171, 6176, 7320, 7578, 7579, 8389, 8390 OH VAP	6055 - Sample Support

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Level 3 – Sample Bottles			
Bottle Preparation	1-P-QM-PRO-9018263	SOP-SB-003	6059 - Sample Bottles
Packing Bottle Orders	1-P-QM-PRO-9018264	SOP-SB-008	6059 - Sample Bottles
Preparation of Trip Blanks	1-P-QM-PRO-9018265	SOP-SB-012	6059 - Sample Bottles
Processing Bottle Orders	1-P-QM-PRO-9018266	SOP-SB-016	6059 - Sample Bottles
Preparation of Acid Dilutions	1-P-QM-PRO-9018267	SOP-SB-017	6059 - Sample Bottles

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Instrument	# of Units	Manufacturer/Model #
Liquid Chromatography/Gas Chromatography/Mass Spectrometry (LC/GC/MS)		
LC/MS/MS	1	Agilent 1200 LC with Agilent 6410 MS/MS
LC/MS/MS	1	Agilent 1290 LC with Micromass Quattro micro MS/MS and Waters 2996 Photodiode Array UV-Vis Detector
LC/MS/MS	1	Thermo Scientific TSQ Quantum Access with Acella LC
LC/MS/MS	2	Waters 2795 LC with Micromass Quattro micro MS/MS
GC/MS	3	Agilent 5972
GC/MS	20	Agilent 5973
GC/MS	10	Agilent 5975
GC/MS	2	Agilent 5977A
GC/MS	2	Shimadzu
GC/MS	1	Thermo Scientific ISQ
GC/MS	1	DSQ II MS with Trace GC Ultra GC
GC/MS/MS	1	Thermo TSQ 8000 MSMS with Trace 1310 GC
GC/MS/MS	1	Thermo TSQ Quantum XLS MSMS with Trace GC Ultra GC
HRGC/HRMS	4	Thermo Scientific DFS
Gas Chromatograph	14	Agilent 5890
Gas Chromatograph	40	Agilent 6890
Gas Chromatograph	2	Shimadzu
Gas Chromatograph	27	Agilent 7890
Gas Chromatograph	1	Varian 3400
Auxiliary Equipment for Gas Chromatographs		
Most of the GC/MS and GC systems include autosamplers and approximately half are fitted with purge and trap concentrators for analysis of volatiles.		
Purge/Trap Concentrators	30	OI 4560/4660
Autosamplers	13	Archon 5100/5100A
Autosamplers	20	Agilent 7673
Autosamplers	21	Agilent 7683
Autosamplers	28	Agilent 7693
Autosamplers	6	OI 4551/4552
Autosamplers	5	EST Centruion
Autosamplers	7	Thermo Scientific AS TriPlus
Autosamplers	3	CTC Combipal Headspace
Automated Sampling System (Tedlar Bags)	1	Tekmar 2016/2032/LSC2000
Automated Sampling System (Summa Canisters)	3	Entech 7016CR Autosamplers
Automated Sampling System (Tedlar Bags/Summa Canisters)	1	Entech 7032A
Automated Concentrator	3	Entech 7100
Detectors available for GC: Electron Capture, Flame Ionization, Photoionization, Hall Electrolytic Conductivity, Nitrogen/Phosphorus, and Thermal Conductivity. All of the chromatographs are connected to electronic integration systems.		

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High Performance Liquid Chromatography		
High Performance Liquid Chromatograph	2	Agilent 1100 LC
High Performance Liquid Chromatograph	2	Agilent 1200 HPLC
High Performance Liquid Chromatograph	1	Waters alliance 2695
High Performance Liquid Chromatograph	1	Waters alliance 2795
Gel Permeation Chromatography		
Gel Permeation Chromatograph	3	J2Scientific AccuPrep
Ion Chromatography		
Ion Chromatograph	1	Metrohm 881 IC Pro
Ion Chromatograph	2	Dionex ICS1000
Ion Chromatograph	1	Dionex ICS3000
Ion Chromatograph	1	Dionex ICS2000
Ion Chromatograph	3	Dionex ICS1100
Atomic Absorption/Emission Spectrophotometry		
ICAP™ 6000 Duo ICP Analyzer	4	Thermo
ICP/MS	1	P/E Sciex Elan 9000
ICP/MS	1	Agilent 7500ce
ICP/MS	1	Agilent 7700x
Mercury Analyzer	2	Leeman Labs Hydra II
Mercury Analyzer	1	Leeman Labs HYDRA AF_{GOLD+}
Prep Station	3	Thomas Cain DEENA 60
UV Vis/IR Spectrophotometry:		
UV-Vis Spectrophotometer	3	Spectronic Genesys
UV-Vis Spectrophotomenter	1	Hach DR2800
Miscellaneous Chemistry Instrumentation		
Auto-titrator System	2	Mantech
Block Digestion Systems	8	Environmental Express SC150
Block Digestion Systems	6	Environmental Express SC154
Centrifuge	5	Various
Chilled water recirculators		Various
Closed Cup Flashpoint Apparatus, Pensky-Martin	1	Fisher Scientific TA6
Cyanide Midi Distillation Kits	3	Various
Dissolved Oxygen Meter	1	YSI Model 59
Flow Solution Autoanalyzer	2	Alpkem
Glassware washer - automated	1	Miele – (2) PG8257 (1) G7827 (1) G7704
Kjehldal Distillation Apparatus	2	Fisher
Microwave Extractors	3	CEM MarsXpress
pH meters	13	Various
Phenol Midi Distillation	2	Andrews Glass
Pressurized Solvent Extractor	2	Dionex ASE200
Sonicators	12	Various
Total Organic Carbon Analyzer	2	O.I. Corp. 1030
Total Organic Carbon Combustion Analyzer	1	O.I. Corp. 1010
Turbidimeter	1	Hach 2100AN
Zero Headspace Extractor	74	Various Models

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Microbiology Equipment		
Autoclave	2	Steris – Amsco,
Balance	5	Mettler, PB 3002
Balance	1	Mettler-Toledo, AT200
Balance	2	Mettler-Toledo, PR2002
Balance	1	Sartorius BP4100
Biological Safety Cabinet	4	NuAire NU-425-600 Type A/B 3
Biological Safety Cabinet	1	NuAire NU-435-600 Type B2 Fume Hood
Colony Counter	3	Quebec Dark Field
Microbiology Equipment		
Incubator	1	PGC 9311-1127
Incubator	1	PS WFY20SAWI
Microscope	1	Stereoscope with Zoom, AO Model 570
Microscope	1	Zeiss
pH Meter	2	Orion Model 410A
Quanti-Tray Sealer	1	IDEXX Model 2X
Water Bath	1	Boekel Grant with Removal Heater Circulator
Water Bath	1	Thermo Electron Corp.
Water Bath	1	Precision Coliform Incubator Bath
Water Bath	1	VWR 1275PC
UV Light	2	Spectronics
UV Sterilizer	1	Millipore

Computer Equipment

Our laboratories make extensive use of computers for business applications, technical operations (e.g., our sample management system), and QA Program (see section on Quality Assurance). The following is a list of the major components of our computer systems.

Numerous physical and virtual servers used to support the systems

Oracle systems run on IBM UNIX servers:

- One IBM Power 740 Server running AIX UNIX with 6 - 3.3 GHz Power7 Cores CPUs, 128GB RAM.
- One IBM P5-520 Server running AIX UNIX with 4-way 1.90GHz CPUs, 24GB RAM.
- 40+ Terra Bytes of disk storage and several SAN devices including V7000, DS4100, HP2000 and Clarion CX4-40.
- Various tape backup systems
- On-line fail over databases are available for all corporate production Oracle databases.

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Networks/Telecommunication:

- TCP/IP based network
- Ten Gigabit switch to accommodate company server farm
- Dual Cisco 6506E network cores

Personal Computers/Servers:

- Internet access is provided with an ASA firewall to control incoming and outgoing traffic
- ArcServe backup server
- Microsoft Exchange server
- Dell PowerEdge file and print servers
- More than 30 Network File Servers
- More than 1000 Personal Computers

Power Systems:

- 3 Phase Uninterrupted Power System

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Prepared by	Kathryn Brungard
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Preventive Maintenance Schedule

Instrument	Preventive Maintenance	Frequency
GC/MS GC/MS/MS	Change septum	AN* : Min. weekly
	Clean/replace injection port seal & liner	AN
	Check/clean fans	Monthly or AN
	Check/clean cool flow	Monthly or AN
	Clean source and replace parts	Bimonthly or AN
	Change oil in diffusion pump	Annually or AN
	Change oil and service rough pump	Annually
	Change column	AN
GC and GC/MS Purge and Trap Concentrators	Check gas flows and pressures	Prior to calib. or AN
	Replace adsorbent trap in concentrators	AN
	Flush purge pathways	Monthly or AN
	Clean/replace water management	AN
GC	Septum change	AN: Min. weekly
	Column/injection port maintenance	AN
	Clean detector	AN
	Leak check ECDs	Semiannually
	Change/clean PID lamp	AN
	Change/clean/Replace FID parts	AN
	Change column	AN
GC/HRMS	System bakeout	AN
	Replacing the Secondary Electron Multiplier (SEM)	AN
	Adjusting potentials on ion source	AN
	Check sensitivity and resolution on ion source	Daily
	Cleaning ion source	AN
	Replace filament on ion source	AN
	Cleaning reference inlet	AN
	Check oil level on forepumps	monthly
	Change oil on forepumps	Yearly or if oil is cloudy or discolored
	Exchange lubricant reservoir on turbopumps	Yearly or after 5000 hours of operation
	Replace injection port liner	AN
	Clip injection port end of column	AN
	Replace septum	AN
	Clean chiller water/air filters and inspect fluid level	Monthly
	Change column	AN
LC/MS/MS	Change rough pump (vacuum) oil	Annually
	Clean cones and spray chamber	As needed, before each calibration
	Clean source and ion lenses	Annually
	Check electrospray capillary	AN
	Empty waste liquid reservoir	AN
	Tune and calibrate MS	AN

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Instrument	Preventive Maintenance	Frequency
HPLC	Pump lubrication	Annually
	Check pump seals	Annually
	Check-valves cleaned or rebuilt	AN
	Replace and/or adjust detector bulb	AN
	Clean detector flow cell	AN
	Replace Teflon lines	AN
	Autosampler septa replacement	AN
	In-line filter sonication/cleaning	AN
	System passivation	AN
	PCRS pump lubrication	AN
	Empty waste liquid reservoir	AN
Cold Vapor AA and Cold Vapor AF	Replace pump tubing	AN
	Lubricate pump head & autosampler	AN
	Clean optical cells and windows	AN
ICP	Replace pump winding	AN
	Lubricate autosampler	AN
	Vacuum instrument airfilters and air intakes	AN
	Clean optics and lenses	AN
	Clean Torch and injector tip	AN
	Clean nebulizer and spray chamber	AN
ICP/MS	Change interface rough pump oil	AN
	Change MS rough pump oil	AN
	Clean cones and ion lenses	AN
	Clean Torch, injector tip, nebulizer and spray chamber	AN
	Change peristaltic tubing	AN
	Vacuum instrument airfilters and air intakes	AN
	Empty waste liquid reservoir	AN
Total Organic Carbon Analyzer	Check for leaks	AN
	Inspect rotary valve	AN
	Clean gas permeation tube	AN
	Check halide scrubber	AN
	Check dessicant tube	AN
	Dust back and clean circuit boards	AN
Autoanalyzer spectrophotometer	Clean sample probe	AN
	Clean proportioning pump	AN
	Inspect pump tubing, replace if worn	AN
	Clean wash receptacles	AN

*AN = as needed. These actions may be performed more frequently as required by the instrument's operational response.

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Details on method/instrument calibration processes are provided in the individual Analytical Procedures. This appendix provides an overview for representative methodology.
Note: This appendix is not applicable to OH VAP work. See the OH VAP approved SOPs for calibration information.

Calibration Summary for SW-846 Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS Volatiles* (8260B)	After C-cal fails	6	RF for SPCCs >0.300 for chlorobenzene and 1,1,2,2-tetrachloroethane, and >0.100 for 1,1-dichloroethene, bromoform and chloromethane %RSD CCCs <30%	Every 12 hours	1	RF for SPCCs >0.300 for chlorobenzene and 1,1,2,2-tetrachloro-ethane, and >0.100 for 1,1-dichloroethene, bromoform and chloromethane %Drift for CCCs <20
GC/MS Volatiles* (8260C)	After C-cal fails	7	RF must meet minimum RF listed in SOP %RSD of <20% for all analytes (10% may fail)	Every 12 hours	1	RF must meet minimum RF listed in SOP %Drift for CCCs <20, 20% can fail if not detected in proceeding samples
GC/MS Semivolatiles (8270C)*	After C-cal fails	6	RF for SPCCs >0.050 Max %RSD for CCCs <30%	Every 12 hours	1	RF for SPCCs 0.050 %Drift for CCCs <20
GC/MS Semivolatiles (8270D)*	After C-cal fails	6	% RSD ≤ 20% for each compound, (no more than 10% of the compounds can exceed 20% RSD); alternate fit must be used for any analyte with RSD >20% (use linear fit if correlation coefficient is 0.990 or greater; if correlation coefficient is < 0.990 then quadratic fit can be used, but the coefficient of determination must be 0.990 or greater). If linear fit is used, it must pass a linear regression check (the low standard must be within 30% of its true concentration)	Every 12 hours	1	%Drift ± 20%; (no more than 20% of the compounds can exceed 20% drift, and all compounds that exceed 20% drift must be ≤ 50% drift)
GC/MS Semi-volatiles SIM	After C-cal Fails	6	% RSD for all compounds ≤20%	Every 12 hours	1	%Drift ± 20%

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Calibration Summary for SW-846 Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC VOA	After C-cal fails	At least 5	% RSD ≤20% for individual compounds. Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20% then the average RF can be used for all compounds.	Every 10 samples	1	%Drift ± 15% for individual compounds or average % drift for all compounds in the standard ± 15%
GC Pesticides (8081A)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Degradation for DDT, endrin 15% Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 20 samples or 12 hours	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard. DDT/Endrin breakdown check 15% every 12 hours or 20 injections
GC Pesticides (8081B)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Degradation for DDT, endrin 15%	Every 20 samples or 12 hours ,	1	≤20% drift from initial response for quantitation DDT/Endrin breakdown check 15% every 12 hours or 20 injections
GC PCBs (8082)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 20 samples or 12 hours	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard.
GC PCBs (8082A)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit.	Every 20 samples or 12 hours	1	≤20% drift from initial response for quantitation
GC Herbicides (8151A)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 10 samples	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard.

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Calibration Summary for SW-846 Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
Explosives by HPLC (8330)	Each new run or after C-cal fails	5	20% RSD of RFs of initial calibration to use average RF, otherwise use curve fit Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 10 samples	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard.
Congeners by HRGC/HRMS	After C-cal fails	6	If %RSD for native compounds <20% and for labeled compounds <35%, otherwise a calibration curve is used	Every 12 hours	1	<15% valley peak resolution for 2378-TCDD All native and labeled compounds meet method defined recovery limits RTs within ±15 secs of RT in ICAL
Dioxins by HRGC/HRMS	After C-cal fails	6	If %RSD for native compounds <20% and for labeled compounds <35%, otherwise a calibration curve is used	Every 12 hours	1	<25% valley peak resolution for 2378-TCDD All native and labeled compounds meet method defined recovery limits RTs within ±15 secs of RT in ICAL
GC TPH-GRO	After C-cal fails	At least 5	% RSD of <20% to use the average CF, otherwise use calibration curve	Every 12 hours	1	%Drift ±15%
GC TPH-DRO	After C-cal fails	5	20% RSD of RFs of initial calibration to use average RF, otherwise use curve fit.	Every 12 hours	1	% Drift ±15%
ICP/MS	Each new run	1	Independent calibration verification (ICV) within ±10%	Every 10 samples	1	±10% of true value
ICP	Each new run	1	Independent calibration verification within ±10%, standards <5%RSD	Every 10 samples	1	Same as initial
CVAA	Each new run	5	Independent calibration verification within ±10% Correlation coefficient >0.995	Every 10 samples	1	±20% of true value
Autoanalyzer	Daily	6	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
TOC Analyzer	Monthly	Water – 6 Soil – 4	Corr. Coeff. > 0.995	Every 10 samples	1	±10% of true value

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Calibration Summary for SW-846 Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
Balance	Daily	bracket range of use	Top-loading: ± 2% or ± 0.02g of true value of weight, whichever is greater. Analytical: ± 0.1% or ± 0.5mg of true value of weight, whichever is greater.	N/A	N/A	N/A

*All compounds with %RSD >15 must use first or second order regression fit of the six calibration points. Alternatively, if average of the %RSD of all compounds in calibration standard is ≤15%, the AVG RF can be used for all compounds.

Abbreviations
Std Conc - The number of standard concentrations used
%RSD - Percent Relative Standard Deviation CF – Calibration Factor
SPCCs - System Performance Check Compounds
CCCs - Calibration Check Compounds C-cal - Continuing Calibration
RF - Response factor
CVAA - Cold Vapor Atomic Absorption
ICP/MS - Inductively Coupled Plasma – Mass Spectrometry
ICP - Inductively Coupled Plasma spectrophotometer; ICP run also includes inter-element correction check standard (at beginning and end of run)

GC/MS Tuning Criteria		
BFB Key Ions and Ion Abundance Criteria:		
Mass	**Method 8260B**	**Method 524.2**
50	15% to 40% of mass 95	15% to 40% of mass 95
75	30% to 60% of mass 95	30% to 80% of mass 95
95	Base peak = 100%	Base peak = 100%
96	5% to 9% of mass 95	5% to 9% of mass 95
173	<2% of mass 174	<2% of mass 174
174	>50% of mass 95	>50% of mass 95
175	5% to 9% of mass 174	5% to 9% of mass 174
176	>95% but <101% of mass 174	>95% but <101% of mass 174
177	5% to 9% of mass 176	5% to 9% of mass 176

DFTPP Key Ions and Ion Abundance Criteria:			
Mass	**Method 8270D**	**Method 8270C**	**Method 525.2**
51	30 % to 80 % of mass 198	30 % to 60 % of mass 198	10 % to 80 % of base peak
68	<2% of mass 69	<2% of mass 69	<2% of mass 69
69	mass 69 relative abundance	mass 69 relative abundance	mass 69 relative abundance
70	<2% of mass 69	<2% of mass 69	<2% of mass 69
127	25 % to 75 % of mass 198	40% to 60 % of mass 198	10% to 80 % of base peak
197	<1% of mass 198	<1% of mass 198	<2% of mass 198
198	Base Peak = 100%	Base Peak = 100%	Base peak or >50 % of mass 442

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199	5% to 9% of mass 198	5% to 9% of mass 198	5% to 9% of mass 198
275	10% to 30% of mass 198	10% to 30% of mass 198	10% to 60% of base peak
365	>0.75% of mass 198	>1% of mass 198	>1% of base peak
441	Present but < 24% mass 442	Present but < mass 443	Present but < mass 443
442	>50% of mass 198	>40% of mass 198	Base peak or >50% of mass 198
443	15% to 24% of mass 442	17% to 23% of mass 442	15% to 24% of mass 442

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Calibration Summary for Drinking Water Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS 525.2	After C-cal fails	6	The RSD for each analyte mean RF must be ≤30%. Or a linear regression calibration curve may be used.	Every 12 hours	1	%D for RF must be ≤30%. If curve used, the point must fall on curve from I-cal.
GC 504.1	Every new run	5	% RSD <20% to use Average RF, otherwise use calibration curve.	Every 10 samples or each batch if <10 samples	1	70% to 130% of expected value
GC/MS 524.2	After C-cal fails	4	% RSD <20% otherwise use calibration curve	Every 12 hours	1	%D for RF must be ≤30%. If curved used, the % recovery based on the concentration spiked must be 70% to 130% of expected value.
GC 507 508 515.1	Each new run, or after C-cal fails	3	≤20% RSD of RFs of Initial Calibration to use avg. RF, otherwise use curve fit. (Degradation for DDT, Endrin ≤20% initially - Method 508.)	Every 10 samples	1	≤20% drift from initial response for both quantitation and confirmation.
HPLC 531.1	Each new run, or after C-cal fails	3	≤20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit	Every 10 samples and/or blanks	1	≤20% drift from initial response.
Mercury auto-analyzer	Each new run	5	Initial calibration verification with ±5%	Every 10 samples	1	±10% of true value
Auto-analyzer	Daily	6	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
Balance	Daily	bracket range of use	Top-loading: ± 2% or ± 0.02g of true value of weight, whichever is greater. Analytical: ± 0.1% or ± 0.5mg of true value of weight, whichever is greater.	N/A	N/A	N/A

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Calibration Summary for Drinking Water Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
ICP	Each new run	1	Initial calibration verification ±5%	Every 10 samples	1	±10% of true value
ICP-MS	Each new run	1	Independent calibration verification within ±10%	Every 10 samples	1	±15% of true value
pH meter	Daily	3	See SOP	Every 10 samples	1	Statistical limits
IC	Monthly	5	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
ISE	Every 3 months	5	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value

Abbreviations

Std Conc - The number of standard concentrations used
SPCCs - System Performance Check Compounds
CCCs - Calibration Check Compounds
RF - Response Factor
%RSD - Percent Relative Standard Deviation
%D - Percent Difference
C-cal - Continuing Calibration
CVAF – Cold Vapor Atomic Fluorescence
HPLC - High Performance Liquid Chromatography
GC - Gas Chromatograph
GC/MS - Gas Chromatography/Mass Spectrometry
ICP - Inductively Coupled Plasma spectrophotometer
ICP/MS - Inductively Coupled Plasma – Mass Spectrometry
IC - Ion Chromatograph
ISE - Ion Specific Electrode

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Method 507

Laboratory Performance Check Solution (analyzed prior to system calibration)

Test	Analyte	Conc. µg/mL	Requirements
Sensitivity	Vernolate	0.05	Detection of analyte; S/N > 3
Chromatographic performance	Bromacil	5.0	0.80 < PGF[a] <1.20
Column performance	Prometon Atrazine	0.30 0.15	Resolution[b] > 0.7

[a]PGF - Peak Gaussian factor. Calculated using the equation:

$$PGF = \frac{1.83 \times W(1/2)}{W(1/10)}$$

Where W(1/2) is the peak width at half height and W(1/10) is the peak width at 10% peak height.

[b]Resolution between the two peaks as defined by the equation:

$$R = \frac{t}{W}$$

Where t is the difference in elution times between the two peaks and W is the average peak width, at the baseline, of the two peaks.

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Method 508 Laboratory Performance Check Solution (analyzed prior to system calibration)			
Test	*1.*	Conc. µg/mL	Requirements
Sensitivity	Chlorpyrifos	0.0020	Detection of analyte; S/N > 3
Chromatographic performance	DCPA	0.0500	0.80 < PGF[a] < 1.15
Column performance	Chlorothalonil HCH-delta	0.0500 0.0400	Resolution[b] > 0.50

[a]PGF - Peak Gaussian factor. Calculated using the equation:

$$PGF = \frac{1.83 \times W(1/2)}{W(1/10)}$$

Where W(1/2) is the peak width at half height and W(1/10) is the peak width at 10% peak height.

[b]Resolution between the two peaks as defined by the equation:

$$R = \frac{t}{W}$$

Where t is the difference in elution times between the two peaks and W is the average peak width, at the baseline, of the two peaks.

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Method 515

Laboratory Performance Check Solution (analyzed prior to system calibration)

Test	Analyte	Conc. µg/mL	Requirements
Sensitivity	Dinoseb	0.004	Detection of analyte; S/N >3
Chromatographic performance	4-Nitrophenol	1.6	0.70 < PGF[a] < 1.05
Column performance	3,5-Dichlorobenzoic acid 4-Nitrophenol	0.6 1.6	Resolution[b] >0.40

[a]PGF - Peak Gaussian factor. Calculated using the equation:

$$PGF = \frac{1.83 \times W(1/2)}{W(1/10)}$$

Where W(1/2) is the peak width at half height and W(1/10) is the peak width at tenth height.

[b]Resolution between the two peaks as defined by the equation:

$$R = \frac{t}{W}$$

Where t is the difference in elution times between the two peaks and W is the average peak width, at the baseline, of the two peaks.

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Calibration Summary for EPA 100, 200, 300, 600 & 1600 Series Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS Volatiles*	After C-cal fails	5	RSD ≤35% for all compounds*, or a linear regression may be used	Every 24 hours	1	All compounds must meet the QC acceptance criteria as stated in the method. Compounds not stated must meet a 65% -135% recovery criteria.
GC/MS Semivolatiles**	After C-cal fails	5	RSD ≤35% for all compounds**, or a linear regression may be used Tailing factors: Benzidine < 3 Pentachlorophenol < 5	Every 24 hours	1	All compounds calibrating for <20
GC Pesticides & PCBs (Method 608)	After C-cal fails	5	10% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Degradation for DDT, Endrin 15%	Every 10 samples	1	≤15% drift from initial response for quantitation
GC VOA Halocarbons and/or Aromatics	After C-cal fails	At least 5	%RSD of ≤10% for individual compounds to use average RFs. If %RSD >10%, a quadratic fit type is used if correlation coefficient is >0.995.	Every 12 hours, or every 10 samples	1	Method defined limits
Dioxins by HRGC/HRMS	After C-cal fails	6	If %RSD for native compounds <20% and for labeled compounds <20%, otherwise a calibration curve is used	Every 12 hours	1	<25% valley peak resolution for 2378-TCDD All native and labeled compounds meet method defined recovery limits RTs within ±15 secs of RT in ICAL
HPLC	Each new run or after C-cal fails	5	10% RSD of RFs of initial calibration to use average RF, otherwise use curve fit	Every 10 samples	1	≤15% difference from initial response for quantitation
ICP/MS	Each new run	1	Independent calibration verification (ICV) within ±10%	Every 10 samples	1	±15% of true value
ICP	Each new run	1	Independent calibration verification within ±3%, standards <5%RSD	Every 10 samples	1	±10% of true value

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Calibration Summary for EPA 100, 200, 300, 600 & 1600 Series Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
CVAA	Each new run	5	Independent calibration verification within ±5% Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
CVAF	Each new run	5	The RSD ≤ 15%, and the low standard recovers ±23% of the true value	After the calibration and at the end of the analytical batch	1	±23% of the true value
Auto-analyzer	Daily	6	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
TOC	Monthly	6	Corr. Coeff. > 0.995	Every 10 samples	1	±10% of true value
Balance	Daily	4	Top-loading ±0.5%, Analytical ± 0.1% for weights >0.1 g 50 mg ± 0.5%, 20 mg ± 1.0% 10 mg and 5 mg ± 2.0%	N/A	N/A	N/A

*All compounds with %RSD >35 must use first or second order regression fit of the five calibration points. The first order regression may only be used if the correlation coefficient r ≥0.990. The second order regression may only be used if the coefficient of determination $r^2 \geq 0.990$.

* * All compounds with % RSD >35 must use first order regression fit of the five calibration points. The first order regression may only be used if the correlation coefficient r ≥0.990.

Abbreviations
Std Conc - The number of standard concentrations used
SPCCs - System Performance Check Compounds
CCCs - Calibration Check Compounds
RF - Response Factor
%RSD - Percent Relative Standard Deviation
C-cal - Continuing Calibration
CVAA - Cold Vapor Atomic Absorption spectrophotometer
CVAF - Cold Vapor Fluorescence spectrophotometer
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma spectrophotometer; ICP run also includes inter-element correction check standard (beginning and end of run)
ICP/MS - Inductively Coupled Plasma - Mass Spectrometry

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Calibration Summary for EPA TO Series Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS Volatiles TO-15	After C-cal fails	Minimum of 5	RSD ≤30% for all compounds, 2 allowed to be >30% as long as <40%.	Every 24 hours	1	All compounds ≤30 difference.
GC/MS Volatiles TO-14A	After C-cal fails	Minimum of 5	RSD ≤30% for all compounds, 2 allowed to be >30% as long as <40%.	Every 24 hours	1	All compounds ≤30 difference.

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NOTE: Current certificates are maintained by the QA Department and are available on our website at http://env.lancasterlabs.com/resources/certifications

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 110.2		Color	NELAP	PA	4/4/2005
EPA 150.1		pH	NELAP	PA	2/28/2002
EPA 1613	B	Dioxin	NELAP	PA	10/5/2010
EPA 1664	B	Oil and grease	NELAP	PA	1/27/2014
EPA 1664	A	Oil and grease	NELAP	PA	5/24/2011
EPA 180.1		Turbidity	NELAP	PA	4/4/2005
EPA 200.7	4.4	Aluminum	NELAP	PA	4/4/2005
EPA 200.7	4.4	Barium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Beryllium	NELAP	PA	6/2/2004
EPA 200.7	4.4	Cadmium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Calcium	NELAP	PA	11/28/2001
EPA 200.7	4.4	Chromium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Cobalt	NELAP	PA	10/16/2008
EPA 200.7	4.4	Copper	NELAP	PA	1/22/2001
EPA 200.7	4.4	Iron	NELAP	PA	4/4/2005
EPA 200.7	4.4	Lithium	NELAP	PA	11/13/2012
EPA 200.7	4.4	Magnesium	NELAP	PA	12/4/2007
EPA 200.7	4.4	Manganese	NELAP	PA	4/4/2005
EPA 200.7	4.4	Nickel	NELAP	PA	1/22/2001
EPA 200.7	4.4	Potassium	NELAP	PA	5/24/2011
EPA 200.7	4.4	Silver	NELAP	PA	1/26/2001
EPA 200.7	4.4	Sodium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Strontium	NELAP	PA	5/24/2011
EPA 200.7	4.4	Sulfur	NELAP	PA	11/9/2012
EPA 200.7	4.4	Tin	NELAP	PA	11/3/2008
EPA 200.7	4.4	Vanadium	NELAP	PA	10/16/2008
EPA 200.7	4.4	Zinc	NELAP	PA	4/4/2005
EPA 200.8	5.4	Antimony	NELAP	PA	2/10/2005
EPA 200.8	5.4	Arsenic	NELAP	PA	2/10/2005
EPA 200.8	5.4	Barium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Beryllium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Cadmium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Calcium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Chromium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Copper	NELAP	PA	3/9/2007
EPA 200.8	5.4	Iron	NELAP	PA	11/2/2012
EPA 200.8	5.4	Lead	NELAP	PA	2/10/2005
EPA 200.8	5.4	Magnesium	NELAP	PA	11/2/2012
EPA 200.8	5.4	Manganese	NELAP	PA	11/16/2011

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Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 200.8	5.4	Nickel	NELAP	PA	2/10/2005
EPA 200.8	5.4	Potassium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Selenium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Sodium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Strontium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Thallium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Zinc	NELAP	PA	11/16/2011
EPA 218.7		Chromium VI	NELAP	PA	11/27/2013
EPA 245.1	3.0	Mercury	NELAP	PA	8/29/2001
EPA 300.0	2.1	Bromide	NELAP	PA	11/9/2012
EPA 300.0	2.1	Chloride	NELAP	PA	5/17/2005
EPA 300.0	2.1	Fluoride	NELAP	PA	1/22/2004
EPA 300.0	2.1	Nitrate as N	NELAP	PA	10/31/2002
EPA 300.0	2.1	Nitrite as N	NELAP	PA	10/31/2002
EPA 300.0	2.1	Sulfate	NELAP	PA	7/7/2003
EPA 314.0		Perchlorate	NELAP	PA	5/24/2007
EPA 335.4		Cyanide	NELAP	PA	7/11/2006
EPA 353.2		Nitrate as N	NELAP	PA	2/28/2002
EPA 353.2		Nitrite as N	NELAP	PA	2/28/2002
EPA 353.2		Total nitrate-nitrite	NELAP	PA	5/24/2011
EPA 504.1	1.1	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	5/17/2005
EPA 504.1	1.1	1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	2/28/2002
EPA 504.1	1.1	1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	1/26/2001
EPA 507	2.1	Alachlor (Lasso)	NELAP	PA	2/28/2002
EPA 507	2.1	Atrazine	NELAP	PA	2/28/2002
EPA 507	2.1	Simazine	NELAP	PA	2/28/2002
EPA 508	3.1	Aldrin (HHDN)	NELAP	PA	5/18/2005
EPA 508	3.1	Aroclor-1016 (PCB-1016)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1221 (PCB-1221)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1232 (PCB-1232)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1242 (PCB-1242)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1248 (PCB-1248)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1254 (PCB-1254)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1260 (PCB-1260)	NELAP	PA	4/24/2007
EPA 508	3.1	Chlordane (tech.)	NELAP	PA	2/28/2002
EPA 508	3.1	Dieldrin	NELAP	PA	1/3/2002
EPA 508	3.1	Endrin	NELAP	PA	2/28/2002
EPA 508	3.1	Heptachlor	NELAP	PA	2/28/2002
EPA 508	3.1	Heptachlor epoxide	NELAP	PA	2/28/2002
EPA 508	3.1	Hexachlorobenzene	NELAP	PA	2/28/2002
EPA 508	3.1	Hexachlorocyclopentadiene	NELAP	PA	2/28/2002
EPA 508	3.1	Methoxychlor	NELAP	PA	2/28/2002
EPA 508	3.1	Toxaphene (Chlorinated camphene)	NELAP	PA	5/25/2007

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EPA 508	3.1	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	2/28/2002
EPA 515.1	4.0	2,4,5-TP (Silvex)	NELAP	PA	1/24/2001
EPA 515.1	4.0	2,4-D	NELAP	PA	1/24/2001
EPA 515.1	4.0	Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	1/24/2001
EPA 515.1	4.0	Dicamba	NELAP	PA	1/24/2001
EPA 515.1	4.0	Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	1/24/2001
EPA 515.1	4.0	Pentachlorophenol (PCP)	NELAP	PA	1/24/2001
EPA 515.1	4.0	Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	1/24/2001
EPA 524.2	4.1	1,1,1,2-Tetrachloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,1-Trichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,2,2-Tetrachloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,2-Trichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloro-2-propanone (1,1-Dichloropropanone)	NELAP	PA	5/17/2005
EPA 524.2	4.1	1,1-Dichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,3-Trichlorobenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,4-Trichlorobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,4-Trimethylbenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2-Dichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,3,5-Trimethylbenzene	NELAP	PA	5/17/2005
EPA 524.2	4.1	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,3-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1-Chlorobutane	NELAP	PA	5/24/2007
EPA 524.2	4.1	2,2-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	5/24/2007
EPA 524.2	4.1	2-Chlorotoluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	2-Hexanone	NELAP	PA	5/24/2007
EPA 524.2	4.1	2-Nitropropane	NELAP	PA	5/24/2007
EPA 524.2	4.1	4-Chlorotoluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	4-Methyl-2-pentanone (MIBK)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Acetone	NELAP	PA	5/24/2007
EPA 524.2	4.1	Acrylonitrile	NELAP	PA	5/24/2007
EPA 524.2	4.1	Allyl chloride (3-Chloropropene)	NELAP	PA	7/3/2007
EPA 524.2	4.1	Benzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Bromobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Bromochloromethane	NELAP	PA	4/4/2005
EPA 524.2	4.1	Bromodichloromethane	NELAP	PA	10/31/2002

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Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 524.2	4.1	Bromoform	NELAP	PA	10/31/2002
EPA 524.2	4.1	Carbon disulfide	NELAP	PA	5/24/2007
EPA 524.2	4.1	Carbon tetrachloride	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroacetonitrile	NELAP	PA	5/24/2007
EPA 524.2	4.1	Chlorobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroform	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dibromochloromethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dibromomethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dichlorodifluoromethane (Freon 12)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Diethyl ether (Ethyl ether)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Diisopropyl ether (DIPE)	NELAP	PA	1/7/2010
EPA 524.2	4.1	Ethyl methacrylate	NELAP	PA	5/24/2007
EPA 524.2	4.1	Ethyl tert-butyl ether (ETBE)	NELAP	PA	1/24/2007
EPA 524.2	4.1	Ethylbenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Hexachloroethane	NELAP	PA	5/24/2007
EPA 524.2	4.1	Isopropylbenzene (Cumene)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Methacrylonitrile	NELAP	PA	5/24/2007
EPA 524.2	4.1	Methyl bromide (Bromomethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methyl chloride (Chloromethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methyl iodide (Iodomethane)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Methyl tert-butyl ether (MTBE)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Methylacrylate	NELAP	PA	5/24/2007
EPA 524.2	4.1	Methylene chloride (Dichloromethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methylmethacrylate	NELAP	PA	5/24/2007
EPA 524.2	4.1	Naphthalene	NELAP	PA	5/17/2005
EPA 524.2	4.1	Nitrobenzene	NELAP	PA	5/17/2005
EPA 524.2	4.1	Pentachloroethane	NELAP	PA	5/24/2007
EPA 524.2	4.1	Propionitrile (Ethyl cyanide)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Styrene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Tetrahydrofuran (THF)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Toluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Total trihalomethanes (TTHMs)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Trichlorofluoromethane (Freon 11)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Vinyl chloride (Chloroethene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Xylenes, total	NELAP	PA	10/31/2002
EPA 524.2	4.1	cis-1,2-Dichloroethene	NELAP	PA	10/31/2002
EPA 524.2	4.1	cis-1,3-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	n-Butylbenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	n-Propylbenzene	NELAP	PA	5/17/2005
EPA 524.2	4.1	p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	5/17/2005
EPA 524.2	4.1	sec-Butylbenzene	NELAP	PA	4/4/2005

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Matrix: Drinking Water

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EPA 524.2	4.1	tert-Amyl methyl ether (TAME)	NELAP	PA	1/24/2007
EPA 524.2	4.1	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	5/24/2007
EPA 524.2	4.1	tert-Butylbenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	trans-1,2-Dichloroethene	NELAP	PA	10/31/2002
EPA 524.2	4.1	trans-1,3-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	trans-1,4-Dichloro-2-butene	NELAP	PA	5/24/2007
EPA 525.2	2.0	2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	5/17/2005
EPA 525.2	2.0	Acenaphthene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Acenaphthylene	NELAP	PA	4/28/2010
EPA 525.2	2.0	Alachlor (Lasso)	NELAP	PA	2/28/2002
EPA 525.2	2.0	Aldrin (HHDN)	NELAP	PA	10/9/2013
EPA 525.2	2.0	Anthracene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Atrazine	NELAP	PA	1/3/2002
EPA 525.2	2.0	Benzo[a]anthracene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Benzo[a]pyrene	NELAP	PA	1/24/2001
EPA 525.2	2.0	Benzo[b]fluoranthene	NELAP	PA	6/4/2007
EPA 525.2	2.0	Benzo[ghi]perylene	NELAP	PA	7/3/2007
EPA 525.2	2.0	Benzo[k]fluoranthene	NELAP	PA	6/4/2007
EPA 525.2	2.0	Benzyl butyl phthalate (Butyl benzyl phthalate)	NELAP	PA	5/25/2007
EPA 525.2	2.0	Butachlor	NELAP	PA	12/19/2002
EPA 525.2	2.0	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	5/25/2007
EPA 525.2	2.0	Di-n-butyl phthalate	NELAP	PA	5/25/2007
EPA 525.2	2.0	Dibenzo[a,h]anthracene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Dieldrin	NELAP	PA	5/17/2005
EPA 525.2	2.0	Diethyl phthalate	NELAP	PA	5/25/2007
EPA 525.2	2.0	Dimethyl phthalate	NELAP	PA	5/25/2007
EPA 525.2	2.0	Endrin	NELAP	PA	5/17/2005
EPA 525.2	2.0	Fluoranthene	NELAP	PA	3/7/2012
EPA 525.2	2.0	Fluorene	NELAP	PA	2/7/2012
EPA 525.2	2.0	Heptachlor	NELAP	PA	5/17/2005
EPA 525.2	2.0	Heptachlor epoxide	NELAP	PA	5/17/2005
EPA 525.2	2.0	Hexachlorobenzene	NELAP	PA	2/11/2005
EPA 525.2	2.0	Hexachlorocyclopentadiene	NELAP	PA	1/24/2001
EPA 525.2	2.0	Indeno(1,2,3-cd)pyrene	NELAP	PA	2/7/2012
EPA 525.2	2.0	Methoxychlor	NELAP	PA	1/24/2001
EPA 525.2	2.0	Metolachlor	NELAP	PA	12/19/2002
EPA 525.2	2.0	Metribuzin	NELAP	PA	12/19/2002
EPA 525.2	2.0	Phenanthrene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Propachlor (Ramrod)	NELAP	PA	1/24/2001
EPA 525.2	2.0	Pyrene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Simazine	NELAP	PA	1/3/2002
EPA 525.2	2.0	bis(2-Ethylhexyl) adipate (di(2-Ethylhexyl) adipate)	NELAP	PA	1/24/2001
EPA 525.2	2.0	bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	1/24/2001

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Matrix: Drinking Water

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EPA 525.2	2.0	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	1/24/2001
EPA 531.1	3.1	3-Hydroxycarbofuran	NELAP	PA	11/7/2006
EPA 531.1	3.1	Aldicarb (Temik)	NELAP	PA	1/24/2001
EPA 531.1	3.1	Aldicarb sulfone	NELAP	PA	1/24/2001
EPA 531.1	3.1	Aldicarb sulfoxide	NELAP	PA	1/24/2001
EPA 531.1	3.1	Carbaryl (Sevin)	NELAP	PA	10/9/2002
EPA 531.1	3.1	Carbofuran (Furadan)	NELAP	PA	1/24/2001
EPA 531.1	3.1	Methomyl (Lannate)	NELAP	PA	1/24/2001
EPA 531.1	3.1	Oxamyl (Vydate)	NELAP	PA	1/24/2001
EPA 8015		Ethane	NELAP	PA	5/24/2011
EPA 8015		Methane	NELAP	PA	5/24/2011
EPA 8015		Propane	NELAP	PA	11/9/2012
SM 2120 B		Color	NELAP	PA	5/25/2005
SM 2130 B		Turbidity	NELAP	PA	5/17/2005
SM 2320 B		Alkalinity as CaCO3	NELAP	PA	1/24/2001
SM 2340 C		Total hardness as CaCO3	NELAP	PA	5/24/2011
SM 2510 B		Conductivity	NELAP	PA	5/17/2005
SM 2540 C		Total dissolved solids (TDS)	NELAP	PA	6/2/2004
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	5/24/2011
SM 2550 B		Temperature, deg. C	NELAP	PA	4/4/2005
SM 4500-Cl F		Total residual chlorine	NELAP	PA	5/24/2011
SM 4500-Cl G		Residual free chlorine	NELAP	PA	1/7/2010
SM 4500-F- C		Fluoride	NELAP	PA	10/15/2003
SM 4500-H+ B		pH	NELAP	PA	5/16/2007
SM 4500-P E		Orthophosphate as P	NELAP	PA	6/12/2007
SM 4500-SiO2 C	20-22	Silica, dissolved	NELAP	PA	5/24/2007
SM 5310 C		Total organic carbon (TOC)	NELAP	PA	4/18/2013
SM 5540 C		Surfactants as MBAS	NELAP	PA	5/24/2007
SM 9215 B		Heterotrophic bacteria (Enumeration)	NELAP	PA	2/5/2003
SM 9223 Colilert		Total coliform & E. coli	NELAP	PA	1/26/2001

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
AK-101		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
AK-102		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
ASTM D7511-09		Total cyanide	NELAP	PA	2/15/2013
EPA 1010		Ignitability	NELAP	PA	12/12/2005
EPA 130.2		Hardness	NELAP	PA	1/19/2005
EPA 1311		Toxicity characteristic leaching procedure (TCLP)	NELAP	PA	12/12/2005
EPA 1312		Synthetic precipitation leaching procedure (SPLP)	NELAP	PA	12/12/2005
EPA 160.1		Residue, filterable (TDS)	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 160.4		Residue, volatile	NELAP	PA	1/19/2005
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	6/30/2010
EPA 1613	B	Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	8/6/2010
EPA 1613	B	Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	8/6/2010
EPA 1613	B	Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	8/6/2010
EPA 1613	B	Total tetrachlorodibenzo-p-dioxin (TCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total tetrachlorodibenzofuran (TCDF)	NELAP	PA	8/6/2010
EPA 1625	C	N-Nitrosodimethylamine	NELAP	PA	11/23/2010
EPA 1631	E	Mercury	NELAP	PA	6/11/2007
EPA 1664	A	Non-polar material	NELAP	PA	11/17/2006
EPA 1664	B	Oil and grease	NELAP	PA	1/27/2014
EPA 1664	A	Oil and grease	NELAP	PA	1/19/2005
EPA 1666	A	4-Methyl-2-pentanone (MIBK)	NELAP	PA	12/12/2005
EPA 1666	A	Diisopropyl ether (DIPE)	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1666	A	Ethyl acetate	NELAP	PA	1/19/2005
EPA 1666	A	Isobutyraldehyde	NELAP	PA	1/19/2005
EPA 1666	A	Isopropyl acetate	NELAP	PA	1/19/2005
EPA 1666	A	Isopropyl alcohol (2-Propanol)	NELAP	PA	12/2/2009
EPA 1666	A	Methyl formate	NELAP	PA	1/19/2005
EPA 1666	A	Tetrahydrofuran (THF)	NELAP	PA	1/19/2005
EPA 1666	A	Xylenes, total	NELAP	PA	1/19/2005
EPA 1666	A	n-Amyl acetate (n-Pentyl acetate)	NELAP	PA	4/4/2005
EPA 1666	A	n-Amyl alcohol (1-Pentanol)	NELAP	PA	4/4/2005
EPA 1666	A	n-Butyl acetate	NELAP	PA	4/4/2005
EPA 1666	A	n-Heptane	NELAP	PA	1/19/2005
EPA 1666	A	n-Hexane	NELAP	PA	1/19/2005
EPA 1666	A	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	4/4/2005
EPA 1668		2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	NELAP	PA	2/1/2013
EPA 1668		2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	NELAP	PA	2/1/2013
EPA 1668		2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3'-Tetrachlorobiphenyl (BZ 40)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	NELAP	PA	2/1/2013
EPA 1668		2,2',3,4',5,6-Hexachlorobiphenyl (BZ 147)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5-Pentachlorobiphenyl (BZ 90)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6'-Pentachlorobiphenyl (BZ 98)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6-Pentachlorobiphenyl (BZ 91)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5-Pentachlorobiphenyl (BZ 86)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6-Pentachlorobiphenyl (BZ 88)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4-Tetrachlorobiphenyl (BZ 41)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6-Pentachlorobiphenyl (BZ 93)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5-Tetrachlorobiphenyl (BZ 43)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6-Tetrachlorobiphenyl (BZ 45)	NELAP	PA	12/17/2012
EPA 1668		2,2',3-Trichlorobiphenyl (BZ 16)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6-Pentachlorobiphenyl (BZ 100)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4'-Tetrachlorobiphenyl (BZ 47)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,6'-Pentachlorobiphenyl (BZ 102)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5-Tetrachlorobiphenyl (BZ 48)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6'-Tetrachlorobiphenyl (BZ 51)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	NELAP	PA	2/1/2013
EPA 1668		2,2',4,6-Tetrachlorobiphenyl (BZ 50)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',4-Trichlorobiphenyl (BZ 17)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,6'-Tetrachlorobiphenyl (BZ 53)	NELAP	PA	12/17/2012
EPA 1668		2,2',5-Trichlorobiphenyl (BZ 18)	NELAP	PA	12/17/2012
EPA 1668		2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	NELAP	PA	12/17/2012
EPA 1668		2,2',6-Trichlorobiphenyl (BZ 19)	NELAP	PA	12/17/2012
EPA 1668		2,2'-Dichlorobiphenyl (BZ 4)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5',6-Pentachlorobiphenyl (BZ 125)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5'-Tetrachlorobiphenyl (BZ 76)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5-Tetrachlorobiphenyl (BZ 70)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',6-Tetrachlorobiphenyl (BZ 71)	NELAP	PA	12/17/2012
EPA 1668		2,3',4'-Trichlorobiphenyl (BZ 33)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5',6-Hexachlorobiphenyl (BZ 168)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',6-Pentachlorobiphenyl (BZ 119)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5-Tetrachlorobiphenyl (BZ 67)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,6-Tetrachlorobiphenyl (BZ 69)	NELAP	PA	12/17/2012
EPA 1668		2,3',4-Trichlorobiphenyl (BZ 25)	NELAP	PA	12/17/2012
EPA 1668		2,3',5',6-Tetrachlorobiphenyl (BZ 73)	NELAP	PA	12/17/2012
EPA 1668		2,3',5'-Trichlorobiphenyl (BZ 34)	NELAP	PA	12/17/2012
EPA 1668		2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	NELAP	PA	12/17/2012
EPA 1668		2,3',5-Trichlorobiphenyl (BZ 26)	NELAP	PA	12/17/2012
EPA 1668		2,3',6-Trichlorobiphenyl (BZ 27)	NELAP	PA	12/17/2012
EPA 1668		2,3'-Dichlorobiphenyl (BZ 6)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5-Pentachlorobiphenyl (BZ 107)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	NELAP	PA	2/1/2013

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5'-Pentachlorobiphenyl (BZ 108)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4-Tetrachlorobiphenyl (BZ 55)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5',6-Pentachlorobiphenyl (BZ 113)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5-Tetrachlorobiphenyl (BZ 57)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',6-Tetrachlorobiphenyl (BZ 59)	NELAP	PA	12/17/2012
EPA 1668		2,3,3'-Trichlorobiphenyl (BZ 20)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5,6-Pentachlorobiphenyl (BZ 117)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5-Tetrachlorobiphenyl (BZ 63)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',6-Tetrachlorobiphenyl (BZ 64)	NELAP	PA	12/17/2012
EPA 1668		2,3,4'-Trichlorobiphenyl (BZ 22)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',6-Pentachlorobiphenyl (BZ 115)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5,6-Pentachlorobiphenyl (BZ 116)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5-Tetrachlorobiphenyl (BZ 61)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,6-Tetrachlorobiphenyl (BZ 62)	NELAP	PA	12/17/2012
EPA 1668		2,3,4-Trichlorobiphenyl (BZ 21)	NELAP	PA	12/17/2012
EPA 1668		2,3,5,6-Tetrachlorobiphenyl (BZ 65)	NELAP	PA	12/17/2012
EPA 1668		2,3,5-Trichlorobiphenyl (BZ 23)	NELAP	PA	12/17/2012
EPA 1668		2,3,6-Trichlorobiphenyl (BZ 24)	NELAP	PA	12/17/2012
EPA 1668		2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	12/17/2012
EPA 1668		2,4',5-Trichlorobiphenyl (BZ 31)	NELAP	PA	12/17/2012
EPA 1668		2,4',6-Trichlorobiphenyl (BZ 32)	NELAP	PA	12/17/2012
EPA 1668		2,4'-Dichlorobiphenyl (BZ 8)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',5-Tetrachlorobiphenyl (BZ 74)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',6-Tetrachlorobiphenyl (BZ 75)	NELAP	PA	12/17/2012
EPA 1668		2,4,4'-Trichlorobiphenyl (BZ 28)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,4,5-Trichlorobiphenyl (BZ 29)	NELAP	PA	12/17/2012
EPA 1668		2,4,6-Trichlorobiphenyl (BZ 30)	NELAP	PA	12/17/2012
EPA 1668		2,4-Dichlorobiphenyl (BZ 7)	NELAP	PA	12/17/2012
EPA 1668		2,5-Dichlorobiphenyl (BZ 9)	NELAP	PA	12/17/2012
EPA 1668		2,6-Dichlorobiphenyl (BZ 10)	NELAP	PA	12/17/2012
EPA 1668		2-Chlorobiphenyl (BZ 1)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5-Tetrachlorobiphenyl (BZ 78)	NELAP	PA	12/17/2012
EPA 1668		3,3',4-Trichlorobiphenyl (BZ 35)	NELAP	PA	12/17/2012
EPA 1668		3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	NELAP	PA	12/17/2012
EPA 1668		3,3',5-Trichlorobiphenyl (BZ 36)	NELAP	PA	12/17/2012
EPA 1668		3,3'-Dichlorobiphenyl (BZ 11)	NELAP	PA	12/17/2012
EPA 1668		3,4',5-Trichlorobiphenyl (BZ 39)	NELAP	PA	12/17/2012
EPA 1668		3,4'-Dichlorobiphenyl (BZ 13)	NELAP	PA	12/17/2012
EPA 1668		3,4,4',5-Tetrachlorobiphenyl (BZ 81)	NELAP	PA	12/17/2012
EPA 1668		3,4,4'-Trichlorobiphenyl (BZ 37)	NELAP	PA	12/17/2012
EPA 1668		3,4,5-Trichlorobiphenyl (BZ 38)	NELAP	PA	12/17/2012
EPA 1668		3,4-Dichlorobiphenyl (BZ 12)	NELAP	PA	12/17/2012
EPA 1668		3,5-Dichlorobiphenyl (BZ 14)	NELAP	PA	12/17/2012
EPA 1668		3-Chlorobiphenyl (BZ 2)	NELAP	PA	12/17/2012
EPA 1668		4,4'-Dichlorobiphenyl (BZ 15)	NELAP	PA	12/17/2012
EPA 1668		4-Chlorobiphenyl (BZ 3)	NELAP	PA	12/17/2012
EPA 1668		Decachlorobiphenyl	NELAP	PA	2/1/2013
EPA 1671	A	Acetonitrile	NELAP	PA	1/19/2005
EPA 1671	A	Diethylamine	NELAP	PA	1/19/2005
EPA 1671	A	Dimethyl sulfoxide	NELAP	PA	1/19/2005
EPA 1671	A	Ethanol	NELAP	PA	1/19/2005
EPA 1671	A	Methanol	NELAP	PA	1/19/2005
EPA 1671	A	Methyl cellosolve (2-Methoxyethanol)	NELAP	PA	1/19/2005
EPA 1671	A	Triethylamine	NELAP	PA	1/19/2005
EPA 1671	A	n-Propanol (1-Propanol)	NELAP	PA	1/19/2005
EPA 170.1		Temperature, deg. C	NELAP	PA	4/4/2005
EPA 180.1		Turbidity	NELAP	PA	1/19/2005
EPA 200.2		Metals sample preparation	NELAP	PA	1/24/2007
EPA 200.7	4.4	Aluminum	NELAP	PA	1/19/2005
EPA 200.7	4.4	Antimony	NELAP	PA	1/19/2005
EPA 200.7	4.4	Arsenic	NELAP	PA	1/19/2005
EPA 200.7	4.4	Barium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Beryllium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Boron	NELAP	PA	1/19/2005
EPA 200.7	4.4	Cadmium	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 200.7	4.4	Calcium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Chromium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Cobalt	NELAP	PA	1/19/2005
EPA 200.7	4.4	Copper	NELAP	PA	1/19/2005
EPA 200.7	4.4	Iron	NELAP	PA	1/19/2005
EPA 200.7	4.4	Lead	NELAP	PA	1/19/2005
EPA 200.7	4.4	Lithium	NELAP	PA	2/7/2012
EPA 200.7	4.4	Magnesium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Manganese	NELAP	PA	1/19/2005
EPA 200.7	4.4	Molybdenum	NELAP	PA	1/19/2005
EPA 200.7	4.4	Nickel	NELAP	PA	1/19/2005
EPA 200.7	4.4	Potassium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Selenium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Silver	NELAP	PA	4/4/2005
EPA 200.7	4.4	Sodium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Strontium	NELAP	PA	5/24/2011
EPA 200.7	4.4	Thallium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Tin	NELAP	PA	1/19/2005
EPA 200.7	4.4	Titanium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Vanadium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Zinc	NELAP	PA	1/19/2005
EPA 200.8	5.4	Aluminum	NELAP	PA	1/7/2010
EPA 200.8	5.4	Antimony	NELAP	PA	4/4/2005
EPA 200.8	5.4	Arsenic	NELAP	PA	4/4/2005
EPA 200.8	5.4	Barium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Beryllium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Boron	NELAP	PA	1/11/2012
EPA 200.8	5.4	Cadmium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Calcium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Chromium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Cobalt	NELAP	PA	11/23/2010
EPA 200.8	5.4	Copper	NELAP	PA	4/4/2005
EPA 200.8	5.4	Iron	NELAP	PA	11/23/2010
EPA 200.8	5.4	Lead	NELAP	PA	4/4/2005
EPA 200.8	5.4	Magnesium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Manganese	NELAP	PA	11/23/2010
EPA 200.8	5.4	Molybdenum	NELAP	PA	1/7/2010
EPA 200.8	5.4	Nickel	NELAP	PA	4/4/2005
EPA 200.8	5.4	Potassium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Selenium	NELAP	PA	12/12/2005
EPA 200.8	5.4	Silver	NELAP	PA	1/2/2007
EPA 200.8	5.4	Sodium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Strontium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Thallium	NELAP	PA	5/31/2006
EPA 200.8	5.4	Tin	NELAP	PA	1/7/2010

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 200.8	5.4	Titanium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Vanadium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Zinc	NELAP	PA	1/18/2011
EPA 218.6		Chromium VI	NELAP	PA	4/4/2005
EPA 245.1	3.0	Mercury	NELAP	PA	1/19/2005
EPA 300.0	2.1	Bromide	NELAP	PA	4/4/2005
EPA 300.0	2.1	Chloride	NELAP	PA	1/19/2005
EPA 300.0	2.1	Fluoride	NELAP	PA	5/25/2005
EPA 300.0	2.1	Nitrate as N	NELAP	PA	1/19/2005
EPA 300.0	2.1	Nitrite as N	NELAP	PA	1/19/2005
EPA 300.0	2.1	Sulfate	NELAP	PA	1/19/2005
EPA 3005	A	Preconcentration under acid	NELAP	PA	12/12/2005
EPA 3010	A	Hot plate acid digestion (HNO3 + HCl)	NELAP	PA	12/12/2005
EPA 3020	A	Hot plate acid digestion (HNO3 only)	NELAP	PA	12/12/2005
EPA 305.2		Acidity as CaCO3	NELAP	PA	1/24/2007
EPA 3060	A	Alkaline digestion of Cr(VI)	NELAP	PA	1/24/2007
EPA 314.0		Perchlorate	NELAP	PA	11/23/2009
EPA 335.4		Total cyanide	NELAP	PA	1/19/2005
EPA 350.1		Ammonia as N	NELAP	PA	10/9/2013
EPA 351.2		Kjeldahl nitrogen, total (TKN)	NELAP	PA	1/19/2005
EPA 3510	C	Separatory funnel liquid-liquid extraction	NELAP	PA	12/12/2005
EPA 3511		Organic compounds in water by microextraction	NELAP	PA	3/7/2012
EPA 3520	C	Continuous liquid-liquid extraction	NELAP	PA	12/12/2005
EPA 353.2		Nitrate as N	NELAP	PA	1/19/2005
EPA 353.2		Nitrite as N	NELAP	PA	1/19/2005
EPA 353.2		Total nitrate-nitrite	NELAP	PA	4/4/2005
EPA 3620	B	Florisil cleanup	NELAP	PA	12/12/2005
EPA 3630	C	Silica gel cleanup	NELAP	PA	12/12/2005
EPA 3640	A	Gel permeation cleanup (GPC)	NELAP	PA	12/12/2005
EPA 365.1		Phosphorus, total	NELAP	PA	4/4/2005
EPA 365.3		Orthophosphate as P	NELAP	PA	1/19/2005
EPA 3660	B	Sulfur cleanup	NELAP	PA	12/12/2005
EPA 375.4		Sulfate	NELAP	PA	4/4/2005
EPA 410.4		Chemical oxygen demand (COD)	NELAP	PA	4/1/2005
EPA 415.1		Total organic carbon (TOC)	NELAP	PA	1/19/2005
EPA 420.4		Total phenolics	NELAP	PA	4/17/2007
EPA 425.1		Surfactants as MBAS	NELAP	PA	1/19/2005
EPA 5030	B	Aqueous-phase purge-and-trap	NELAP	PA	12/12/2005
EPA 5030	C	Aqueous-phase purge-and-trap	NELAP	PA	1/27/2014
EPA 524.2	4.1	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/18/2011
EPA 524.2	4.1	1,2-Dichloroethane	NELAP	PA	1/18/2011
EPA 524.2	4.1	4-Methyl-2-pentanone (MIBK)	NELAP	PA	5/24/2011
EPA 524.2	4.1	Acetone	NELAP	PA	1/18/2011
EPA 524.2	4.1	Benzene	NELAP	PA	1/18/2011
EPA 524.2	4.1	Chlorobenzene	NELAP	PA	1/18/2011

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 524.2	4.1	Chloroform	NELAP	PA	1/18/2011
EPA 524.2	4.1	Methylene chloride (Dichloromethane)	NELAP	PA	5/24/2011
EPA 524.2	4.1	Tetrahydrofuran (THF)	NELAP	PA	5/24/2011
EPA 524.2	4.1	Toluene	NELAP	PA	1/18/2011
EPA 524.2	4.1	m+p-Xylene	NELAP	PA	7/25/2011
EPA 524.2	4.1	o-Xylene	NELAP	PA	5/24/2011
EPA 6010		Aluminum	NELAP	PA	12/12/2005
EPA 6010		Antimony	NELAP	PA	12/12/2005
EPA 6010		Arsenic	NELAP	PA	12/12/2005
EPA 6010		Barium	NELAP	PA	12/12/2005
EPA 6010		Beryllium	NELAP	PA	12/12/2005
EPA 6010		Boron	NELAP	PA	12/12/2005
EPA 6010		Cadmium	NELAP	PA	12/12/2005
EPA 6010		Calcium	NELAP	PA	12/12/2005
EPA 6010		Chromium	NELAP	PA	12/12/2005
EPA 6010		Cobalt	NELAP	PA	12/12/2005
EPA 6010		Copper	NELAP	PA	12/12/2005
EPA 6010		Iron	NELAP	PA	12/12/2005
EPA 6010		Lead	NELAP	PA	12/12/2005
EPA 6010		Lithium	NELAP	PA	1/18/2011
EPA 6010		Magnesium	NELAP	PA	12/12/2005
EPA 6010		Manganese	NELAP	PA	12/12/2005
EPA 6010	C	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010	B	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010		Molybdenum	NELAP	PA	12/12/2005
EPA 6010		Nickel	NELAP	PA	12/12/2005
EPA 6010		Potassium	NELAP	PA	12/12/2005
EPA 6010		Selenium	NELAP	PA	12/12/2005
EPA 6010		Silver	NELAP	PA	12/12/2005
EPA 6010		Sodium	NELAP	PA	12/12/2005
EPA 6010		Strontium	NELAP	PA	12/12/2005
EPA 6010		Sulfur	NELAP	PA	12/19/2011
EPA 6010		Thallium	NELAP	PA	12/12/2005
EPA 6010		Tin	NELAP	PA	12/12/2005
EPA 6010		Titanium	NELAP	PA	12/12/2005
EPA 6010		Vanadium	NELAP	PA	12/12/2005
EPA 6010		Zinc	NELAP	PA	12/12/2005
EPA 602		Benzene	NELAP	PA	1/19/2005
EPA 602		Ethylbenzene	NELAP	PA	1/19/2005
EPA 602		Methyl tert-butyl ether (MTBE)	NELAP	PA	1/19/2005
EPA 602		Naphthalene	NELAP	PA	1/18/2011
EPA 602		Styrene	NELAP	PA	6/24/2008
EPA 602		Toluene	NELAP	PA	1/19/2005
EPA 602		Xylenes, total	NELAP	PA	1/19/2005
EPA 602		m+p-Xylene	NELAP	PA	1/18/2011

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 602		o-Xylene	NELAP	PA	1/18/2011
EPA 6020		Aluminum	NELAP	PA	1/7/2010
EPA 6020		Antimony	NELAP	PA	12/12/2005
EPA 6020		Arsenic	NELAP	PA	12/12/2005
EPA 6020		Barium	NELAP	PA	12/12/2005
EPA 6020		Beryllium	NELAP	PA	12/12/2005
EPA 6020		Boron	NELAP	PA	1/11/2012
EPA 6020		Cadmium	NELAP	PA	12/12/2005
EPA 6020		Calcium	NELAP	PA	1/7/2010
EPA 6020		Chromium	NELAP	PA	12/12/2005
EPA 6020		Cobalt	NELAP	PA	11/23/2010
EPA 6020		Copper	NELAP	PA	12/12/2005
EPA 6020		Iron	NELAP	PA	11/23/2010
EPA 6020		Lead	NELAP	PA	12/12/2005
EPA 6020		Magnesium	NELAP	PA	1/7/2010
EPA 6020		Manganese	NELAP	PA	11/23/2010
EPA 6020	A	Metals by ICP/MS	NELAP	PA	3/26/2012
EPA 6020		Molybdenum	NELAP	PA	1/7/2010
EPA 6020		Nickel	NELAP	PA	7/23/2008
EPA 6020		Potassium	NELAP	PA	1/7/2010
EPA 6020		Selenium	NELAP	PA	12/12/2005
EPA 6020		Silver	NELAP	PA	1/12/2007
EPA 6020		Sodium	NELAP	PA	1/7/2010
EPA 6020		Strontium	NELAP	PA	1/7/2010
EPA 6020		Thallium	NELAP	PA	12/12/2005
EPA 6020		Tin	NELAP	PA	1/7/2010
EPA 6020		Titanium	NELAP	PA	1/7/2010
EPA 6020		Vanadium	NELAP	PA	1/7/2010
EPA 6020		Zinc	NELAP	PA	1/18/2011
EPA 608		4,4'-DDD	NELAP	PA	1/19/2005
EPA 608		4,4'-DDE	NELAP	PA	1/19/2005
EPA 608		4,4'-DDT	NELAP	PA	1/19/2005
EPA 608		Aldrin (HHDN)	NELAP	PA	1/19/2005
EPA 608		Aroclor-1016 (PCB-1016)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1221 (PCB-1221)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1232 (PCB-1232)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1242 (PCB-1242)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1248 (PCB-1248)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1254 (PCB-1254)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1260 (PCB-1260)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1268 (PCB-1268)	NELAP	PA	11/13/2012
EPA 608		Chlordane (tech.)	NELAP	PA	1/19/2005
EPA 608		Dieldrin	NELAP	PA	1/19/2005
EPA 608		Endosulfan I	NELAP	PA	1/19/2005
EPA 608		Endosulfan II	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 608		Endosulfan sulfate	NELAP	PA	1/19/2005
EPA 608		Endrin	NELAP	PA	1/19/2005
EPA 608		Endrin aldehyde	NELAP	PA	1/19/2005
EPA 608		Heptachlor	NELAP	PA	1/19/2005
EPA 608		Heptachlor epoxide	NELAP	PA	1/19/2005
EPA 608		Methoxychlor	NELAP	PA	5/2/2006
EPA 608		Mirex	NELAP	PA	11/13/2012
EPA 608		Toxaphene (Chlorinated camphene)	NELAP	PA	1/19/2005
EPA 608		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 608		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 608		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 608		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 622		Azinphos-methyl (Guthion)	NELAP	PA	6/15/2009
EPA 622		Bolstar (Sulprofos)	NELAP	PA	6/15/2009
EPA 622		Carbophenothion (Trithion)	NELAP	PA	4/28/2010
EPA 622		Chlorpyrifos	NELAP	PA	6/15/2009
EPA 622		Coumaphos	NELAP	PA	6/15/2009
EPA 622		Demeton-O	NELAP	PA	6/15/2009
EPA 622		Demeton-S	NELAP	PA	6/15/2009
EPA 622		Diazinon (Spectracide)	NELAP	PA	6/15/2009
EPA 622		Dichlorovos (DDVP, Dichlorvos)	NELAP	PA	6/15/2009
EPA 622		Disulfoton	NELAP	PA	6/15/2009
EPA 622		EPN (Santox)	NELAP	PA	6/15/2009
EPA 622		Ethion	NELAP	PA	6/15/2009
EPA 622		Ethoprop (Prophos)	NELAP	PA	6/15/2009
EPA 622		Famphur	NELAP	PA	6/15/2009
EPA 622		Fensulfothion	NELAP	PA	6/15/2009
EPA 622		Fenthion	NELAP	PA	6/15/2009
EPA 622		Malathion	NELAP	PA	6/15/2009
EPA 622		Merphos	NELAP	PA	6/15/2009
EPA 622		Methyl parathion (Parathion, methyl)	NELAP	PA	6/15/2009
EPA 622		Mevinphos	NELAP	PA	6/15/2009
EPA 622		Naled	NELAP	PA	6/15/2009
EPA 622		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	6/15/2009
EPA 622		Phorate (Thimet)	NELAP	PA	6/15/2009
EPA 622		Ronnel	NELAP	PA	6/15/2009
EPA 622		Stirophos (Tetrachlorovinphos)	NELAP	PA	6/15/2009
EPA 622		Tokuthion (Prothiophos)	NELAP	PA	6/15/2009
EPA 622		Trichloronate	NELAP	PA	6/15/2009
EPA 624		1,1,1,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 624		1,1,1-Trichloroethane	NELAP	PA	1/19/2005
EPA 624		1,1,2,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 624		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	7/3/2007
EPA 624		1,1,2-Trichloroethane	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 624		1,1-Dichloroethane	NELAP	PA	1/19/2005
EPA 624		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	1/19/2005
EPA 624		1,1-Dichloropropene	NELAP	PA	7/3/2007
EPA 624		1,2,3-Trichlorobenzene	NELAP	PA	7/3/2007
EPA 624		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	7/3/2007
EPA 624		1,2,3-Trimethylbenzene	NELAP	PA	7/3/2007
EPA 624		1,2,4-Trichlorobenzene	NELAP	PA	7/3/2007
EPA 624		1,2,4-Trimethylbenzene	NELAP	PA	7/3/2007
EPA 624		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	7/3/2007
EPA 624		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	7/3/2007
EPA 624		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 624		1,2-Dichloroethane	NELAP	PA	1/19/2005
EPA 624		1,2-Dichloropropane	NELAP	PA	1/19/2005
EPA 624		1,3,5-Trimethylbenzene	NELAP	PA	7/3/2007
EPA 624		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 624		1,3-Dichloropropane	NELAP	PA	7/3/2007
EPA 624		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 624		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	7/3/2007
EPA 624		2,2-Dichloropropane	NELAP	PA	7/3/2007
EPA 624		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	7/3/2007
EPA 624		2-Chloroethyl vinyl ether	NELAP	PA	1/19/2005
EPA 624		2-Chlorotoluene	NELAP	PA	7/3/2007
EPA 624		2-Hexanone	NELAP	PA	7/3/2007
EPA 624		4-Chloro-2-nitrophenol	NELAP	PA	7/3/2007
EPA 624		4-Chlorotoluene	NELAP	PA	7/3/2007
EPA 624		4-Methyl-2-pentanone (MIBK)	NELAP	PA	5/2/2006
EPA 624		Acetone	NELAP	PA	7/3/2007
EPA 624		Acetonitrile	NELAP	PA	7/3/2007
EPA 624		Acrolein (Propenal)	NELAP	PA	1/19/2005
EPA 624		Acrylonitrile	NELAP	PA	1/19/2005
EPA 624		Allyl chloride (3-Chloropropene)	NELAP	PA	7/3/2007
EPA 624		Benzene	NELAP	PA	1/19/2005
EPA 624		Bromobenzene	NELAP	PA	7/3/2007
EPA 624		Bromochloromethane	NELAP	PA	5/2/2006
EPA 624		Bromodichloromethane	NELAP	PA	1/19/2005
EPA 624		Bromoform	NELAP	PA	1/19/2005
EPA 624		Carbon disulfide	NELAP	PA	7/3/2007
EPA 624		Carbon tetrachloride	NELAP	PA	1/19/2005
EPA 624		Chlorobenzene	NELAP	PA	1/19/2005
EPA 624		Chloroethane	NELAP	PA	1/19/2005
EPA 624		Chloroform	NELAP	PA	1/19/2005
EPA 624		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	6/12/2009
EPA 624		Cyclohexane	NELAP	PA	7/3/2007
EPA 624		Dibromochloromethane	NELAP	PA	4/4/2005

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 624		Dibromomethane	NELAP	PA	7/3/2007
EPA 624		Dichlorodifluoromethane (Freon 12)	NELAP	PA	7/3/2007
EPA 624		Diisopropyl ether (DIPE)	NELAP	PA	5/2/2006
EPA 624		Ethyl acetate	NELAP	PA	1/20/2012
EPA 624		Ethyl methacrylate	NELAP	PA	7/3/2007
EPA 624		Ethylbenzene	NELAP	PA	1/19/2005
EPA 624		Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	NELAP	PA	2/1/2011
EPA 624		Freon-123A	NELAP	PA	2/1/2011
EPA 624		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	7/3/2007
EPA 624		Isopropylbenzene (Cumene)	NELAP	PA	5/2/2006
EPA 624		Methacrylonitrile	NELAP	PA	7/3/2007
EPA 624		Methyl bromide (Bromomethane)	NELAP	PA	1/19/2005
EPA 624		Methyl chloride (Chloromethane)	NELAP	PA	1/19/2005
EPA 624		Methyl iodide (Iodomethane)	NELAP	PA	7/3/2007
EPA 624		Methyl tert-butyl ether (MTBE)	NELAP	PA	12/12/2005
EPA 624		Methylene chloride (Dichloromethane)	NELAP	PA	1/19/2005
EPA 624		Methylmethacrylate	NELAP	PA	7/3/2007
EPA 624		Naphthalene	NELAP	PA	7/3/2007
EPA 624		Pentachloroethane	NELAP	PA	7/3/2007
EPA 624		Propionitrile (Ethyl cyanide)	NELAP	PA	7/3/2007
EPA 624		Styrene	NELAP	PA	5/2/2006
EPA 624		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	1/19/2005
EPA 624		Tetrahydrofuran (THF)	NELAP	PA	7/3/2007
EPA 624		Toluene	NELAP	PA	1/19/2005
EPA 624		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	1/19/2005
EPA 624		Trichlorofluoromethane (Freon 11)	NELAP	PA	1/19/2005
EPA 624		Vinyl acetate	NELAP	PA	7/3/2007
EPA 624		Vinyl chloride (Chloroethene)	NELAP	PA	1/19/2005
EPA 624		Xylenes, total	NELAP	PA	1/19/2005
EPA 624		cis-1,2-Dichloroethene	NELAP	PA	6/12/2009
EPA 624		cis-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 624		n-Butylbenzene	NELAP	PA	7/3/2007
EPA 624		n-Heptane	NELAP	PA	7/3/2007
EPA 624		n-Hexane	NELAP	PA	7/3/2007
EPA 624		n-Propylbenzene	NELAP	PA	7/3/2007
EPA 624		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	7/3/2007
EPA 624		sec-Butylbenzene	NELAP	PA	7/3/2007
EPA 624		tert-Amyl methyl ether (TAME)	NELAP	PA	5/2/2006
EPA 624		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	5/2/2006
EPA 624		tert-Butyl ethyl ether	NELAP	PA	5/2/2006
EPA 624		tert-Butylbenzene	NELAP	PA	7/3/2007
EPA 624		trans-1,2-Dichloroethene	NELAP	PA	1/19/2005
EPA 624		trans-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 625		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	7/3/2007
EPA 625		1,2,4,5-Tetrachlorobenzene	NELAP	PA	5/2/2006

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 625		1,2,4-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 625		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 625		1,2-Diphenylhydrazine	NELAP	PA	5/2/2006
EPA 625		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 625		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 625		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	7/3/2007
EPA 625		1-Methylphenanthrene	NELAP	PA	5/2/2006
EPA 625		2,3,4,6-Tetrachlorophenol	NELAP	PA	7/3/2007
EPA 625		2,3-Dichloroaniline	NELAP	PA	5/2/2006
EPA 625		2,3-Dinitrotoluene	NELAP	PA	7/3/2007
EPA 625		2,4,5-Trichlorophenol	NELAP	PA	7/3/2007
EPA 625		2,4,6-Trichlorophenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dichlorophenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dimethylphenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dinitrophenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	1/19/2005
EPA 625		2,6-Dichlorophenol	NELAP	PA	7/3/2007
EPA 625		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	1/19/2005
EPA 625		2-Chloronaphthalene	NELAP	PA	1/19/2005
EPA 625		2-Chlorophenol	NELAP	PA	1/19/2005
EPA 625		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	1/19/2005
EPA 625		2-Methylnaphthalene	NELAP	PA	7/3/2007
EPA 625		2-Methylphenol (o-Cresol)	NELAP	PA	7/3/2007
EPA 625		2-Nitroaniline	NELAP	PA	7/3/2007
EPA 625		2-Nitrophenol	NELAP	PA	1/19/2005
EPA 625		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	7/3/2007
EPA 625		3,3'-Dichlorobenzidine	NELAP	PA	1/19/2005
EPA 625		3-Nitroaniline	NELAP	PA	7/3/2007
EPA 625		4-Bromophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 625		4-Chloro-3-methylphenol	NELAP	PA	1/19/2005
EPA 625		4-Chloroaniline	NELAP	PA	7/3/2007
EPA 625		4-Chlorophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 625		4-Nitroaniline	NELAP	PA	7/3/2007
EPA 625		4-Nitrophenol	NELAP	PA	1/19/2005
EPA 625		Acenaphthene	NELAP	PA	1/19/2005
EPA 625		Acenaphthylene	NELAP	PA	1/19/2005
EPA 625		Acetophenone	NELAP	PA	5/2/2006
EPA 625		Aniline	NELAP	PA	5/2/2006
EPA 625		Anthracene	NELAP	PA	4/4/2005
EPA 625		Benzidine	NELAP	PA	1/19/2005
EPA 625		Benzo[a]anthracene	NELAP	PA	1/19/2005
EPA 625		Benzo[a]pyrene	NELAP	PA	1/19/2005
EPA 625		Benzo[b]fluoranthene	NELAP	PA	1/19/2005
EPA 625		Benzo[ghi]perylene	NELAP	PA	1/19/2005
EPA 625		Benzo[k]fluoranthene	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 625		Benzoic acid	NELAP	PA	5/2/2006
EPA 625		Benzyl alcohol	NELAP	PA	7/3/2007
EPA 625		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	1/19/2005
EPA 625		Carbazole	NELAP	PA	5/2/2006
EPA 625		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	1/19/2005
EPA 625		Di-n-butyl phthalate	NELAP	PA	1/19/2005
EPA 625		Di-n-octyl phthalate	NELAP	PA	1/19/2005
EPA 625		Dibenzo[a,h]anthracene	NELAP	PA	1/19/2005
EPA 625		Dibenzofuran	NELAP	PA	7/3/2007
EPA 625		Diethyl phthalate	NELAP	PA	1/19/2005
EPA 625		Dimethyl phthalate	NELAP	PA	1/19/2005
EPA 625		Diphenyl ether	NELAP	PA	7/3/2007
EPA 625		Fluoranthene	NELAP	PA	1/19/2005
EPA 625		Fluorene	NELAP	PA	1/19/2005
EPA 625		Hexachlorobenzene	NELAP	PA	1/19/2005
EPA 625		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	1/19/2005
EPA 625		Hexachlorocyclopentadiene	NELAP	PA	1/19/2005
EPA 625		Hexachloroethane	NELAP	PA	1/19/2005
EPA 625		Indeno(1,2,3-cd)pyrene	NELAP	PA	1/19/2005
EPA 625		Isophorone	NELAP	PA	1/19/2005
EPA 625		N-Nitrosodi-n-butylamine	NELAP	PA	5/2/2006
EPA 625		N-Nitrosodi-n-propylamine	NELAP	PA	1/19/2005
EPA 625		N-Nitrosodiethylamine	NELAP	PA	5/2/2006
EPA 625		N-Nitrosodimethylamine	NELAP	PA	1/19/2005
EPA 625		N-Nitrosodiphenylamine	NELAP	PA	1/19/2005
EPA 625		N-Nitrosopyrrolidine	NELAP	PA	5/2/2006
EPA 625		Naphthalene	NELAP	PA	1/19/2005
EPA 625		Nitrobenzene	NELAP	PA	1/19/2005
EPA 625		Pentachlorobenzene	NELAP	PA	7/3/2007
EPA 625		Pentachlorophenol (PCP)	NELAP	PA	1/19/2005
EPA 625		Phenanthrene	NELAP	PA	1/19/2005
EPA 625		Phenol	NELAP	PA	1/19/2005
EPA 625		Pyrene	NELAP	PA	1/19/2005
EPA 625		Pyridine	NELAP	PA	5/2/2006
EPA 625		alpha-Terpineol	NELAP	PA	5/2/2006
EPA 625		bis(2-Chloroethoxy)methane	NELAP	PA	1/19/2005
EPA 625		bis(2-Chloroethyl) ether	NELAP	PA	1/19/2005
EPA 625		bis(2-Chloroisopropyl) ether	NELAP	PA	1/19/2005
EPA 625		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	1/19/2005
EPA 625		n-Decane	NELAP	PA	5/2/2006
EPA 625		n-Docosane	NELAP	PA	5/2/2006
EPA 625		n-Dodecane	NELAP	PA	5/2/2006
EPA 625		n-Eicosane	NELAP	PA	5/2/2006
EPA 625		n-Hexadecane	NELAP	PA	5/2/2006

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 625		n-Octadecane	NELAP	PA	5/2/2006
EPA 625		n-Tetradecane	NELAP	PA	5/2/2006
EPA 625		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	7/3/2007
EPA 6850		Perchlorate	NELAP	PA	1/19/2011
EPA 7196	A	Chromium VI	NELAP	PA	4/6/2006
EPA 7199		Chromium VI	NELAP	PA	1/4/2006
EPA 7470		Mercury	NELAP	PA	11/21/2005
EPA 8011		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	5/2/2006
EPA 8011		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	12/12/2005
EPA 8015		2-Methyl-propanoic acid (Isobutyric acid)	NELAP	PA	12/14/2012
EPA 8015		Acetic acid (Ethanoic acid)	NELAP	PA	12/14/2012
EPA 8015		Butanedoic acid (Succinic acid)	NELAP	PA	12/14/2012
EPA 8015		Butyric acid	NELAP	PA	12/14/2012
EPA 8015		Citric acid	NELAP	PA	12/14/2012
EPA 8015		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
EPA 8015		Diethylene glycol	NELAP	PA	1/20/2012
EPA 8015		Ethane	NELAP	PA	12/4/2007
EPA 8015		Ethanol	NELAP	PA	12/4/2007
EPA 8015		Ethene	NELAP	PA	12/4/2007
EPA 8015		Ethylene glycol	NELAP	PA	12/4/2007
EPA 8015		Formic acid	NELAP	PA	12/14/2012
EPA 8015		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
EPA 8015		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	2/7/2012
EPA 8015		Isopropyl alcohol (2-Propanol)	NELAP	PA	12/4/2007
EPA 8015		Lactic acid	NELAP	PA	12/14/2012
EPA 8015		Methane	NELAP	PA	12/4/2007
EPA 8015		Methanol	NELAP	PA	12/4/2007
EPA 8015	C	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015	B	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015		Oxalic acid	NELAP	PA	12/14/2012
EPA 8015		Propane	NELAP	PA	12/4/2007
EPA 8015		Propionic acid	NELAP	PA	12/14/2012
EPA 8015		Propylene glycol	NELAP	PA	1/20/2012
EPA 8015		Pyruvic acid	NELAP	PA	12/14/2012
EPA 8015		Quinic acid	NELAP	PA	12/21/2012
EPA 8015		Tartaric acid	NELAP	PA	12/14/2012
EPA 8015		Tetraethylene glycol	NELAP	PA	1/20/2012
EPA 8015		Total petroleum hydrocarbons (TPH)	NELAP	PA	1/24/2007
EPA 8015		Triethylene glycol	NELAP	PA	1/20/2012
EPA 8015		n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	2/7/2012
EPA 8015		n-Propanol (1-Propanol)	NELAP	PA	2/7/2012
EPA 8021		Benzene	NELAP	PA	12/12/2005
EPA 8021		Ethylbenzene	NELAP	PA	12/12/2005
EPA 8021		Isopropylbenzene (Cumene)	NELAP	PA	12/12/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8021		Methyl tert-butyl ether (MTBE)	NELAP	PA	2/11/2011
EPA 8021		Naphthalene	NELAP	PA	6/24/2008
EPA 8021		Toluene	NELAP	PA	12/12/2005
EPA 8021	B	VOCs by GC/PID/ELCD	NELAP	PA	3/26/2012
EPA 8021		Xylenes, total	NELAP	PA	12/12/2005
EPA 8021		m-Xylene	NELAP	PA	11/23/2009
EPA 8021		o-Xylene	NELAP	PA	11/23/2009
EPA 8021		p-Xylene	NELAP	PA	11/23/2009
EPA 8081		4,4'-DDD	NELAP	PA	2/10/2006
EPA 8081		4,4'-DDE	NELAP	PA	12/12/2005
EPA 8081		4,4'-DDT	NELAP	PA	12/12/2005
EPA 8081		Aldrin (HHDN)	NELAP	PA	12/12/2005
EPA 8081		Chlordane (tech.)	NELAP	PA	12/12/2005
EPA 8081		Dieldrin	NELAP	PA	12/12/2005
EPA 8081		Endosulfan I	NELAP	PA	2/10/2006
EPA 8081		Endosulfan II	NELAP	PA	12/12/2005
EPA 8081		Endosulfan sulfate	NELAP	PA	12/12/2005
EPA 8081		Endrin	NELAP	PA	12/12/2005
EPA 8081		Endrin aldehyde	NELAP	PA	12/12/2005
EPA 8081		Endrin ketone	NELAP	PA	2/10/2006
EPA 8081		Heptachlor	NELAP	PA	12/12/2005
EPA 8081		Heptachlor epoxide	NELAP	PA	12/12/2005
EPA 8081		Kepone	NELAP	PA	5/2/2006
EPA 8081		Methoxychlor	NELAP	PA	12/12/2005
EPA 8081		Mirex	NELAP	PA	12/12/2005
EPA 8081	B	Organochlorine pesticides by GC/ECD	NELAP	PA	1/1/2013
EPA 8081	A	Organochlorine pesticides by GC/ECD	NELAP	PA	3/26/2012
EPA 8081		Toxaphene (Chlorinated camphene)	NELAP	PA	12/12/2005
EPA 8081		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		alpha-Chlordane	NELAP	PA	2/10/2006
EPA 8081		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		gamma-Chlordane	NELAP	PA	2/10/2006
EPA 8082		Aroclor-1016 (PCB-1016)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1221 (PCB-1221)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1232 (PCB-1232)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1242 (PCB-1242)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1248 (PCB-1248)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1254 (PCB-1254)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1260 (PCB-1260)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1262 (PCB-1262)	NELAP	PA	7/23/2008
EPA 8082		Aroclor-1268 (PCB-1268)	NELAP	PA	7/23/2008
EPA 8082		Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 8082	A	PCBs by GC/ECD	NELAP	PA	3/26/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8141		Alachlor (Lasso)	NELAP	PA	1/21/2009
EPA 8141		Atrazine	NELAP	PA	12/12/2005
EPA 8141		Azinphos-methyl (Guthion)	NELAP	PA	12/12/2005
EPA 8141		Bolstar (Sulprofos)	NELAP	PA	12/12/2005
EPA 8141		Carbophenothion (Trithion)	NELAP	PA	11/9/2012
EPA 8141		Chlorpyrifos	NELAP	PA	12/12/2005
EPA 8141		Coumaphos	NELAP	PA	12/12/2005
EPA 8141		Demeton-O	NELAP	PA	12/12/2005
EPA 8141		Demeton-S	NELAP	PA	12/12/2005
EPA 8141		Diazinon (Spectracide)	NELAP	PA	12/12/2005
EPA 8141		Dichlorovos (DDVP, Dichlorvos)	NELAP	PA	12/12/2005
EPA 8141		Disulfoton	NELAP	PA	12/12/2005
EPA 8141		EPN (Santox)	NELAP	PA	12/12/2005
EPA 8141		Ethion	NELAP	PA	12/12/2005
EPA 8141		Ethoprop (Prophos)	NELAP	PA	12/12/2005
EPA 8141		Famphur	NELAP	PA	12/12/2005
EPA 8141		Fensulfothion	NELAP	PA	12/12/2005
EPA 8141		Fenthion	NELAP	PA	12/12/2005
EPA 8141		Malathion	NELAP	PA	12/12/2005
EPA 8141		Merphos	NELAP	PA	12/12/2005
EPA 8141		Methyl parathion (Parathion, methyl)	NELAP	PA	12/12/2005
EPA 8141		Metolachlor	NELAP	PA	1/24/2007
EPA 8141		Mevinphos	NELAP	PA	12/12/2005
EPA 8141		Naled	NELAP	PA	12/12/2005
EPA 8141	B	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141	A	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	12/12/2005
EPA 8141		Phorate (Thimet)	NELAP	PA	12/12/2005
EPA 8141		Ronnel	NELAP	PA	12/12/2005
EPA 8141		Simazine	NELAP	PA	12/12/2005
EPA 8141		Stirophos (Tetrachlorovinphos)	NELAP	PA	5/2/2006
EPA 8141		Tokuthion (Prothiophos)	NELAP	PA	12/12/2005
EPA 8141		Trichloronate	NELAP	PA	5/2/2006
EPA 8151		2,4,5-T	NELAP	PA	12/12/2005
EPA 8151		2,4,5-TP (Silvex)	NELAP	PA	12/12/2005
EPA 8151		2,4-D	NELAP	PA	12/12/2005
EPA 8151		2,4-DB (Butoxon)	NELAP	PA	12/12/2005
EPA 8151	A	Chlorinated herbicides by GC/ECD	NELAP	PA	3/26/2012
EPA 8151		Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	12/12/2005
EPA 8151		Dicamba	NELAP	PA	12/12/2005
EPA 8151		Dichloroprop (Dichlorprop)	NELAP	PA	1/24/2007
EPA 8151		Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	12/12/2005
EPA 8151		MCPA	NELAP	PA	12/12/2005
EPA 8151		MCPP (Mecoprop)	NELAP	PA	12/12/2005
EPA 8151		Pentachlorophenol (PCP)	NELAP	PA	12/12/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8151		Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	12/12/2005
EPA 8260		1,1,1,2-Tetrachloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1,1-Trichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1,2,2-Tetrachloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	12/12/2005
EPA 8260		1,1,2-Trichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1-Dichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	12/12/2005
EPA 8260		1,1-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260		1,2,3-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8260		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	12/12/2005
EPA 8260		1,2,4-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8260		1,2,4-Trimethylbenzene	NELAP	PA	12/12/2005
EPA 8260		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	12/12/2005
EPA 8260		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	12/12/2005
EPA 8260		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260		1,2-Dichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,2-Dichloropropane	NELAP	PA	12/12/2005
EPA 8260		1,3,5-Trimethylbenzene	NELAP	PA	12/12/2005
EPA 8260		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260		1,3-Dichloropropane	NELAP	PA	12/12/2005
EPA 8260		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/12/2005
EPA 8260		2,2-Dichloropropane	NELAP	PA	5/2/2006
EPA 8260		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	5/2/2006
EPA 8260		2-Chloroethyl vinyl ether	NELAP	PA	12/12/2005
EPA 8260		2-Chlorotoluene	NELAP	PA	12/12/2005
EPA 8260		2-Hexanone	NELAP	PA	12/12/2005
EPA 8260		2-Nitropropane	NELAP	PA	1/19/2011
EPA 8260		3,3'-Dimethyl-1-butanol	NELAP	PA	4/17/2009
EPA 8260		4-Chlorotoluene	NELAP	PA	12/12/2005
EPA 8260		4-Methyl-2-pentanone (MIBK)	NELAP	PA	12/12/2005
EPA 8260		Acetone	NELAP	PA	12/12/2005
EPA 8260		Acetonitrile	NELAP	PA	12/12/2005
EPA 8260		Acrolein (Propenal)	NELAP	PA	12/12/2005
EPA 8260		Acrylonitrile	NELAP	PA	12/12/2005
EPA 8260		Allyl chloride (3-Chloropropene)	NELAP	PA	12/12/2005
EPA 8260		Benzene	NELAP	PA	12/12/2005
EPA 8260		Benzyl chloride	NELAP	PA	7/3/2007
EPA 8260		Bromobenzene	NELAP	PA	12/12/2005
EPA 8260		Bromochloromethane	NELAP	PA	12/12/2005
EPA 8260		Bromodichloromethane	NELAP	PA	12/12/2005

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		Bromoform	NELAP	PA	12/12/2005
EPA 8260		Carbon disulfide	NELAP	PA	12/12/2005
EPA 8260		Carbon tetrachloride	NELAP	PA	12/12/2005
EPA 8260		Chlorobenzene	NELAP	PA	12/12/2005
EPA 8260		Chloroethane	NELAP	PA	12/12/2005
EPA 8260		Chloroform	NELAP	PA	12/12/2005
EPA 8260		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	7/3/2007
EPA 8260		Cyclohexane	NELAP	PA	7/3/2007
EPA 8260		Cyclohexanone	NELAP	PA	6/7/2012
EPA 8260		Dibromochloromethane	NELAP	PA	12/12/2005
EPA 8260		Dibromomethane	NELAP	PA	5/2/2006
EPA 8260		Dichlorodifluoromethane (Freon 12)	NELAP	PA	12/12/2005
EPA 8260		Diethyl ether (Ethyl ether)	NELAP	PA	2/1/2011
EPA 8260		Diisopropyl ether (DIPE)	NELAP	PA	7/3/2007
EPA 8260		Dimethyl ether	NELAP	PA	6/7/2012
EPA 8260		Epichlorohydrin (1-Chloro-2,3-epoxypropane)	NELAP	PA	4/17/2009
EPA 8260		Ethanol	NELAP	PA	1/24/2007
EPA 8260		Ethyl acetate	NELAP	PA	1/24/2007
EPA 8260		Ethyl methacrylate	NELAP	PA	1/24/2007
EPA 8260		Ethyl tert-butyl ether (ETBE)	NELAP	PA	1/24/2007
EPA 8260		Ethylbenzene	NELAP	PA	12/12/2005
EPA 8260		Gasoline-range organics (GRO)	NELAP	PA	6/8/2006
EPA 8260		Heptane	NELAP	PA	1/20/2012
EPA 8260		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	12/12/2005
EPA 8260		Hexachloroethane	NELAP	PA	5/23/2012
EPA 8260		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	7/3/2007
EPA 8260		Isopropyl alcohol (2-Propanol)	NELAP	PA	1/18/2011
EPA 8260		Isopropylbenzene (Cumene)	NELAP	PA	5/2/2006
EPA 8260		Methacrylonitrile	NELAP	PA	7/3/2007
EPA 8260		Methyl acetate	NELAP	PA	1/24/2007
EPA 8260		Methyl bromide (Bromomethane)	NELAP	PA	12/12/2005
EPA 8260		Methyl chloride (Chloromethane)	NELAP	PA	12/12/2005
EPA 8260		Methyl iodide (Iodomethane)	NELAP	PA	5/25/2007
EPA 8260		Methyl tert-butyl ether (MTBE)	NELAP	PA	12/12/2005
EPA 8260		Methylcyclohexane	NELAP	PA	1/21/2009
EPA 8260		Methylene chloride (Dichloromethane)	NELAP	PA	12/12/2005
EPA 8260		Methylmethacrylate	NELAP	PA	5/25/2007
EPA 8260		Naphthalene	NELAP	PA	12/12/2005
EPA 8260		Pentachloroethane	NELAP	PA	1/24/2007
EPA 8260		Propionitrile (Ethyl cyanide)	NELAP	PA	12/12/2005
EPA 8260		Styrene	NELAP	PA	12/12/2005
EPA 8260		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	12/12/2005
EPA 8260		Tetrahydrofuran (THF)	NELAP	PA	1/18/2011
EPA 8260		Toluene	NELAP	PA	12/12/2005

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	12/12/2005
EPA 8260		Trichlorofluoromethane (Freon 11)	NELAP	PA	12/12/2005
EPA 8260	B	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260	C	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260		Vinyl acetate	NELAP	PA	12/12/2005
EPA 8260		Vinyl chloride (Chloroethene)	NELAP	PA	12/12/2005
EPA 8260		Xylenes, total	NELAP	PA	12/12/2005
EPA 8260		cis-1,2-Dichloroethene	NELAP	PA	12/12/2005
EPA 8260		cis-1,3-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260		m+p-Xylene	NELAP	PA	4/17/2009
EPA 8260		n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	4/17/2009
EPA 8260		n-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260		n-Hexane	NELAP	PA	1/20/2012
EPA 8260		n-Propylamine	NELAP	PA	12/12/2005
EPA 8260		n-Propylbenzene	NELAP	PA	1/24/2007
EPA 8260		o-Xylene	NELAP	PA	4/17/2009
EPA 8260		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	1/24/2007
EPA 8260		sec-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260		tert-Amyl alcohol (2-Methyl-2-butanol)	NELAP	PA	4/17/2009
EPA 8260		tert-Amyl methyl ether (TAME)	NELAP	PA	1/24/2007
EPA 8260		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	12/12/2005
EPA 8260		tert-Butyl formate	NELAP	PA	4/17/2009
EPA 8260		tert-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260		trans-1,2-Dichloroethene	NELAP	PA	12/12/2005
EPA 8260		trans-1,3-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260		trans-1,4-Dichloro-2-butene	NELAP	PA	7/3/2007
EPA 8260 SIM		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/4/2007
EPA 8270		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	4/17/2009
EPA 8270		1,2,3,4-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,3,4-Tetrahydronaphthalene	NELAP	PA	4/17/2009
EPA 8270		1,2,3,5-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,4,5-Tetrachlorobenzene	NELAP	PA	12/12/2005
EPA 8270		1,2,4-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8270		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270		1,2-Diphenylhydrazine	NELAP	PA	12/12/2005
EPA 8270		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	12/12/2005
EPA 8270		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	12/12/2005
EPA 8270		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270		1,4-Dinitrobenzene (1,4-DNB)	NELAP	PA	4/17/2009
EPA 8270		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	4/17/2009
EPA 8270		1,4-Naphthoquinone	NELAP	PA	12/12/2005
EPA 8270		1,4-Phenylenediamine	NELAP	PA	12/12/2005
EPA 8270		1-Chloronaphthalene	NELAP	PA	12/12/2005
EPA 8270		1-Methylnaphthalene	NELAP	PA	4/17/2009

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		1-Naphthylamine (alpha-Naphthylamine)	NELAP	PA	12/12/2005
EPA 8270		2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl) ether)	NELAP	PA	1/19/2011
EPA 8270		2,3,4,6-Tetrachlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4,5-Trichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4,6-Trichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dimethylphenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dinitrophenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	12/12/2005
EPA 8270		2,6-Dichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	12/12/2005
EPA 8270		2-Acetylaminofluorene	NELAP	PA	12/12/2005
EPA 8270		2-Butoxyethanol	NELAP	PA	2/7/2012
EPA 8270		2-Chloronaphthalene	NELAP	PA	12/12/2005
EPA 8270		2-Chlorophenol	NELAP	PA	12/12/2005
EPA 8270		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	12/12/2005
EPA 8270		2-Methylnaphthalene	NELAP	PA	12/12/2005
EPA 8270		2-Methylphenol (o-Cresol)	NELAP	PA	12/12/2005
EPA 8270		2-Naphthylamine (beta-Naphthylamine)	NELAP	PA	12/12/2005
EPA 8270		2-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270		2-Nitrophenol	NELAP	PA	12/12/2005
EPA 8270		2-Picoline (2-Methylpyridine)	NELAP	PA	5/2/2006
EPA 8270		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	12/12/2005
EPA 8270		3,3'-Dichlorobenzidine	NELAP	PA	12/12/2005
EPA 8270		3,3'-Dimethylbenzidine	NELAP	PA	7/3/2007
EPA 8270		3-Methylcholanthrene	NELAP	PA	12/12/2005
EPA 8270		3-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270		4,4'-Methylenebis(2-chloroaniline)	NELAP	PA	12/12/2005
EPA 8270		4-Aminobiphenyl	NELAP	PA	12/12/2005
EPA 8270		4-Bromophenyl phenyl ether	NELAP	PA	12/12/2005
EPA 8270		4-Chloro-3-methylphenol	NELAP	PA	12/12/2005
EPA 8270		4-Chloroaniline	NELAP	PA	12/12/2005
EPA 8270		4-Chlorophenyl phenyl ether	NELAP	PA	12/12/2005
EPA 8270		4-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270		4-Nitrophenol	NELAP	PA	12/12/2005
EPA 8270		4-Nitroquinoline-1-oxide	NELAP	PA	7/3/2007
EPA 8270		5-Nitro-o-toluidine	NELAP	PA	12/12/2005
EPA 8270		6-Methylchrysene	NELAP	PA	1/19/2011
EPA 8270		7,12-Dimethylbenz(a)anthracene	NELAP	PA	12/12/2005
EPA 8270		Acenaphthene	NELAP	PA	12/12/2005
EPA 8270		Acenaphthylene	NELAP	PA	12/12/2005
EPA 8270		Acetophenone	NELAP	PA	12/12/2005
EPA 8270		Aniline	NELAP	PA	12/12/2005
EPA 8270		Anthracene	NELAP	PA	12/12/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Aramite	NELAP	PA	12/12/2005
EPA 8270		Atrazine	NELAP	PA	1/22/2007
EPA 8270		Benzaldehyde	NELAP	PA	4/17/2009
EPA 8270		Benzenethiol	NELAP	PA	4/17/2009
EPA 8270		Benzidine	NELAP	PA	12/12/2005
EPA 8270		Benzo[a]anthracene	NELAP	PA	12/12/2005
EPA 8270		Benzo[a]pyrene	NELAP	PA	12/12/2005
EPA 8270		Benzo[b]fluoranthene	NELAP	PA	12/12/2005
EPA 8270		Benzo[ghi]perylene	NELAP	PA	12/12/2005
EPA 8270		Benzo[k]fluoranthene	NELAP	PA	12/12/2005
EPA 8270		Benzoic acid	NELAP	PA	12/12/2005
EPA 8270		Benzyl alcohol	NELAP	PA	12/12/2005
EPA 8270		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	12/12/2005
EPA 8270		Caprolactam	NELAP	PA	4/17/2009
EPA 8270		Carbazole	NELAP	PA	12/12/2005
EPA 8270		Chlorobenzilate	NELAP	PA	12/12/2005
EPA 8270		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/12/2005
EPA 8270		Di-n-butyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Di-n-octyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Diallate (cis or trans)	NELAP	PA	12/12/2005
EPA 8270		Dibenz[a,h]acridine	NELAP	PA	4/17/2009
EPA 8270		Dibenz[a,j]acridine	NELAP	PA	12/12/2005
EPA 8270		Dibenzo[a,h]anthracene	NELAP	PA	12/12/2005
EPA 8270		Dibenzofuran	NELAP	PA	12/12/2005
EPA 8270		Diethyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Dimethoate	NELAP	PA	12/12/2005
EPA 8270		Dimethyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Dimethylaminoazobenzene (4-Dimethylaminoazobenzene)	NELAP	PA	5/2/2006
EPA 8270		Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	12/12/2005
EPA 8270		Diphenylamine	NELAP	PA	12/12/2005
EPA 8270		Disulfoton	NELAP	PA	12/12/2005
EPA 8270		Ethyl methanesulfonate	NELAP	PA	12/12/2005
EPA 8270		Famphur	NELAP	PA	12/12/2005
EPA 8270		Fluoranthene	NELAP	PA	12/12/2005
EPA 8270		Fluorene	NELAP	PA	12/12/2005
EPA 8270		Hexachlorobenzene	NELAP	PA	12/12/2005
EPA 8270		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	12/12/2005
EPA 8270		Hexachlorocyclopentadiene	NELAP	PA	12/12/2005
EPA 8270		Hexachloroethane	NELAP	PA	12/12/2005
EPA 8270		Hexachloropropene	NELAP	PA	12/12/2005
EPA 8270		Indene	NELAP	PA	4/17/2009
EPA 8270		Indeno(1,2,3-cd)pyrene	NELAP	PA	12/12/2005

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Isodrin	NELAP	PA	12/12/2005
EPA 8270		Isophorone	NELAP	PA	12/12/2005
EPA 8270		Isosafrole	NELAP	PA	12/12/2005
EPA 8270		Kepone	NELAP	PA	12/12/2005
EPA 8270		Methapyrilene	NELAP	PA	12/12/2005
EPA 8270		Methyl methanesulfonate	NELAP	PA	12/12/2005
EPA 8270		Methyl parathion (Parathion, methyl)	NELAP	PA	5/25/2007
EPA 8270		N,N-Dimethylacetamide	NELAP	PA	4/17/2009
EPA 8270		N,N-Dimethylformamide	NELAP	PA	4/17/2009
EPA 8270		N-Nitrosodi-n-butylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodi-n-propylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodiethylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodimethylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodiphenylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosomethylethylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosomorpholine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosopiperidine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosopyrrolidine	NELAP	PA	12/12/2005
EPA 8270		Naphthalene	NELAP	PA	12/12/2005
EPA 8270		Nitrobenzene	NELAP	PA	12/12/2005
EPA 8270		O,O,O-Triethyl phosphorothioate	NELAP	PA	12/12/2005
EPA 8270		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	5/25/2007
EPA 8270		Pentachlorobenzene	NELAP	PA	12/12/2005
EPA 8270		Pentachloronitrobenzene (PCNB)	NELAP	PA	12/12/2005
EPA 8270		Pentachlorophenol (PCP)	NELAP	PA	12/12/2005
EPA 8270		Phenacetin	NELAP	PA	12/12/2005
EPA 8270		Phenanthrene	NELAP	PA	12/12/2005
EPA 8270		Phenol	NELAP	PA	12/12/2005
EPA 8270		Phorate (Thimet)	NELAP	PA	12/12/2005
EPA 8270		Phthalic anhydride	NELAP	PA	1/21/2009
EPA 8270		Pronamide (Kerb)	NELAP	PA	12/12/2005
EPA 8270		Pyrene	NELAP	PA	12/12/2005
EPA 8270		Pyridine	NELAP	PA	12/12/2005
EPA 8270		Quinoline	NELAP	PA	4/17/2009
EPA 8270	C	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270	D	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270		Safrole	NELAP	PA	12/12/2005
EPA 8270		Sulfotepp (Tetraethyl dithiopyrophosphate)	NELAP	PA	4/17/2009
EPA 8270		Tetraethyl lead	NELAP	PA	3/7/2012
EPA 8270		Thionazine (Thionazin, Zinophos)	NELAP	PA	12/12/2005
EPA 8270		a,a-Dimethylphenethylamine (Phentermine)	NELAP	PA	12/12/2005
EPA 8270		a-Methylstyrene	NELAP	PA	4/17/2009
EPA 8270		bis(2-Chloroethoxy)methane	NELAP	PA	12/12/2005
EPA 8270		bis(2-Chloroethyl) ether	NELAP	PA	12/12/2005
EPA 8270		bis(2-Chloroisopropyl) ether	NELAP	PA	12/12/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		bis(2-Chloromethyl) ether	NELAP	PA	1/21/2009
EPA 8270		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	12/12/2005
EPA 8270		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	12/12/2005
EPA 8270		p-(Dimethylamino)azobenzene	NELAP	PA	4/17/2009
EPA 8270		tris-(2,3-Dibromopropyl) phosphate (tris-BP)	NELAP	PA	4/17/2009
EPA 8270 SIM		1-Methylnaphthalene	NELAP	PA	7/25/2011
EPA 8270 SIM		2-Methylnaphthalene	NELAP	PA	5/23/2012
EPA 8270 SIM		Acenaphthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Acenaphthylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[b]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[ghi]perylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[k]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/4/2007
EPA 8270 SIM		Dibenzo[a,h]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluorene	NELAP	PA	12/4/2007
EPA 8270 SIM		Indeno(1,2,3-cd)pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Naphthalene	NELAP	PA	12/4/2007
EPA 8270 SIM		Phenanthrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Pyrene	NELAP	PA	12/4/2007
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	8/6/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8290		1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	8/6/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	6/30/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	6/30/2010
EPA 8290		PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	3/26/2012
EPA 8290		Total TCDD	NELAP	PA	6/30/2010
EPA 8290		Total TCDF	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8315		2,5-Dimethylbenzaldehyde	NELAP	PA	12/12/2005
EPA 8315		Acetaldehyde	NELAP	PA	12/12/2005
EPA 8315		Benzaldehyde	NELAP	PA	12/12/2005
EPA 8315		Butanal (Butyraldehyde)	NELAP	PA	5/2/2006
EPA 8315	A	Carbonyl compounds by HPLC	NELAP	PA	3/26/2012
EPA 8315		Crotonaldehyde	NELAP	PA	12/12/2005
EPA 8315		Formaldehyde	NELAP	PA	12/12/2005
EPA 8315		Hexanal (Hexaldehyde)	NELAP	PA	1/21/2009
EPA 8315		Isovaleraldehyde	NELAP	PA	12/12/2005
EPA 8315		Pentanal (Valeraldehyde)	NELAP	PA	12/12/2005
EPA 8315		Propanal (Propionaldehyde)	NELAP	PA	1/21/2009
EPA 8315		m-Tolualdehyde (1,3-Tolualdehyde)	NELAP	PA	5/2/2006
EPA 8315		o-Tolualdehyde (1,2-Tolualdehyde)	NELAP	PA	1/24/2007
EPA 8315		p-Tolualdehyde (1,4-Tolualdehyde)	NELAP	PA	1/24/2007
EPA 8330		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	12/12/2005
EPA 8330		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	12/12/2005
EPA 8330		2,4,6-Trinitrotoluene (2,4,6-TNT)	NELAP	PA	12/12/2005
EPA 8330		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	6/11/2007
EPA 8330		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	6/11/2007
EPA 8330		2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NELAP	PA	12/12/2005
EPA 8330		2-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330		3-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330		4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NELAP	PA	12/12/2005
EPA 8330		4-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330		Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	NELAP	PA	12/12/2005
EPA 8330	A	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330		Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330		Nitrobenzene	NELAP	PA	6/11/2007

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8330		Nitroglycerin	NELAP	PA	1/24/2007
EPA 8330		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NELAP	PA	12/12/2005
EPA 8330		Pentacrythritol tetranitrate (PETN)	NELAP	PA	5/2/2006
EPA 8330		RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NELAP	PA	12/12/2005
EPA 8332		Nitroglycerin	NELAP	PA	12/12/2005
EPA 9012		Total cyanide	NELAP	PA	12/12/2005
EPA 9040		pH	NELAP	PA	12/12/2005
EPA 9050	A	Conductivity	NELAP	PA	1/27/2014
EPA 9050		Conductivity	NELAP	PA	12/12/2005
EPA 9056		Bromide	NELAP	PA	12/12/2005
EPA 9056		Chloride	NELAP	PA	12/12/2005
EPA 9056		Fluoride	NELAP	PA	12/12/2005
EPA 9056		Nitrate as N	NELAP	PA	12/12/2005
EPA 9056		Nitrite as N	NELAP	PA	1/19/2005
EPA 9056		Sulfate	NELAP	PA	12/12/2005
EPA 9060		Total organic carbon (TOC)	NELAP	PA	12/12/2005
EPA 9066		Total phenolics	NELAP	PA	12/12/2005
FL-PRO		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
MA DEP EPH	1.1	C11-C22 Aromatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C19-C36 Aliphatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C9-C18 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C5-C8 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C9-C12 Aliphatics	NELAP	PA	7/15/2013
NWTPH-Dx		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
NWTPH-Gx		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
NWTPH-HCID		GRO/DRO/HRO Screen	NELAP	PA	10/16/2008
OIA 1677		Available cyanide	NELAP	PA	10/9/2013
OIA 1677		Free cyanide	NELAP	PA	10/9/2013
PA-DEP 3686		Acetylene (Ethyne)	NELAP	PA	2/1/2013
PA-DEP 3686		Ethane	NELAP	PA	2/1/2013
PA-DEP 3686		Ethene	NELAP	PA	2/1/2013
PA-DEP 3686		Methane	NELAP	PA	2/1/2013
PA-DEP 3686		Propane	NELAP	PA	2/1/2013
PA-DEP 3686		n-Butane	NELAP	PA	2/1/2013
RSK-175		Acetylene (Ethyne)	NELAP	PA	1/20/2012
RSK-175		Ethane	NELAP	PA	6/29/2010
RSK-175		Ethene	NELAP	PA	6/29/2010
RSK-175		Methane	NELAP	PA	6/29/2010
RSK-175		Propane	NELAP	PA	6/29/2010
RSK-175		n-Butane	NELAP	PA	12/22/2011
SM 2120 B		Color	NELAP	PA	4/17/2007
SM 2310 B		Acidity as CaCO3	NELAP	PA	4/17/2007
SM 2320 B		Alkalinity as CaCO3	NELAP	PA	1/19/2005
SM 2340 C		Total hardness as CaCO3	NELAP	PA	4/17/2007

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
SM 2510 B		Conductivity	NELAP	PA	12/12/2005
SM 2540 B		Residue, total	NELAP	PA	4/17/2007
SM 2540 C		Residue, filterable (TDS)	NELAP	PA	4/17/2007
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	4/17/2007
SM 2540 F		Residue, settleable	NELAP	PA	4/17/2007
SM 3500-Cr B	20-22	Chromium VI	NELAP	PA	5/24/2007
SM 3500-Fe B	20/21	Ferrous iron	NELAP	PA	6/15/2009
SM 4500-CN- G		Amenable cyanide	NELAP	PA	5/24/2007
SM 4500-Cl F		Total residual chlorine	NELAP	PA	1/11/2012
SM 4500-Cl- C		Chloride	NELAP	PA	4/17/2007
SM 4500-F- B		Preliminary distillation of fluoride	NELAP	PA	4/28/2010
SM 4500-F- C		Fluoride	NELAP	PA	1/19/2005
SM 4500-H+ B		pH	NELAP	PA	4/17/2007
SM 4500-NH3 B		Ammonia distillation	NELAP	PA	4/17/2007
SM 4500-NH3 C		Ammonia as N	NELAP	PA	4/17/2007
SM 4500-NH3 D		Ammonia as N	NELAP	PA	4/17/2007
SM 4500-O G		Oxygen (dissolved)	NELAP	PA	4/17/2007
SM 4500-P B		Phosphorus, total	NELAP	PA	4/28/2010
SM 4500-P E		Orthophosphate as P	NELAP	PA	12/12/2005
SM 4500-P F		Phosphorus, total	NELAP	PA	4/28/2010
SM 4500-S D		Sulfide	NELAP	PA	4/17/2007
SM 4500-S F		Sulfide	NELAP	PA	4/17/2007
SM 4500-SO3 B		Sulfite, SO3	NELAP	PA	4/17/2007
SM 4500-SiO2 C	20-22	Silica, as SiO2	NELAP	PA	5/25/2007
SM 4500-SiO2 C	20-22	Silica, dissolved	NELAP	PA	5/24/2007
SM 5210 B		Biochemical oxygen demand (BOD)	NELAP	PA	4/4/2005
SM 5210 B		Carbonaceous BOD (CBOD)	NELAP	PA	1/19/2005
SM 5310 B		Total organic carbon (TOC)	NELAP	PA	4/17/2007
SM 5310 C		Total organic carbon (TOC)	NELAP	PA	5/24/2007
SM 5540 C		Surfactants as MBAS	NELAP	PA	4/17/2007
SM 9222 D		Fecal coliforms	NELAP	PA	7/6/2007
TX1005 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
TX1006 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
WA-EPH		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WA-VPH		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
WI-DRO		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WI-GRO		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
AK-101		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
AK-102		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
AK-103		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
EPA 1010		Ignitability	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1311		Toxicity characteristic leaching procedure (TCLP)	NELAP	PA	12/12/2005
EPA 1312		Synthetic precipitation leaching procedure (SPLP)	NELAP	PA	12/12/2005
EPA 1668		2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300

PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3'-Tetrachlorobiphenyl (BZ 40)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6-Hexachlorobiphenyl (BZ 147)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5-Pentachlorobiphenyl (BZ 90)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6'-Pentachlorobiphenyl (BZ 98)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6-Pentachlorobiphenyl (BZ 91)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)	NELAP	PA	12/17/2012

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PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5-Pentachlorobiphenyl (BZ 86)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6-Pentachlorobiphenyl (BZ 88)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4-Tetrachlorobiphenyl (BZ 41)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6-Pentachlorobiphenyl (BZ 93)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5-Tetrachlorobiphenyl (BZ 43)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6-Tetrachlorobiphenyl (BZ 45)	NELAP	PA	12/17/2012
EPA 1668		2,2',3-Trichlorobiphenyl (BZ 16)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6-Pentachlorobiphenyl (BZ 100)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4'-Tetrachlorobiphenyl (BZ 47)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,6'-Pentachlorobiphenyl (BZ 102)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5-Tetrachlorobiphenyl (BZ 48)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6'-Tetrachlorobiphenyl (BZ 51)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6-Tetrachlorobiphenyl (BZ 50)	NELAP	PA	12/17/2012
EPA 1668		2,2',4-Trichlorobiphenyl (BZ 17)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,6'-Tetrachlorobiphenyl (BZ 53)	NELAP	PA	12/17/2012
EPA 1668		2,2',5-Trichlorobiphenyl (BZ 18)	NELAP	PA	12/17/2012
EPA 1668		2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	NELAP	PA	12/17/2012
EPA 1668		2,2',6-Trichlorobiphenyl (BZ 19)	NELAP	PA	12/17/2012
EPA 1668		2,2'-Dichlorobiphenyl (BZ 4)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5',6-Pentachlorobiphenyl (BZ 125)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5'-Tetrachlorobiphenyl (BZ 76)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,3',4',5-Tetrachlorobiphenyl (BZ 70)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',6-Tetrachlorobiphenyl (BZ 71)	NELAP	PA	12/17/2012
EPA 1668		2,3',4'-Trichlorobiphenyl (BZ 33)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5',6-Hexachlorobiphenyl (BZ 168)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',6-Pentachlorobiphenyl (BZ 119)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5-Tetrachlorobiphenyl (BZ 67)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,6-Tetrachlorobiphenyl (BZ 69)	NELAP	PA	12/17/2012
EPA 1668		2,3',4-Trichlorobiphenyl (BZ 25)	NELAP	PA	12/17/2012
EPA 1668		2,3',5',6-Tetrachlorobiphenyl (BZ 73)	NELAP	PA	12/17/2012
EPA 1668		2,3',5'-Trichlorobiphenyl (BZ 34)	NELAP	PA	12/17/2012
EPA 1668		2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	NELAP	PA	12/17/2012
EPA 1668		2,3',5-Trichlorobiphenyl (BZ 26)	NELAP	PA	12/17/2012
EPA 1668		2,3',6-Trichlorobiphenyl (BZ 27)	NELAP	PA	12/17/2012
EPA 1668		2,3'-Dichlorobiphenyl (BZ 6)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5-Pentachlorobiphenyl (BZ 107)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5'-Pentachlorobiphenyl (BZ 108)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4-Tetrachlorobiphenyl (BZ 55)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5',6-Pentachlorobiphenyl (BZ 113)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5-Tetrachlorobiphenyl (BZ 57)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',6-Tetrachlorobiphenyl (BZ 59)	NELAP	PA	12/17/2012
EPA 1668		2,3,3'-Trichlorobiphenyl (BZ 20)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5,6-Pentachlorobiphenyl (BZ 117)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5-Tetrachlorobiphenyl (BZ 63)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',6-Tetrachlorobiphenyl (BZ 64)	NELAP	PA	12/17/2012
EPA 1668		2,3,4'-Trichlorobiphenyl (BZ 22)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',6-Pentachlorobiphenyl (BZ 115)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5,6-Pentachlorobiphenyl (BZ 116)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5-Tetrachlorobiphenyl (BZ 61)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,6-Tetrachlorobiphenyl (BZ 62)	NELAP	PA	12/17/2012
EPA 1668		2,3,4-Trichlorobiphenyl (BZ 21)	NELAP	PA	12/17/2012
EPA 1668		2,3,5,6-Tetrachlorobiphenyl (BZ 65)	NELAP	PA	12/17/2012
EPA 1668		2,3,5-Trichlorobiphenyl (BZ 23)	NELAP	PA	12/17/2012
EPA 1668		2,3,6-Trichlorobiphenyl (BZ 24)	NELAP	PA	12/17/2012
EPA 1668		2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	12/17/2012
EPA 1668		2,4',5-Trichlorobiphenyl (BZ 31)	NELAP	PA	12/17/2012
EPA 1668		2,4',6-Trichlorobiphenyl (BZ 32)	NELAP	PA	12/17/2012
EPA 1668		2,4'-Dichlorobiphenyl (BZ 8)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',5-Tetrachlorobiphenyl (BZ 74)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',6-Tetrachlorobiphenyl (BZ 75)	NELAP	PA	12/17/2012
EPA 1668		2,4,4'-Trichlorobiphenyl (BZ 28)	NELAP	PA	12/17/2012
EPA 1668		2,4,5-Trichlorobiphenyl (BZ 29)	NELAP	PA	12/17/2012
EPA 1668		2,4,6-Trichlorobiphenyl (BZ 30)	NELAP	PA	12/17/2012
EPA 1668		2,4-Dichlorobiphenyl (BZ 7)	NELAP	PA	12/17/2012
EPA 1668		2,5-Dichlorobiphenyl (BZ 9)	NELAP	PA	12/17/2012
EPA 1668		2,6-Dichlorobiphenyl (BZ 10)	NELAP	PA	12/17/2012
EPA 1668		2-Chlorobiphenyl (BZ 1)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		3,3',4,5-Tetrachlorobiphenyl (BZ 78)	NELAP	PA	12/17/2012
EPA 1668		3,3',4-Trichlorobiphenyl (BZ 35)	NELAP	PA	12/17/2012
EPA 1668		3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	NELAP	PA	12/17/2012
EPA 1668		3,3',5-Trichlorobiphenyl (BZ 36)	NELAP	PA	12/17/2012
EPA 1668		3,3'-Dichlorobiphenyl (BZ 11)	NELAP	PA	12/17/2012
EPA 1668		3,4',5-Trichlorobiphenyl (BZ 39)	NELAP	PA	12/17/2012
EPA 1668		3,4'-Dichlorobiphenyl (BZ 13)	NELAP	PA	12/17/2012
EPA 1668		3,4,4',5-Tetrachlorobiphenyl (BZ 81)	NELAP	PA	12/17/2012
EPA 1668		3,4,4'-Trichlorobiphenyl (BZ 37)	NELAP	PA	12/17/2012
EPA 1668		3,4,5-Trichlorobiphenyl (BZ 38)	NELAP	PA	12/17/2012
EPA 1668		3,4-Dichlorobiphenyl (BZ 12)	NELAP	PA	12/17/2012
EPA 1668		3,5-Dichlorobiphenyl (BZ 14)	NELAP	PA	12/17/2012
EPA 1668		3-Chlorobiphenyl (BZ 2)	NELAP	PA	12/17/2012
EPA 1668		4,4'-Dichlorobiphenyl (BZ 15)	NELAP	PA	12/17/2012
EPA 1668		4-Chlorobiphenyl (BZ 3)	NELAP	PA	12/17/2012
EPA 1668		Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 300.0	2.1	Bromide	NELAP	PA	10/16/2012
EPA 300.0	2.1	Fluoride	NELAP	PA	10/16/2012
EPA 300.0	2.1	Nitrate as N	NELAP	PA	10/16/2012
EPA 300.0	2.1	Nitrite as N	NELAP	PA	10/16/2012
EPA 300.0	2.1	Sulfate	NELAP	PA	10/16/2012
EPA 3050	B	Acid digestion of solids	NELAP	PA	4/4/2005
EPA 3060	A	Alkaline digestion of Cr(VI)	NELAP	PA	4/4/2005
EPA 3510	C	Separatory funnel liquid-liquid extraction	NELAP	PA	4/4/2005
EPA 3540	C	Soxhlet extraction	NELAP	PA	4/4/2005
EPA 3546		Microwave extraction	NELAP	PA	9/25/2009
EPA 3550		Ultrasonic extraction	NELAP	PA	4/4/2005
EPA 3620	B	Florisil cleanup	NELAP	PA	4/4/2005
EPA 3630	C	Silica gel cleanup	NELAP	PA	4/4/2005
EPA 3640	A	Gel permeation cleanup (GPC)	NELAP	PA	4/4/2005
EPA 3660	B	Sulfur cleanup	NELAP	PA	4/4/2005
EPA 3665	A	Sulfuric acid/permanganate clean-up	NELAP	PA	4/4/2005
EPA 5030		Bulk purge-and-trap (methanol)	NELAP	PA	12/4/2007
EPA 5035		Closed-system purge-and-trap (bisulfate option)	NELAP	PA	12/12/2005
EPA 5035		Closed-system purge-and-trap (methanol option)	NELAP	PA	4/4/2005
EPA 5035		Closed-system purge-and-trap (unpreserved)	NELAP	PA	4/4/2005
EPA 6010		Aluminum	NELAP	PA	1/19/2005
EPA 6010		Antimony	NELAP	PA	1/19/2005
EPA 6010		Arsenic	NELAP	PA	1/19/2005
EPA 6010		Barium	NELAP	PA	1/19/2005
EPA 6010		Beryllium	NELAP	PA	1/19/2005
EPA 6010		Boron	NELAP	PA	1/19/2005
EPA 6010		Cadmium	NELAP	PA	1/19/2005
EPA 6010		Calcium	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 6010		Chromium	NELAP	PA	1/19/2005
EPA 6010		Cobalt	NELAP	PA	1/19/2005
EPA 6010		Copper	NELAP	PA	1/19/2005
EPA 6010		Iron	NELAP	PA	1/19/2005
EPA 6010		Lead	NELAP	PA	1/19/2005
EPA 6010		Lithium	NELAP	PA	1/20/2012
EPA 6010		Magnesium	NELAP	PA	1/19/2005
EPA 6010		Manganese	NELAP	PA	1/19/2005
EPA 6010	C	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010	B	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010		Molybdenum	NELAP	PA	1/19/2005
EPA 6010		Nickel	NELAP	PA	1/19/2005
EPA 6010		Potassium	NELAP	PA	1/19/2005
EPA 6010		Selenium	NELAP	PA	1/19/2005
EPA 6010		Silica, as SiO2	NELAP	PA	1/20/2012
EPA 6010		Silver	NELAP	PA	1/19/2005
EPA 6010		Sodium	NELAP	PA	1/19/2005
EPA 6010		Strontium	NELAP	PA	1/19/2005
EPA 6010		Sulfur	NELAP	PA	12/19/2011
EPA 6010		Thallium	NELAP	PA	1/19/2005
EPA 6010		Tin	NELAP	PA	1/19/2005
EPA 6010		Titanium	NELAP	PA	1/19/2005
EPA 6010		Vanadium	NELAP	PA	1/19/2005
EPA 6010		Zinc	NELAP	PA	1/19/2005
EPA 6020		Aluminum	NELAP	PA	4/29/2010
EPA 6020		Antimony	NELAP	PA	1/19/2005
EPA 6020		Arsenic	NELAP	PA	1/19/2005
EPA 6020		Barium	NELAP	PA	1/20/2012
EPA 6020		Beryllium	NELAP	PA	1/19/2005
EPA 6020		Boron	NELAP	PA	4/29/2010
EPA 6020		Cadmium	NELAP	PA	1/19/2005
EPA 6020		Calcium	NELAP	PA	4/29/2010
EPA 6020		Chromium	NELAP	PA	1/19/2005
EPA 6020		Cobalt	NELAP	PA	4/29/2010
EPA 6020		Copper	NELAP	PA	1/19/2005
EPA 6020		Iron	NELAP	PA	4/29/2010
EPA 6020		Lead	NELAP	PA	1/19/2005
EPA 6020		Magnesium	NELAP	PA	4/29/2010
EPA 6020		Manganese	NELAP	PA	4/29/2010
EPA 6020	A	Metals by ICP/MS	NELAP	PA	3/26/2012
EPA 6020		Molybdenum	NELAP	PA	7/25/2011
EPA 6020		Nickel	NELAP	PA	4/4/2005
EPA 6020		Potassium	NELAP	PA	4/29/2010
EPA 6020		Selenium	NELAP	PA	4/4/2005
EPA 6020		Silver	NELAP	PA	2/23/2010

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PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 6020		Sodium	NELAP	PA	4/29/2010
EPA 6020		Strontium	NELAP	PA	4/29/2010
EPA 6020		Thallium	NELAP	PA	1/19/2005
EPA 6020		Tin	NELAP	PA	4/29/2010
EPA 6020		Titanium	NELAP	PA	4/29/2010
EPA 6020		Vanadium	NELAP	PA	1/7/2010
EPA 6020		Zinc	NELAP	PA	2/1/2011
EPA 6850		Perchlorate	NELAP	PA	1/19/2011
EPA 7.3.3.2		Reactive cyanide	NELAP	PA	12/12/2005
EPA 7.3.4.2		Reactive sulfide	NELAP	PA	12/12/2005
EPA 7196		Chromium VI	NELAP	PA	1/19/2005
EPA 7199		Chromium VI	NELAP	PA	5/2/2006
EPA 7471		Mercury	NELAP	PA	10/17/2007
EPA 8015		Diesel-range organics (DRO)	NELAP	PA	4/4/2005
EPA 8015		Ethanol	NELAP	PA	1/19/2005
EPA 8015		Ethylene glycol	NELAP	PA	12/4/2007
EPA 8015		Gasoline-range organics (GRO)	NELAP	PA	4/4/2005
EPA 8015		Isopropyl alcohol (2-Propanol)	NELAP	PA	12/4/2007
EPA 8015		Methanol	NELAP	PA	1/19/2005
EPA 8015	C	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015	B	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8021		Benzene	NELAP	PA	1/19/2005
EPA 8021		Ethylbenzene	NELAP	PA	1/19/2005
EPA 8021		Isopropylbenzene (Cumene)	NELAP	PA	1/24/2007
EPA 8021		Methyl tert-butyl ether (MTBE)	NELAP	PA	5/2/2006
EPA 8021		Naphthalene	NELAP	PA	12/4/2007
EPA 8021		Toluene	NELAP	PA	1/19/2005
EPA 8021	B	VOCs by GC/PID/ELCD	NELAP	PA	3/26/2012
EPA 8021		Xylenes, total	NELAP	PA	1/19/2005
EPA 8021		m-Xylene	NELAP	PA	1/24/2007
EPA 8021		o-Xylene	NELAP	PA	1/24/2007
EPA 8021		p-Xylene	NELAP	PA	1/24/2007
EPA 8081		4,4'-DDD	NELAP	PA	1/19/2005
EPA 8081		4,4'-DDE	NELAP	PA	1/19/2005
EPA 8081		4,4'-DDT	NELAP	PA	1/19/2005
EPA 8081		Aldrin (HHDN)	NELAP	PA	1/19/2005
EPA 8081		Chlordane (tech.)	NELAP	PA	1/19/2005
EPA 8081		Dieldrin	NELAP	PA	1/19/2005
EPA 8081		Endosulfan I	NELAP	PA	1/19/2005
EPA 8081		Endosulfan II	NELAP	PA	1/19/2005
EPA 8081		Endosulfan sulfate	NELAP	PA	1/19/2005
EPA 8081		Endrin	NELAP	PA	1/19/2005
EPA 8081		Endrin aldehyde	NELAP	PA	1/19/2005
EPA 8081		Endrin ketone	NELAP	PA	1/19/2005
EPA 8081		Heptachlor	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8081		Heptachlor epoxide	NELAP	PA	1/19/2005
EPA 8081		Kepone	NELAP	PA	1/19/2005
EPA 8081		Methoxychlor	NELAP	PA	1/19/2005
EPA 8081		Mirex	NELAP	PA	1/19/2005
EPA 8081	A	Organochlorine pesticides by GC/ECD	NELAP	PA	3/26/2012
EPA 8081	B	Organochlorine pesticides by GC/ECD	NELAP	PA	1/1/2013
EPA 8081		Toxaphene (Chlorinated camphene)	NELAP	PA	1/19/2005
EPA 8081		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		alpha-Chlordane	NELAP	PA	4/4/2005
EPA 8081		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		gamma-Chlordane	NELAP	PA	4/4/2005
EPA 8082		Aroclor-1016 (PCB-1016)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1016 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1221 (PCB-1221)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1221 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1232 (PCB-1232)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1232 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1242 (PCB-1242)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1242 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1248 (PCB-1248)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1248 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1254 (PCB-1254)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1254 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1260 (PCB-1260)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1260 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1262 (PCB-1262)	NELAP	PA	7/23/2008
EPA 8082		Aroclor-1268 (PCB-1268)	NELAP	PA	7/23/2008
EPA 8082		Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 8082	A	PCBs by GC/ECD	NELAP	PA	3/26/2012
EPA 8141		Alachlor (Lasso)	NELAP	PA	1/21/2009
EPA 8141		Atrazine	NELAP	PA	1/19/2005
EPA 8141		Azinphos-methyl (Guthion)	NELAP	PA	4/4/2005
EPA 8141		Bolstar (Sulprofos)	NELAP	PA	1/19/2005
EPA 8141		Carbophenothion (Trithion)	NELAP	PA	11/9/2012
EPA 8141		Chlorpyrifos	NELAP	PA	4/4/2005
EPA 8141		Coumaphos	NELAP	PA	1/19/2005
EPA 8141		Demeton-O	NELAP	PA	1/19/2005
EPA 8141		Demeton-S	NELAP	PA	1/19/2005
EPA 8141		Diazinon (Spectracide)	NELAP	PA	1/19/2005
EPA 8141		Dichlorovos (DDVP, Dichlorvos)	NELAP	PA	1/19/2005
EPA 8141		Disulfoton	NELAP	PA	1/19/2005
EPA 8141		EPN (Santox)	NELAP	PA	1/19/2005
EPA 8141		Ethion	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8141		Ethoprop (Prophos)	NELAP	PA	1/19/2005
EPA 8141		Famphur	NELAP	PA	1/19/2005
EPA 8141		Fensulfothion	NELAP	PA	1/19/2005
EPA 8141		Fenthion	NELAP	PA	4/4/2005
EPA 8141		Malathion	NELAP	PA	1/19/2005
EPA 8141		Merphos	NELAP	PA	1/19/2005
EPA 8141		Methyl parathion (Parathion, methyl)	NELAP	PA	5/25/2005
EPA 8141		Mevinphos	NELAP	PA	1/19/2005
EPA 8141		Naled	NELAP	PA	1/19/2005
EPA 8141	B	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141	A	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	1/19/2005
EPA 8141		Phorate (Thimet)	NELAP	PA	1/19/2005
EPA 8141		Ronnel	NELAP	PA	1/19/2005
EPA 8141		Simazine	NELAP	PA	1/4/2006
EPA 8141		Stirophos (Tetrachlorovinphos)	NELAP	PA	1/19/2005
EPA 8141		Tokuthion (Prothiophos)	NELAP	PA	1/19/2005
EPA 8141		Trichloronate	NELAP	PA	1/19/2005
EPA 8151		2,4,5-T	NELAP	PA	1/19/2005
EPA 8151		2,4,5-TP (Silvex)	NELAP	PA	1/19/2005
EPA 8151		2,4-D	NELAP	PA	1/19/2005
EPA 8151		2,4-DB (Butoxon)	NELAP	PA	4/4/2005
EPA 8151	A	Chlorinated herbicides by GC/ECD	NELAP	PA	3/26/2012
EPA 8151		Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	1/19/2005
EPA 8151		Dicamba	NELAP	PA	1/19/2005
EPA 8151		Dichloroprop (Dichlorprop)	NELAP	PA	1/19/2005
EPA 8151		Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	1/19/2005
EPA 8151		MCPA	NELAP	PA	1/19/2005
EPA 8151		MCPP (Mecoprop)	NELAP	PA	5/2/2006
EPA 8151		Pentachlorophenol (PCP)	NELAP	PA	1/19/2005
EPA 8151		Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	1/19/2005
EPA 8260		1,1,1,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1,1-Trichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1,2,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	5/2/2006
EPA 8260		1,1,2-Trichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1-Dichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	1/19/2005
EPA 8260		1,1-Dichloropropene	NELAP	PA	1/19/2005
EPA 8260		1,2,3-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 8260		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	1/19/2005
EPA 8260		1,2,4-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 8260		1,2,4-Trimethylbenzene	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	1/19/2005
EPA 8260		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	1/19/2005
EPA 8260		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8260		1,2-Dichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,2-Dichloropropane	NELAP	PA	1/19/2005
EPA 8260		1,3,5-Trimethylbenzene	NELAP	PA	1/19/2005
EPA 8260		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8260		1,3-Dichloropropane	NELAP	PA	1/19/2005
EPA 8260		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8260		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	1/19/2005
EPA 8260		2,2-Dichloropropane	NELAP	PA	1/19/2005
EPA 8260		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	1/19/2005
EPA 8260		2-Chloroethyl vinyl ether	NELAP	PA	1/19/2005
EPA 8260		2-Chlorotoluene	NELAP	PA	5/2/2006
EPA 8260		2-Hexanone	NELAP	PA	1/19/2005
EPA 8260		2-Nitropropane	NELAP	PA	12/17/2012
EPA 8260		3,3'-Dimethyl-1-butanol	NELAP	PA	4/17/2009
EPA 8260		4-Chloro-2-nitrophenol	NELAP	PA	5/2/2006
EPA 8260		4-Chlorotoluene	NELAP	PA	1/19/2005
EPA 8260		4-Methyl-2-pentanone (MIBK)	NELAP	PA	1/19/2005
EPA 8260		Acetone	NELAP	PA	1/19/2005
EPA 8260		Acetonitrile	NELAP	PA	1/4/2006
EPA 8260		Acrolein (Propenal)	NELAP	PA	1/19/2005
EPA 8260		Acrylonitrile	NELAP	PA	1/19/2005
EPA 8260		Allyl chloride (3-Chloropropene)	NELAP	PA	1/19/2005
EPA 8260		Benzene	NELAP	PA	1/19/2005
EPA 8260		Benzyl chloride	NELAP	PA	1/4/2006
EPA 8260		Bromobenzene	NELAP	PA	1/19/2005
EPA 8260		Bromochloromethane	NELAP	PA	1/19/2005
EPA 8260		Bromodichloromethane	NELAP	PA	1/19/2005
EPA 8260		Bromoform	NELAP	PA	1/19/2005
EPA 8260		Carbon disulfide	NELAP	PA	1/19/2005
EPA 8260		Carbon tetrachloride	NELAP	PA	1/19/2005
EPA 8260		Chlorobenzene	NELAP	PA	1/19/2005
EPA 8260		Chloroethane	NELAP	PA	1/19/2005
EPA 8260		Chloroform	NELAP	PA	1/19/2005
EPA 8260		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	4/17/2009
EPA 8260		Cyclohexane	NELAP	PA	6/29/2010
EPA 8260		Cyclohexanone	NELAP	PA	7/3/2007
EPA 8260		Dibromochloromethane	NELAP	PA	1/19/2005
EPA 8260		Dibromomethane	NELAP	PA	1/19/2005
EPA 8260		Dichlorodifluoromethane (Freon 12)	NELAP	PA	1/19/2005
EPA 8260		Diisopropyl ether (DIPE)	NELAP	PA	7/3/2007

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PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		Epichlorohydrin (1-Chloro-2,3-epoxypropane)	NELAP	PA	1/4/2006
EPA 8260		Ethanol	NELAP	PA	1/4/2006
EPA 8260		Ethyl acetate	NELAP	PA	1/4/2006
EPA 8260		Ethyl methacrylate	NELAP	PA	1/4/2006
EPA 8260		Ethyl tert-butyl ether (ETBE)	NELAP	PA	7/3/2007
EPA 8260		Ethylbenzene	NELAP	PA	1/19/2005
EPA 8260		Gasoline-range organics (GRO)	NELAP	PA	6/8/2006
EPA 8260		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	1/19/2005
EPA 8260		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	7/3/2007
EPA 8260		Isopropyl alcohol (2-Propanol)	NELAP	PA	1/19/2005
EPA 8260		Isopropylbenzene (Cumene)	NELAP	PA	8/7/2005
EPA 8260		Methacrylonitrile	NELAP	PA	1/24/2007
EPA 8260		Methyl acetate	NELAP	PA	6/29/2010
EPA 8260		Methyl bromide (Bromomethane)	NELAP	PA	1/19/2005
EPA 8260		Methyl chloride (Chloromethane)	NELAP	PA	1/19/2005
EPA 8260		Methyl iodide (Iodomethane)	NELAP	PA	5/2/2006
EPA 8260		Methyl tert-butyl ether (MTBE)	NELAP	PA	1/19/2005
EPA 8260		Methylcyclohexane	NELAP	PA	1/21/2009
EPA 8260		Methylene chloride (Dichloromethane)	NELAP	PA	1/19/2005
EPA 8260		Methylmethacrylate	NELAP	PA	5/2/2006
EPA 8260		Naphthalene	NELAP	PA	1/19/2005
EPA 8260		Pentachloroethane	NELAP	PA	1/24/2007
EPA 8260		Propionitrile (Ethyl cyanide)	NELAP	PA	1/24/2007
EPA 8260		Styrene	NELAP	PA	1/19/2005
EPA 8260		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	1/19/2005
EPA 8260		Tetrahydrofuran (THF)	NELAP	PA	6/7/2012
EPA 8260		Toluene	NELAP	PA	1/19/2005
EPA 8260		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	1/19/2005
EPA 8260		Trichlorofluoromethane (Freon 11)	NELAP	PA	1/19/2005
EPA 8260	B	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260	C	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260		Vinyl acetate	NELAP	PA	1/19/2005
EPA 8260		Vinyl chloride (Chloroethene)	NELAP	PA	1/19/2005
EPA 8260		Xylenes, total	NELAP	PA	1/19/2005
EPA 8260		cis-1,2-Dichloroethene	NELAP	PA	1/19/2005
EPA 8260		cis-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 8260		m+p-Xylene	NELAP	PA	1/24/2007
EPA 8260		n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	1/19/2005
EPA 8260		n-Butylbenzene	NELAP	PA	1/19/2005
EPA 8260		n-Propylbenzene	NELAP	PA	1/4/2006
EPA 8260		o-Xylene	NELAP	PA	1/24/2007
EPA 8260		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	1/24/2007
EPA 8260		sec-Butylbenzene	NELAP	PA	1/19/2005
EPA 8260		tert-Amyl alcohol (2-Methyl-2-butanol)	NELAP	PA	4/17/2009

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PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		tert-Amyl methyl ether (TAME)	NELAP	PA	7/3/2007
EPA 8260		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	1/19/2005
EPA 8260		tert-Butyl ethyl ether	NELAP	PA	5/25/2007
EPA 8260		tert-Butyl formate	NELAP	PA	4/17/2009
EPA 8260		tert-Butylbenzene	NELAP	PA	1/19/2005
EPA 8260		trans-1,2-Dichloroethene	NELAP	PA	1/19/2005
EPA 8260		trans-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 8260		trans-1,4-Dichloro-2-butene	NELAP	PA	7/3/2007
EPA 8260 SIM		1,4-Dioxane (1,4-Diethylenoxide)	NELAP	PA	4/17/2009
EPA 8270		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	12/4/2007
EPA 8270		1,2,3,4-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,3,4-Tetrahydronaphthalene	NELAP	PA	12/4/2007
EPA 8270		1,2,3,5-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,4,5-Tetrachlorobenzene	NELAP	PA	4/4/2005
EPA 8270		1,2,4-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 8270		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8270		1,2-Dinitrobenzene (1,2-DNB)	NELAP	PA	1/19/2005
EPA 8270		1,2-Diphenylhydrazine	NELAP	PA	5/2/2006
EPA 8270		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	1/4/2006
EPA 8270		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8270		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	1/19/2005
EPA 8270		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8270		1,4-Dinitrobenzene (1,4-DNB)	NELAP	PA	5/2/2006
EPA 8270		1,4-Dioxane (1,4-Diethylenoxide)	NELAP	PA	12/4/2007
EPA 8270		1,4-Naphthoquinone	NELAP	PA	1/19/2005
EPA 8270		1,4-Phenylenediamine	NELAP	PA	1/19/2005
EPA 8270		1-Chloronaphthalene	NELAP	PA	1/4/2006
EPA 8270		1-Methylnaphthalene	NELAP	PA	12/4/2007
EPA 8270		1-Naphthylamine (alpha-Naphthylamine)	NELAP	PA	4/4/2005
EPA 8270		2,3,4,6-Tetrachlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4,5-Trichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4,6-Trichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dimethylphenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dinitrophenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	1/19/2005
EPA 8270		2,6-Dichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	1/19/2005
EPA 8270		2-Acetylaminofluorene	NELAP	PA	1/19/2005
EPA 8270		2-Chloronaphthalene	NELAP	PA	1/19/2005
EPA 8270		2-Chlorophenol	NELAP	PA	1/19/2005
EPA 8270		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	1/19/2005
EPA 8270		2-Methylnaphthalene	NELAP	PA	1/19/2005
EPA 8270		2-Methylphenol (o-Cresol)	NELAP	PA	1/19/2005
EPA 8270		2-Naphthylamine (beta-Naphthylamine)	NELAP	PA	5/17/2005

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PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		2-Nitroaniline	NELAP	PA	4/4/2005
EPA 8270		2-Nitrophenol	NELAP	PA	1/19/2005
EPA 8270		2-Picoline (2-Methylpyridine)	NELAP	PA	1/19/2005
EPA 8270		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	1/19/2005
EPA 8270		3,3'-Dichlorobenzidine	NELAP	PA	1/19/2005
EPA 8270		3,3'-Dimethoxybenzidine	NELAP	PA	4/17/2009
EPA 8270		3,3'-Dimethylbenzidine	NELAP	PA	1/19/2005
EPA 8270		3-Methylcholanthrene	NELAP	PA	1/19/2005
EPA 8270		3-Nitroaniline	NELAP	PA	1/19/2005
EPA 8270		4,4'-Methylenebis(2-chloroaniline)	NELAP	PA	1/19/2005
EPA 8270		4-Aminobiphenyl	NELAP	PA	1/19/2005
EPA 8270		4-Bromophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 8270		4-Chloro-3-methylphenol	NELAP	PA	1/19/2005
EPA 8270		4-Chloroaniline	NELAP	PA	1/19/2005
EPA 8270		4-Chlorophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 8270		4-Nitroaniline	NELAP	PA	4/4/2005
EPA 8270		4-Nitrophenol	NELAP	PA	1/19/2005
EPA 8270		4-Nitroquinoline-1-oxide	NELAP	PA	7/3/2007
EPA 8270		5-Nitro-o-toluidine	NELAP	PA	4/4/2005
EPA 8270		6-Methylchrysene	NELAP	PA	12/4/2007
EPA 8270		7,12-Dimethylbenz(a)anthracene	NELAP	PA	1/19/2005
EPA 8270		Acenaphthene	NELAP	PA	1/19/2005
EPA 8270		Acenaphthylene	NELAP	PA	1/19/2005
EPA 8270		Acetophenone	NELAP	PA	1/19/2005
EPA 8270		Acrylamide	NELAP	PA	1/21/2009
EPA 8270		Aniline	NELAP	PA	1/19/2005
EPA 8270		Anthracene	NELAP	PA	1/19/2005
EPA 8270		Aramite	NELAP	PA	5/17/2005
EPA 8270		Atrazine	NELAP	PA	1/12/2007
EPA 8270		Benzaldehyde	NELAP	PA	12/4/2007
EPA 8270		Benzenethiol	NELAP	PA	12/4/2007
EPA 8270		Benzidine	NELAP	PA	1/19/2005
EPA 8270		Benzo[a]anthracene	NELAP	PA	1/19/2005
EPA 8270		Benzo[a]pyrene	NELAP	PA	1/19/2005
EPA 8270		Benzo[b]fluoranthene	NELAP	PA	1/19/2005
EPA 8270		Benzo[ghi]perylene	NELAP	PA	1/19/2005
EPA 8270		Benzo[k]fluoranthene	NELAP	PA	1/19/2005
EPA 8270		Benzoic acid	NELAP	PA	1/19/2005
EPA 8270		Benzyl alcohol	NELAP	PA	1/19/2005
EPA 8270		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	5/17/2005
EPA 8270		Caprolactam	NELAP	PA	12/4/2007
EPA 8270		Carbazole	NELAP	PA	1/19/2005
EPA 8270		Chlorobenzilate	NELAP	PA	5/2/2006
EPA 8270		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	1/19/2005
EPA 8270		Di-n-butyl phthalate	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Di-n-octyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Diallate (cis or trans)	NELAP	PA	5/2/2006
EPA 8270		Dibenz[a,h]acridine	NELAP	PA	12/4/2007
EPA 8270		Dibenz[a,j]acridine	NELAP	PA	5/17/2005
EPA 8270		Dibenzo[a,h]anthracene	NELAP	PA	1/19/2005
EPA 8270		Dibenzofuran	NELAP	PA	1/19/2005
EPA 8270		Diethyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Dimethoate	NELAP	PA	5/2/2006
EPA 8270		Dimethyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Diphenylamine	NELAP	PA	5/2/2006
EPA 8270		Disulfoton	NELAP	PA	7/1/2007
EPA 8270		Ethyl methanesulfonate	NELAP	PA	1/19/2005
EPA 8270		Famphur	NELAP	PA	5/2/2006
EPA 8270		Fluoranthene	NELAP	PA	1/19/2005
EPA 8270		Fluorene	NELAP	PA	1/19/2005
EPA 8270		Hexachlorobenzene	NELAP	PA	1/19/2005
EPA 8270		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	1/19/2005
EPA 8270		Hexachlorocyclopentadiene	NELAP	PA	1/19/2005
EPA 8270		Hexachloroethane	NELAP	PA	1/19/2005
EPA 8270		Hexachloropropene	NELAP	PA	1/19/2005
EPA 8270		Indene	NELAP	PA	12/4/2007
EPA 8270		Indeno(1,2,3-cd)pyrene	NELAP	PA	1/19/2005
EPA 8270		Isodrin	NELAP	PA	5/2/2006
EPA 8270		Isophorone	NELAP	PA	1/19/2005
EPA 8270		Isosafrole	NELAP	PA	1/19/2005
EPA 8270		Kepone	NELAP	PA	5/2/2006
EPA 8270		Malononitrile	NELAP	PA	5/23/2013
EPA 8270		Methapyrilene	NELAP	PA	1/19/2005
EPA 8270		Methyl methanesulfonate	NELAP	PA	1/19/2005
EPA 8270		Methyl parathion (Parathion, methyl)	NELAP	PA	5/25/2007
EPA 8270		N,N-Dimethylacetamide	NELAP	PA	12/4/2007
EPA 8270		N,N-Dimethylformamide	NELAP	PA	12/4/2007
EPA 8270		N-Nitrosodi-n-butylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodi-n-propylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodiethylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodimethylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodiphenylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosomethylethylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosomorpholine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosopiperidine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosopyrrolidine	NELAP	PA	1/19/2005
EPA 8270		Naphthalene	NELAP	PA	1/19/2005
EPA 8270		Nitrobenzene	NELAP	PA	1/4/2006
EPA 8270		O,O,O-Triethyl phosphorothioate	NELAP	PA	5/2/2006
EPA 8270		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	5/25/2007

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Pentachlorobenzene	NELAP	PA	1/19/2005
EPA 8270		Pentachloronitrobenzene (PCNB)	NELAP	PA	1/19/2005
EPA 8270		Pentachlorophenol (PCP)	NELAP	PA	1/19/2005
EPA 8270		Phenacetin	NELAP	PA	1/19/2005
EPA 8270		Phenanthrene	NELAP	PA	1/19/2005
EPA 8270		Phenol	NELAP	PA	1/19/2005
EPA 8270		Phorate (Thimet)	NELAP	PA	5/2/2006
EPA 8270		Phthalic anhydride	NELAP	PA	1/21/2009
EPA 8270		Pronamide (Kerb)	NELAP	PA	1/19/2005
EPA 8270		Pyrene	NELAP	PA	1/19/2005
EPA 8270		Pyridine	NELAP	PA	4/4/2005
EPA 8270		Quinoline	NELAP	PA	12/4/2007
EPA 8270	D	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270	C	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270		Safrole	NELAP	PA	1/19/2005
EPA 8270		Sulfotepp (Tetraethyl dithiopyrophosphate)	NELAP	PA	12/4/2007
EPA 8270		Tetraethyl lead	NELAP	PA	3/7/2012
EPA 8270		Thionazine (Thionazin, Zinophos)	NELAP	PA	5/2/2006
EPA 8270		a,a-Dimethylphenethylamine (Phentermine)	NELAP	PA	5/2/2006
EPA 8270		bis(2-Chloroethoxy)methane	NELAP	PA	1/19/2005
EPA 8270		bis(2-Chloroethyl) ether	NELAP	PA	1/19/2005
EPA 8270		bis(2-Chloroisopropyl) ether	NELAP	PA	1/4/2006
EPA 8270		bis(2-Chloromethyl) ether	NELAP	PA	1/21/2009
EPA 8270		bis(2-Ethylhexyl) adipate (di(2-Ethylhexyl) adipate)	NELAP	PA	1/21/2009
EPA 8270		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	1/19/2005
EPA 8270		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	1/19/2005
EPA 8270		p-(Dimethylamino)azobenzene	NELAP	PA	5/2/2006
EPA 8270		p-Chloronitrobenzene	NELAP	PA	1/21/2009
EPA 8270		tris-(2,3-Dibromopropyl) phosphate (tris-BP)	NELAP	PA	12/4/2007
EPA 8270 SIM		1-Methylnaphthalene	NELAP	PA	7/25/2011
EPA 8270 SIM		2-Methylnaphthalene	NELAP	PA	5/23/2012
EPA 8270 SIM		Acenaphthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Acenaphthylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[b]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[ghi]perylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[k]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/4/2007
EPA 8270 SIM		Dibenzo[a,h]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluorene	NELAP	PA	12/4/2007
EPA 8270 SIM		Indeno(1,2,3-cd)pyrene	NELAP	PA	12/4/2007

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 013-003 expiration date January 31, 2015. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270 SIM		Naphthalene	NELAP	PA	12/4/2007
EPA 8270 SIM		Phenanthrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Pyrene	NELAP	PA	12/4/2007
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	8/6/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	8/6/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	6/30/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	6/30/2010
EPA 8290		PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	3/26/2012
EPA 8290		Total TCDD	NELAP	PA	6/30/2010
EPA 8290		Total TCDF	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8315		2,5-Dimethylbenzaldehyde	NELAP	PA	1/21/2009
EPA 8315		Acetaldehyde	NELAP	PA	1/21/2009
EPA 8315		Benzaldehyde	NELAP	PA	1/21/2009
EPA 8315		Butanal (Butyraldehyde)	NELAP	PA	1/21/2009

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8315	A	Carbonyl compounds by HPLC	NELAP	PA	3/26/2012
EPA 8315		Crotonaldehyde	NELAP	PA	1/21/2009
EPA 8315		Formaldehyde	NELAP	PA	1/19/2005
EPA 8315		Hexanal (Hexaldehyde)	NELAP	PA	1/21/2009
EPA 8315		Isovaleraldehyde	NELAP	PA	1/21/2009
EPA 8315		Pentanal (Valeraldehyde)	NELAP	PA	1/21/2009
EPA 8315		Propanal (Propionaldehyde)	NELAP	PA	1/21/2009
EPA 8315		m-Tolualdehyde (1,3-Tolualdehyde)	NELAP	PA	1/21/2009
EPA 8315		o-Tolualdehyde (1,2-Tolualdehyde)	NELAP	PA	1/21/2009
EPA 8315		p-Tolualdehyde (1,4-Tolualdehyde)	NELAP	PA	1/21/2009
EPA 8318		3-Hydroxycarbofuran	NELAP	PA	4/4/2005
EPA 8318		Aldicarb (Temik)	NELAP	PA	4/4/2005
EPA 8318		Aldicarb sulfone	NELAP	PA	4/4/2005
EPA 8318		Aldicarb sulfoxide	NELAP	PA	12/12/2005
EPA 8318		Carbaryl (Sevin)	NELAP	PA	4/4/2005
EPA 8318		Carbofuran (Furadan)	NELAP	PA	4/4/2005
EPA 8318		Methiocarb (Mesurol)	NELAP	PA	4/4/2005
EPA 8318		Methomyl (Lannate)	NELAP	PA	4/4/2005
EPA 8318	A	N-Methylcarbamates by HPLC	NELAP	PA	10/15/2012
EPA 8318		Oxamyl (Vydate)	NELAP	PA	12/12/2005
EPA 8318		Propoxur (Baygon)	NELAP	PA	4/4/2005
EPA 8330		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	1/19/2005
EPA 8330		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	1/19/2005
EPA 8330		2,4,6-Trinitrotoluene (2,4,6-TNT)	NELAP	PA	1/19/2005
EPA 8330		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	1/19/2005
EPA 8330		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	1/19/2005
EPA 8330		2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NELAP	PA	1/19/2005
EPA 8330		2-Nitrotoluene	NELAP	PA	1/19/2005
EPA 8330		3-Nitrotoluene	NELAP	PA	1/19/2005
EPA 8330		4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NELAP	PA	1/19/2005
EPA 8330		4-Nitrotoluene	NELAP	PA	1/19/2005
EPA 8330		Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	NELAP	PA	1/19/2005
EPA 8330	A	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330		Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330		Nitrobenzene	NELAP	PA	1/19/2005
EPA 8330		Nitroglycerin	NELAP	PA	10/9/2013
EPA 8330		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NELAP	PA	1/24/2006
EPA 8330		Pentaerythritol tetranitrate (PETN)	NELAP	PA	11/21/2005
EPA 8330		RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NELAP	PA	1/19/2005
EPA 9012		Total cyanide	NELAP	PA	4/18/2013
EPA 9045		pH	NELAP	PA	11/19/2008
EPA 9050	A	Conductivity	NELAP	PA	1/27/2014
EPA 9050		Conductivity	NELAP	PA	5/17/2005

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DEP Laboratory ID: 36-00037 EPA Lab Code: PA00009 TNI Code: (717) 656-2300
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 9060		Total organic carbon (TOC)	NELAP	PA	1/19/2005
EPA 9066		Total phenolics	NELAP	PA	4/4/2005
EPA 9071	B	Oil and grease	NELAP	PA	1/19/2005
EPA 9081		Cation exchange capacity of soils (Ammonium acetate)	NELAP	PA	5/25/2005
EPA 9095	A	Paint filter liquids test	NELAP	PA	1/24/2007
EPA Lloyd Kahn Method		Total organic carbon (TOC)	NELAP	PA	10/9/2013
FL-PRO		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
MA DEP EPH	1.1	C11-C22 Aromatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C19-C36 Aliphatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C9-C18 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C5-C8 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C9-C10 Aromatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C9-C12 Aliphatics	NELAP	PA	7/15/2013
NWTPH-Dx		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
NWTPH-Gx		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
NWTPH-HCID		GRO/DRO/HRO Screen	NELAP	PA	10/16/2008
SM 2540 G		Residue, total	NELAP	PA	2/25/2014
SM 5310 B		Total organic carbon (TOC)	NELAP	PA	10/9/2013
TX1005 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
TX1006 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
WA-EPH		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WA-VPH		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
WI-DRO		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WI-GRO		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005

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STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY
Issue Date: July 1, 2014

Eurofins Lancaster Laboratory Environmental LLC
AI Number: 30729
Expiration Date: June 30, 2015

2425 New Holland Pike, Lancaster, Pennsylvania 17601-5994

Certificate Number: 02055

Air Emissions

Analyte	Method Name	Method Code	Type	AB
4385 - Bromobenzene	EPA TO-15 (extended)	2368	NELAP	LA
4577 - Chlorodifluoromethane (Freon-22)	EPA TO-15 (extended)	2368	NELAP	LA
4627 - Dichlorofluoromethane (Freon 21)	EPA TO-15 (extended)	2368	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA TO-15 (extended)	2368	NELAP	LA
5027 - n-Octane	EPA TO-15 (extended)	2368	NELAP	LA
5028 - n-Pentane	EPA TO-15 (extended)	2368	NELAP	LA
100170 - Gaseous Organic Compound Emissions	EPA 18	10246636	NELAP	LA
100077 - Gaseous Nonmethane Organic Emissions	EPA Method 25	10246738	NELAP	LA
5105 - 1,1,I,2-Tetrachloroethane	EPA TO-15	10248803	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA TO-15	10248803	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA TO-15	10248803	NELAP	LA
5195 - 1,1,2-Trichloro-I,2,2-trifluoroethane	EPA TO-15	10248803	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA TO-15	10248803	NELAP	LA
4630 - 1,1-Dichloroethane	EPA TO-15	10248803	NELAP	LA
4640 - 1,1-Dichloroethylene	EPA TO-15	10248803	NELAP	LA
5155 - 1,2,4-Trichlorobenzene	EPA TO-15	10248803	NELAP	LA
5210 - 1,2,4-Trimethylbenzene	EPA TO-15	10248803	NELAP	LA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA TO-15	10248803	NELAP	LA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA TO-15	10248803	NELAP	LA
4695 - 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	EPA TO-15	10248803	NELAP	LA
4610 - 1,2-Dichlorobenzene	EPA TO-15	10248803	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA TO-15	10248803	NELAP	LA
4655 - 1,2-Dichloropropane	EPA TO-15	10248803	NELAP	LA
5215 - 1,3,5-Trimethylbenzene	EPA TO-15	10248803	NELAP	LA
9318 - 1,3-Butadiene	EPA TO-15	10248803	NELAP	LA
4615 - 1,3-Dichlorobenzene	EPA TO-15	10248803	NELAP	LA
4620 - 1,4-Dichlorobenzene	EPA TO-15	10248803	NELAP	LA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA TO-15	10248803	NELAP	LA
5220 - 2,2,4-Trimethylpentane (Isooctane)	EPA TO-15	10248803	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA TO-15	10248803	NELAP	LA
4535 - 2-Chlorotoluene	EPA TO-15	10248803	NELAP	LA
4860 - 2-Hexanone	EPA TO-15	10248803	NELAP	LA
4542 - 4-Ethyltoluene	EPA TO-15	10248803	NELAP	LA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA TO-15	10248803	NELAP	LA
4315 - Acetone	EPA TO-15	10248803	NELAP	LA
4320 - Acetonitrile	EPA TO-15	10248803	NELAP	LA
4325 - Acrolein (Propenal)	EPA TO-15	10248803	NELAP	LA
4340 - Acrylonitrile	EPA TO-15	10248803	NELAP	LA
4355 - Allyl chloride (3-Chloropropene)	EPA TO-15	10248803	NELAP	LA
4375 - Benzene	EPA TO-15	10248803	NELAP	LA
5635 - Benzyl chloride	EPA TO-15	10248803	NELAP	LA
4395 - Bromodichloromethane	EPA TO-15	10248803	NELAP	LA
4400 - Bromoform	EPA TO-15	10248803	NELAP	LA

Clients and Customers are urged to verify the laboratory's current certification status with the Louisiana Environmental Laboratory Accreditation Program.

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Air Emissions

Analyte	Method Name	Method Code	Type	AB
4450 - Carbon disulfide	EPA TO-15	10248803	NELAP	LA
4455 - Carbon tetrachloride	EPA TO-15	10248803	NELAP	LA
4475 - Chlorobenzene	EPA TO-15	10248803	NELAP	LA
4575 - Chlorodibromomethane	EPA TO-15	10248803	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA TO-15	10248803	NELAP	LA
4505 - Chloroform	EPA TO-15	10248803	NELAP	LA
4555 - Cyclohexane	EPA TO-15	10248803	NELAP	LA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA TO-15	10248803	NELAP	LA
4595 - Dibromomethane (Methylene bromide)	EPA TO-15	10248803	NELAP	LA
4625 - Dichlorodifluoromethane (Freon-12)	EPA TO-15	10248803	NELAP	LA
4750 - Ethanol	EPA TO-15	10248803	NELAP	LA
4755 - Ethyl acetate	EPA TO-15	10248803	NELAP	LA
4760 - Ethyl acrylate	EPA TO-15	10248803	NELAP	LA
4810 - Ethyl methacrylate	EPA TO-15	10248803	NELAP	LA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA TO-15	10248803	NELAP	LA
4765 - Ethylbenzene	EPA TO-15	10248803	NELAP	LA
4835 - Hexachlorobutadiene	EPA TO-15	10248803	NELAP	LA
4840 - Hexachloroethane	EPA TO-15	10248803	NELAP	LA
4870 - Iodomethane (Methyl iodide)	EPA TO-15	10248803	NELAP	LA
4900 - Isopropylbenzene	EPA TO-15	10248803	NELAP	LA
4945 - Methyl acrylate	EPA TO-15	10248803	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA TO-15	10248803	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA TO-15	10248803	NELAP	LA
100201 - Methyl isobutyl ketone (Hexanone)	EPA TO-15	10248803	NELAP	LA
4990 - Methyl methacrylate	EPA TO-15	10248803	NELAP	LA
5000 - Methyl tert-butyl ether (MTBE)	EPA TO-15	10248803	NELAP	LA
4975 - Methylene chloride (Dichloromethane)	EPA TO-15	10248803	NELAP	LA
5005 - Naphthalene	EPA TO-15	10248803	NELAP	LA
4836 - Propylene	EPA TO-15	10248803	NELAP	LA
5100 - Styrene	EPA TO-15	10248803	NELAP	LA
4370 - T-amylmethylether (TAME)	EPA TO-15	10248803	NELAP	LA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA TO-15	10248803	NELAP	LA
5120 - Tetrahydrofuran (THF)	EPA TO-15	10248803	NELAP	LA
5140 - Toluene	EPA TO-15	10248803	NELAP	LA
5170 - Trichloroethene (Trichloroethylene)	EPA TO-15	10248803	NELAP	LA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA TO-15	10248803	NELAP	LA
5225 - Vinyl acetate	EPA TO-15	10248803	NELAP	LA
5230 - Vinyl bromide (Bromoethane)	EPA TO-15	10248803	NELAP	LA
5235 - Vinyl chloride	EPA TO-15	10248803	NELAP	LA
5260 - Xylene (total)	EPA TO-15	10248803	NELAP	LA
4705 - cis & trans-1,2-Dichloroethene	EPA TO-15	10248803	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA TO-15	10248803	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA TO-15	10248803	NELAP	LA
5240 - m+p-xylene	EPA TO-15	10248803	NELAP	LA
5245 - m-Xylene	EPA TO-15	10248803	NELAP	LA
4435 - n-Butylbenzene	EPA TO-15	10248803	NELAP	LA
4825 - n-Heptane	EPA TO-15	10248803	NELAP	LA
4855 - n-Hexane	EPA TO-15	10248803	NELAP	LA
5090 - n-Propylbenzene	EPA TO-15	10248803	NELAP	LA

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Air Emissions

Analyte	Method Name	Method Code	Type	AB
5250 - o-Xylene	EPA TO-15	10248803	NELAP	LA
5255 - p-Xylene	EPA TO-15	10248803	NELAP	LA
4440 - sec-Butylbenzene	EPA TO-15	10248803	NELAP	LA
4420 - tert-Butyl alcohol	EPA TO-15	10248803	NELAP	LA
4445 - tert-Butylbenzene	EPA TO-15	10248803	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA TO-15	10248803	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA TO-15	10248803	NELAP	LA
5105 - 1,1,1,2-Tetrachloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4630 - 1,1-Dichloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4640 - 1,1-Dichloroethylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5180 - 1,2,3-Trichloropropane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5155 - 1,2,4-Trichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5210 - 1,2,4-Trimethylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4695 - 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4610 - 1,2-Dichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4655 - 1,2-Dichloropropane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5215 - 1,3,5-Trimethylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4615 - 1,3-Dichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4835 - 1,3-Hexachlorobutadiene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4620 - 1,4-Dichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5220 - 2,2,4-Trimethylpentane (Isooctane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4860 - 2-Hexanone	EPA TO-14A, Rev.2	10312002	NELAP	LA
4542 - 4-Ethyltoluene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4315 - Acetone	EPA TO-14A, Rev.2	10312002	NELAP	LA
4375 - Benzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5635 - Benzyl chloride	EPA TO-14A, Rev.2	10312002	NELAP	LA
4385 - Bromobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4395 - Bromodichloromethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4400 - Bromoform	EPA TO-14A, Rev.2	10312002	NELAP	LA
4450 - Carbon disulfide	EPA TO-14A, Rev.2	10312002	NELAP	LA
4455 - Carbon tetrachloride	EPA TO-14A, Rev.2	10312002	NELAP	LA
4475 - Chlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4505 - Chloroform	EPA TO-14A, Rev.2	10312002	NELAP	LA
4555 - Cyclohexane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4625 - Dichlorodifluoromethane (Freon-12)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4755 - Ethyl acetate	EPA TO-14A, Rev.2	10312002	NELAP	LA
4765 - Ethylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4835 - Hexachlorobutadiene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4990 - Methyl methacrylate	EPA TO-14A, Rev.2	10312002	NELAP	LA
5000 - Methyl tert-butyl ether (MTBE)	EPA TO-14A, Rev.2	10312002	NELAP	LA

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Air Emissions

Analyte	Method Name	Method Code	Type	AB
4975 - Methylene chloride (Dichloromethane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5100 - Styrene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5140 - Toluene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5170 - Trichloroethene (Trichloroethylene)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5225 - Vinyl acetate	EPA TO-14A, Rev.2	10312002	NELAP	LA
5235 - Vinyl chloride	EPA TO-14A, Rev.2	10312002	NELAP	LA
5260 - Xylene (total)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5240 - m+p-xylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5027 - n-Octane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5028 - n-Pentane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5090 - n-Propylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5250 - o-Xylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA TO-14A, Rev.2	10312002	NELAP	LA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1605 - Color	EPA 110.2	10005400	NELAP	PA
1755 - Total hardness as CaCO3	EPA 120.1	10006209	NELAP	PA
1610 - Conductivity	EPA 120.1	10006403	NELAP	PA
1750 - Hardness	EPA 130.2	10007202	NELAP	PA
1755 - Total hardness as CaCO3	EPA 130.2	10007202	NELAP	PA
1900 - pH	EPA 150.1	10008205	NELAP	PA
1955 - Residue-filterable (TDS)	EPA 160.1	10009004	NELAP	PA
1955 - Residue-filterable (TDS)	EPA 160.1	10009208	NELAP	PA
1960 - Residue-nonfilterable (TSS)	EPA 160.2	10009402	NELAP	PA
1950 - Residue-total	EPA 160.3	10009800	NELAP	PA
1970 - Residue-volatile	EPA 160.4	10010205	NELAP	PA
2030 - Temperature, deg. C	EPA 170.1	10011004	NELAP	PA
2055 - Turbidity	EPA 180.1	10011402	NELAP	PA
2055 - Turbidity	EPA 180.1, Rev.2	10011800	NELAP	PA
1015 - Barium	EPA 200.7	10013408	NELAP	PA
1000 - Aluminum	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1005 - Antimony	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1010 - Arsenic	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1015 - Barium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1020 - Beryllium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1025 - Boron	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1030 - Cadmium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1035 - Calcium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1040 - Chromium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1050 - Cobalt	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1055 - Copper	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1070 - Iron	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1075 - Lead	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1085 - Magnesium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1090 - Manganese	EPA 200.7, Rev.4.4	10013806	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1100 - Molybdenum	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1105 - Nickel	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1125 - Potassium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1140 - Selenium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1150 - Silver	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1155 - Sodium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1160 - Strontium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1165 - Thallium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1175 - Tin	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1180 - Titanium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1185 - Vanadium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1190 - Zinc	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1000 - Aluminum	EPA 200.7	10014207	NELAP	PA
1005 - Antimony	EPA 200.7	10014207	NELAP	PA
1010 - Arsenic	EPA 200.7	10014207	NELAP	PA
1015 - Barium	EPA 200.7	10014207	NELAP	PA
1020 - Beryllium	EPA 200.7	10014207	NELAP	PA
1025 - Boron	EPA 200.7	10014207	NELAP	PA
1030 - Cadmium	EPA 200.7	10014207	NELAP	PA
1035 - Calcium	EPA 200.7	10014207	NELAP	PA
1040 - Chromium	EPA 200.7	10014207	NELAP	PA
1050 - Cobalt	EPA 200.7	10014207	NELAP	PA
1055 - Copper	EPA 200.7	10014207	NELAP	PA
1070 - Iron	EPA 200.7	10014207	NELAP	PA
1075 - Lead	EPA 200.7	10014207	NELAP	PA
1085 - Magnesium	EPA 200.7	10014207	NELAP	PA
1090 - Manganese	EPA 200.7	10014207	NELAP	PA
1100 - Molybdenum	EPA 200.7	10014207	NELAP	PA
1105 - Nickel	EPA 200.7	10014207	NELAP	PA
1125 - Potassium	EPA 200.7	10014207	NELAP	PA
1140 - Selenium	EPA 200.7	10014207	NELAP	PA
1150 - Silver	EPA 200.7	10014207	NELAP	PA
1155 - Sodium	EPA 200.7	10014207	NELAP	PA
1165 - Thallium	EPA 200.7	10014207	NELAP	PA
1175 - Tin	EPA 200.7	10014207	NELAP	PA
1185 - Vanadium	EPA 200.7	10014207	NELAP	PA
1190 - Zinc	EPA 200.7	10014207	NELAP	PA
1000 - Aluminum	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1005 - Antimony	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1010 - Arsenic	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1015 - Barium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1020 - Beryllium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1025 - Boron	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1030 - Cadmium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1035 - Calcium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1040 - Chromium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1050 - Cobalt	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1055 - Copper	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1070 - Iron	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1075 - Lead	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1085 - Magnesium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1090 - Manganese	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1100 - Molybdenum	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1105 - Nickel	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1125 - Potassium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1140 - Selenium	EPA 200.8, Rev.5.4	10014605	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1150 - Silver	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1155 - Sodium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1160 - Strontium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1165 - Thallium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1175 - Tin	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1180 - Titanium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1185 - Vanadium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1190 - Zinc	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1045 - Chromium VI	EPA 218.6	10027802	NELAP	PA
1045 - Chromium VI	EPA 218.6, Rev.3.3	10028009	NELAP	PA
1095 - Mercury	EPA 245.1, Rev.3	10036609	NELAP	PA
1540 - Bromide	EPA 300.0	10053006	NELAP	PA
1730 - Fluoride	EPA 300.0	10053006	NELAP	PA
1810 - Nitrate as N	EPA 300.0	10053006	NELAP	PA
1540 - Bromide	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1575 - Chloride	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1730 - Fluoride	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1810 - Nitrate as N	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1835 - Nitrite	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1840 - Nitrite as N	EPA 300.0, Rev.2.1	10053200	NELAP	PA
2000 - Sulfate	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1505 - Alkalinity as CaCO3	EPA 310.1	10054601	NELAP	PA
1895 - Perchlorate	EPA 314, Rev.1	10055604	NELAP	PA
1575 - Chloride	EPA 325.3	10057406	NELAP	PA
1645 - Total Cyanide	EPA 335.4	10061402	NELAP	PA
1515 - Ammonia as N	EPA 350.2	10063806	NELAP	PA
1515 - Ammonia as N	EPA 350.3	10064207	NELAP	PA
1795 - Kjeldahl nitrogen - total	EPA 351.2	10065006	NELAP	PA
1795 - Kjeldahl nitrogen - total	EPA 351.2, Rev.2	10065404	NELAP	PA
1840 - Nitrite as N	EPA 353.2	10067206	NELAP	PA
1825 - Total Nitrate+Nitrite	EPA 353.2	10067206	NELAP	PA
1810 - Nitrate as N	EPA 353.2, Rev.2	10067604	NELAP	PA
1820 - Nitrate-Nitrite	EPA 353.2, Rev.2	10067604	NELAP	PA
1840 - Nitrite as N	EPA 353.2, Rev.2	10067604	NELAP	PA
1880 - Oxygen, dissolved	EPA 360.1	10069008	NELAP	PA
1910 - Total Phosphorus	EPA 365.1, Rev.2	10070005	NELAP	PA
1870 - Orthophosphate as P	EPA 365.3	10070607	NELAP	PA
2005 - Sulfide	EPA 376.2	10074405	NELAP	PA
1555 - Carbonaceous BOD, CBOD	EPA 405.1	10075408	NELAP	PA
1565 - Chemical oxygen demand	EPA 410.4, Rev.2	10077404	NELAP	PA
1905 - Total Phenolics	EPA 420.4, Rev.1	10080203	NELAP	PA
2025 - Surfactants - MBAS	EPA 425.1	10080601	NELAP	PA
4375 - Benzene	EPA 602	10102202	NELAP	PA
4765 - Ethylbenzene	EPA 602	10102202	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 602	10102202	NELAP	PA
5005 - Naphthalene	EPA 602	10102202	NELAP	PA
5100 - Styrene	EPA 602	10102202	NELAP	PA
5140 - Toluene	EPA 602	10102202	NELAP	PA
5260 - Xylene (total)	EPA 602	10102202	NELAP	PA
5250 - o-Xylene	EPA 602	10102202	NELAP	PA
5255 - p-Xylene	EPA 602	10102202	NELAP	PA
7355 - 4,4'-DDD	EPA 608	10103603	NELAP	PA
7360 - 4,4'-DDE	EPA 608	10103603	NELAP	PA
7365 - 4,4'-DDT	EPA 608	10103603	NELAP	PA
7025 - Aldrin	EPA 608	10103603	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 608	10103603	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
8885 - Aroclor-1221 (PCB-1221)	EPA 608	10103603	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 608	10103603	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 608	10103603	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 608	10103603	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 608	10103603	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 608	10103603	NELAP	PA
7250 - Chlordane (tech.)	EPA 608	10103603	NELAP	PA
7470 - Dieldrin	EPA 608	10103603	NELAP	PA
7510 - Endosulfan I	EPA 608	10103603	NELAP	PA
7515 - Endosulfan II	EPA 608	10103603	NELAP	PA
7520 - Endosulfan sulfate	EPA 608	10103603	NELAP	PA
7540 - Endrin	EPA 608	10103603	NELAP	PA
7530 - Endrin aldehyde	EPA 608	10103603	NELAP	PA
7685 - Heptachlor	EPA 608	10103603	NELAP	PA
7690 - Heptachlor epoxide	EPA 608	10103603	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 608	10103603	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	10103603	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	10103603	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 608	10103603	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 624	10107207	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 624	10107207	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 624	10107207	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 624	10107207	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 624	10107207	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 624	10107207	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 624	10107207	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 624	10107207	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 624	10107207	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 624	10107207	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 624	10107207	NELAP	PA
4325 - Acrolein (Propenal)	EPA 624	10107207	NELAP	PA
4340 - Acrylonitrile	EPA 624	10107207	NELAP	PA
4375 - Benzene	EPA 624	10107207	NELAP	PA
4395 - Bromodichloromethane	EPA 624	10107207	NELAP	PA
4400 - Bromoform	EPA 624	10107207	NELAP	PA
4455 - Carbon tetrachloride	EPA 624	10107207	NELAP	PA
4475 - Chlorobenzene	EPA 624	10107207	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 624	10107207	NELAP	PA
4505 - Chloroform	EPA 624	10107207	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 624	10107207	NELAP	PA
4765 - Ethylbenzene	EPA 624	10107207	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 624	10107207	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 624	10107207	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 624	10107207	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 624	10107207	NELAP	PA
5140 - Toluene	EPA 624	10107207	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 624	10107207	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 624	10107207	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
5235 - Vinyl chloride	EPA 624	10107207	NELAP	PA
5260 - Xylene (total)	EPA 624	10107207	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 624	10107207	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 624	10107207	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 624	10107207	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 625	10107401	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 625	10107401	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 625	10107401	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 625	10107401	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 625	10107401	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 625	10107401	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 625	10107401	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 625	10107401	NELAP	PA
9363 - 2,3-Dichloroaniline	EPA 625	10107401	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 625	10107401	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 625	10107401	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 625	10107401	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 625	10107401	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 625	10107401	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 625	10107401	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 625	10107401	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 625	10107401	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 625	10107401	NELAP	PA
5800 - 2-Chlorophenol	EPA 625	10107401	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 625	10107401	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 625	10107401	NELAP	PA
6460 - 2-Nitroaniline	EPA 625	10107401	NELAP	PA
6490 - 2-Nitrophenol	EPA 625	10107401	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 625	10107401	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 625	10107401	NELAP	PA
6465 - 3-Nitroaniline	EPA 625	10107401	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 625	10107401	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 625	10107401	NELAP	PA
5745 - 4-Chloroaniline	EPA 625	10107401	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 625	10107401	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 625	10107401	NELAP	PA
6470 - 4-Nitroaniline	EPA 625	10107401	NELAP	PA
6500 - 4-Nitrophenol	EPA 625	10107401	NELAP	PA
5500 - Acenaphthene	EPA 625	10107401	NELAP	PA
5505 - Acenaphthylene	EPA 625	10107401	NELAP	PA
5510 - Acetophenone	EPA 625	10107401	NELAP	PA
5545 - Aniline	EPA 625	10107401	NELAP	PA
5555 - Anthracene	EPA 625	10107401	NELAP	PA
5595 - Benzidine	EPA 625	10107401	NELAP	PA
5575 - Benzo(a)anthracene	EPA 625	10107401	NELAP	PA
5580 - Benzo(a)pyrene	EPA 625	10107401	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 625	10107401	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 625	10107401	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 625	10107401	NELAP	PA
5610 - Benzoic acid	EPA 625	10107401	NELAP	PA
5630 - Benzyl alcohol	EPA 625	10107401	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 625	10107401	NELAP	PA
5680 - Carbazole	EPA 625	10107401	NELAP	PA
5855 - Chrysene	EPA 625	10107401	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-	EPA 625	10107401	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
Ethylhexyl)phthalate, DEHP)				
5925 - Di-n-butyl phthalate	EPA 625	10107401	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 625	10107401	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 625	10107401	NELAP	PA
5905 - Dibenzofuran	EPA 625	10107401	NELAP	PA
6070 - Diethyl phthalate	EPA 625	10107401	NELAP	PA
6135 - Dimethyl phthalate	EPA 625	10107401	NELAP	PA
6265 - Fluoranthene	EPA 625	10107401	NELAP	PA
6270 - Fluorene	EPA 625	10107401	NELAP	PA
6275 - Hexachlorobenzene	EPA 625	10107401	NELAP	PA
4835 - Hexachlorobutadiene	EPA 625	10107401	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 625	10107401	NELAP	PA
4840 - Hexachloroethane	EPA 625	10107401	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 625	10107401	NELAP	PA
6320 - Isophorone	EPA 625	10107401	NELAP	PA
5005 - Naphthalene	EPA 625	10107401	NELAP	PA
5015 - Nitrobenzene	EPA 625	10107401	NELAP	PA
6590 - Pentachlorobenzene	EPA 625	10107401	NELAP	PA
6605 - Pentachlorophenol	EPA 625	10107401	NELAP	PA
6615 - Phenanthrene	EPA 625	10107401	NELAP	PA
6625 - Phenol	EPA 625	10107401	NELAP	PA
6665 - Pyrene	EPA 625	10107401	NELAP	PA
5095 - Pyridine	EPA 625	10107401	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 625	10107401	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 625	10107401	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 625	10107401	NELAP	PA
6062 - bis(2-Ethylhexyl)adipate	EPA 625	10107401	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 625	10107401	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 625	10107401	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 625	10107401	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 625	10107401	NELAP	PA
6580 - n-Octadecane	EPA 625	10107401	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B	10120602	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B	10120602	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 1613B	10120602	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613B	10120602	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613B	10120602	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 1613B	10120602	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 1613B	10120602	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 1613B	10120602	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 1613B	10120602	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 1613B	10120602	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 1613B	10120602	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 1613B	10120602	NELAP	PA
9438 - Total Hpcdd	EPA 1613B	10120602	NELAP	PA
9444 - Total Hpcdf	EPA 1613B	10120602	NELAP	PA
9468 - Total Hxcdd	EPA 1613B	10120602	NELAP	PA
9483 - Total Hxcdf	EPA 1613B	10120602	NELAP	PA
9555 - Total Pecdd	EPA 1613B	10120602	NELAP	PA
9552 - Total Pecdf	EPA 1613B	10120602	NELAP	PA
9609 - Total TCDD	EPA 1613B	10120602	NELAP	PA
9615 - Total TCDF	EPA 1613B	10120602	NELAP	PA
1860 - Oil & Grease	EPA 1664A	10127409	NELAP	PA
1860 - Oil & Grease	EPA 1664A (HEM)	10127807	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	EPA 1664A (HEM)	10127807	NELAP	PA
100003 - Acid Digestion of waters for Total Recoverable or Dissolved Metals	EPA 3005A	10133207	NELAP	PA
100004 - Acid Digestion of Aqueous samples and Extracts for Total Metals	EPA 3010A	10133605	NELAP	PA
100642 - Acid Digestion of Aqueous samples and Extracts for Total Metals (HNO3 only)	EPA 3020A	10134404	NELAP	PA
1444 - Separatory Funnel Liquid-liquid extraction	EPA 3510C	10138202	NELAP	PA
1000 - Aluminum	EPA 6010B	10155609	NELAP	PA
1005 - Antimony	EPA 6010B	10155609	NELAP	PA
1010 - Arsenic	EPA 6010B	10155609	NELAP	PA
1015 - Barium	EPA 6010B	10155609	NELAP	PA
1020 - Beryllium	EPA 6010B	10155609	NELAP	PA
1025 - Boron	EPA 6010B	10155609	NELAP	PA
1030 - Cadmium	EPA 6010B	10155609	NELAP	PA
1035 - Calcium	EPA 6010B	10155609	NELAP	PA
1040 - Chromium	EPA 6010B	10155609	NELAP	PA
1050 - Cobalt	EPA 6010B	10155609	NELAP	PA
1055 - Copper	EPA 6010B	10155609	NELAP	PA
1070 - Iron	EPA 6010B	10155609	NELAP	PA
1075 - Lead	EPA 6010B	10155609	NELAP	PA
1080 - Lithium	EPA 6010B	10155609	NELAP	PA
1085 - Magnesium	EPA 6010B	10155609	NELAP	PA
1090 - Manganese	EPA 6010B	10155609	NELAP	PA
1100 - Molybdenum	EPA 6010B	10155609	NELAP	PA
1105 - Nickel	EPA 6010B	10155609	NELAP	PA
1125 - Potassium	EPA 6010B	10155609	NELAP	PA
1140 - Selenium	EPA 6010B	10155609	NELAP	PA
1150 - Silver	EPA 6010B	10155609	NELAP	PA
1155 - Sodium	EPA 6010B	10155609	NELAP	PA
1160 - Strontium	EPA 6010B	10155609	NELAP	PA
1165 - Thallium	EPA 6010B	10155609	NELAP	PA
1175 - Tin	EPA 6010B	10155609	NELAP	PA
1180 - Titanium	EPA 6010B	10155609	NELAP	PA
1185 - Vanadium	EPA 6010B	10155609	NELAP	PA
1190 - Zinc	EPA 6010B	10155609	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1000 - Aluminum	EPA 6010C	10155803	NELAP	PA
1005 - Antimony	EPA 6010C	10155803	NELAP	PA
1010 - Arsenic	EPA 6010C	10155803	NELAP	PA
1015 - Barium	EPA 6010C	10155803	NELAP	PA
1020 - Beryllium	EPA 6010C	10155803	NELAP	PA
1025 - Boron	EPA 6010C	10155803	NELAP	PA
1030 - Cadmium	EPA 6010C	10155803	NELAP	PA
1035 - Calcium	EPA 6010C	10155803	NELAP	PA
1040 - Chromium	EPA 6010C	10155803	NELAP	PA
1050 - Cobalt	EPA 6010C	10155803	NELAP	PA
1055 - Copper	EPA 6010C	10155803	NELAP	PA
1070 - Iron	EPA 6010C	10155803	NELAP	PA
1075 - Lead	EPA 6010C	10155803	NELAP	PA
1080 - Lithium	EPA 6010C	10155803	NELAP	PA
1085 - Magnesium	EPA 6010C	10155803	NELAP	PA
1090 - Manganese	EPA 6010C	10155803	NELAP	PA
1100 - Molybdenum	EPA 6010C	10155803	NELAP	PA
1105 - Nickel	EPA 6010C	10155803	NELAP	PA
1125 - Potassium	EPA 6010C	10155803	NELAP	PA
1140 - Selenium	EPA 6010C	10155803	NELAP	PA
1150 - Silver	EPA 6010C	10155803	NELAP	PA
1155 - Sodium	EPA 6010C	10155803	NELAP	PA
1160 - Strontium	EPA 6010C	10155803	NELAP	PA
2017 - Sulfur	EPA 6010C	10155803	NELAP	PA
1165 - Thallium	EPA 6010C	10155803	NELAP	PA
1175 - Tin	EPA 6010C	10155803	NELAP	PA
1180 - Titanium	EPA 6010C	10155803	NELAP	PA
1185 - Vanadium	EPA 6010C	10155803	NELAP	PA
1190 - Zinc	EPA 6010C	10155803	NELAP	PA
1000 - Aluminum	EPA 6020	10156000	NELAP	PA
1005 - Antimony	EPA 6020	10156000	NELAP	PA
1010 - Arsenic	EPA 6020	10156000	NELAP	PA
1015 - Barium	EPA 6020	10156000	NELAP	PA
1020 - Beryllium	EPA 6020	10156000	NELAP	PA
1025 - Boron	EPA 6020	10156000	NELAP	PA
1030 - Cadmium	EPA 6020	10156000	NELAP	PA
1035 - Calcium	EPA 6020	10156000	NELAP	PA
1055 - Copper	EPA 6020	10156000	NELAP	PA
1075 - Lead	EPA 6020	10156000	NELAP	PA
1085 - Magnesium	EPA 6020	10156000	NELAP	PA
1090 - Manganese	EPA 6020	10156000	NELAP	PA
1100 - Molybdenum	EPA 6020	10156000	NELAP	PA
1105 - Nickel	EPA 6020	10156000	NELAP	PA
1125 - Potassium	EPA 6020	10156000	NELAP	PA
1140 - Selenium	EPA 6020	10156000	NELAP	PA
1150 - Silver	EPA 6020	10156000	NELAP	PA
1155 - Sodium	EPA 6020	10156000	NELAP	PA
1160 - Strontium	EPA 6020	10156000	NELAP	PA
1165 - Thallium	EPA 6020	10156000	NELAP	PA
1175 - Tin	EPA 6020	10156000	NELAP	PA
1180 - Titanium	EPA 6020	10156000	NELAP	PA
1185 - Vanadium	EPA 6020	10156000	NELAP	PA
1040 - Chromium	EPA 6020	10156204	NELAP	PA
1050 - Cobalt	EPA 6020	10156204	NELAP	PA
1070 - Iron	EPA 6020	10156204	NELAP	PA
1190 - Zinc	EPA 6020	10156204	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1000 - Aluminum	EPA 6020A	10156408	NELAP	PA
1005 - Antimony	EPA 6020A	10156408	NELAP	PA
1010 - Arsenic	EPA 6020A	10156408	NELAP	PA
1015 - Barium	EPA 6020A	10156408	NELAP	PA
1020 - Beryllium	EPA 6020A	10156408	NELAP	PA
1025 - Boron	EPA 6020A	10156408	NELAP	PA
1030 - Cadmium	EPA 6020A	10156408	NELAP	PA
1035 - Calcium	EPA 6020A	10156408	NELAP	PA
1040 - Chromium	EPA 6020A	10156408	NELAP	PA
1050 - Cobalt	EPA 6020A	10156408	NELAP	PA
1055 - Copper	EPA 6020A	10156408	NELAP	PA
1070 - Iron	EPA 6020A	10156408	NELAP	PA
1075 - Lead	EPA 6020A	10156408	NELAP	PA
1085 - Magnesium	EPA 6020A	10156408	NELAP	PA
1090 - Manganese	EPA 6020A	10156408	NELAP	PA
1100 - Molybdenum	EPA 6020A	10156408	NELAP	PA
1105 - Nickel	EPA 6020A	10156408	NELAP	PA
1125 - Potassium	EPA 6020A	10156408	NELAP	PA
1140 - Selenium	EPA 6020A	10156408	NELAP	PA
1150 - Silver	EPA 6020A	10156408	NELAP	PA
1155 - Sodium	EPA 6020A	10156408	NELAP	PA
1160 - Strontium	EPA 6020A	10156408	NELAP	PA
1165 - Thallium	EPA 6020A	10156408	NELAP	PA
1175 - Tin	EPA 6020A	10156408	NELAP	PA
1180 - Titanium	EPA 6020A	10156408	NELAP	PA
1185 - Vanadium	EPA 6020A	10156408	NELAP	PA
1190 - Zinc	EPA 6020A	10156408	NELAP	PA
1045 - Chromium VI	EPA 7196A	10162400	NELAP	PA
1045 - Chromium VI	EPA 7199	10163005	NELAP	PA
1095 - Mercury	EPA 7470A	10165807	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	10173009	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011	10173009	NELAP	PA
4750 - Ethanol	EPA 8015	10173203	NELAP	PA
4785 - Ethylene glycol	EPA 8015	10173203	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8015	10173203	NELAP	PA
4930 - Methanol	EPA 8015	10173203	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8015	10173203	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015B	10173601	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015B	10173601	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	EPA 8015B	10173601	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015C	10173805	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015C	10173805	NELAP	PA
4375 - Benzene	EPA 8021B	10174808	NELAP	PA
4765 - Ethylbenzene	EPA 8021B	10174808	NELAP	PA
4900 - Isopropylbenzene	EPA 8021B	10174808	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8021B	10174808	NELAP	PA
5005 - Naphthalene	EPA 8021B	10174808	NELAP	PA
5140 - Toluene	EPA 8021B	10174808	NELAP	PA
5260 - Xylene (total)	EPA 8021B	10174808	NELAP	PA
5245 - m-Xylene	EPA 8021B	10174808	NELAP	PA
5250 - o-Xylene	EPA 8021B	10174808	NELAP	PA
5255 - p-Xylene	EPA 8021B	10174808	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
7355 - 4,4'-DDD	EPA 8081B	10178800	NELAP	PA
7360 - 4,4'-DDE	EPA 8081B	10178800	NELAP	PA
7365 - 4,4'-DDT	EPA 8081B	10178800	NELAP	PA
7025 - Aldrin	EPA 8081B	10178800	NELAP	PA
7250 - Chlordane (tech.)	EPA 8081B	10178800	NELAP	PA
7470 - Dieldrin	EPA 8081B	10178800	NELAP	PA
7510 - Endosulfan I	EPA 8081B	10178800	NELAP	PA
7515 - Endosulfan II	EPA 8081B	10178800	NELAP	PA
7520 - Endosulfan sulfate	EPA 8081B	10178800	NELAP	PA
7540 - Endrin	EPA 8081B	10178800	NELAP	PA
7530 - Endrin aldehyde	EPA 8081B	10178800	NELAP	PA
7535 - Endrin ketone	EPA 8081B	10178800	NELAP	PA
7685 - Heptachlor	EPA 8081B	10178800	NELAP	PA
7690 - Heptachlor epoxide	EPA 8081B	10178800	NELAP	PA
7740 - Kepone	EPA 8081B	10178800	NELAP	PA
7810 - Methoxychlor	EPA 8081B	10178800	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081B	10178800	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7105 - delta-BHC	EPA 8081B	10178800	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081B	10178800	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082	10179007	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082	10179007	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082	10179007	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082	10179007	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082	10179007	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082	10179007	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082	10179007	NELAP	PA
8912 - Aroclor-1262 (PCB-1262)	EPA 8082	10179007	NELAP	PA
8913 - Aroclor-1268 (PCB-1268)	EPA 8082	10179007	NELAP	PA
7065 - Atrazine	EPA 8141	10181803	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141	10181803	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141	10181803	NELAP	PA
7300 - Chlorpyrifos	EPA 8141	10181803	NELAP	PA
7315 - Coumaphos	EPA 8141	10181803	NELAP	PA
7395 - Demeton-o	EPA 8141	10181803	NELAP	PA
7385 - Demeton-s	EPA 8141	10181803	NELAP	PA
7410 - Diazinon	EPA 8141	10181803	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141	10181803	NELAP	PA
8625 - Disulfoton	EPA 8141	10181803	NELAP	PA
7550 - EPN	EPA 8141	10181803	NELAP	PA
7565 - Ethion	EPA 8141	10181803	NELAP	PA
7570 - Ethoprop	EPA 8141	10181803	NELAP	PA
7580 - Famphur	EPA 8141	10181803	NELAP	PA
7600 - Fensulfothion	EPA 8141	10181803	NELAP	PA
7770 - Malathion	EPA 8141	10181803	NELAP	PA
7785 - Merphos	EPA 8141	10181803	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141	10181803	NELAP	PA
7850 - Mevinphos	EPA 8141	10181803	NELAP	PA
7905 - Naled	EPA 8141	10181803	NELAP	PA
7955 - Parathion, ethyl	EPA 8141	10181803	NELAP	PA
7985 - Phorate	EPA 8141	10181803	NELAP	PA
8110 - Ronnel	EPA 8141	10181803	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
8125 - Simazine	EPA 8141	10181803	NELAP	PA
8140 - Stirophos	EPA 8141	10181803	NELAP	PA
8245 - Tokuthion (Prothiophos)	EPA 8141	10181803	NELAP	PA
8275 - Trichloronate	EPA 8141	10181803	NELAP	PA
7065 - Atrazine	EPA 8141A	10182000	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141A	10182000	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141A	10182000	NELAP	PA
7300 - Chlorpyrifos	EPA 8141A	10182000	NELAP	PA
7315 - Coumaphos	EPA 8141A	10182000	NELAP	PA
7395 - Demeton-o	EPA 8141A	10182000	NELAP	PA
7385 - Demeton-s	EPA 8141A	10182000	NELAP	PA
7410 - Diazinon	EPA 8141A	10182000	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141A	10182000	NELAP	PA
8625 - Disulfoton	EPA 8141A	10182000	NELAP	PA
7550 - EPN	EPA 8141A	10182000	NELAP	PA
7565 - Ethion	EPA 8141A	10182000	NELAP	PA
7570 - Ethoprop	EPA 8141A	10182000	NELAP	PA
7580 - Famphur	EPA 8141A	10182000	NELAP	PA
7600 - Fensulfothion	EPA 8141A	10182000	NELAP	PA
7770 - Malathion	EPA 8141A	10182000	NELAP	PA
7785 - Merphos	EPA 8141A	10182000	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141A	10182000	NELAP	PA
7850 - Mevinphos	EPA 8141A	10182000	NELAP	PA
7905 - Naled	EPA 8141A	10182000	NELAP	PA
7955 - Parathion, ethyl	EPA 8141A	10182000	NELAP	PA
7985 - Phorate	EPA 8141A	10182000	NELAP	PA
8110 - Ronnel	EPA 8141A	10182000	NELAP	PA
8125 - Simazine	EPA 8141A	10182000	NELAP	PA
8140 - Stirophos	EPA 8141A	10182000	NELAP	PA
8245 - Tokuthion (Prothiophos)	EPA 8141A	10182000	NELAP	PA
8275 - Trichloronate	EPA 8141A	10182000	NELAP	PA
8655 - 2,4,5-T	EPA 8151	10183003	NELAP	PA
8545 - 2,4-D	EPA 8151	10183003	NELAP	PA
8555 - Dalapon	EPA 8151	10183003	NELAP	PA
8595 - Dicamba	EPA 8151	10183003	NELAP	PA
8605 - Dichloroprop (Dichlorprop)	EPA 8151	10183003	NELAP	PA
7775 - MCPA	EPA 8151	10183003	NELAP	PA
7780 - MCPP	EPA 8151	10183003	NELAP	PA
8650 - Silvex (2,4,5-TP)	EPA 8151	10183003	NELAP	PA
5105 - 1,1,1,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 8260B	10184802	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	10184802	NELAP	PA
5185 - 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260B	10184802	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 8260B	10184802	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 8260B	10184802	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5180 - 1,2,3-Trichloropropane	EPA 8260B	10184802	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5210 - 1,2,4-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260B	10184802	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene	EPA 8260B	10184802	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
dibromide)				
4610 - 1,2-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260B	10184802	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
5215 - 1,3,5-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260B	10184802	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B	10184802	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 8260B	10184802	NELAP	PA
4535 - 2-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4860 - 2-Hexanone	EPA 8260B	10184802	NELAP	PA
4540 - 4-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 8260B	10184802	NELAP	PA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA 8260B	10184802	NELAP	PA
4315 - Acetone	EPA 8260B	10184802	NELAP	PA
4320 - Acetonitrile	EPA 8260B	10184802	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8260B	10184802	NELAP	PA
4340 - Acrylonitrile	EPA 8260B	10184802	NELAP	PA
4350 - Allyl alcohol	EPA 8260B	10184802	NELAP	PA
4355 - Allyl chloride (3-Chloropropene)	EPA 8260B	10184802	NELAP	PA
4375 - Benzene	EPA 8260B	10184802	NELAP	PA
5635 - Benzyl chloride	EPA 8260B	10184802	NELAP	PA
4385 - Bromobenzene	EPA 8260B	10184802	NELAP	PA
4390 - Bromochloromethane	EPA 8260B	10184802	NELAP	PA
4395 - Bromodichloromethane	EPA 8260B	10184802	NELAP	PA
4400 - Bromoform	EPA 8260B	10184802	NELAP	PA
4450 - Carbon disulfide	EPA 8260B	10184802	NELAP	PA
4455 - Carbon tetrachloride	EPA 8260B	10184802	NELAP	PA
4475 - Chlorobenzene	EPA 8260B	10184802	NELAP	PA
4575 - Chlorodibromomethane	EPA 8260B	10184802	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 8260B	10184802	NELAP	PA
4505 - Chloroform	EPA 8260B	10184802	NELAP	PA
4525 - Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260B	10184802	NELAP	PA
4555 - Cyclohexane	EPA 8260B	10184802	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 8260B	10184802	NELAP	PA
4580 - Dibromochloropropane	EPA 8260B	10184802	NELAP	PA
4590 - Dibromofluoromethane	EPA 8260B	10184802	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 8260B	10184802	NELAP	PA
4625 - Dichlorodifluoromethane (Freon-12)	EPA 8260B	10184802	NELAP	PA
4745 - Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 8260B	10184802	NELAP	PA
4750 - Ethanol	EPA 8260B	10184802	NELAP	PA
4755 - Ethyl acetate	EPA 8260B	10184802	NELAP	PA
4810 - Ethyl methacrylate	EPA 8260B	10184802	NELAP	PA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 8260B	10184802	NELAP	PA
4765 - Ethylbenzene	EPA 8260B	10184802	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8260B	10184802	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
4835 - Hexachlorobutadiene	EPA 8260B	10184802	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 8260B	10184802	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260B	10184802	NELAP	PA
4900 - Isopropylbenzene	EPA 8260B	10184802	NELAP	PA
4925 - Methacrylonitrile	EPA 8260B	10184802	NELAP	PA
4940 - Methyl acetate	EPA 8260B	10184802	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 8260B	10184802	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 8260B	10184802	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8260B	10184802	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 8260B	10184802	NELAP	PA
5005 - Naphthalene	EPA 8260B	10184802	NELAP	PA
5035 - Pentachloroethane	EPA 8260B	10184802	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 8260B	10184802	NELAP	PA
5100 - Styrene	EPA 8260B	10184802	NELAP	PA
4370 - T-amylmethylether (TAME)	EPA 8260B	10184802	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260B	10184802	NELAP	PA
5120 - Tetrahydrofuran (THF)	EPA 8260B	10184802	NELAP	PA
5140 - Toluene	EPA 8260B	10184802	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 8260B	10184802	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260B	10184802	NELAP	PA
5225 - Vinyl acetate	EPA 8260B	10184802	NELAP	PA
5235 - Vinyl chloride	EPA 8260B	10184802	NELAP	PA
5260 - Xylene (total)	EPA 8260B	10184802	NELAP	PA
4705 - cis & trans-1,2-Dichloroethene	EPA 8260B	10184802	NELAP	PA
4645 - cis-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5240 - m+p-xylene	EPA 8260B	10184802	NELAP	PA
4435 - n-Butylbenzene	EPA 8260B	10184802	NELAP	PA
5085 - n-Propylamine	EPA 8260B	10184802	NELAP	PA
5090 - n-Propylbenzene	EPA 8260B	10184802	NELAP	PA
5250 - o-Xylene	EPA 8260B	10184802	NELAP	PA
4440 - sec-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8260B	10184802	NELAP	PA
4445 - tert-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 8260B	10184802	NELAP	PA
4605 - trans-1,4-Dichloro-2-butene	EPA 8260B	10184802	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270C	10185805	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270C	10185805	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270C	10185805	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270C	10185805	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270C	10185805	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270C	10185805	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270C	10185805	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270C	10185805	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270C	10185805	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270C	10185805	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270C	10185805	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270C	10185805	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270C	10185805	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270C	10185805	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270C	10185805	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270C	10185805	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270C	10185805	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270C	10185805	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270C	10185805	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270C	10185805	NELAP	PA
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270C	10185805	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270C	10185805	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270C	10185805	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270C	10185805	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270C	10185805	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270C	10185805	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270C	10185805	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270C	10185805	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270C	10185805	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270C	10185805	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270C	10185805	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270C	10185805	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270C	10185805	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270C	10185805	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270C	10185805	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270C	10185805	NELAP	PA
5500 - Acenaphthene	EPA 8270C	10185805	NELAP	PA
5505 - Acenaphthylene	EPA 8270C	10185805	NELAP	PA
5510 - Acetophenone	EPA 8270C	10185805	NELAP	PA
5545 - Aniline	EPA 8270C	10185805	NELAP	PA
5555 - Anthracene	EPA 8270C	10185805	NELAP	PA
5560 - Aramite	EPA 8270C	10185805	NELAP	PA
5595 - Benzidine	EPA 8270C	10185805	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C	10185805	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C	10185805	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C	10185805	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C	10185805	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C	10185805	NELAP	PA
5610 - Benzoic acid	EPA 8270C	10185805	NELAP	PA
5630 - Benzyl alcohol	EPA 8270C	10185805	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270C	10185805	NELAP	PA
7180 - Caprolactam	EPA 8270C	10185805	NELAP	PA
5680 - Carbazole	EPA 8270C	10185805	NELAP	PA
5855 - Chrysene	EPA 8270C	10185805	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-	EPA 8270C	10185805	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
Ethylhexyl)phthalate, DEHP)				
5925 - Di-n-butyl phthalate	EPA 8270C	10185805	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270C	10185805	NELAP	PA
7405 - Diallate	EPA 8270C	10185805	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C	10185805	NELAP	PA
5905 - Dibenzofuran	EPA 8270C	10185805	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270C	10185805	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270C	10185805	NELAP	PA
6205 - Diphenylamine	EPA 8270C	10185805	NELAP	PA
8625 - Disulfoton	EPA 8270C	10185805	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7580 - Famphur	EPA 8270C	10185805	NELAP	PA
6265 - Fluoranthene	EPA 8270C	10185805	NELAP	PA
6270 - Fluorene	EPA 8270C	10185805	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270C	10185805	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270C	10185805	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270C	10185805	NELAP	PA
4840 - Hexachloroethane	EPA 8270C	10185805	NELAP	PA
6295 - Hexachloropropene	EPA 8270C	10185805	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C	10185805	NELAP	PA
7725 - Isodrin	EPA 8270C	10185805	NELAP	PA
6320 - Isophorone	EPA 8270C	10185805	NELAP	PA
6325 - Isosafrole	EPA 8270C	10185805	NELAP	PA
7740 - Kepone	EPA 8270C	10185805	NELAP	PA
6345 - Methapyrilene	EPA 8270C	10185805	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270C	10185805	NELAP	PA
5005 - Naphthalene	EPA 8270C	10185805	NELAP	PA
5015 - Nitrobenzene	EPA 8270C	10185805	NELAP	PA
7955 - Parathion, ethyl	EPA 8270C	10185805	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270C	10185805	NELAP	PA
6605 - Pentachlorophenol	EPA 8270C	10185805	NELAP	PA
6610 - Phenacetin	EPA 8270C	10185805	NELAP	PA
6615 - Phenanthrene	EPA 8270C	10185805	NELAP	PA
6625 - Phenol	EPA 8270C	10185805	NELAP	PA
7985 - Phorate	EPA 8270C	10185805	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270C	10185805	NELAP	PA
6665 - Pyrene	EPA 8270C	10185805	NELAP	PA
5095 - Pyridine	EPA 8270C	10185805	NELAP	PA
6670 - Quinoline	EPA 8270C	10185805	NELAP	PA
6685 - Safrole	EPA 8270C	10185805	NELAP	PA
8155 - Sulfotepp	EPA 8270C	10185805	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270C	10185805	NELAP	PA
6750 - Thiophenol (Benzenethiol)	EPA 8270C	10185805	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270C	10185805	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270C	10185805	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270C	10185805	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270C	10185805	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270C	10185805	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270C	10185805	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270C	10185805	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270C	10185805	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270C	10185805	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270C	10185805	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270C	10185805	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6560 - n-Nitrosopiperidine	EPA 8270C	10185805	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270C	10185805	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270C	10185805	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270C	10185805	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270D	10186002	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270D	10186002	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	10186002	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	10186002	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270D	10186002	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270D	10186002	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270D	10186002	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270D	10186002	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270D	10186002	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270D	10186002	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270D	10186002	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D	10186002	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D	10186002	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270D	10186002	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270D	10186002	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270D	10186002	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270D	10186002	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270D	10186002	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270D	10186002	NELAP	PA
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270D	10186002	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270D	10186002	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270D	10186002	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270D	10186002	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270D	10186002	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270D	10186002	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270D	10186002	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270D	10186002	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270D	10186002	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270D	10186002	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270D	10186002	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270D	10186002	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270D	10186002	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270D	10186002	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270D	10186002	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270D	10186002	NELAP	PA
5500 - Acenaphthene	EPA 8270D	10186002	NELAP	PA
5505 - Acenaphthylene	EPA 8270D	10186002	NELAP	PA
5510 - Acetophenone	EPA 8270D	10186002	NELAP	PA
5545 - Aniline	EPA 8270D	10186002	NELAP	PA
5555 - Anthracene	EPA 8270D	10186002	NELAP	PA
5560 - Aramite	EPA 8270D	10186002	NELAP	PA
5595 - Benzidine	EPA 8270D	10186002	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D	10186002	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D	10186002	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D	10186002	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D	10186002	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D	10186002	NELAP	PA
5610 - Benzoic acid	EPA 8270D	10186002	NELAP	PA
5630 - Benzyl alcohol	EPA 8270D	10186002	NELAP	PA
5635 - Benzyl chloride	EPA 8270D	10186002	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270D	10186002	NELAP	PA
7180 - Caprolactam	EPA 8270D	10186002	NELAP	PA
5680 - Carbazole	EPA 8270D	10186002	NELAP	PA
5855 - Chrysene	EPA 8270D	10186002	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270D	10186002	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270D	10186002	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270D	10186002	NELAP	PA
7405 - Diallate	EPA 8270D	10186002	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D	10186002	NELAP	PA
5905 - Dibenzofuran	EPA 8270D	10186002	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270D	10186002	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D	10186002	NELAP	PA
6205 - Diphenylamine	EPA 8270D	10186002	NELAP	PA
8625 - Disulfoton	EPA 8270D	10186002	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7580 - Famphur	EPA 8270D	10186002	NELAP	PA
6265 - Fluoranthene	EPA 8270D	10186002	NELAP	PA
6270 - Fluorene	EPA 8270D	10186002	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270D	10186002	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270D	10186002	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270D	10186002	NELAP	PA
4840 - Hexachloroethane	EPA 8270D	10186002	NELAP	PA
6295 - Hexachloropropene	EPA 8270D	10186002	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D	10186002	NELAP	PA
7725 - Isodrin	EPA 8270D	10186002	NELAP	PA
6320 - Isophorone	EPA 8270D	10186002	NELAP	PA
6325 - Isosafrole	EPA 8270D	10186002	NELAP	PA
7740 - Kepone	EPA 8270D	10186002	NELAP	PA
6345 - Methapyrilene	EPA 8270D	10186002	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270D	10186002	NELAP	PA
5005 - Naphthalene	EPA 8270D	10186002	NELAP	PA
5015 - Nitrobenzene	EPA 8270D	10186002	NELAP	PA
7955 - Parathion, ethyl	EPA 8270D	10186002	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270D	10186002	NELAP	PA
6605 - Pentachlorophenol	EPA 8270D	10186002	NELAP	PA
6610 - Phenacetin	EPA 8270D	10186002	NELAP	PA
6615 - Phenanthrene	EPA 8270D	10186002	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6625 - Phenol	EPA 8270D	10186002	NELAP	PA
7985 - Phorate	EPA 8270D	10186002	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270D	10186002	NELAP	PA
5095 - Pyridine	EPA 8270D	10186002	NELAP	PA
6670 - Quinoline	EPA 8270D	10186002	NELAP	PA
6685 - Safrole	EPA 8270D	10186002	NELAP	PA
8155 - Sulfotepp	EPA 8270D	10186002	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270D	10186002	NELAP	PA
6750 - Thiophenol (Benzenethiol)	EPA 8270D	10186002	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270D	10186002	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270D	10186002	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270D	10186002	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270D	10186002	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270D	10186002	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270D	10186002	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270D	10186002	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270D	10186002	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270D	10186002	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270D	10186002	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270D	10186002	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270D	10186002	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270D	10186002	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270D	10186002	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270D	10186002	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A	10187403	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A	10187403	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290A	10187403	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A	10187403	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A	10187403	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A	10187403	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A	10187403	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
9438 - Total Hpcdd	EPA 8290A	10187403	NELAP	PA
9444 - Total Hpcdf	EPA 8290A	10187403	NELAP	PA
9468 - Total Hxcdd	EPA 8290A	10187403	NELAP	PA
9483 - Total Hxcdf	EPA 8290A	10187403	NELAP	PA
9555 - Total Pecdd	EPA 8290A	10187403	NELAP	PA
9552 - Total Pecdf	EPA 8290A	10187403	NELAP	PA
9609 - Total TCDD	EPA 8290A	10187403	NELAP	PA
9615 - Total TCDF	EPA 8290A	10187403	NELAP	PA
5500 - Acenaphthene	EPA 8310	10187607	NELAP	PA
5505 - Acenaphthylene	EPA 8310	10187607	NELAP	PA
5555 - Anthracene	EPA 8310	10187607	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8310	10187607	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8310	10187607	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8310	10187607	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8310	10187607	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8310	10187607	NELAP	PA
5855 - Chrysene	EPA 8310	10187607	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8310	10187607	NELAP	PA
6265 - Fluoranthene	EPA 8310	10187607	NELAP	PA
6270 - Fluorene	EPA 8310	10187607	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8310	10187607	NELAP	PA
5005 - Naphthalene	EPA 8310	10187607	NELAP	PA
6615 - Phenanthrene	EPA 8310	10187607	NELAP	PA
6665 - Pyrene	EPA 8310	10187607	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	10189807	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	10189807	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	10189807	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	10189807	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	10189807	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	10189807	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	10189807	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330	10189807	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330	10189807	NELAP	PA
5015 - Nitrobenzene	EPA 8330	10189807	NELAP	PA
6485 - Nitroglycerin	EPA 8330	10189807	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	10189807	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330	10189807	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	10189807	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330A	10190008	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330A	10190008	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330A	10190008	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330A	10190008	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330A	10190008	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330A	10190008	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330A	10190008	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
9513 - 4-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330A	10190008	NELAP	PA
5015 - Nitrobenzene	EPA 8330A	10190008	NELAP	PA
6485 - Nitroglycerin	EPA 8330A	10190008	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A	10190008	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330A	10190008	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A	10190008	NELAP	PA
6485 - Nitroglycerin	EPA 8332	10190406	NELAP	PA
1645 - Total Cyanide	EPA 9012	10193201	NELAP	PA
1645 - Total Cyanide	EPA 9012A	10193405	NELAP	PA
1900 - pH	EPA 9040B	10197203	NELAP	PA
1625 - Corrosivity (pH)	EPA 9045	10197805	NELAP	PA
1900 - pH	EPA 9045	10197805	NELAP	PA
1610 - Conductivity	EPA 9050	10198604	NELAP	PA
1610 - Conductivity	EPA 9050A	10198808	NELAP	PA
1540 - Bromide	EPA 9056	10199005	NELAP	PA
1575 - Chloride	EPA 9056	10199403	NELAP	PA
1730 - Fluoride	EPA 9056	10199403	NELAP	PA
1805 - Nitrate	EPA 9056	10199403	NELAP	PA
1835 - Nitrite	EPA 9056	10199403	NELAP	PA
2000 - Sulfate	EPA 9056	10199403	NELAP	PA
1575 - Chloride	EPA 9056A	10199607	NELAP	PA
1730 - Fluoride	EPA 9056A	10199607	NELAP	PA
1805 - Nitrate	EPA 9056A	10199607	NELAP	PA
1835 - Nitrite	EPA 9056A	10199607	NELAP	PA
1840 - Nitrite as N	EPA 9056A	10199607	NELAP	PA
2000 - Sulfate	EPA 9056A	10199607	NELAP	PA
2040 - Total Organic Carbon	EPA 9060	10200201	NELAP	PA
1905 - Total Phenolics	EPA 9066	10200609	NELAP	PA
4747 - Ethane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
4926 - Methane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
100263 - Propane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
5029 - n-Propane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
1095 - Mercury	EPA 1631E	10237204	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C SIM	10242407	NELAP	PA
5500 - Acenaphthene	EPA 8270C SIM	10242407	NELAP	PA
5505 - Acenaphthylene	EPA 8270C SIM	10242407	NELAP	PA
5555 - Anthracene	EPA 8270C SIM	10242407	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C SIM	10242407	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C SIM	10242407	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C SIM	10242407	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5855 - Chrysene	EPA 8270C SIM	10242407	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C SIM	10242407	NELAP	PA
6265 - Fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
6270 - Fluorene	EPA 8270C SIM	10242407	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C SIM	10242407	NELAP	PA
5005 - Naphthalene	EPA 8270C SIM	10242407	NELAP	PA
6615 - Phenanthrene	EPA 8270C SIM	10242407	NELAP	PA
6665 - Pyrene	EPA 8270C SIM	10242407	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D SIM	10242509	NELAP	PA
5500 - Acenaphthene	EPA 8270D SIM	10242509	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
5505 - Acenaphthylene	EPA 8270D SIM	10242509	NELAP	PA
5555 - Anthracene	EPA 8270D SIM	10242509	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D SIM	10242509	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D SIM	10242509	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D SIM	10242509	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5855 - Chrysene	EPA 8270D SIM	10242509	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D SIM	10242509	NELAP	PA
6265 - Fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
6270 - Fluorene	EPA 8270D SIM	10242509	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D SIM	10242509	NELAP	PA
5005 - Naphthalene	EPA 8270D SIM	10242509	NELAP	PA
6615 - Phenanthrene	EPA 8270D SIM	10242509	NELAP	PA
6665 - Pyrene	EPA 8270D SIM	10242509	NELAP	PA
1645 - Total Cyanide	EPA 9012B	10243206	NELAP	PA
1900 - pH	EPA 9040C	10244403	NELAP	PA
1575 - Chloride	EPA 300.0	10275408	NELAP	PA
1840 - Nitrite as N	EPA 300.0	10275408	NELAP	PA
2000 - Sulfate	EPA 300.0	10275408	NELAP	PA
1500 - Acidity, as CaCO3	SM 2310 B, 20th ED	20044206	NELAP	PA
100410 - Alkalinity, bicarbonate	SM 2320 B, 18th ED	20044808	NELAP	LA
100411 - Alkalinity, carbonate	SM 2320 B, 18th ED	20044808	NELAP	LA
1505 - Alkalinity as CaCO3	SM 2320 B, 20th ED	20045209	NELAP	PA
1755 - Total hardness as CaCO3	SM 2340 B, 19th ED	20046008	NELAP	PA
1755 - Total hardness as CaCO3	SM 2340 B, 20th ED	20046202	NELAP	PA
1955 - Residue-filterable (TDS)	SM 2340 C, 20th ED	20047205	NELAP	PA
1610 - Conductivity	SM 2510 B, 20th ED	20048208	NELAP	PA
1610 - Conductivity	SM 2510 B, 21st ED	20048402	NELAP	PA
1950 - Residue-total	SM 2540 B, 20th ED	20049007	NELAP	PA
1955 - Residue-filterable (TDS)	SM 2540 C, 20th ED	20050004	NELAP	PA
1960 - Residue-nonfilterable (TSS)	SM 2540 D, 20th ED	20050800	NELAP	PA
1965 - Residue-settleable	SM 2540 F, 20th ED	20051803	NELAP	PA
2030 - Temperature, deg. C	SM 2550 B, 20th ED	20052806	NELAP	PA
1575 - Chloride	SM 4500-Cl⁻ C, 20th ED	20084804	NELAP	PA
1940 - Total residual chlorine	SM 4500-Cl⁻ F, 20th ED	20087201	NELAP	PA
1645 - Total Cyanide	SM 4500-CN⁻ C, 20th ED	20091605	NELAP	PA
1635 - Cyanide	SM 4500-CN⁻ E, 20th ED	20092404	NELAP	PA
1510 - Amenable cyanide	SM 4500-CN⁻ G, 20th ED	20093203	NELAP	PA
1730 - Fluoride	SM 4500-F⁻ B, 20th ED	20101002	NELAP	PA
1900 - pH	SM 4500-H+ B, 20th ED	20104807	NELAP	PA
1515 - Ammonia as N	SM 4500-NH3 B, 20th ED	20105606	NELAP	PA
1515 - Ammonia as N	SM 4500-NH3 C, 20th ED	20106405	NELAP	PA
1515 - Ammonia as N	SM 4500-NH3 D, 20th ED	20109006	NELAP	PA
1880 - Oxygen, dissolved	SM 4500-O G, 20th ED	20121204	NELAP	PA
1910 - Total Phosphorus	SM 4500-P B 5, 20th ED	20123200	NELAP	PA
1910 - Total Phosphorus	SM 4500-P E, 20th ED	20123802	NELAP	PA
1910 - Total Phosphorus	SM 4500-P F, 20th ED	20124601	NELAP	PA
2005 - Sulfide	SM 4500-S2⁻ D, 20th ED	20125400	NELAP	PA
2005 - Sulfide	SM 4500-S2⁻ F, 20th ED	20126209	NELAP	PA
1990 - Silica as SiO2	SM 4500-SiO2 C, 20th ED	20128205	NELAP	PA
1530 - Biochemical oxygen demand	SM 5210 B, 20th ED	20134809	NELAP	PA
1555 - Carbonaceous BOD, CBOD	SM 5210 B, 20th ED	20134809	NELAP	PA
2040 - Total Organic Carbon	SM 5310 B, 20th ED	20137400	NELAP	PA
2040 - Total Organic Carbon	SM 5310 C, 20th ED	20138403	NELAP	PA
2025 - Surfactants - MBAS	SM 5540 C, 20th ED	20144609	NELAP	PA

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Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1605 - Color	SM 2120 B, 20th ED	20224004	NELAP	PA
6385 - 2-Methylnaphthalene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5500 - Acenaphthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5505 - Acenaphthylene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5555 - Anthracene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5575 - Benzo(a)anthracene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5580 - Benzo(a)pyrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5585 - Benzo(b)fluoranthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5590 - Benzo(g,h,i)perylene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5600 - Benzo(k)fluoranthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5855 - Chrysene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5895 - Dibenz(a,h) anthracene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6218 - EPH Aliphatic C19-C36	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6222 - EPH Aliphatic C9-C18	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6232 - EPH Aromatic C11-C22	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6234 - EPH Aromatic C11-C22 Unadjusted	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6265 - Fluoranthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6270 - Fluorene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5005 - Naphthalene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6615 - Phenanthrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6665 - Pyrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
4375 - Benzene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
4765 - Ethylbenzene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5005 - Naphthalene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5140 - Toluene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5304 - VPH Aliphatic C5-C8	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5305 - VPH Aliphatic C5-C8 Unadjusted	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5306 - VPH Aliphatic C9-C12	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5307 - VPH Aliphatic C9-C12 Unadjusted	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5311 - VPH Aromatic C9-C10	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5240 - m+p-xylene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5250 - o-Xylene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	TNRCC 1005, Rev.3	90019208	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4330 - Acrylamide	EPA 8270C (extended)	2330	NELAP	PA
5570 - Benzaldehyde	EPA 8270C (extended)	2330	NELAP	PA
4330 - Acrylamide	EPA 8270D (extended)	2560	NELAP	PA
5570 - Benzaldehyde	EPA 8270D (extended)	2560	NELAP	PA
1780 - Ignitability	EPA 1010	10116606	NELAP	PA
1466 - Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	10118806	NELAP	PA
1460 - Synthetic Precipitation Leaching Procedure	EPA 1312	10119003	NELAP	PA
100007 - Acid Digestion of Sediments, Sludges, and soils	EPA 3050B	10135601	NELAP	PA
1402 - Alkaline Digestion for Hexavalent Chromium	EPA 3060A	10136604	NELAP	PA
1444 - Separatory Funnel Liquid-liquid extraction	EPA 3510C	10138202	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1452 - Soxhlet Extraction	EPA 3540C	10140202	NELAP	PA
1428 - Microwave Extraction	EPA 3546	10141205	NELAP	PA
1468 - Ultrasonic Extraction	EPA 3550C	10142004	NELAP	PA
1456 - Sulfur Clean-Up	EPA 3660B	10148400	NELAP	PA
2020 - Sulfuric acid/permanganate clean-up	EPA 3665	10148604	NELAP	PA
2020 - Sulfuric acid/permanganate clean-up	EPA 3665A	10148808	NELAP	PA
100017 - Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples	EPA 5030	10153001	NELAP	PA
1406 - Purge and trap for aqueous phase samples	EPA 5030	10153001	NELAP	PA
100017 - Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples	EPA 5035	10154004	NELAP	PA
1000 - Aluminum	EPA 6010B	10155609	NELAP	PA
1005 - Antimony	EPA 6010B	10155609	NELAP	PA
1010 - Arsenic	EPA 6010B	10155609	NELAP	PA
1015 - Barium	EPA 6010B	10155609	NELAP	PA
1020 - Beryllium	EPA 6010B	10155609	NELAP	PA
1025 - Boron	EPA 6010B	10155609	NELAP	PA
1030 - Cadmium	EPA 6010B	10155609	NELAP	PA
1035 - Calcium	EPA 6010B	10155609	NELAP	PA
1040 - Chromium	EPA 6010B	10155609	NELAP	PA
1050 - Cobalt	EPA 6010B	10155609	NELAP	PA
1055 - Copper	EPA 6010B	10155609	NELAP	PA
1070 - Iron	EPA 6010B	10155609	NELAP	PA
1075 - Lead	EPA 6010B	10155609	NELAP	PA
1080 - Lithium	EPA 6010B	10155609	NELAP	PA
1085 - Magnesium	EPA 6010B	10155609	NELAP	PA
1090 - Manganese	EPA 6010B	10155609	NELAP	PA
1100 - Molybdenum	EPA 6010B	10155609	NELAP	PA
1105 - Nickel	EPA 6010B	10155609	NELAP	PA
1125 - Potassium	EPA 6010B	10155609	NELAP	PA
1140 - Selenium	EPA 6010B	10155609	NELAP	PA
1150 - Silver	EPA 6010B	10155609	NELAP	PA
1155 - Sodium	EPA 6010B	10155609	NELAP	PA
1160 - Strontium	EPA 6010B	10155609	NELAP	PA
1165 - Thallium	EPA 6010B	10155609	NELAP	PA
1175 - Tin	EPA 6010B	10155609	NELAP	PA
1180 - Titanium	EPA 6010B	10155609	NELAP	PA
1185 - Vanadium	EPA 6010B	10155609	NELAP	PA
1190 - Zinc	EPA 6010B	10155609	NELAP	PA
1000 - Aluminum	EPA 6010C	10155803	NELAP	PA
1005 - Antimony	EPA 6010C	10155803	NELAP	PA
1010 - Arsenic	EPA 6010C	10155803	NELAP	PA
1015 - Barium	EPA 6010C	10155803	NELAP	PA
1020 - Beryllium	EPA 6010C	10155803	NELAP	PA
1025 - Boron	EPA 6010C	10155803	NELAP	PA
1030 - Cadmium	EPA 6010C	10155803	NELAP	PA
1035 - Calcium	EPA 6010C	10155803	NELAP	PA
1040 - Chromium	EPA 6010C	10155803	NELAP	PA
1050 - Cobalt	EPA 6010C	10155803	NELAP	PA
1055 - Copper	EPA 6010C	10155803	NELAP	PA
1070 - Iron	EPA 6010C	10155803	NELAP	PA
1075 - Lead	EPA 6010C	10155803	NELAP	PA
1080 - Lithium	EPA 6010C	10155803	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1085 - Magnesium	EPA 6010C	10155803	NELAP	PA
1090 - Manganese	EPA 6010C	10155803	NELAP	PA
1100 - Molybdenum	EPA 6010C	10155803	NELAP	PA
1105 - Nickel	EPA 6010C	10155803	NELAP	PA
1125 - Potassium	EPA 6010C	10155803	NELAP	PA
1140 - Selenium	EPA 6010C	10155803	NELAP	PA
1150 - Silver	EPA 6010C	10155803	NELAP	PA
1155 - Sodium	EPA 6010C	10155803	NELAP	PA
1160 - Strontium	EPA 6010C	10155803	NELAP	PA
2017 - Sulfur	EPA 6010C	10155803	NELAP	PA
1165 - Thallium	EPA 6010C	10155803	NELAP	PA
1175 - Tin	EPA 6010C	10155803	NELAP	PA
1180 - Titanium	EPA 6010C	10155803	NELAP	PA
1185 - Vanadium	EPA 6010C	10155803	NELAP	PA
1190 - Zinc	EPA 6010C	10155803	NELAP	PA
1000 - Aluminum	EPA 6020	10156000	NELAP	PA
1005 - Antimony	EPA 6020	10156000	NELAP	PA
1010 - Arsenic	EPA 6020	10156000	NELAP	PA
1015 - Barium	EPA 6020	10156000	NELAP	PA
1020 - Beryllium	EPA 6020	10156000	NELAP	PA
1030 - Cadmium	EPA 6020	10156000	NELAP	PA
1035 - Calcium	EPA 6020	10156000	NELAP	PA
1040 - Chromium	EPA 6020	10156000	NELAP	PA
1050 - Cobalt	EPA 6020	10156000	NELAP	PA
1055 - Copper	EPA 6020	10156000	NELAP	PA
1070 - Iron	EPA 6020	10156000	NELAP	PA
1075 - Lead	EPA 6020	10156000	NELAP	PA
1085 - Magnesium	EPA 6020	10156000	NELAP	PA
1090 - Manganese	EPA 6020	10156000	NELAP	PA
1100 - Molybdenum	EPA 6020	10156000	NELAP	PA
1105 - Nickel	EPA 6020	10156000	NELAP	PA
1125 - Potassium	EPA 6020	10156000	NELAP	PA
1140 - Selenium	EPA 6020	10156000	NELAP	PA
1150 - Silver	EPA 6020	10156000	NELAP	PA
1155 - Sodium	EPA 6020	10156000	NELAP	PA
1160 - Strontium	EPA 6020	10156000	NELAP	PA
1165 - Thallium	EPA 6020	10156000	NELAP	PA
1175 - Tin	EPA 6020	10156000	NELAP	PA
1185 - Vanadium	EPA 6020	10156000	NELAP	PA
1190 - Zinc	EPA 6020	10156000	NELAP	PA
1155 - Sodium	EPA 6020	10156204	NELAP	PA
1000 - Aluminum	EPA 6020A	10156408	NELAP	PA
1005 - Antimony	EPA 6020A	10156408	NELAP	PA
1010 - Arsenic	EPA 6020A	10156408	NELAP	PA
1015 - Barium	EPA 6020A	10156408	NELAP	PA
1020 - Beryllium	EPA 6020A	10156408	NELAP	PA
1030 - Cadmium	EPA 6020A	10156408	NELAP	PA
1035 - Calcium	EPA 6020A	10156408	NELAP	PA
1040 - Chromium	EPA 6020A	10156408	NELAP	PA
1050 - Cobalt	EPA 6020A	10156408	NELAP	PA
1055 - Copper	EPA 6020A	10156408	NELAP	PA
1070 - Iron	EPA 6020A	10156408	NELAP	PA
1075 - Lead	EPA 6020A	10156408	NELAP	PA
1085 - Magnesium	EPA 6020A	10156408	NELAP	PA
1090 - Manganese	EPA 6020A	10156408	NELAP	PA
1100 - Molybdenum	EPA 6020A	10156408	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1105 - Nickel	EPA 6020A	10156408	NELAP	PA
1125 - Potassium	EPA 6020A	10156408	NELAP	PA
1140 - Selenium	EPA 6020A	10156408	NELAP	PA
1150 - Silver	EPA 6020A	10156408	NELAP	PA
1155 - Sodium	EPA 6020A	10156408	NELAP	PA
1160 - Strontium	EPA 6020A	10156408	NELAP	PA
1165 - Thallium	EPA 6020A	10156408	NELAP	PA
1175 - Tin	EPA 6020A	10156408	NELAP	PA
1180 - Titanium	EPA 6020A	10156408	NELAP	PA
1185 - Vanadium	EPA 6020A	10156408	NELAP	PA
1190 - Zinc	EPA 6020A	10156408	NELAP	PA
1045 - Chromium VI	EPA 7196A	10162400	NELAP	PA
1045 - Chromium VI	EPA 7199	10163005	NELAP	PA
1095 - Mercury	EPA 7471A	10166208	NELAP	PA
1095 - Mercury	EPA 7471B	10166402	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015B	10173601	NELAP	PA
4750 - Ethanol	EPA 8015B	10173601	NELAP	PA
4785 - Ethylene glycol	EPA 8015B	10173601	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015B	10173601	NELAP	PA
4930 - Methanol	EPA 8015B	10173601	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015C	10173805	NELAP	PA
4750 - Ethanol	EPA 8015C	10173805	NELAP	PA
4785 - Ethylene glycol	EPA 8015C	10173805	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015C	10173805	NELAP	PA
4930 - Methanol	EPA 8015C	10173805	NELAP	PA
4375 - Benzene	EPA 8021B	10174808	NELAP	PA
4765 - Ethylbenzene	EPA 8021B	10174808	NELAP	PA
4900 - Isopropylbenzene	EPA 8021B	10174808	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8021B	10174808	NELAP	PA
5005 - Naphthalene	EPA 8021B	10174808	NELAP	PA
5140 - Toluene	EPA 8021B	10174808	NELAP	PA
5260 - Xylene (total)	EPA 8021B	10174808	NELAP	PA
5245 - m-Xylene	EPA 8021B	10174808	NELAP	PA
5250 - o-Xylene	EPA 8021B	10174808	NELAP	PA
5255 - p-Xylene	EPA 8021B	10174808	NELAP	PA
7355 - 4,4'-DDD	EPA 8081A	10178606	NELAP	PA
7360 - 4,4'-DDE	EPA 8081A	10178606	NELAP	PA
7365 - 4,4'-DDT	EPA 8081A	10178606	NELAP	PA
7025 - Aldrin	EPA 8081A	10178606	NELAP	PA
7250 - Chlordane (tech.)	EPA 8081A	10178606	NELAP	PA
7470 - Dieldrin	EPA 8081A	10178606	NELAP	PA
7510 - Endosulfan I	EPA 8081A	10178606	NELAP	PA
7515 - Endosulfan II	EPA 8081A	10178606	NELAP	PA
7520 - Endosulfan sulfate	EPA 8081A	10178606	NELAP	PA
7540 - Endrin	EPA 8081A	10178606	NELAP	PA
7530 - Endrin aldehyde	EPA 8081A	10178606	NELAP	PA
7535 - Endrin ketone	EPA 8081A	10178606	NELAP	PA
7685 - Heptachlor	EPA 8081A	10178606	NELAP	PA
7690 - Heptachlor epoxide	EPA 8081A	10178606	NELAP	PA
7740 - Kepone	EPA 8081A	10178606	NELAP	PA
7810 - Methoxychlor	EPA 8081A	10178606	NELAP	PA
7870 - Mirex	EPA 8081A	10178606	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081A	10178606	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081A	10178606	NELAP	PA
7240 - alpha-Chlordane	EPA 8081A	10178606	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081A	10178606	NELAP	PA
7105 - delta-BHC	EPA 8081A	10178606	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081A	10178606	NELAP	PA
7245 - gamma-Chlordane	EPA 8081A	10178606	NELAP	PA
7355 - 4,4'-DDD	EPA 8081B	10178800	NELAP	PA
7360 - 4,4'-DDE	EPA 8081B	10178800	NELAP	PA
7365 - 4,4'-DDT	EPA 8081B	10178800	NELAP	PA
7025 - Aldrin	EPA 8081B	10178800	NELAP	PA
7250 - Chlordane (tech.)	EPA 8081B	10178800	NELAP	PA
7470 - Dieldrin	EPA 8081B	10178800	NELAP	PA
7510 - Endosulfan I	EPA 8081B	10178800	NELAP	PA
7515 - Endosulfan II	EPA 8081B	10178800	NELAP	PA
7520 - Endosulfan sulfate	EPA 8081B	10178800	NELAP	PA
7540 - Endrin	EPA 8081B	10178800	NELAP	PA
7530 - Endrin aldehyde	EPA 8081B	10178800	NELAP	PA
7535 - Endrin ketone	EPA 8081B	10178800	NELAP	PA
7685 - Heptachlor	EPA 8081B	10178800	NELAP	PA
7690 - Heptachlor epoxide	EPA 8081B	10178800	NELAP	PA
7740 - Kepone	EPA 8081B	10178800	NELAP	PA
7810 - Methoxychlor	EPA 8081B	10178800	NELAP	PA
7870 - Mirex	EPA 8081B	10178800	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081B	10178800	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7240 - alpha-Chlordane	EPA 8081B	10178800	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7105 - delta-BHC	EPA 8081B	10178800	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081B	10178800	NELAP	PA
7245 - gamma-Chlordane	EPA 8081B	10178800	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082	10179007	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082	10179007	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082	10179007	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082	10179007	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082	10179007	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082	10179007	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082	10179007	NELAP	PA
8912 - Aroclor-1262 (PCB-1262)	EPA 8082	10179007	NELAP	PA
8913 - Aroclor-1268 (PCB-1268)	EPA 8082	10179007	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082A	10179201	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082A	10179201	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082A	10179201	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082A	10179201	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082A	10179201	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082A	10179201	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082A	10179201	NELAP	PA
8912 - Aroclor-1262 (PCB-1262)	EPA 8082A	10179201	NELAP	PA
8913 - Aroclor-1268 (PCB-1268)	EPA 8082A	10179201	NELAP	PA
7600 - Fensulfothion	EPA 8141	10181803	NELAP	PA
7785 - Merphos	EPA 8141	10181803	NELAP	PA
8140 - Stirophos	EPA 8141	10181803	NELAP	PA
7005 - Alachlor	EPA 8141A	10182000	NELAP	PA
7065 - Atrazine	EPA 8141A	10182000	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
7075 - Azinphos-methyl (Guthion)	EPA 8141A	10182000	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141A	10182000	NELAP	PA
7300 - Chlorpyrifos	EPA 8141A	10182000	NELAP	PA
7395 - Demeton-o	EPA 8141A	10182000	NELAP	PA
7385 - Demeton-s	EPA 8141A	10182000	NELAP	PA
7410 - Diazinon	EPA 8141A	10182000	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141A	10182000	NELAP	PA
8625 - Disulfoton	EPA 8141A	10182000	NELAP	PA
7550 - EPN	EPA 8141A	10182000	NELAP	PA
7565 - Ethion	EPA 8141A	10182000	NELAP	PA
7570 - Ethoprop	EPA 8141A	10182000	NELAP	PA
7580 - Famphur	EPA 8141A	10182000	NELAP	PA
7600 - Fensulfothion	EPA 8141A	10182000	NELAP	PA
7605 - Fenthion	EPA 8141A	10182000	NELAP	PA
7770 - Malathion	EPA 8141A	10182000	NELAP	PA
7785 - Merphos	EPA 8141A	10182000	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141A	10182000	NELAP	PA
7850 - Mevinphos	EPA 8141A	10182000	NELAP	PA
7905 - Naled	EPA 8141A	10182000	NELAP	PA
7955 - Parathion, ethyl	EPA 8141A	10182000	NELAP	PA
7985 - Phorate	EPA 8141A	10182000	NELAP	PA
8110 - Ronnel	EPA 8141A	10182000	NELAP	PA
8125 - Simazine	EPA 8141A	10182000	NELAP	PA
7005 - Alachlor	EPA 8141B	10182204	NELAP	PA
7065 - Atrazine	EPA 8141B	10182204	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141B	10182204	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141B	10182204	NELAP	PA
7300 - Chlorpyrifos	EPA 8141B	10182204	NELAP	PA
7395 - Demeton-o	EPA 8141B	10182204	NELAP	PA
7385 - Demeton-s	EPA 8141B	10182204	NELAP	PA
7410 - Diazinon	EPA 8141B	10182204	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141B	10182204	NELAP	PA
8625 - Disulfoton	EPA 8141B	10182204	NELAP	PA
7550 - EPN	EPA 8141B	10182204	NELAP	PA
7565 - Ethion	EPA 8141B	10182204	NELAP	PA
7570 - Ethoprop	EPA 8141B	10182204	NELAP	PA
7580 - Famphur	EPA 8141B	10182204	NELAP	PA
7600 - Fensulfothion	EPA 8141B	10182204	NELAP	PA
7605 - Fenthion	EPA 8141B	10182204	NELAP	PA
7770 - Malathion	EPA 8141B	10182204	NELAP	PA
7785 - Merphos	EPA 8141B	10182204	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141B	10182204	NELAP	PA
7850 - Mevinphos	EPA 8141B	10182204	NELAP	PA
7905 - Naled	EPA 8141B	10182204	NELAP	PA
7955 - Parathion, ethyl	EPA 8141B	10182204	NELAP	PA
7985 - Phorate	EPA 8141B	10182204	NELAP	PA
8110 - Ronnel	EPA 8141B	10182204	NELAP	PA
8125 - Simazine	EPA 8141B	10182204	NELAP	PA
8655 - 2,4,5-T	EPA 8151	10183003	NELAP	PA
8545 - 2,4-D	EPA 8151	10183003	NELAP	PA
8560 - 2,4-DB	EPA 8151	10183003	NELAP	PA
8555 - Dalapon	EPA 8151	10183003	NELAP	PA
8595 - Dicamba	EPA 8151	10183003	NELAP	PA
8605 - Dichloroprop (Dichlorprop)	EPA 8151	10183003	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	10183003	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
7775 - MCPA	EPA 8151	10183003	NELAP	PA
7780 - MCPP	EPA 8151	10183003	NELAP	PA
6605 - Pentachlorophenol	EPA 8151	10183003	NELAP	PA
8645 - Picloram	EPA 8151	10183003	NELAP	PA
8650 - Silvex (2,4,5-TP)	EPA 8151	10183003	NELAP	PA
8655 - 2,4,5-T	EPA 8151A	10183207	NELAP	PA
8545 - 2,4-D	EPA 8151A	10183207	NELAP	PA
8560 - 2,4-DB	EPA 8151A	10183207	NELAP	PA
8555 - Dalapon	EPA 8151A	10183207	NELAP	PA
8595 - Dicamba	EPA 8151A	10183207	NELAP	PA
8605 - Dichloroprop (Dichlorprop)	EPA 8151A	10183207	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A	10183207	NELAP	PA
7775 - MCPA	EPA 8151A	10183207	NELAP	PA
7780 - MCPP	EPA 8151A	10183207	NELAP	PA
6605 - Pentachlorophenol	EPA 8151A	10183207	NELAP	PA
8645 - Picloram	EPA 8151A	10183207	NELAP	PA
8650 - Silvex (2,4,5-TP)	EPA 8151A	10183207	NELAP	PA
5105 - 1,1,1,2-Tetrachloroethane	EPA 8260	10184404	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 8260	10184404	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260	10184404	NELAP	PA
5185 - 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260	10184404	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 8260	10184404	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 8260	10184404	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 8260	10184404	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 8260	10184404	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 8260	10184404	NELAP	PA
5180 - 1,2,3-Trichloropropane	EPA 8260	10184404	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8260	10184404	NELAP	PA
5210 - 1,2,4-Trimethylbenzene	EPA 8260	10184404	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	10184404	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	10184404	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8260	10184404	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260	10184404	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 8260	10184404	NELAP	PA
5215 - 1,3,5-Trimethylbenzene	EPA 8260	10184404	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8260	10184404	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 8260	10184404	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8260	10184404	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260	10184404	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 8260	10184404	NELAP	PA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	10184404	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 8260	10184404	NELAP	PA
4535 - 2-Chlorotoluene	EPA 8260	10184404	NELAP	PA
4860 - 2-Hexanone	EPA 8260	10184404	NELAP	PA
4540 - 4-Chlorotoluene	EPA 8260	10184404	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 8260	10184404	NELAP	PA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA 8260	10184404	NELAP	PA
4315 - Acetone	EPA 8260	10184404	NELAP	PA
4320 - Acetonitrile	EPA 8260	10184404	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8260	10184404	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4340 - Acrylonitrile	EPA 8260	10184404	NELAP	PA
4355 - Allyl chloride (3-Chloropropene)	EPA 8260	10184404	NELAP	PA
4375 - Benzene	EPA 8260	10184404	NELAP	PA
5635 - Benzyl chloride	EPA 8260	10184404	NELAP	PA
4385 - Bromobenzene	EPA 8260	10184404	NELAP	PA
4390 - Bromochloromethane	EPA 8260	10184404	NELAP	PA
4395 - Bromodichloromethane	EPA 8260	10184404	NELAP	PA
4400 - Bromoform	EPA 8260	10184404	NELAP	PA
4450 - Carbon disulfide	EPA 8260	10184404	NELAP	PA
4455 - Carbon tetrachloride	EPA 8260	10184404	NELAP	PA
4475 - Chlorobenzene	EPA 8260	10184404	NELAP	PA
4575 - Chlorodibromomethane	EPA 8260	10184404	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 8260	10184404	NELAP	PA
4505 - Chloroform	EPA 8260	10184404	NELAP	PA
4525 - Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260	10184404	NELAP	PA
4555 - Cyclohexane	EPA 8260	10184404	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 8260	10184404	NELAP	PA
4580 - Dibromochloropropane	EPA 8260	10184404	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 8260	10184404	NELAP	PA
4625 - Dichlorodifluoromethane (Freon-12)	EPA 8260	10184404	NELAP	PA
4750 - Ethanol	EPA 8260	10184404	NELAP	PA
4755 - Ethyl acetate	EPA 8260	10184404	NELAP	PA
4810 - Ethyl methacrylate	EPA 8260	10184404	NELAP	PA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 8260	10184404	NELAP	PA
4765 - Ethylbenzene	EPA 8260	10184404	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8260	10184404	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8260	10184404	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	10184404	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8260	10184404	NELAP	PA
4900 - Isopropylbenzene	EPA 8260	10184404	NELAP	PA
4925 - Methacrylonitrile	EPA 8260	10184404	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 8260	10184404	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 8260	10184404	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8260	10184404	NELAP	PA
4965 - Methylcyclohexane	EPA 8260	10184404	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 8260	10184404	NELAP	PA
5005 - Naphthalene	EPA 8260	10184404	NELAP	PA
5035 - Pentachloroethane	EPA 8260	10184404	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 8260	10184404	NELAP	PA
5100 - Styrene	EPA 8260	10184404	NELAP	PA
4370 - T-amylmethylether (TAME)	EPA 8260	10184404	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260	10184404	NELAP	PA
5140 - Toluene	EPA 8260	10184404	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 8260	10184404	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260	10184404	NELAP	PA
5225 - Vinyl acetate	EPA 8260	10184404	NELAP	PA
5235 - Vinyl chloride	EPA 8260	10184404	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5260 - Xylene (total)	EPA 8260	10184404	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 8260	10184404	NELAP	PA
5240 - m+p-xylene	EPA 8260	10184404	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260	10184404	NELAP	PA
4435 - n-Butylbenzene	EPA 8260	10184404	NELAP	PA
5090 - n-Propylbenzene	EPA 8260	10184404	NELAP	PA
5250 - o-Xylene	EPA 8260	10184404	NELAP	PA
4440 - sec-Butylbenzene	EPA 8260	10184404	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8260	10184404	NELAP	PA
4445 - tert-Butylbenzene	EPA 8260	10184404	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 8260	10184404	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 8260	10184404	NELAP	PA
4605 - trans-1,4-Dichloro-2-butene	EPA 8260	10184404	NELAP	PA
5105 - 1,1,1,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 8260B	10184802	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	10184802	NELAP	PA
5185 - 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260B	10184802	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 8260B	10184802	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 8260B	10184802	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5180 - 1,2,3-Trichloropropane	EPA 8260B	10184802	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5210 - 1,2,4-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260B	10184802	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260B	10184802	NELAP	PA
4610 - 1,2-Dicblorobenzene	EPA 8260B	10184802	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260B	10184802	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
5215 - 1,3,5-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260B	10184802	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B	10184802	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 8260B	10184802	NELAP	PA
4535 - 2-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4860 - 2-Hexanone	EPA 8260B	10184802	NELAP	PA
4368 - 2-methyl-2-butanol (tert-Amyl alcohol)	EPA 8260B	10184802	NELAP	PA
4540 - 4-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 8260B	10184802	NELAP	PA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA 8260B	10184802	NELAP	PA
4315 - Acetone	EPA 8260B	10184802	NELAP	PA
4320 - Acetonitrile	EPA 8260B	10184802	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8260B	10184802	NELAP	PA
4340 - Acrylonitrile	EPA 8260B	10184802	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4355 - Allyl chloride (3-Chloropropene)	EPA 8260B	10184802	NELAP	PA
4375 - Benzene	EPA 8260B	10184802	NELAP	PA
5635 - Benzyl chloride	EPA 8260B	10184802	NELAP	PA
4380 - Bromoacetone	EPA 8260B	10184802	NELAP	PA
4385 - Bromobenzene	EPA 8260B	10184802	NELAP	PA
4390 - Bromochloromethane	EPA 8260B	10184802	NELAP	PA
4395 - Bromodichloromethane	EPA 8260B	10184802	NELAP	PA
4400 - Bromoform	EPA 8260B	10184802	NELAP	PA
4450 - Carbon disulfide	EPA 8260B	10184802	NELAP	PA
4455 - Carbon tetrachloride	EPA 8260B	10184802	NELAP	PA
4475 - Chlorobenzene	EPA 8260B	10184802	NELAP	PA
4575 - Chlorodibromomethane	EPA 8260B	10184802	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 8260B	10184802	NELAP	PA
4505 - Chloroform	EPA 8260B	10184802	NELAP	PA
4525 - Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260B	10184802	NELAP	PA
4555 - Cyclohexane	EPA 8260B	10184802	NELAP	PA
4560 - Cyclohexanone	EPA 8260B	10184802	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 8260B	10184802	NELAP	PA
4580 - Dibromochloropropane	EPA 8260B	10184802	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 8260B	10184802	NELAP	PA
4625 - Dichlorodifluoromethane (Freon-12)	EPA 8260B	10184802	NELAP	PA
4745 - Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 8260B	10184802	NELAP	PA
4750 - Ethanol	EPA 8260B	10184802	NELAP	PA
4755 - Ethyl acetate	EPA 8260B	10184802	NELAP	PA
4810 - Ethyl methacrylate	EPA 8260B	10184802	NELAP	PA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 8260B	10184802	NELAP	PA
4765 - Ethylbenzene	EPA 8260B	10184802	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8260B	10184802	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8260B	10184802	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 8260B	10184802	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260B	10184802	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8260B	10184802	NELAP	PA
4900 - Isopropylbenzene	EPA 8260B	10184802	NELAP	PA
4925 - Methacrylonitrile	EPA 8260B	10184802	NELAP	PA
4940 - Methyl acetate	EPA 8260B	10184802	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 8260B	10184802	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 8260B	10184802	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8260B	10184802	NELAP	PA
4965 - Methylcyclohexane	EPA 8260B	10184802	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 8260B	10184802	NELAP	PA
5005 - Naphthalene	EPA 8260B	10184802	NELAP	PA
5035 - Pentachloroethane	EPA 8260B	10184802	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 8260B	10184802	NELAP	PA
5100 - Styrene	EPA 8260B	10184802	NELAP	PA
4370 - T-amylmethylether (TAME)	EPA 8260B	10184802	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260B	10184802	NELAP	PA
5140 - Toluene	EPA 8260B	10184802	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5170 - Trichloroethene (Trichloroethylene)	EPA 8260B	10184802	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260B	10184802	NELAP	PA
5225 - Vinyl acetate	EPA 8260B	10184802	NELAP	PA
5235 - Vinyl chloride	EPA 8260B	10184802	NELAP	PA
5260 - Xylene (total)	EPA 8260B	10184802	NELAP	PA
4705 - cis & trans-1,2-Dichloroethene	EPA 8260B	10184802	NELAP	PA
4645 - cis-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5240 - m+p-xylene	EPA 8260B	10184802	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260B	10184802	NELAP	PA
4435 - n-Butylbenzene	EPA 8260B	10184802	NELAP	PA
5090 - n-Propylbenzene	EPA 8260B	10184802	NELAP	PA
5250 - o-Xylene	EPA 8260B	10184802	NELAP	PA
4440 - sec-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8260B	10184802	NELAP	PA
4445 - tert-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 8260B	10184802	NELAP	PA
4605 - trans-1,4-Dichloro-2-butene	EPA 8260B	10184802	NELAP	PA
5510 - Acetophenone	EPA 8270	10185203	NELAP	PA
5560 - Aramite	EPA 8270	10185203	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270	10185203	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270	10185203	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270	10185203	NELAP	PA
6703 - 1,1'-Biphenyl (BZ-0)	EPA 8270C	10185805	NELAP	PA
6705 - 1,2,3,4-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
6710 - 1,2,3,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270C	10185805	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6155 - 1,2-Dinitrobenzene	EPA 8270C	10185805	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270C	10185805	NELAP	PA
6800 - 1,3,5-Trichlorobenzene	EPA 8270C	10185805	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270C	10185805	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270C	10185805	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270C	10185805	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270C	10185805	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270C	10185805	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270C	10185805	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270C	10185805	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270C	10185805	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270C	10185805	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270C	10185805	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270C	10185805	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270C	10185805	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5795 - 2-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270C	10185805	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270C	10185805	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270C	10185805	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270C	10185805	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270C	10185805	NELAP	PA
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270C	10185805	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270C	10185805	NELAP	PA
6100 - 3,3'-Dimethoxybenzidine	EPA 8270C	10185805	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270C	10185805	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270C	10185805	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270C	10185805	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6365 - 4,4'-Methylenebis(2-chloroaniline)	EPA 8270C	10185805	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270C	10185805	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270C	10185805	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270C	10185805	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270C	10185805	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270C	10185805	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270C	10185805	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270C	10185805	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270C	10185805	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270C	10185805	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270C	10185805	NELAP	PA
5500 - Acenaphthene	EPA 8270C	10185805	NELAP	PA
5505 - Acenaphthylene	EPA 8270C	10185805	NELAP	PA
5510 - Acetophenone	EPA 8270C	10185805	NELAP	PA
5545 - Aniline	EPA 8270C	10185805	NELAP	PA
5555 - Anthracene	EPA 8270C	10185805	NELAP	PA
5560 - Aramite	EPA 8270C	10185805	NELAP	PA
7065 - Atrazine	EPA 8270C	10185805	NELAP	PA
5570 - Benzaldehyde	EPA 8270C	10185805	NELAP	PA
5567 - Benzenethiol	EPA 8270C	10185805	NELAP	PA
5595 - Benzidine	EPA 8270C	10185805	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C	10185805	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C	10185805	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C	10185805	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C	10185805	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C	10185805	NELAP	PA
5610 - Benzoic acid	EPA 8270C	10185805	NELAP	PA
5630 - Benzyl alcohol	EPA 8270C	10185805	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270C	10185805	NELAP	PA
7180 - Caprolactam	EPA 8270C	10185805	NELAP	PA
5680 - Carbazole	EPA 8270C	10185805	NELAP	PA
7260 - Chlorobenzilate	EPA 8270C	10185805	NELAP	PA
5855 - Chrysene	EPA 8270C	10185805	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270C	10185805	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270C	10185805	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270C	10185805	NELAP	PA
7405 - Diallate	EPA 8270C	10185805	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9354 - Dibenz(a, h) acridine	EPA 8270C	10185805	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270C	10185805	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C	10185805	NELAP	PA
5905 - Dibenzofuran	EPA 8270C	10185805	NELAP	PA
6070 - Diethyl phthalate	EPA 8270C	10185805	NELAP	PA
7475 - Dimethoate	EPA 8270C	10185805	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270C	10185805	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270C	10185805	NELAP	PA
6205 - Diphenylamine	EPA 8270C	10185805	NELAP	PA
8625 - Disulfoton	EPA 8270C	10185805	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7580 - Famphur	EPA 8270C	10185805	NELAP	PA
6265 - Fluoranthene	EPA 8270C	10185805	NELAP	PA
6270 - Fluorene	EPA 8270C	10185805	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270C	10185805	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270C	10185805	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270C	10185805	NELAP	PA
4840 - Hexachloroethane	EPA 8270C	10185805	NELAP	PA
6295 - Hexachloropropene	EPA 8270C	10185805	NELAP	PA
6312 - Indene	EPA 8270C	10185805	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C	10185805	NELAP	PA
7725 - Isodrin	EPA 8270C	10185805	NELAP	PA
6320 - Isophorone	EPA 8270C	10185805	NELAP	PA
6325 - Isosafrole	EPA 8270C	10185805	NELAP	PA
7740 - Kepone	EPA 8270C	10185805	NELAP	PA
6345 - Methapyrilene	EPA 8270C	10185805	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270C	10185805	NELAP	PA
5005 - Naphthalene	EPA 8270C	10185805	NELAP	PA
5015 - Nitrobenzene	EPA 8270C	10185805	NELAP	PA
7955 - Parathion, ethyl	EPA 8270C	10185805	NELAP	PA
6590 - Pentachlorobenzene	EPA 8270C	10185805	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270C	10185805	NELAP	PA
6605 - Pentachlorophenol	EPA 8270C	10185805	NELAP	PA
6610 - Phenacetin	EPA 8270C	10185805	NELAP	PA
6615 - Phenanthrene	EPA 8270C	10185805	NELAP	PA
6625 - Phenol	EPA 8270C	10185805	NELAP	PA
7985 - Phorate	EPA 8270C	10185805	NELAP	PA
6640 - Phthalic anhydride	EPA 8270C	10185805	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270C	10185805	NELAP	PA
6665 - Pyrene	EPA 8270C	10185805	NELAP	PA
5095 - Pyridine	EPA 8270C	10185805	NELAP	PA
6670 - Quinoline	EPA 8270C	10185805	NELAP	PA
6685 - Safrole	EPA 8270C	10185805	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270C	10185805	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270C	10185805	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270C	10185805	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270C	10185805	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270C	10185805	NELAP	PA
6245 - bis(2-Ethoxyethyl) phthalate	EPA 8270C	10185805	NELAP	PA
6062 - bis(2-Ethylhexyl)adipate	EPA 8270C	10185805	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270C	10185805	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270C	10185805	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270C	10185805	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270C	10185805	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6535 - n-Nitrosodiphenylamine	EPA 8270C	10185805	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270C	10185805	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270C	10185805	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270C	10185805	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270C	10185805	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270C	10185805	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270C	10185805	NELAP	PA
6703 - 1,1'-Biphenyl (BZ-0)	EPA 8270D	10186002	NELAP	PA
6705 - 1,2,3,4-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
6710 - 1,2,3,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270D	10186002	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6155 - 1,2-Dinitrobenzene	EPA 8270D	10186002	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270D	10186002	NELAP	PA
6800 - 1,3,5-Trichlorobenzene	EPA 8270D	10186002	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	10186002	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	10186002	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270D	10186002	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270D	10186002	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270D	10186002	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270D	10186002	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270D	10186002	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270D	10186002	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270D	10186002	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D	10186002	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D	10186002	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270D	10186002	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270D	10186002	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270D	10186002	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270D	10186002	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270D	10186002	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270D	10186002	NELAP	PA
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270D	10186002	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270D	10186002	NELAP	PA
6100 - 3,3'-Dimethoxybenzidine	EPA 8270D	10186002	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270D	10186002	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270D	10186002	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270D	10186002	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6365 - 4,4'-Methylenebis(2-chloroaniline)	EPA 8270D	10186002	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5540 - 4-Aminobiphenyl	EPA 8270D	10186002	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270D	10186002	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270D	10186002	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270D	10186002	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270D	10186002	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270D	10186002	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270D	10186002	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270D	10186002	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270D	10186002	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270D	10186002	NELAP	PA
5500 - Acenaphthene	EPA 8270D	10186002	NELAP	PA
5505 - Acenaphthylene	EPA 8270D	10186002	NELAP	PA
5510 - Acetophenone	EPA 8270D	10186002	NELAP	PA
5545 - Aniline	EPA 8270D	10186002	NELAP	PA
5555 - Anthracene	EPA 8270D	10186002	NELAP	PA
5560 - Aramite	EPA 8270D	10186002	NELAP	PA
7065 - Atrazine	EPA 8270D	10186002	NELAP	PA
5567 - Benzenethiol	EPA 8270D	10186002	NELAP	PA
5595 - Benzidine	EPA 8270D	10186002	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D	10186002	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D	10186002	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D	10186002	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D	10186002	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D	10186002	NELAP	PA
5610 - Benzoic acid	EPA 8270D	10186002	NELAP	PA
5630 - Benzyl alcohol	EPA 8270D	10186002	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270D	10186002	NELAP	PA
7180 - Caprolactam	EPA 8270D	10186002	NELAP	PA
5680 - Carbazole	EPA 8270D	10186002	NELAP	PA
7260 - Chlorobenzilate	EPA 8270D	10186002	NELAP	PA
5855 - Chrysene	EPA 8270D	10186002	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270D	10186002	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270D	10186002	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270D	10186002	NELAP	PA
7405 - Diallate	EPA 8270D	10186002	NELAP	PA
9354 - Dibenz(a, h) acridine	EPA 8270D	10186002	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270D	10186002	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D	10186002	NELAP	PA
5905 - Dibenzofuran	EPA 8270D	10186002	NELAP	PA
6070 - Diethyl phthalate	EPA 8270D	10186002	NELAP	PA
7475 - Dimethoate	EPA 8270D	10186002	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270D	10186002	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D	10186002	NELAP	PA
6205 - Diphenylamine	EPA 8270D	10186002	NELAP	PA
8625 - Disulfoton	EPA 8270D	10186002	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7580 - Famphur	EPA 8270D	10186002	NELAP	PA
6265 - Fluoranthene	EPA 8270D	10186002	NELAP	PA
6270 - Fluorene	EPA 8270D	10186002	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270D	10186002	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270D	10186002	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270D	10186002	NELAP	PA
4840 - Hexachloroethane	EPA 8270D	10186002	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6295 - Hexachloropropene	EPA 8270D	10186002	NELAP	PA
6312 - Indene	EPA 8270D	10186002	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D	10186002	NELAP	PA
6320 - Isophorone	EPA 8270D	10186002	NELAP	PA
6325 - Isosafrole	EPA 8270D	10186002	NELAP	PA
6345 - Methapyrilene	EPA 8270D	10186002	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270D	10186002	NELAP	PA
5005 - Naphthalene	EPA 8270D	10186002	NELAP	PA
5015 - Nitrobenzene	EPA 8270D	10186002	NELAP	PA
7955 - Parathion, ethyl	EPA 8270D	10186002	NELAP	PA
6590 - Pentachlorobenzene	EPA 8270D	10186002	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270D	10186002	NELAP	PA
6605 - Pentachlorophenol	EPA 8270D	10186002	NELAP	PA
6610 - Phenacetin	EPA 8270D	10186002	NELAP	PA
6615 - Phenanthrene	EPA 8270D	10186002	NELAP	PA
6625 - Phenol	EPA 8270D	10186002	NELAP	PA
7985 - Phorate	EPA 8270D	10186002	NELAP	PA
6640 - Phthalic anhydride	EPA 8270D	10186002	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270D	10186002	NELAP	PA
6665 - Pyrene	EPA 8270D	10186002	NELAP	PA
5095 - Pyridine	EPA 8270D	10186002	NELAP	PA
6670 - Quinoline	EPA 8270D	10186002	NELAP	PA
6685 - Safrole	EPA 8270D	10186002	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270D	10186002	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270D	10186002	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270D	10186002	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270D	10186002	NELAP	PA
5780 - his(2-Chloroisopropyl) ether	EPA 8270D	10186002	NELAP	PA
6062 - bis(2-Ethylhexyl)adipate	EPA 8270D	10186002	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270D	10186002	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270D	10186002	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270D	10186002	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270D	10186002	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270D	10186002	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270D	10186002	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270D	10186002	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270D	10186002	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270D	10186002	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270D	10186002	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270D	10186002	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	10187209	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	10187209	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	10187209	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	10187209	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	10187209	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290	10187209	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290	10187209	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290	10187209	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290	10187209	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290	10187209	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290	10187209	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290	10187209	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290	10187209	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290	10187209	NELAP	PA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290	10187209	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290	10187209	NELAP	PA
9438 - Total Hpcdd	EPA 8290	10187209	NELAP	PA
9444 - Total Hpcdf	EPA 8290	10187209	NELAP	PA
9468 - Total Hxcdd	EPA 8290	10187209	NELAP	PA
9483 - Total Hxcdf	EPA 8290	10187209	NELAP	PA
9555 - Total Pecdd	EPA 8290	10187209	NELAP	PA
9552 - Total Pecdf	EPA 8290	10187209	NELAP	PA
9609 - Total TCDD	EPA 8290	10187209	NELAP	PA
9615 - Total TCDF	EPA 8290	10187209	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A	10187403	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A	10187403	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290A	10187403	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A	10187403	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A	10187403	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A	10187403	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A	10187403	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290A	10187403	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9438 - Total Hpcdd	EPA 8290A	10187403	NELAP	PA
9444 - Total Hpcdf	EPA 8290A	10187403	NELAP	PA
9468 - Total Hxcdd	EPA 8290A	10187403	NELAP	PA
9483 - Total Hxcdf	EPA 8290A	10187403	NELAP	PA
9555 - Total Pecdd	EPA 8290A	10187403	NELAP	PA
9552 - Total Pecdf	EPA 8290A	10187403	NELAP	PA
9609 - Total TCDD	EPA 8290A	10187403	NELAP	PA
9615 - Total TCDF	EPA 8290A	10187403	NELAP	PA
5500 - Acenaphthene	EPA 8310	10187607	NELAP	PA
5505 - Acenaphthylene	EPA 8310	10187607	NELAP	PA
5555 - Anthracene	EPA 8310	10187607	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8310	10187607	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8310	10187607	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8310	10187607	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8310	10187607	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8310	10187607	NELAP	PA
5855 - Chrysene	EPA 8310	10187607	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8310	10187607	NELAP	PA
6265 - Fluoranthene	EPA 8310	10187607	NELAP	PA
6270 - Fluorene	EPA 8310	10187607	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8310	10187607	NELAP	PA
5005 - Naphthalene	EPA 8310	10187607	NELAP	PA
6615 - Phenanthrene	EPA 8310	10187607	NELAP	PA
6665 - Pyrene	EPA 8310	10187607	NELAP	PA
6110 - 2,5-Dimethylbenzaldehyde	EPA 8315	10187801	NELAP	PA
4300 - Acetaldehyde	EPA 8315	10187801	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8315	10187801	NELAP	PA
5570 - Benzaldehyde	EPA 8315	10187801	NELAP	PA
4430 - Butylaldehyde (Butanal)	EPA 8315	10187801	NELAP	PA
4545 - Crotonaldehyde	EPA 8315	10187801	NELAP	PA
4815 - Formaldehyde	EPA 8315	10187801	NELAP	PA
3825 - Hexanaldehyde (Hexanal)	EPA 8315	10187801	NELAP	PA
6330 - Isovaleraldehyde	EPA 8315	10187801	NELAP	PA
3965 - Propionaldehyde (Propanal)	EPA 8315	10187801	NELAP	PA
6755 - Tolualdehyde (1,2-Tolualdehyde)	EPA 8315	10187801	NELAP	PA
5125 - m-Tolualdehyde (1,3-Tolualdehyde)	EPA 8315	10187801	NELAP	PA
6760 - p-Tolualdehyde (1,4-Tolualdehyde)	EPA 8315	10187801	NELAP	PA
7710 - 3-Hydroxycarbofuran	EPA 8318	10188406	NELAP	PA
7010 - Aldicarb (Temik)	EPA 8318	10188406	NELAP	PA
7015 - Aldicarb sulfone	EPA 8318	10188406	NELAP	PA
7195 - Carbaryl (Sevin)	EPA 8318	10188406	NELAP	PA
7205 - Carbofuran (Furaden)	EPA 8318	10188406	NELAP	PA
7800 - Methiocarb (Mesurol)	EPA 8318	10188406	NELAP	PA
7805 - Methomyl (Lannate)	EPA 8318	10188406	NELAP	PA
8080 - Propoxur (Baygon)	EPA 8318	10188406	NELAP	PA
7710 - 3-Hydroxycarbofuran	EPA 8318A	10188600	NELAP	PA
7010 - Aldicarb (Temik)	EPA 8318A	10188600	NELAP	PA
7015 - Aldicarb sulfone	EPA 8318A	10188600	NELAP	PA
7195 - Carbaryl (Sevin)	EPA 8318A	10188600	NELAP	PA
7205 - Carbofuran (Furaden)	EPA 8318A	10188600	NELAP	PA
7800 - Methiocarb (Mesurol)	EPA 8318A	10188600	NELAP	PA
7805 - Methomyl (Lannate)	EPA 8318A	10188600	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
8080 - Propoxur (Baygon)	EPA 8318A	10188600	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	10189807	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	10189807	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	10189807	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	10189807	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	10189807	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	10189807	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	10189807	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330	10189807	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330	10189807	NELAP	PA
5015 - Nitrobenzene	EPA 8330	10189807	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	10189807	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330	10189807	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	10189807	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330A	10190008	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330A	10190008	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330A	10190008	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330A	10190008	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330A	10190008	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330A	10190008	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330A	10190008	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330A	10190008	NELAP	PA
5015 - Nitrobenzene	EPA 8330A	10190008	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A	10190008	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330A	10190008	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A	10190008	NELAP	PA
1645 - Total Cyanide	EPA 9012A	10193405	NELAP	PA
1615 - Corrosivity	EPA 9045C	10198400	NELAP	PA
1900 - pH	EPA 9045C	10198400	NELAP	PA
1610 - Conductivity	EPA 9050	10198604	NELAP	PA
1610 - Conductivity	EPA 9050A	10198808	NELAP	PA
1905 - Total Phenolics	EPA 9066	10200609	NELAP	PA
1860 - Oil & Grease	EPA 9071B	10201602	NELAP	PA
1560 - Cation exchange capacity	EPA 9081	10203404	NELAP	PA
1780 - Ignitability	EPA 1010A	10234807	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C SIM	10242407	NELAP	PA
5500 - Acenaphthene	EPA 8270C SIM	10242407	NELAP	PA
5505 - Acenaphthylene	EPA 8270C SIM	10242407	NELAP	PA
5555 - Anthracene	EPA 8270C SIM	10242407	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C SIM	10242407	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C SIM	10242407	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5585 - Benzo(b)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C SIM	10242407	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5855 - Chrysene	EPA 8270C SIM	10242407	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C SIM	10242407	NELAP	PA
6265 - Fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
6270 - Fluorene	EPA 8270C SIM	10242407	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C SIM	10242407	NELAP	PA
5005 - Naphthalene	EPA 8270C SIM	10242407	NELAP	PA
6615 - Phenanthrene	EPA 8270C SIM	10242407	NELAP	PA
6665 - Pyrene	EPA 8270C SIM	10242407	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D SIM	10242509	NELAP	PA
5500 - Acenaphthene	EPA 8270D SIM	10242509	NELAP	PA
5505 - Acenaphthylene	EPA 8270D SIM	10242509	NELAP	PA
5555 - Anthracene	EPA 8270D SIM	10242509	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D SIM	10242509	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D SIM	10242509	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D SIM	10242509	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5855 - Chrysene	EPA 8270D SIM	10242509	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D SIM	10242509	NELAP	PA
6265 - Fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
6270 - Fluorene	EPA 8270D SIM	10242509	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D SIM	10242509	NELAP	PA
5005 - Naphthalene	EPA 8270D SIM	10242509	NELAP	PA
6615 - Phenanthrene	EPA 8270D SIM	10242509	NELAP	PA
6665 - Pyrene	EPA 8270D SIM	10242509	NELAP	PA
1900 - pH	EPA 9040C	10244403	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 8260C	10307003	NELAP	PA
9369 - Diesel range organics (DRO)	TNRCC 1005, Rev.3	90019208	NELAP	PA

Biological Tissue

Analyte	Method Name	Method Code	Type	AB
1000 - Aluminum	EPA 6010	10155201	NELAP	LA
1005 - Antimony	EPA 6010	10155201	NELAP	LA
1010 - Arsenic	EPA 6010	10155201	NELAP	LA
1015 - Barium	EPA 6010	10155201	NELAP	LA
1020 - Beryllium	EPA 6010	10155201	NELAP	LA
1025 - Boron	EPA 6010	10155201	NELAP	LA
1030 - Cadmium	EPA 6010	10155201	NELAP	LA
1035 - Calcium	EPA 6010	10155201	NELAP	LA
1040 - Chromium	EPA 6010	10155201	NELAP	LA
1050 - Cobalt	EPA 6010	10155201	NELAP	LA
1055 - Copper	EPA 6010	10155201	NELAP	LA
1070 - Iron	EPA 6010	10155201	NELAP	LA
1075 - Lead	EPA 6010	10155201	NELAP	LA
1085 - Magnesium	EPA 6010	10155201	NELAP	LA
1090 - Manganese	EPA 6010	10155201	NELAP	LA
1100 - Molybdenum	EPA 6010	10155201	NELAP	LA
1105 - Nickel	EPA 6010	10155201	NELAP	LA
1125 - Potassium	EPA 6010	10155201	NELAP	LA
1140 - Selenium	EPA 6010	10155201	NELAP	LA
1150 - Silver	EPA 6010	10155201	NELAP	LA

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Biological Tissue

Analyte	Method Name	Method Code	Type	AB
1155 - Sodium	EPA 6010	10155201	NELAP	LA
1160 - Strontium	EPA 6010	10155201	NELAP	LA
1165 - Thallium	EPA 6010	10155201	NELAP	LA
1175 - Tin	EPA 6010	10155201	NELAP	LA
1180 - Titanium	EPA 6010	10155201	NELAP	LA
1185 - Vanadium	EPA 6010	10155201	NELAP	LA
1190 - Zinc	EPA 6010	10155201	NELAP	LA
1005 - Antimony	EPA 6020	10156000	NELAP	LA
1010 - Arsenic	EPA 6020	10156000	NELAP	LA
1020 - Beryllium	EPA 6020	10156000	NELAP	LA
1030 - Cadmium	EPA 6020	10156000	NELAP	LA
1040 - Chromium	EPA 6020	10156000	NELAP	LA
1055 - Copper	EPA 6020	10156000	NELAP	LA
1075 - Lead	EPA 6020	10156000	NELAP	LA
1105 - Nickel	EPA 6020	10156000	NELAP	LA
1140 - Selenium	EPA 6020	10156000	NELAP	LA
1165 - Thallium	EPA 6020	10156000	NELAP	LA
1095 - Mercury	EPA 7471	10166004	NELAP	LA
7355 - 4,4'-DDD	EPA 8081	10178402	NELAP	LA
7360 - 4,4'-DDE	EPA 8081	10178402	NELAP	LA
7365 - 4,4'-DDT	EPA 8081	10178402	NELAP	LA
7025 - Aldrin	EPA 8081	10178402	NELAP	LA
7250 - Chlordane (tech.)	EPA 8081	10178402	NELAP	LA
7470 - Dieldrin	EPA 8081	10178402	NELAP	LA
7685 - Heptachlor	EPA 8081	10178402	NELAP	LA
7690 - Heptachlor epoxide	EPA 8081	10178402	NELAP	LA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081	10178402	NELAP	LA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	10178402	NELAP	LA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	10178402	NELAP	LA
7105 - delta-BHC	EPA 8081	10178402	NELAP	LA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081	10178402	NELAP	LA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082	10179007	NELAP	LA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082	10179007	NELAP	LA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082	10179007	NELAP	LA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082	10179007	NELAP	LA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082	10179007	NELAP	LA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082	10179007	NELAP	LA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082	10179007	NELAP	LA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270	10185203	NELAP	LA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270	10185203	NELAP	LA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270	10185203	NELAP	LA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270	10185203	NELAP	LA
5855 - Chrysene	EPA 8270	10185203	NELAP	LA
6275 - Hexachlorobenzene	EPA 8270	10185203	NELAP	LA
4835 - Hexachlorobutadiene	EPA 8270	10185203	NELAP	LA
6285 - Hexachlorocyclopentadiene	EPA 8270	10185203	NELAP	LA
4840 - Hexachloroethane	EPA 8270	10185203	NELAP	LA
6290 - Hexachlorophene	EPA 8270	10185203	NELAP	LA
6590 - Pentachlorobenzene	EPA 8270	10185203	NELAP	LA
6605 - Pentachlorophenol	EPA 8270	10185203	NELAP	LA
5095 - Pyridine	EPA 8270	10185203	NELAP	LA
5025 - n-Nitroso-di-n-butylamine	EPA 8270	10185203	NELAP	LA
6525 - n-Nitrosodiethylamine	EPA 8270	10185203	NELAP	LA

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Details on method quality control (QC) processes are provided in the individual Analytical Procedures. QC limits are maintained in the LIMS. This appendix provides an overview for representative methodology.
NOTE: This appendix is not applicable to OH VAP work. See the OH VAP approved SOPs for QC information.

SW - 846 Quality Control GC/MS Volatiles Method 8260		
Type	**Frequency**	**Corrective Action**
Surrogates: Toluene-d_8 Bromofluorobenzene 1,2-Dichloroethane-d_4 Dibromofluoromethane	Each sample, MS, MSD, LCS, and blank	Reanalyze sample if outside limits; if reanalysis confirms original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Samples: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze LCS and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Matrix Spike Duplicates (RPD): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (iSTD): Fluorobenzene Chlorobenzene-d_5 1,4-Dichlorobenzene-d_4	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

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SW - 846 Quality Control GC/MS Semivolatiles Method 8270		
Type	**Frequency**	**Corrective Action**
Surrogate: Nitrobenzene-d_5 2-Fluorobiphenyl Terphenyl-d_{14} Phenol-d_6 2-Fluorophenol 2,4,6-Tribromophenol	Each sample, MS, MSD, LCS, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Matrix Spike Duplicates (RPD): Same as for matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Re-extract and reanalyze blank and associated samples
Internal Standards (ISTD): 1,4-Dichlorobenzene-d_4 Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

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SW - 846 Quality Control GC/MS Semivolatiles Method 8270 SIM		
Type	**Frequency**	**Corrective Action**
Surrogate: **1-Methylnaphthalene-d10** **Fluoranthene-d10** **Benzo(a)pyrene-d12**	Each sample, MS, MSD, LCS, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Matrix Spike Duplicates (RPD): Same as for matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Re-extract and reanalyze blank and associated samples
Internal Standards (ISTD): 1,4-Dichlorobenzene-d_4 Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

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SW - 846 Quality Control Dioxins/Furans Method 8290		
Type	**Frequency**	**Corrective Action**
Labeled Compounds: 13C Labeled Isotope of each of 17 Toxic PCDD/PCDF	Each sample, OPR, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Ongoing Precision and Recovery Standard (OPR): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze OPR and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the OPR and are ND in the samples, can be reported.
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): 13C12-1234-TCDD 13C12-123468-HxCDD	Each sample, OPR, and blank	RT ± 15 secs of retention time in initial calibration.

Quality Control Dioxins/Furans Method 1613B		
Type	**Frequency**	**Corrective Action**
Labeled Compounds: 13C Labeled Isotope of each of 17 Toxic PCDD/PCDF	Each sample, OPR, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Ongoing Precision and Recovery Standard (OPR): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze OPR and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the OPR and are ND in the samples, can be reported.
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): 13C12-1234-TCDD 13C12-123468-HxCDD	Each sample, OPR, and blank	RT ± 15 secs of retention time in initial calibration.

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Quality Control Congeners Method 1668		
Type	**Frequency**	**Corrective Action**
Labeled Compounds: 13C Labeled Isotope of each of 18 Toxic PCBs	Each sample, OPR, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Ongoing Precision and Recovery Standard (OPR): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze OPR and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the OPR and are ND in the samples, can be reported.
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): 13C12-PCB70 13C12-PCB111 13C12-PCB141 13C12-PCB170	Each sample, OPR, and blank	RT ± 15 secs of retention time in initial calibration.

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SW-846 Quality Control Pesticides/PCBs Methods 8081; 8082; 8141; 8151		
Type	**Frequency**	**Corrective Action**
Surrogate: Organochlorine Pesticides & PCBs Decachlorobiphenyl (DCB) Tetrachloro-*m*-xylene (TCMX) Herbicides: Dichloroacetic acid (DCAA) Organophosphorous Pesticides: 2-nitro-*m*-xylene (2NMX)	Added to each sample, MS/MSD, blank, LCS/LCSD during the extraction phase	Repeat extraction and analysis. If reanalysis confirms original result, report results and comment in case narrative
Matrix Spikes: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene Herbicides & Organophosphorous Pesticides: all compounds of interest PCBs: Aroclor 1016 & Aroclor 1260	Each extraction group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene Herbicides & Organophosphorous Pesticides: all compounds of interest PCBs: Aroclor 1016 & Aroclor 1260	Each group (≤20) when MS/MSD falls outside established limits	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.

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SW-846 Quality Control Pesticides/PCBs Methods 8081; 8082; 8141; 8151 (continued)		
Type	**Frequency**	**Corrective Action**
Matrix Spike Duplicates (RPD): Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene Herbicides & Organophosphorous Pesticides: all compounds of interest PCBs: Aroclor 1016 & Aroclor 1260	Each extraction group (≤20) of samples per matrix/level	Evaluated in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Inject a hexane or solvent blank first to be sure the analytical system is clean then reinject the blank itself. If the reinjected blank is acceptable, any samples extracted with this blank should be reinjected if they, too, contain the analyte which was contaminating the blank. If the reinjected blank is unacceptable, any affected samples must be reextracted.
Internal Standards (ISTD): Herbicides: 4,4'-dibromo octafluorobiphenyl (DBOB)	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

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SW-846 Quality Control Volatiles by GC 8021		
Type	**Frequency**	**Corrective Action**
Surrogates: Aromatics; 1-Bromo-4-chlorobenzene (PID)	Each sample, MS, MSD, LCS and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident.
Matrix Spikes: Spike all compounds of interest	Each group of samples (≤20) of similar matrix/level each method	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20); LCSD is analyzed if sufficient volume is not available for MS/MSD	Reanalyze LCS and associated samples for compounds outside of acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.
Internal Standard (ISTD): Aromatics; 1-chloro-3-fluorobenzene	Each sample, LCS , MS, MSD, blank, and standard	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative. In cases where the sample matrix is elevating the ISTD recovery, a dilution and reanalysis may be performed.
Matrix Spike Duplicate (RPD): Same compounds as matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	At least once per batch (≤20 samples) and once per 24 hours	Reanalyze blank and associated samples if blank is outside limits

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SW-846 Quality Control Petroleum Analysis		
Type	**Frequency**	**Corrective Action**
Surrogate: α,α,α-Trifluorotoluene (PID)	Each sample, MS, MSD, LCS, and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident.
Matrix Spike: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level. LCSD analyzed if sufficient volume is not available for MS/MSD	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD):	Each group (≤20) of samples per matrix/level	Evaluated by an analyst in relationship to other QC results
Blanks:	At least once per batch (≤20 samples) and once per 24 hours	Reanalyze blank and associated samples if blank is outside limits
Internal Standards (ISTD): 1-Chloro-3-fluorobenzene (PID)	Each sample, MS, MSD, LCS, and blank analyzed on the PID	Reanalyze samples; if reanalysis confirms original result, document on report or case narrative. In cases where the sample matrix is elevating the ISTD recovery, a dilution and reanalysis may be performed.

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SW-846 Quality Control TPH-DRO 8015B		
Type	**Frequency**	**Corrective Action**
Surrogate: *o*-Terphenyl	Added to each sample, MS/MSD, blank, LCS/LCSD during the extraction phase	Repeat extraction and analysis. If reanalysis confirms original result. report results and comment in case narrative.
Matrix Spike: # 2 Fuel	Each group (≤20) of samples per matrix/level	Reinject if surrogates appear low. If still out of spec, evaluate for matrix effect. If matrix effect, accept based on LCS data. If no matrix effect, repeat batch.
Laboratory Control Sample: # 2 Fuel	Each group (≤20) of samples per matrix/level	Reinject if surrogates appear low. If still out of spec, reextract batch. LCS that fails high and DRO is ND in the samples can be reported.
Laboratory Control Duplicates (RPD): # 2 Fuel	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Inject a solvent blank first to be sure the analytical system is clean then reinject the blank itself. If the reinjected blank is acceptable, any samples extracted with this blank should be reinjected, if they, too, contain the analyte which was contaminating the blank. If the reinjected blank is unacceptable, any affected samples must be re-extracted.

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SW-846 Quality Control TPH-GRO 8015B		
Type	**Frequency**	**Corrective Action**
Surrogate: Trifluorotoluene (FID)	Each sample, MS/MSD, LCS, and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident
Matrix Spike: Gasoline standard	Each group of samples of similar matrix/level (≤20) each method	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample Gasoline standard	Each group (≤20) of samples. LCSD analyzed if sufficient volume is not available for MS/MSD.	Reanalyze LCS and associated samples. LCS that fails high and GRO is ND in the samples can be reported.
Matrix Spike Duplicate (RPD): Same compounds as matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	At least one per 20 samples and at least once per 24 hours.	Reanalyze blank and associated samples if blank is outside limits

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SW-846 Quality Control* Inorganics (Metals)		
Type	**Frequency**	**Corrective Action**
Internal Standard (ICP & ICP/MS only):	Each sample, standard and QC (Unspiked, Dup., MS, MSD, LCS, dilution, post digestion spike and blank)	If the internal standard response falls outside the specified range, then the samples would be reanalyzed.
Matrix Spikes:	Each group of samples of similar matrix/level (≤20) each method	Analyze post-digestion spike sample
Matrix Spike Duplicate (RPD):	Each group of samples of similar matrix/level (20) each method	Analyze post-digestion spike sample if not already run for MS, flag the data
Duplicates (RPD):	Each group of samples of similar matrix/level (≤20) each method	Flag the data

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SW-846 Quality Control* Inorganics (Metals)		
Type	**Frequency**	**Corrective Action**
Blanks: Initial Calibration (ICB) Continuing Calibration (CCB)	Each element immediately after calibration verification at 10% frequency or every 2 hours (beginning and end of run min.)	Correct problem, recalibrate, and rerun
Preparation Blank	Each SDG or batch (≤20 samples)	Redigest and reanalyze blank and associated samples if sample result is greater than the LOQ and <20× blank result
Serial Dilutions (ICP, ICP/MS only):	Each group of (≤20) of similar matrix/level	Flag the data
Interference Check Sample (ICP, ICP/MS only):	Each element after Initial Calibration Verification at beginning and end of the run or min. of 2× per 8 hour	Correct for interference, recalibrate the instrument
Laboratory Control Sample:	Each SDG or batch (≤20 samples), each method	Redigest and reanalyze LCS and associated samples. Elements in the LCS that fail high and are ND in the samples can be reported.
Post Digestion Spike:	When matrix spikes are outside 75 % - 125% range, or the statistical window (whichever is tighter).	Flag the data

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QC Table for SW-846 Miscellaneous Water Tests			
Test	**QC Type**	**Frequency**	**Corrective Action**
Sulfide	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze. LCSs that fail high (and associated samples are ND) can be reported.
	Duplicate	Each group of samples of similar matrix (≤20)	Ensure that LCS meets acceptance criteria.
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤20)	Ensure that LCS meets acceptance criteria.
	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.

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Bromide (IC) **Chloride (IC)** **Cyanide (total)** **Fluoride (IC)** **Nitrate/Nitrite (IC)** **Sulfate (IC)**	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze. LCSs that fail high (and associated samples are ND) can be reported.
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
	Matrix Spike	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
Phenols **TOC Quad**	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze. LCSs that fail high (and associated samples are ND) can be reported.
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
pH **Moisture**	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Re-analyze samples.
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
Microbiology	Organism control	Each lot of media (minimum of one per month)	Investigate cause
	Negative control	Each lot of media (minimum of one per month)	Investigate cause

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Drinking Water Quality Control Inorganics (Metals)		
Type	**Frequency**	**Corrective Action**
Internal Standard (ICP & ICP/MS only):	Each sample, standard and QC (Unspiked, Dup., MS, LFB, Post Digestion Spike, dilution and blank)	If the internal standard response falls outside the specified range, then the samples would be reanalyzed.
Matrix Spikes:	Each group of samples of similar matrix/level (≤10) each method	Analyze post-digestion spike sample
Duplicates (RPD):	Each group of samples of similar matrix/level (≤10) each method	Flag the data
Blanks: Initial Calibration (ICB) Continuing Calibration (CCB)	Each wavelength immediately after calibration verification at 10% frequency	Correct problem, recalibrate, and rerun
Preparation Blank	Each batch (≤10 samples)	Redigest and reanalyze blank and associated samples if sample result <10 times blank result or >LOQ
Laboratory Fortified Blank (LFB):	Each batch (≤10 samples)	Redigest and reanalyze LFB and associated samples. Elements that fail high in the LFB and are ND in the samples can be reported.
Post Digestion Spike:	When matrix spikes are outside range	Flag the data

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Drinking Water EPA Method 525.2 Quality Control		
Type	**Frequency**	**Corrective Action**
Lab Reagent Blank (LRB):	One per extraction batch of (≤20) samples	Re-extract and reanalyze blank and associated samples
Lab Fortified Blank (LFB): Spike all compounds of interest	One per extraction batch of (≤20) samples	Re-extract and reanalyze LFB and associated samples for compounds outside acceptance limits. Compounds that fail high in the LFB and are ND in the samples can be reported.
Matrix Spike/Matrix Spike Duplicate (MS/MSD): Spike all compounds of interest	One per extraction batch of (≤20) samples	Recoveries for LFB must be within criteria. If there is insufficient sample for MSD, then a duplicate (extraction and analysis) of another sample in the batch must be performed.
Surrogates: 1,3-Dimethyl-2-nitrobenzene Perylene-d_{12} Triphenylphosphate	Each sample, LFB, MS, MSD, and blank	Re-extract and reanalyze the sample
Internal Standards (ISTD): Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12}	Each sample, LFB, MS, MSD, and blank	Reanalyze samples

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QC Table for Miscellaneous Water Tests			
Test	**QC Type**	**Frequency**	**Corrective Action**
Alkalinity Ammonia (ISE) Ammonia (Distill) Dissolved Solids Fluoride (ISE) Hardness Sulfate (TURB) Sulfide Total Solids Turbidity	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Fortified Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.*
	Duplicate	Each group of samples of similar matrix (≤20) Alkalinity, Dissolved Solids, Total Solids, Turbidity each group of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤20) (not for Turbidity)	Ensure that LFB meets acceptance criteria.
Bromide (IC) Chloride (IC) Cyanide (total & free) Fluoride (IC) Nitrogen (TKN) Nitrate/Nitrite Sulfate (IC) Total Phosphorus TOC	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Fortified Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.*
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
	Matrix Spike	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
Phenols	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Fortified Blank/Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.*
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
pH Moisture	Laboratory Fortified Blank	Each group of samples of similar matrix (≤20)	Re-analyze samples.
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
Microbiology	Organism control (+)	Each lot of media (minimum of one per month)	Investigate cause
	Negative control (-)	Each lot of media (minimum of one per month)	Investigate cause

*LFBs that fail high and associated samples are ND can be reported.

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QC Table for Drinking Water Methods: 507, 508, 515.1, 531.1		
Type of QC	**Frequency**	**Corrective Action**
Blank	Each batch of (≤20) samples	Inject a solvent blank to check for analytical system contamination. Re-inject the blank. If the re-injected blank is acceptable then any samples with positive results must be re-injected. If the re-injected blank is unacceptable, all associated samples must be re-extracted.
Surrogate 507 – 2-NMX 508 – DCB 515 – DCAA 531 – BDMC	Added to each field and QC sample during the extraction.	Recovery must be within specifications unless matrix-related problems are evident, in which case report results and comment.
Matrix Spike/Matrix Spike Duplicate Spike all compounds of interest, except multipeak compounds	Each batch (≤20) of samples if sample volume is available.	Evaluate in conjunction with the LFB.
Laboratory Fortified Blank (LFB) Spike all compounds of interest, rotate multipeak compounds	Each batch of (≤20) samples. LCSD may be used if insufficient sample for MS/MSD is submitted.	If LFB compounds are outside of acceptance limits, re-extract and re-analyze the batch. Compounds that fail high in the LFB and are ND in the samples can be reported.

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QC Table for Drinking Water Method: 524.2		
Type of QC	**Frequency**	**Corrective Action**
Blank	One blank for each 12-hour period or batch of ≤20 samples	Reanalyze blank and associated samples if blank is unacceptable.
Surrogate 4-Bromofluorobenzene 1,2-Dichlorobenzene-d_4	Added to each field and QC sample prior to analysis	Reanalyze sample if outside limits. If reanalysis confirms original, document on report.
Matrix Spike/Matrix Spike Duplicate Spike all compounds of interest	At client request.	Evaluate in conjunction with the LFB.
Laboratory Fortified Blank (LFB) Spike all compounds of interest	One LFB for each 12 hour period.	If target compounds are outside of acceptance limits, re-analyze the LFB. If second LFB fails, recalibrate instrument, re-analyze LFB and any associated samples. Compounds that fail high in the LFB and are ND in the samples can be reported.
Internal standard (ISTD) Fluorobenzene	Added to each field and QC sample prior to analysis	Reanalyze sample if outside limits. If reanalysis confirms original, document on report.

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EPA 624 Quality Control GC/MS Volatiles		
Type	**Frequency**	**Corrective Action**
Surrogates: 4-Bromofluorobenzene 1,2-Dichloroethane-d_4 Fluorobenzene	Each sample, MS, MSD, LCS, and blank	Reanalyze sample if outside limits; if reanalysis is within limits, the reanalysis data is reported. If surrogates confirm original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each batch (≤20) of samples	Evaluated by analyst in conjunction with the LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Samples: Spike all compounds of interest	Each batch (≤20) of samples	Reanalyze LCS and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD): Spike all compounds of interest	Each batch (≤20) of samples	Evaluated by analyst in relationship to other QC results
Blanks:	Once every 24-hour tune period and/or 20 samples, which ever comes first	Reanalyze blank and associated samples if blank outside QC limits
Internal Standards (ISTD): Bromochloromethane 2-Bromo-1-chloropropane 1,4-Difluorobenzene	Each sample, MS, MSD, LCS, and blank	Reanalyze sample if outside limits; if reanalysis is within limits, the reanalysis data is reported. If internals confirm original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

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EPA 625 Quality Control GC/MS Semivolatiles		
Type	**Frequency**	**Corrective Action**
Surrogate: Nitrobenzene-d_5 2-Fluorobiphenyl Terphenyl-d_{14} Phenol-d_6 2-Fluorophenol 2,4,6-Tribromophenol	Each sample, MS, MSD, LCS, and blank	Re-extract and reanalyze if more than one surrogate out per fraction (acid/base) or any recovery <10%; if re-extraction and reanalysis confirms originals, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluate in conjunction with the LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD): Same as for matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level, instrument	Re-extract and reanalyze blank and associated samples
Internal Standards (ISTD): 1,4-Dichlorobenzene-d_4 2-Fluoronaphthalene Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

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EPA 608 Quality Control Pesticides/PCBs		
Type	**Frequency**	**Corrective Action**
Surrogate: Organochlorine Pesticides & PCBs DCB TCMX	Each sample, MS, MSD, LCS, and blank	Repeat extraction and analysis if reanalysis confirms original report results and comment in case narrative
Matrix Spikes: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene PCBs: Aroclor 1016 and Aroclor 1260	Each batch (≤20) of samples	Evaluate in conjunction with LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Matrix Spike Duplicates (RPD): Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene PCBs: Aroclor 1016 and Aroclor 1260	Each batch (≤20) of samples	Evaluated by analyst in relationship to other QC results
Laboratory Control Sample: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene PCBs: Aroclor 1016 and Aroclor 1260	Each batch (≤20) of samples	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds in the LCS that fail high and are ND in the samples can be reported.
Blanks:	Each batch (≤20) of samples	Inject a hexane or solvent blank first to be sure the analytical system is clean then reinject the blank itself. If the reinjected blank is acceptable, any samples extracted with this blank should be reinjected if they, too, contain the analyte which was contaminating the blank. If the reinjected blank is unacceptable, any affected samples must be reextracted.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

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EPA Method 602 Petroleum Analysis Acceptance Criteria		
Type	**Frequency**	**Corrective Action**
Surrogate: α,α,α-Trifluorotoluene (PID)	Each sample, MS, MSD, LCS, and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident.
Matrix Spike: Spike all compounds of interest	Each group (≤20) of samples	Evaluate in conjunction with LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples. LCSD analyzed if sufficient volume is not available for MS/MSD	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds in the LCS that fail high and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD): Same compounds as the matrix spike	Each group (≤20) of samples	Evaluated by an analyst in relationship to other QC results
Blanks:	At least once per 24 hours	Reanalyze blank and associated samples if blank is outside limits
Internal Standards (ISTD): 1-Chloro-3-fluorobenzene (PID)	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original result, document on report or case narrative. In cases where the sample matrix is elevating the ISTD recovery, a dilution and reanalysis may be performed.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change

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EPA Method 600 Series (Method 200.8 for ICP/MS) Quality Control Inorganics (Metals)		
Type	**Frequency**	**Corrective Action**
Internal Standard:	Each sample, standard and QC (Unspiked, Dup., MS, LCS, dilution, Post Digestion Spike and blank)	If the internal standard response falls outside the specified range, then the samples would be reanalyzed.
Matrix Spikes:	Each group of samples of similar matrix/level (≤10) each method	Analyze post-digestion spike sample
Matrix Spike Duplicate (RPD):	Not required	N/A
Duplicates (RPD):	Each group of samples of similar matrix/level (≤10) each method	Flag the data
Blanks: Initial Calibration (ICB) Continuing Calibration (CCB) Preparation Blank	Each wavelength immediately after calibration verification at 10% frequency or every 2 hours (beginning and end of run min.) Each SDG or batch (≤10 samples)	Correct problem, recalibrate, and rerun Redigest and reanalyze blank and associated samples if sample result is greater than the LOQ and <10× blank result
Serial Dilutions:	Each group of (≤10) of similar matrix/level	Flag the data
Interference Check Sample:	Each wavelength after Initial Calibration Verification at beginning and end of the run or min. of 2 times per 8 hour	Correct for interference, recalibrate the instrument
Laboratory Control Sample:	Each SDG or batch (≤10 samples), each method	Redigest and reanalyze LCS and associated samples. Elements in the LCS that fail high and are ND in the samples can be reported.
Post Digestion Spike:	When matrix spikes are outside 70% to 130% range or within the statistical window (whichever is tighter)	Flag the data
Analytical Spike:	One per 10 field samples	ICP-MS – flag the data

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Quality Control for Miscellaneous 600 Series Water Tests			
Test	**QC Type**	**Frequency**	**Corrective Action**
Alkalinity **Ammonia (ISE)** **Ammonia (Distill.)** **Dissolved Solids** **Fluoride (ISE)** **Hardness** **Sulfate (turb)** **Sulfide** **Total Solids** **Turbidity**	Blank	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.*
	Duplicate	Each batch (≤20) of samples	Ensure that LCS meets acceptance criteria.
	Matrix Spike/ Matrix Spike Duplicate	Each batch (≤20) of samples (not for turbidity)	Ensure that LCS meets acceptance criteria.
Bromide (IC) **Chloride (IC)** **Sulfate (IC)** **Cyanide (total & free)** **Fluoride (IC)** **Nitrogen (TKN)** **Nitrate/Nitrite** **Total Phosphorus** **TOC**	Blank	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.*
	Duplicate	Each batch (≤10) of samples	Ensure that LCS meets acceptance criteria.
	Matrix Spike	Each batch (≤10) of samples	Ensure that LCS meets acceptance criteria.
Phenols	Blank	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.*
	Matrix Spike/ Matrix Spike Duplicate	Each batch (≤10) of samples	Ensure that LCS meets acceptance criteria.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

*LCSs that fail high and associated samples are ND can be reported.

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TO-15 Volatile Organics in Air		
Type	**Frequency**	**Corrective Action**
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Blanks:	Once for each 24-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): Bromochloromethane 1,4-Difluorobenzene Chlorobenzene-d_5	Each sample, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

TO-14A Volatile Organics in Air		
Type	**Frequency**	**Corrective Action**
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Blanks:	Once for each 24-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): Bromochloromethane 1,4-Difluorobenzene Chlorobenzene-d_5	Each sample, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

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MICROBIOLOGICAL TESTING

1. MICROBIOLOGICAL SAMPLE HANDLING

1.1. Microbiological Sample Collection

The containers for environmental microbiology are typically sterile, screw-cap plastic bottles. A minimum of 100 mL of sample is required. The sampling containers are purchased with a sterility certification. The sterility, absence of autofluoresence, and volume of each purchased lot of containers is verified by randomly selecting a container from each purchased lot and inoculating it with approximately 100 mL of sterile tryptic soy broth and placing it in incubation for 24 hours at 35° ± 0.5°C. Each lot of bottles is also checked for absence of autofluoresence with a 366-nm UV light with a 6-Watt bulb. The 100-mL calibration line on the container is verified using a 100-mL Class A graduated cylinder to 2.5% tolerance.

Samples collected for microbiological analyses must follow a specific protocol:

- The sampling taps are to be free of aerators, strainers, hose attachments, and purification devices; they should not be mixing type faucets, and avoid leaky faucets.
- Maintain a steady water flow for 3 to 5 minutes before collecting the sample.
- Using aseptic techniques, fill the container to just above the 100-mL mark on the container. This will allow for mixing and chlorine residual analysis.
- Do not overfill the container.
- If another environmental microbial analysis is required, or if the water is discolored (to act as a color standard), a separate container will be required.

1.2. Microbiological Sample Storage

Because sample integrity can be compromised by improper storage, the environmental microbiology samples are refrigerated with the temperature monitored until requested by the microbiologist for analysis.

Holding times for samples are monitored and analysis is scheduled accordingly. For Safe Drinking Water Act (SDWA) compliance purposes, no sample (for total coliform analysis) with over 30 hours elapsed time from collection will be analyzed. HPC samples from SDWA surface water systems must be tested within 8 hours of collection. Fecal coliform tests on effluents for National Pollutant Discharge Elimination System (NPDES) compliance purposes must be transported to the laboratory within 6 hours of collection. Samples that arrive past 6 hours of when they were collected cannot be tested. Whenever possible, the sample should be tested within 2 hours of receipt.

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1.3. Microbiological Sample Return/Disposal

All solid wastes generated from the microbiological analyses are disposed of in bags designated as “BioHazard”, sterilized via autoclave and disposed of by incineration. The laboratory uses a sophisticated, laboratory information management system (LIMS), which includes programming to assist in the identification of hazardous wastes at time of discard. In most cases, a sample for coliform testing is collected in a container that will also be the test vessel. When this occurs, samples are discarded in the laboratory immediately after analysis is completed. When samples are not tested in the sample container, the sample containers are returned to sample storage for disposal.

2. MICROBIOLOGICAL TECHNICAL REQUIREMENTS AND TRACEABILITY OF MEASUREMENTS

2.1. Media

- Within the microbiology laboratory, procedures are in place to address preparation, labeling, storage, expiration, documentation, and quality/sterility evaluation requirements for these materials. Only commercially prepared or manufactured dehydrated media is used for SDWA water work. Media may not be formulated from basic ingredients. Each new lot of dehydrated or commercially prepared medium is checked against positive and negative culture controls. Each purchased lot of MMO-MUG media is tested for performance using *E. coli*, *K. pneumoniae*, and *Ps. aeruginosa*, or equivalent organisms following a standard operating procedure. The positive/negative organism check is performed on each new lot of purchased or prepared media for QC purposes.

- Each analytical method includes a list of media needed for the test. These are fully described, including name, purity, and description of preparation. Where applicable, shelf life and storage conditions are also listed.

- The Microbiology Department is responsible for maintaining an inventory of the media needed. New supplies of media are checked by the Purchasing Department to ensure that they match the purchase order. The laboratory is responsible for checking that new supplies meet the method requirements.

- In addition to the name and concentration, the media containers are labeled with the storage conditions, the date opened, and an expiration or re-evaluation date. Subsequent media preparations at the laboratory are fully documented in a logbook and are traceable to, or labeled to include:

    1. Name of media
    2. Concentration, as appropriate
    3. Date prepared
    4. Name of analyst preparing or reference to logbook
    5. Storage conditions
    6. Expiration/re-evaluation date
    7. Manufacturer name and lot #
    8. Sterilization time and temperature
    9. Final pH, where required
    10. Sterility check result

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2.2. Microbiological Standard Sources, Calibration, and Preparation

Microbial Control Species - Where required, laboratory cultures are obtained from the American Type Culture Collection (ATCC). Cultures used in testing are no more than five transfers from ATCC freeze-dried cultures.

2.3. Microbiological Equipment Maintenance

Equipment maintenance and calibration is addressed in instrument-specific Operation, Maintenance, and Calibration Procedures (OMC) or instrument-specific instruction manuals located within the department.

The general process for sterilization procedures are outlined below:

2.3.1. All autoclaving is done at 121° ± 1°C, with times as specified below (in minutes):

Carbohydrate media	25
Rinse water	60
Contaminated materials	minimum of 70

2.3.2. Sterile disposable single use membrane filter units or sterile glass filter funnels are used for methods that require filtration.

2.4. Microbiological Labware Cleaning

Sterile disposable plastic ware is primarily used for microbiological analysis. However, procedures are in place to outline the washing process for each type of labware used in the laboratory. Most glassware is machine-washed. Labware that is washed by hand is either air dried or dried in specifically designed ovens and sterilized appropriately. Each new lot, or at least annually, of detergents used to wash glassware for Environmental Microbiology labware, is tested using the Inhibitory Residue Test, as outlined in SM20 9020.B.4.a.2).

MICROBIOLOGICAL INTERNAL QUALITY CONTROL CHECKS

2.5. Microbiological Laboratory Quality Control Samples and Acceptance Criteria

Quality control (QC) samples are analyzed with each batch of samples or new lot of reagents, as required by the referenced methods, to demonstrate that all aspects of the analysis are in control within established limits of precision and accuracy. Chromofluorogenic media QC tests are lot-specific and performed on each newly received lot.

Each laboratory analytical method specifies (or includes cross-references to) the type of QC sample, frequency of analysis, acceptance criteria for QC sample results, and corrective action to be taken if QC sample results fall outside of the acceptance range. The handling of QC data is described in section 9.2 of the Environmental Quality Policy Manual. The types of QC samples and the information each provides are discussed in the following paragraphs.

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2.5.1. Negative System Control - The QC on this is method specific and can be found in 1-P-QM-PRO-9018209, Quality Control/Quality Assurance Procedure for Environmental Microbiology.

2.5.2. Positive and Negative Organism Controls - Each lot/batch of media is tested using positive and negative organism controls.

2.5.3. Duplicate Counting (Test Variability/Reproducibility) - duplicate counting is performed monthly on HPC and fecal MF plates. Each analyst who counted samples for a month, counts the plates and their results are evaluated. Counts must be within 10% difference of the total average for all analysts to be acceptable.

2.5.4. Duplicates - For heterotrophic plate count samples, a duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test. The plate counts are averaged.

2.5.5. Serial Dilutions - Fecal coliform, biosolids analyses, and heterotrophic plate counts may require serial dilution of the sample.

2.6. Microbiological Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for the required QC samples, where appropriate. The corrective action required when a QC result fails to meet the acceptance criteria is also given, where appropriate.

The QC acceptance criteria are available to analysts in the laboratory. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This may include, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a comment stating the observed deviation, and invalidating results. It should be noted that resampling may be required in the case of invalidated results for SDWA, Environmental Protection Agency (EPA), Pennsylvania Department of Environmental Protection (PADEP), or Pennsylvania Department of Health (DOH) compliance samples due to the short hold-times in microbiological analysis.

2.7. Microbiological Water Systems

Laboratory Reagent Water Suitability Testing - On an annual basis, a sample is sent to a PADEP certified laboratory for suitability analyses. These serve as confirmation of our analyses, as well as to supply additional data on the water suitability.

2.8. Microbiological Reporting Limits

For microbiological analysis, the limits are method-specified and/or project-specific. This information is programmed into the LIMS for reporting purposes.

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H&P's 8260SV Method for Soil Vapor Analysis

SOP A 008
Revision 4
Revised: March 4, 2015
Effective March 4, 2015

Approved:

Janis Villarreal 03/11/2015

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Janis Villarreal Date
Laboratory Director

Lisa D Em 3/11/2015

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Lisa Eminhizer Date
QAO

QA/QC REQUIREMENTS SUMMARY
Vapor/Air for VOCs
Analytical Method / SOP Reference: H&P 8260SV / SOPA008

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	Once every analytical batch of 20 or fewer samples	No analyte detected equal to or above the MRL (DoD: No analytes > ½ MRL; common lab contaminants none detected > MRL)	1) Analyze water blank 2) Identify and correct problem 3) Reanalyze method blank and affected samples 4) Qualify data	Accuracy/Bias - Contamination	No analytes detected less than half the RL
LCS	Once every analytical batch of 20 or fewer samples	Percent recovery (%R) within 70-130%	1) Reanalyze 2) Identify and correct problem 3) Qualify data *DoD projects require corrective action for all exceedances	Accuracy/Bias	Recoveries within 70-130% recovery
Surrogate	Every analytical sample	A minimum of three surrogates must pass QAQC limits	Reprep and reanalyze all samples processed with the non-conforming surrogate. Dilute sample if necessary.	Accuracy/Bias	Dibromofluoromethane, 4-Bromofluorobenzene, Toluene-d8, and 1,2-Dichloroethane-d4: 75-125%
Sample Replicate	One field sample replicate each day	Main analytes of concern must meet precision requirements	Re-collect and analyze sample replicate, report the two closest results	Precision	RPD must be equal or less than 50%
MS/MSD	Not applicable				

Initial Calibration
5 points minimum RSD <30% Linear Regression acceptable in correlation >0.99 2nd Source Verification

Daily Calibration Beginning & Ending (CCV)
BFB Tune Valid for 12 Hr %D <20% (Flag analytes >20% as appropriate)

DEFINITIONS:

% D	Percent Deviation (from initial calibration)
BFB	Bromofluorobenzene
CCV	Continuing Calibration Verification (daily calibration)
DoD	Department of Defense
LCS	Laboratory Control Spike
MRL	Method Reporting Limit
MS/MSD	Matrix Spike and Matrix Spike Duplicate
RSD	Relative Standard Deviation
RPD	Relative Percent Difference

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EPA METHOD TO-15

SOP A 004
Revision 11
Revised: March 4, 2015
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Approved:

---	03/10/2015 ---
Janis Villarreal Laboratory Director	Date
---	3/10/2015 ---
Lisa Eminhizer QAO	Date

QA/QC REQUIREMENTS SUMMARY
Vapor/Air for VOCs
Analytical Method / SOP Reference: EPA TO-15

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Internal Standard Responses	Data Quality Indicator	Measurement Performance Criteria
Method Blank	Once every analytical batch of 20 or fewer samples	No analyte detected equal to or above the MRL (DoD: No analytes > ½ MRL; common lab contaminants none detected > MRL)	1) Reanalyze blank 2) Identify and correct problem 3) Reanalyze blank and affected samples 4) Qualify data	60-140%	Accuracy/Bias - Contamination	No analytes detected greater that RL. DoD project - no analytes greater than half the RL)
LCS/ LCSD, if required)	Once every analytical batch of 20 or fewer samples	Percent recovery (%R) within 65-135%	1) Reanalyze 2) Identify and correct problem 3) Qualify data	60-140%	Accuracy/Bias	Recoveries within 70-130% recovery, RPD: 25% (if LCSD required)
Surrogate	Every analytical sample	A minimum of two surrogates must pass QAQC limits	Reprep and reanalyze all samples processed with the non-conforming surrogate. Dilute sample if necessary.	60-140%	Accuracy/Bias	4-Bromofluorobenzene: 76-134% Toluene-d8: 78-125% 1,2-Dichloroethane-d4: 77-127%
MS/MSD	Not applicable					

Initial Calibration
5 points minimum RSD <30%, 2 analytes with RSD <40% allowed 2nd Source Verification

Daily Calibration (CCV)
BFB Tune Valid for 24 Hr %D <30% (Flag analytes >30% %D as appropriate)

DEFINITIONS:

% D	percent Deviation (from initial calibration)
BFB	Bromofluorobenzene
CCV	Continuing Calibration Verification (daily calibration)
DoD	Department of Defense
LCS	Laboratory Control Spike
MRL	Method Reporting Limit
MS/MSD	Matrix Spike and Matrix Spike Duplicate
RSD	Relative Standard Deviation

QUALITY MANUAL

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Revision Number:	15	Effective Date:	March 1, 2013

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Section 3

INTRODUCTION AND SCOPE
(TNI V1:M2 – Sections 1, 2, 3)

The purpose of this *Quality Manual* is to outline the quality management system for PDC Laboratories, Inc. The *Quality Manual* defines the policies, procedures, and documentation that assure analytical services continually meet a defined standard of quality that is designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance.

The *Quality Manual* sets the standard under which all laboratory operations are performed, including the laboratory's organization, objectives, and operating philosophy. The *Quality Manual* has been prepared to assure compliance with the 2009 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1-M1 through M7-ISO-2009). This Standard is consistent with ISO/IEC 17025:2005 requirements that are relevant to the scope of environmental testing services and thus, the laboratory operates a quality system in conformance with ISO/IEC 17025:2005(E). In addition, the policies and procedures outlined are compliant with the various accreditation and certification programs listed in Appendix E.

In addition, the *Quality Manual* has been prepared to be consistent with the requirements of the following documents:

1. Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth Edition,
2. Standard Methods for the Examination of Water and Wastewater, as updated by MUR II,
3. 40 CFR Part 136 including Appendices,
4. Test Methods for Evaluating Solid Waste: SW-846,
5. State–specific analytical methods (such as OA-1 and OA-2 for State of Iowa), and
6. Title 77 Illinois Administrative Code, Chapter I, Subchapter d, Part 465 – Certification and Operation of Environmental Laboratories (Microbiology)

3.1 Scope of Testing

The laboratory's scope of analytical testing services includes those listed in Appendix E. Copies of current certificates and parameter lists for each organization are available upon request from the Quality Assurance Department.

3.2 Table of Contents, References and Appendices

The Table of Contents is in Section 2 and Appendices follow Section 28.

This *Quality Manual* uses the references included in Modules 1-7 in the 2009 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis.

3.3 Glossary and Acronyms Used

Quality control terms are generally defined within the Section that describes the activity.

3.3.1 Glossary

A consolidated list of terms and definitions is found in Appendix D.

3.3.1.1 **The TNI Standard:** Terms and definitions may also be found in Modules 1-7 in the 2009 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1, M1 through M7, ISO-2009).

3.3.2 Acronyms

A list of acronyms used in this document and their definitions are found at the end of Appendix D.

3.4 Management of the *Quality Manual*

The Director of Quality Assurance is responsible for maintaining the currency of the *Quality Manual*.

The *Quality Manual* is reviewed every two (2) years by the Director of Quality Assurance and laboratory personnel to ensure it still reflects current practices and meets the requirements of any applicable regulations or client specifications. Sections of the manual are updated by making a change to the Section and then increasing the revision number by one. The cover sheet of the *Quality Manual* (Section 1) must be re-signed and the Table of Contents (Section 2) is updated whenever a Section is updated.

The *Quality Manual* is considered confidential within PDC Laboratories, Inc. and may not be altered in any way except by approval of the Laboratory Vice President and Director of Quality Assurance. If it is distributed to external users, it is for the purpose of reviewing PDC Laboratories, Inc.'s quality management system and may not be used for any other purpose without written permission. Hardcopy printed versions of the *Quality Manual* are not considered controlled documents.

Section 4

ORGANIZATION
(TNI V1:M2 – Section 4.1)

The laboratory is a legally identifiable organization. The laboratory is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/EIC 17025 Standard, and that meet the needs of the client. Through application of the policies and procedures outlined in this Section and throughout the *Quality Manual*:

- The laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment.
- Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system.
- Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system.
- Ethics and data integrity procedures (see Appendix A, Section 5 – "Management" and Section 19 – "Data Integrity Investigations") ensure personnel do not engage in activities that diminish confidence in the laboratory's capabilities.
- Confidentiality is maintained.

4.1 Organization

PDC Laboratories, Inc., incorporated in the State of Illinois in 1981, is a commercial environmental and analytical laboratory group serving diverse clients in the industrial, government, engineering, consulting and private sectors. Documentation of legal identification is available upon request.

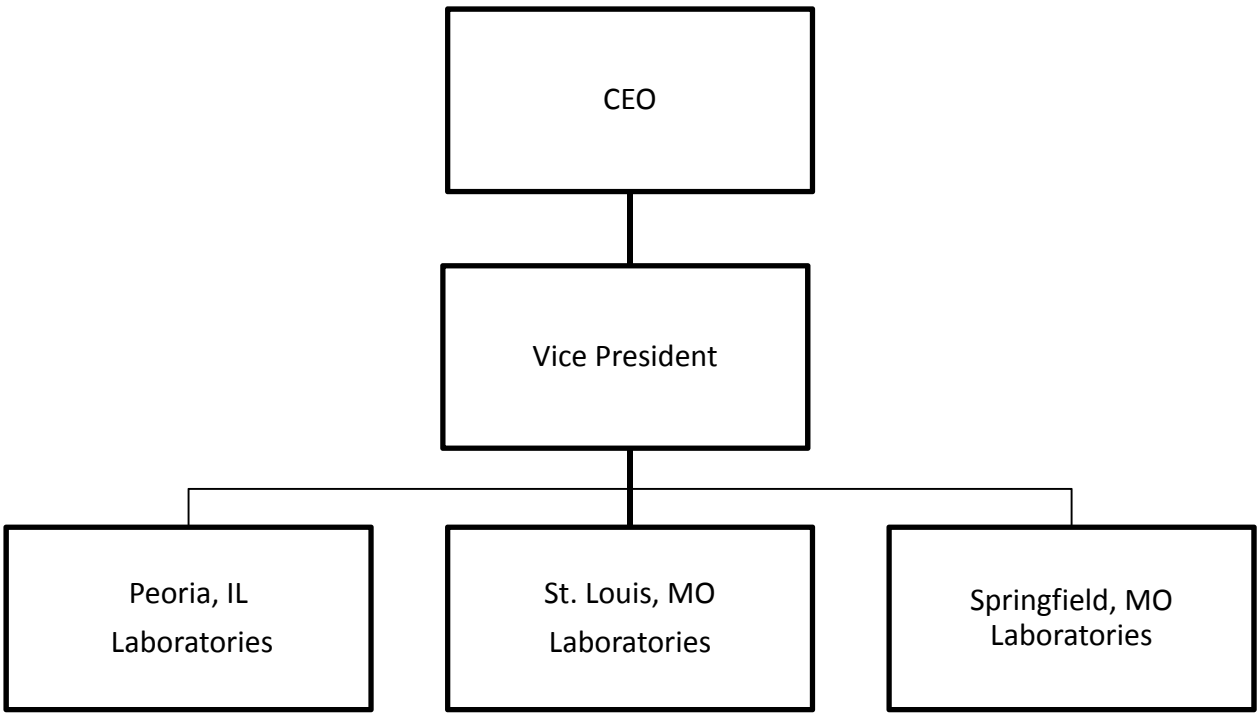
Laboratories at three locations comprise the laboratories group – Peoria, Illinois, Florissant, Missouri (St. Louis, MO area), and Springfield, Missouri. PDC Laboratories, Inc. is a wholly owned subsidiary of Coulter Companies, Inc.

A general corporate organization chart can be found in Figure 4-1.

The laboratory's organization chart can be found in Appendix B. Additional information regarding responsibilities, authority and interrelationship of personnel who manage, perform or verify testing is included in Section 5 –"Management" and Section 20 – "Personnel". These Sections also include information on supervision, training, technical management, job descriptions, quality personnel, and appointment of deputies for key managerial personnel.

The laboratory has the resources and authority to operate a management system that is capable of identifying departures from that system and from procedures during testing, and initiates actions to minimize or prevent departures.

Figure 4-1 – Corporate Organization Chart



4.2 Conflict of Interest and Undue Pressure

The organizational structure indicated in Appendix B minimizes the potential for conflicting or undue interests that might influence the technical judgment of analytical personnel. In addition, procedures are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

A conflict of interest can occur when outside activities or personal interests interfere or appear to interfere with the ability to objectively perform the work assignment or act in the best interest of PDC Laboratories, Inc. Employees have an obligation to avoid actual or potential conflicts of interest. Employees are to contact the Corporate Human Resources Department for more information or questions about conflicts of interest.

Business dealings with outside firms should not result in unusual gains for those firms. Unusual gain refers to bribes, product bonuses, special fringe benefits,

unusual price breaks, and other windfalls designed to ultimately benefit the employer, the employee, or both.

An actual or potential conflict of interest occurs when an employee is in a position to influence a decision that may result in a personal gain for that employee or for a relative as a result of the laboratories' business dealings. For the purposes of this policy, a relative is any person who is related by blood or marriage, or whose relationship with the employee is similar to that of persons who are related by blood or marriage.

If an employee has any influence on transactions involving purchases, contracts, or leases, it is imperative that the employee disclose to the Corporate Human Resources Department or the Laboratory Vice President, as soon as possible, the existence of any actual or potential conflict of interest so that safeguards can be established and/or other appropriate decisions can be made to protect all parties. The Laboratory Vice President must contact the CEO in regards to their situations of potential conflict of interest.

Personal gain may result not only in cases where an employee or relative has a significant ownership in a firm with which the laboratories do business, but also when an employee or relative receives any kickback, bribe, substantial gift, or special consideration as a result of any transaction or business dealings involving the laboratory.

Situations which create the appearance of a conflict should be avoided as well.

All financial, business and other activities both inside and outside of the job must be lawful and free of conflicts or even the suggestion of a conflict with responsibilities as a PDC Laboratories, Inc. employee.

Section 5

MANAGEMENT
(TNI V1:M2 – Section 4.2)

The laboratory maintains a management system that is appropriate to the scope of its activities.

5.1 Management Requirements

Corporate Management includes the Chief Executive Officer (CEO), Chief Financial Officer (CFO), Vice Presidents, Directors, Managers, and Supervisors. The CEO establishes the overall management system and data integrity program for the company, providing the necessary leadership and resources to assure that the management system and integrity program requirements are met.

Senior Management at PDC Laboratories, Inc. includes the Laboratory Vice President, Director of Quality Assurance, Director of Sample Logistics, Corporate Information Technology Manager, Senior Project Manager, and Facility Manager. The Laboratory Department Managers, Laboratory Supervisors and Project Managers may be included if the need arises.

Management's commitment to good professional practice and to the quality of its products is defined in the Quality Policy statement, Section 5.3

Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting client, statutory, and regulatory requirements. Management assures that the system documentation is known and available so that appropriate personnel can implement their part of the management system. When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, and that meet the needs of the client.

Managers implement, maintain and improve the management system, and identify noncompliance with the management system of procedures. Managers initiate actions to prevent or minimize noncompliance.

Management ensures technical competence of personnel operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised as documented by training records.

Management is responsible for defining the minimal level of education, qualifications, experience, and skills necessary for all positions in the laboratory and assuring that technical staff have demonstrated capabilities in their tasks.

Training is kept up to date as described in Section 20 – "Personnel" by periodic review of training records and through employee performance reviews.

Management bears specific responsibility for maintenance of the management system. This includes defining roles and responsibilities to personnel, approving documents, providing required training, providing a procedure for confidential reporting of data integrity issues, and periodically reviewing data, procedures, and documentation. The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests is documented in the organizational chart found in Appendix B and in Section 20 of this manual

Management ensures that audit findings and corrective actions are completed within required time frames.

If the Vice President, a Director or a Department Manager is absent for fifteen (15) consecutive calendar days or more, a deputy with appropriate qualifications will perform the Vice President's, Director's or Department Manager's duties. Beyond a thirty-five (35) consecutive calendar day absence, management will notify the primary accreditation body in writing of the absence of the Vice President, Director or Department Manager and the appointment of a deputy.

5.2 Management Roles and Responsibilities

5.2.1 Laboratory Vice President

The Laboratory Vice President is responsible for the overall quality, safety, financial, technical, human resource and service performance of the laboratory. The Laboratory Vice President provides the resources necessary to implement and maintain an effective quality and data integrity program. Signatory approval is unrestricted as a corporate officer.

The Laboratory Vice-President's training and proof of experience and education are available in training records maintained by the Quality Assurance Department.

5.2.1.1 Responsibilities

The Laboratory Vice President is responsible for:

a. ensuring that personnel are free from any commercial, financial and other undue pressures that might adversely affect the quality of their work;

b. ensuring that all analysts and supervisors/managers have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented;

c. ensuring that the annual management review meeting is held and used as a forum for discussions concerning: the suitability of policies and procedures, reports from managerial and supervisory personnel, the outcomes of recent internal audits with related possible corrective actions and potential preventive actions, assessments by external bodies, results of proficiency testing, changes in volume and type of work, client feedback, complaints, recommendations for improvements, and other relevant items such as quality control activities, use of resources and staff training;

d. ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits; (Procedures that do not meet the standards set forth in the Quality Manual, laboratory SOPs or laboratory policies may be temporarily suspended by the Laboratory Vice President.)

e. ensuring that all SOPs and policies have been reviewed and approved prior to their implementation and ensures all approved SOPs and policies are provided to laboratory personnel and are adhered to;

f. facilitating a two-way exchange of information between the laboratory and corporate management as the intermediary between the laboratory and corporate office;

g. general and financial planning, revenue budgeting, expense budgeting, and capital budgeting; and

h. determining the availability of the laboratory to accept new projects. This availability includes considerations of equipment, facilities, staff, experience, etc.

5.2.2 Director of Quality Assurance

The Director of Quality Assurance is responsible for all quality assurance (QA) and quality control (QC) activities and is independent from laboratory operations. The Director of Quality Assurance's training and proof of experience in QA/QC procedures, knowledge of analytical methods, and the laboratory's management system are available in training records maintained by the Quality Assurance Department.

5.2.2.1 Responsibilities

The Director of Quality Assurance is responsible for:

a. serving as a focal point for QA/QC;

b. direction and training of the quality assurance staff;

c. planning and budgeting for the QA Department;

d. ensuring that Standard Operating Procedures (SOPs) are maintained, updated as needed, and followed;

e. arranging or conducting annual internal audits without outside (e.g., managerial) influence;

f. oversight of analysis and reporting of Performance Testing (PT) samples;

g. notifying management of deficiencies, and monitoring corrective actions;

h. oversight and review of quality control data;

i. ensuring that the management system related to quality is implemented and followed at all times;

j. arranging external audits;

k. maintaining a base of approved subcontract laboratories (with the assistance of the Director of Sample Logistics);

l. assisting with and/or advising on laboratory procedure development and implementation;

m. monitoring and maintaining laboratory certifications; and

n. ensuring that this *Quality Manual* is kept current.

5.2.3 Director of Sample Logistics

The Director of Sample Logistics is responsible for budgeting, departmental purchasing, departmental training and the day-to-day performance of the shipping, receiving and courier staff members.

The responsibilities of these sections are to send approved sample containers to clients, pick up samples if required, receive, unpack and inspect samples after delivery, log the samples into the LIMS and maintain the organization and storage of samples housed during analysis.

The Director of Sample Logistics' training and proof of experience and education are available in training records maintained by the Quality Assurance Department.

5.2.3.1 Responsibilities

The Director of Sample Logistics is responsible for:

a. evaluation and ordering approved sample containers;

b. sending samples to subcontracted laboratories for non-routine or overflow analyses;

c. coordinating and controlling the order cycle and associated storage and movement of sample containers between storage and clients;

d. using maps, discussions with couriers, and the Internet to determine best routes to use for container delivery and sample pick-up;

e. analyzing data to monitor performance and plan improvements in delivery performance;

f. oversight of vehicle acquisition and vehicle repair;

g. coordinating with all required freight carriers including negotiating prices and conditions regularly;

h. coordinating, monitoring, and reporting internal bottle QC; and

i. maintaining daily sample receipt report as an electronic file.

5.2.4 Information Technology Manager

The Information Technology Manager, a Corporate employee, is responsible for management of electronic records, electronic data archival storage, operational integrity of the electronic data systems, research and development of automated laboratory information management procedures, budgeting and staff training related to the use of the LIMS.

5.2.4.1 Responsibilities

The Information Technology Manager is responsible for:

a. devising the overall IT framework comprised of all the IT procedures, practices, procurement and setting up and maintenance of the IT infrastructure encompassing internet resources, network resources, electronic communications infrastructure, and information technologies infrastructure;

b. leading an internal IT team who is responsible for managing and maintaining day-to–day operations of the IT infrastructure with delegation of day-to-day responsibilities of PDC Laboratories, Inc. to the Laboratory System Administrator;

c. dealing with external IT vendors, suppliers and outsourcing partners and software developers to buy IT assets;

d. ensuring that new IT hires are trained with completed training documentation submitted to the Quality Assurance Department;

e. delivering IT and IT allied services to the organization; and

f. ensuring that the PDC Laboratories, Inc. staff is trained in the laboratory Electronic Communications Policy. Required documentation of training is maintained by the Quality Assurance Department.

5.2.5 Senior Project Manager

The Senior Project Manager is responsible for oversight of various client services such as primary and secondary project management duties as well as back-up to other project managers. The Senior Project Manager is a liaison with the marketing staff and a link between the laboratory department managers and other project managers.

The Senior Project Manager's training and proof of experience and education are available in training records maintained by the Quality Assurance Department

5.2.5.1 Responsibilities

The Senior Project Manager is responsible for:

a. implementing quality assurance procedures and review in accordance with the laboratory methodology and procedures to ensure successful execution of the project as measured by clients' data quality objectives (DQOs);

b. setting appropriate and correct pricing and ensuring accurate invoicing;

c. documenting complaints received from clients so that the Quality Assurance Department can track and monitor the complaint process;

d. documenting instances of "Service to the Client" so that the Quality Assurance Department can verify compliance with the TNI Standard;

e. working in conjunction with sales team to follow up on sales;

f. growing long-term relationships with clients;

g. effectively communicating relevant project information to laboratory personnel;

h. raising laboratory visibility through involvement in local industry organizations;

i. possessing a thorough understanding of laboratory offerings, technical preferences, and technical direction;

j. continually seeking and capitalizing upon opportunities to increase client satisfaction and deepen client relationships;

k. anticipating client needs and proposing alternative business solutions;

l. identifying partnership opportunities and capitalizes on "add-on" sales opportunities across projects; and

m. possessing a knowledge base of each client's business, organization and objectives.

5.2.6 Project Managers

The project managers are responsible for assisting clients in the administration of their sampling and analysis programs. Projects are assessed and assigned to specific project managers based on the general nature of the work. Typically, projects are categorized as municipal wastewater, municipal drinking water, industrial waste, industrial wastewater, groundwater, clean-up and remediation, homeowner ("private clients") or as samples in accordance with Federal contracted program-specific requirements.

The Project Manager's training and proof of experience and education are available in training records maintained by the Quality Assurance Department

5.2.6.1 Responsibilities

The Project Managers are responsible for:

a. informing clients of the PDC Laboratories, Inc. Sample Acceptance Policy;

b. obtaining project specific requirements regarding data quality objectives (DQOs) or regulatory requirements, turn-a-round times, number of samples, matrix, analytes, methods, reporting limits, required quality control elements, evidentiary requirements, and report requirements (QC summary forms, CLP-like forms, case narratives, etc.);

c. effectively communicating relevant project information to laboratory personnel;

d. obtaining a current copy of the client's Quality Assurance Project Plan, if required;

e. setting up the account information in the LIMs (create clients, bids, and projects);

f. setting up analyses or custom analyses as needed for login;

g. arranging for the delivery and receipt of sample containers;

h. informing applicable laboratory personnel of non-routine/special requests or expedited analysis requirements;

i. oversight of sample login and review of submitted documentation;

j. monitoring sample progress through the laboratory;

k. report generation;

l. answering project inquiries by the client;

m. documenting complaints received from clients so that the Quality Assurance Department can track and monitor the complaint process;

n. documenting instances of "Service to the Client" so that the Quality Assurance Department can verify compliance with the TNI Standard;

o. reporting any potential problems to the client in a timely fashion; and

p. generation and review of invoices for work performed.

5.2.7 Facility Manager

The Facility Manager is responsible for oversight of facility and grounds maintenance, evaluates use of space and facilities, supervisor of facility support personnel, facility security, management of hardcopy records, archival hardcopy storage and hardcopy data destruction.

The Facility Manager and designee are also on call and have to be available during non-working hours in case of emergencies.

The Facility Manager's training and proof of experience are available in training records maintained by the Quality Assurance Department

5.2.7.1 Responsibilities

The Facility Manager is responsible for:

a. ensuring the laboratory facility operates as efficiently as possible;

b. improving the facility's energy efficiency to meet government environmental regulations;

c. overseeing and directing maintenance personnel and workers engaged in equipment installation, facilities equipment repair and preventative maintenance.

d. oversight of the sampling and reporting of wastewater effluent monitoring to comply with the Greater Peoria Sanitary District (GPSD) permit requirements

e. maintaining a Class K Operator's permit in order to maintain the on-site Pretreatment Works;

f. maintaining the recycling program;

g. coordinating with the Director of Quality Assurance in developing and running the ethics training program;

h. performing new employee orientation; and

i. participating in both hazardous and non-hazardous waste storage and disposal procedures including auditing and documentation of storage, assisting in transferring containers of waste from the facility to the hazardous waste storage location and disposal. Duties do not include handling or labeling any of the designated hazardous waste streams

5.2.8 Department Managers (Organic/Metals/Inorganic/Microbiology/Field)

The Department Manager (or designee) is a full-time laboratory staff member who supervises laboratory operations and data reporting. The Department Manager meets the education and qualification requirements of Section 5.2.6.1 of the TNI Standard – EL–V1M2-2009 by possessing at least a bachelor's degree in the chemical, environmental, biological or physical sciences or engineering with at least two years of experience in the environmental analysis of representative inorganic or organic analytes for which the laboratory seeks or maintains accreditation.

The Department Manager's proof of experience in the fields of accreditation may be found in training records maintained by the Quality Assurance Department

The Department Manager is not a department manager of more than one accredited environmental laboratory.

5.2.8.1 Responsibilities

The Department Manager is responsible for:

a. exercising actual-day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results;

b. monitoring standards of performance data in quality control and quality assurance;

c. monitoring the validity of the analyses performed and data generated in the laboratory to assure reliable data;

d. planning and budgeting;

e. active in the hiring of new staff and ensuring that personnel have the appropriate education and technical background to perform the tests for which the laboratory is accredited;

f. providing necessary training as needed; and

g. leading laboratory procedure development and implementation.

5.2.9 Laboratory Key Personnel Deputies

Key Personnel Deputies with appropriate qualifications are appointed as needed.

5.3 Quality Policy

Management's commitment to quality and to the management system is stated in the Quality Policy below, which is upheld through the application of related policies and procedures described in the laboratory's *Quality Manual*, SOPs and policies.

Quality Policy Statement

The mission of PDC Laboratories, Inc. is to generate and report data of known and documented quality in a fashion that meets our clients' requirements. Our policy is to use good professional practices, to maintain quality, to uphold the highest quality of service and to comply with the TNI Standard. In support of this mission, our quality assurance program has been implemented as an integral part of laboratory management and practice. The PDC Laboratories, Inc. Quality Manual (QM) describes the standard practices and requirements that have been established to assure the quality of the laboratories' services. It describes the requirements, implementation, management and review of these practices. The Laboratory Vice President, directors, department managers, section supervisors and staff members are individually obligated to comply with its stated requirements, responsibilities and objectives.

The PDC Laboratories, Inc. management is committed to comply with the TNI Standard and will continually improve the effectiveness of the management system that results from implementation of the Standard in its entirety. Each staff member must familiarize themselves with the quality documentation and to implement the quality policies and procedures in their work. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority.

The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality.

Updates and modifications to the QM will be made as needed. The Quality Assurance Department has the authority to make these changes as well as the responsibility of verifying the adherence to technical policies and procedures. All revisions to the QM are reviewed and authorized by laboratory management prior to their release and implementation.

5.4 Ethics and Data Integrity System

The laboratory has an Ethics and Data Integrity policy that is included in Appendix A. The laboratory's Ethics and Data Integrity program, training and investigations are discussed in Section 19 – "Data Integrity Investigations".

5.5 Documentation of Management/Quality System

The management system is defined through the policies and procedures provided in this *Quality Manual* and written laboratory Standard Operating Procedures (SOPs) and documented policies.

5.5.1 Quality Manual

The *Quality Manual* contains the following required items:

5.5.1.1 document title;

5.5.1.2 laboratory's full name and address;

5.5.1.3 name, address (if different from above), and telephone number of individual(s) responsible for the laboratory;

5.5.1.4 identification of all major organizational units which are to be covered by this quality manual and the effective date of the version;

5.5.1.5 identification of the laboratory's approved signatories;

5.5.1.6 the signed and dated concurrence (with appropriate names and titles), of all responsible parties including the agent who is in charge of all laboratory activities – the Laboratory Vice President and the Director of Quality Assurance.

5.5.1.7 the objectives of the management system and contain or reference the laboratory's policies and procedures;

5.5.1.8 the laboratory's official quality policy statement, which shall include management system objectives and management's commitment to ethical laboratory practices and to upholding the requirements of this Standard; and

5.5.1.9 a table of contents, and applicable lists of references, glossaries and appendices.

This *Quality Manual* contains or references all required elements as defined by the TNI Standard - V1:M2, Section 4.2.8.4.

5.5.2 Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) represent all phases of current laboratory operations (they include a date, revision number, and signature of the approving authorities) and are available to all personnel. They contain sufficient detail such that someone with similar qualifications could perform the procedures. The SOP entitled Standard Operating Procedures describes the preparation and use of SOPs within the laboratory quality system. There are two types of SOPs used in the laboratory: 1) test method SOPs, which have specific requirements as outlined below, and 2) general use SOPs which document general, non-analytical procedures.

Each accredited analyte or method has an SOP. The laboratory's test method SOPs include the following topics, where applicable:

1. Scope and Application – describe the purpose of the process or procedure

2. Summary – briefly summarizes the procedure

3. Definitions – identify any specialized terms used

4. Interferences – describe any component of the process that may interfere with the accuracy of the final product

5. Safety – general safety issues

6. Equipment & Supplies – listing of applicable equipment and materials, including instrumentation and pertinent software applications

7. Reagents & Standards – list of reagents and chemical standards

8. Sample, Collection, Preservation, Holding Times - list of collection bottles, temperature and preservation additives and method applicable holding times)

9. Quality Control/Corrective Action and Contingencies for Out-of-Control Data – required QC with corrective actions when applicable

10. Calibration – instrument or method calibration or standardization

11. Procedure/Instrument Analysis – such as extraction, digestion, analysis, identification

12. Additional Corrective Action and Contingencies for Out-of-Control Data – list corrective action for samples and method specific occurrences

13. Calculations – list any mathematical steps to be followed

14. Method Performance – MDL information

15. Pollution Prevention – disposal of samples

16. Waste Management – disposal of laboratory waste

17. References – any procedures that interface with the SOP such as methods, including revision or published literature

18. Tables, Diagrams, Flow Charts & Validation Data – any related attachments

19. Revision Record – traceability of revision changes

20. Addendums – additional information as needed

Each general use SOP includes the Cover page – Signatory Section (must include approval signatures with date) and the following sections:

1. Purpose

2. Scope

3. Procedure

4. Tables/Attachments

5. Revision Record

6. Addendum (as needed)

7. References(as needed)

5.5.3 Order of Precedence

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

- Quality Manual (unless a specific SOP is referenced in manual)
- SOPs
- Documented Policies
- Other (Work Instructions, memos, flow charts, etc.)

Section 6

DOCUMENT CONTROL
(TNI V1:M2 – Section 4.3)

This Section describes how the laboratory establishes and maintains a process for document management. Procedures for document management include controlling, distributing, reviewing, and accepting modifications. The purpose of document management is to preclude the use of invalid and/or obsolete documents.

Documents can be SOPs, documented procedures, policy statements, specifications, calibration tables, charts, textbooks, posters, notices, memoranda, software, drawings, plans, etc. These may be on various media, whether hard copy or electronic, and they may be digital, analog, photographic or written.

The laboratory manages three types of documents: 1) controlled, 2) approved, and 3) obsolete.

A controlled document is one that is uniquely identified, issued, tracked, and kept current as part of the management system. Controlled documents may be internal or external documents. An example of a controlled document is a standard operating procedure (SOP).

An approved document means it has been reviewed and either signed and dated, or acknowledged in writing or by secure electronic means by the issuing authority (ies).

Obsolete documents are documents that have been superseded by more recent versions or are no longer needed and have been archived.

6.1 Controlled Documents

Documents will be reviewed, revised (as appropriate) and approved for use by the appropriate level of management for that type of document prior to issue.

Documents are reviewed every two to three years depending on the type of document or as needed to ensure their contents are suitable and in compliance with the current management systems requirements, and accurately describe current operations.

Approved copies of documents are available to staff at all locations where operations are essential to the effective functions of the laboratory. For example, all technical SOPs are available electronically - analysts are able to view the SOPs on computers at work stations. These documents are in PDF format and are generally maintained on a network that all computers have access to. However, aside from the QA Department, copying or printing of SOPs is forbidden. Hardcopy versions must be requested from the QA Department. Prior to performing a procedure for the first time, the individual must document in writing that they have “Read and Understood” the specific SOP.

Controlled internal documents are uniquely identified with 1) a unique name and number identification 2) date of issue, 3) revision identification, 4) page number, 5) the total number of pages, and 6) the signatures of the issuing authority (i.e. management)

A master list of controlled internal documents such as SOPs is maintained that includes description, number, revision, date and means of distribution. The controlled document list is maintained by the QA Department and is updated as needed.

6.1.1 Document Changes to Controlled Documents (SOPs)

6.1.1.1 Paper Document Changes

If it is found that a given procedure is not performed in accordance with the current SOP or does not accurately describe the procedure or equipment used, the SOP must be revised immediately. Prior to any change to the SOP, the original signatories and the QA Department must be advised of the change and approve the change. The department manager must determine the effect, if any, the deviation may have on the integrity of data.

Document changes are approved by the original approving authority and the QA Department.

A SOP modification form must be completed before any changes can be implemented. Handwritten modifications are not allowed.

All document modifications are approved. Changes that are not process modifications but clarifications may be performed without revision. Approval is required. The modified document is then copied and distributed, and obsolete documents are removed according to the master list of controlled documents.

Amendments/modifications to documents are incorporated into a new revision and reissued when the document is reviewed and updated on or before its scheduled review cycle.

A reason for the modification or change is provided as historical information in the revised document.

6.1.1.2 Electronic Document Changes

The same process that occurs with paper document changes is followed with electronic document changes.

Suggested revisions to electronic documents are presented to the QA Department for review and approval. Changes to electronic documents are approved either on a change or modification form or through electronic means such as email or system messages. Where practical, the altered text

or new text in the draft is identified during the revision or review process to provide for easy identification of the modifications.

6.2 Obsolete Documents

All invalid or obsolete documents are removed from general distribution, or otherwise prevented from unintended use.

Obsolete paper documents are collected from employees when a new revision is released. The master copy with original signatures is retained for legal use or historical knowledge preservation. The front page is marked “VOID” and retained by the QA Department. Electronic versions of the documents are archived on the laboratory server under the QA Department.

Section 7

REVIEW OF REQUESTS, TENDERS AND CONTRACTS
(TNI V1:M2 – Section 4.4)

The review of all new work assures that oversight is provided so that requirements are clearly defined, the laboratory has adequate resources and capability, and the test method is applicable to the client's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality.

Contracts for new work may be formal bids, signed documents, verbal, or electronic. The client's requirements, including the methods to be used, must be clearly defined, documented and understood. Requirements might include target analyte lists, project specific reporting limits (if any), project specific quality control requirements (if any), turnaround time, and requirements for data deliverables. The review must also cover any work that will be subcontracted by the laboratory.

7.1 Procedure for the Review of Work Requests

Projects are assessed and assigned to specific project managers based on the nature of the work. Typically, projects are categorized by market segments such as municipal drinking water, groundwater, municipal wastewater, industrial wastewater, industrial waste, clean-up/remediation, homeowner ("private clients") or Federal/State programs. The project manager responsible for that market segment is allowed to use discretion in accepting work that is of a routine or on-going nature for PDC Laboratories, Inc. after confirming that the laboratory has any required certifications, that it can meet the client's data quality and reporting requirements and that the laboratory has the capacity to meet the client's turn-around needs.

Any new, large or complex (non-routine) projects that have the potential to impact the normal workflow of the laboratory are cleared by the appropriate Department Manager and/or the Laboratory Vice President.

The work request review process can vary even with the same client ranging from a simple verbal request with approval to a formal request for bid or proposal with negotiation. These requests can also involve formal contracts covering aspects such as insurance requirements, payments terms and other work-specific conditions.

Based on the results of the initial inquiry, quotes may be prepared by project managers, sales representatives, directors, or corporate officers. Client contracts must be reviewed and signed by a corporate officer such as the Laboratory Vice President or his designee. A Contract Review Record serves to document and finalize this review process.

The designated project manager 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 the complete the work satisfactorily.

The client is informed of any deviation from the contract including the test method or sample handling processes. All differences between the request and the final contract are resolved and recorded before any work begins. It is necessary that the contract be acceptable to both the laboratory and the client.

The review process is repeated when there are amendments to the original contract by the client. The participating personnel are given copies of the amendments. The amendments are maintained with the original documentation by the project manager.

7.2 Documentation of Review

Formal requests and subsequent responses are filed in unique client-specific files. Records are maintained for every contract or work request, when appropriate. This includes 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. Individual documents are stored as separate electronic files but are all cataloged by specific client number, account name and project name. All written correspondences pertaining to a project are also filed in the client files. Project modifications may be documented by placing comments on the Chain of Custody (COC) forms, memoranda placed in files or comments placed in the LIMS – Element DataSystem®.

Figure 7-1

PDC Laboratories Inc.
Peoria, IL
Contract Review Record

Date:_____

Client Name: _____

PDC Reviewer: _____

General Description of Services to be provided under this contract:

_____

_____

Length of Contract: _____

Dollar value of Contract:_____

Circle YES, NO, or NA as appropriate for the following: for any NO answers, elaborate in the comments section as appropriate.

1. Does the lab have the proper technical capability? YES NO N/A
2. Does the lab have adequate capacity? YES NO N/A
3. Does the lab have proper resources? YES NO N/A
4. Does the lab have the necessary accreditations/certification? YES NO N/A
5. Does the lab use the required test methods? YES NO N/A
6. Does the lab have the proper quality control measures? YES NO N/A
7. Will any work need to be subcontracted? YES NO N/A
   If yes, does the subcontractor meet all of these requirements? YES NO N/A

   Name of Subcontractor, and nature of subcontracted work.

   _____

8. Will the lab be required to collect samples? YES NO N/A
9. Does the lab have the necessary sample collection capabilities? YES NO N/A
10. Will the lab be able to meet the turnaround time required YES NO N/A
11. Are there any special reporting requirements? YES NO N/A

Comments: _____

_____

Final decision for contract acceptance YES NO Initials_____
Attach additional comments/pages if necessary.

Return completed form to Laboratory Vice President or Designee.

Section 8

SUBCONTRACT OF ENVIRONMENTAL TESTS
(TNI V1:M2 – Section 4.5)

A subcontract laboratory is defined as a laboratory external to this laboratory, or at a different location than the address indicated on the front cover of this manual, that performs analyses for this laboratory.

When subcontracting analytical services, the laboratory assures work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests. The laboratory ensures that the subcontract laboratory understands the requirements and will meet the same commitments made to the client by the primary laboratory except in the case where a client or a regulating authority specifies which subcontractor is to be used.

8.1 Procedure

Determination of Need

During the initiation of a project, a project manager will determine if there is a need to subcontract. Subcontracting is typically needed when PDC Laboratories, Inc. does not perform the requested analysis or does not possess the necessary accreditation for the requested analysis and/or the end user requirements for the resultant data. PDC Laboratories, Inc. shall advise the client in writing of its intention to subcontract any portion of the testing to another party. When internal capacity or equipment issues occur, the Laboratory Vice President will authorize that work which needs to be subcontracted by the project manager.

Analyses that are routinely subcontracted include: radiochemistry, dioxins/furans (soils), asbestos in drinking water, air matrix adsorbent materials, geotechnical (physical properties of soils), suitability, sieve, BTU, coal testing, methane/ethane, yeast and mold, low-level mercury, tannins, PIXE, and carbamates in solid samples by SW-846 Method 8321.

Choice of Subcontract Laboratory

Project managers are responsible for the selection of the subcontract laboratory and should be consistent in their choice. The subcontract laboratory must have the capability and capacity to perform the needed analysis and to submit the results of the tests performed. The subcontract laboratory must possess the appropriate accreditation or certification as required for the end user of the data, if applicable. When a laboratory subcontracts any part of the testing covered under TNI, this work must be sent to a laboratory accredited under TNI, or with a laboratory that meets applicable statutory and regulatory requirements.

The Director of Sample Logistics maintains the list of subcontractors.

The project manager will obtain the cost of the subcontracted work, and the anticipated turnaround time for the subcontracted work.

Project Setup

The project manager is responsible for ensuring that the Sample Control Department is aware of the need to subcontract samples by giving advance notice or by putting the appropriate Element DataSystem® analytes in a schedule for those samples.

Sample Login

All subcontract work must be tracked through the Element DataSystem®. Subcontract analytes in Element start with "01-…" and are assigned to Department 304. If the subcontracted work is known at the time of the original login, the Sample Control Department will add the appropriate codes to the login. If the need to subcontract develops at a later time, the project manager will add the subcontract code to the login. In instances where the sample must be sent directly to the subcontract laboratory from the client, the project manager is responsible for getting appropriate subcontract codes entered and updated in Element.

Shipping

The Sample Control Department is responsible for splitting the sample (if necessary), packaging, filling out the Chain-of-Custody (COC), filling out a Purchase Order (PO), and shipping the samples to the subcontract laboratory. The only sample information provided to the subcontract laboratory is the PDC Element DataSystem® assigned sample number, date and time of collection, and matrix. If a sample is contracted for compliance, it may be necessary to provide more information. Copies of the PO are given to the Director of Sample Logistics. After filling out the appropriate paperwork, the Sample Control department will update the status of the subcontract code in Element to "shipped" status when the sample(s) ship. The Director of Sample Logistics will run a worklist from Element at least daily to verify that subcontracted samples were shipped. Any samples showing up on the worklist will indicate they have not been shipped and the Director of Sample Logistics will question the appropriate project manager as to the status of the project.

If a subcontract code is added after the initial login creation, the project manager is responsible for informing the Director of Sample Logistics that the sample needs to be shipped.

Reporting

When the final report is submitted to the client, the original subcontractor's report must be sent to the client. The PDC Element DataSystem® generated report should include the subcontracted analytes and indicate "Subcontracted Report Attached". In some instances, a transfer file may be used to incorporate subcontracted laboratory data into the body of the standard LIMS report. However, the subcontracted laboratory has to use a LIMS compatible with the Element Data System® and the results must be appropriately identified. Copies of all reports and COCs will be kept in the client report file.

Invoicing

The project manager is responsible for assigning the correct pricing in Element for the subcontracted samples. These costs should be reviewed carefully since some subcontract codes in Element are generic codes that can be used under different circumstances.

Interlaboratory Transfer of Samples Between Network Laboratories

The email/telephone notification portions of this protocol are applicable when transferred samples arrive at the receiving laboratory with less than five calendar days before the expiration of hold time and/or due date. The login/labeling/statuses/COC portions are applicable for all transfers between labs.

The facility receiving the sample initially will log the samples into the Element DataSystem®, assign the appropriate project, testing analytes, complete the COC paperwork, and label the bottles. For those analyses to be performed at the other facility, the appropriate analyte codes need to be entered into Element and the correct department status set. When the facility doing the analysis changes after the initial login, the facility originally doing the analysis needs to change the analysis to the receiving facility's analysis and set the status appropriately.

For short notice samples being shipped from St. Louis, a representative from Client Services will email the appropriate receiving laboratory department manager with the details of what is coming. **A phone call will precede the email**.

The Laboratory Vice President, Senior Project Manager, and Laboratory Supervisor must be copied on the emails. The Sample Control staff at each facility must also be included on the email.

The details of the email should include how many samples are being sent, the sample matrix, when they should arrive, what testing parameters are required, what the requested completion date is, and any other special instructions or pertinent information. The appropriate department manager will respond to all parties via email, acknowledging receipt of the email and informing the sending laboratory whether the requested time frames can be met and if not, what can be done. If the Peoria department manager is out of the office, the Senior Project Manager or Laboratory Vice President will follow up on the email.

For samples being sent from Peoria the same protocol applies.

The Laboratory Supervisor and Client Services must be copied on the emails. The Sample Control staff at each facility must also be included on the email.

If the St Louis contact person is out of the office, a representative of the St. Louis Client Service Department will follow up on the email.

For any instances where this protocol applies to samples being shipped to or from the Springfield lab the contact person is the Laboratory Supervisor or in his absence, the Administrative Assistant.

Section 9

PURCHASING SERVICES AND SUPPLIES
(TNI V1:M2 – Section 4.6)

The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality by using approved suppliers and products. Services include balance calibration, NIST thermometer calibration, autoclave maintenance, Class 1 weight calibrations and service contracts for instrumentation.

The laboratory has procedures for purchasing, receiving, and storage of supplies that affect the quality of environmental tests.

9.1 Procedure

General authority for purchasing rests with the Vice President, Directors and Department Managers. Authority for specific purchasing may be delegated to other staff by these management employees and to the designated Purchasing Agent who deals primarily with laboratory chemicals, reagents and consumables.

Certain supplies and services are unique to a particular section of the laboratory. Purchasing is administered through that particular section.

Quality Assurance**:** Proficiency Testing (PT) samples; balance calibrations; NIST thermometer calibrations; Class 1 weight calibrations

Sample Logistics: sample containers (except microbiological specific sample containers); subcontracted samples; shipping supplies; vehicle repair and maintenance

Facility: supplies – lighting, filters for air handling units, laboratory repair parts and supplies; services – HVAC repair, water purification system and maintenance, wastewater treatment maintenance, security, hazardous waste and lab pack

Chemistry: general supplies, capital purchases, building modifications and repairs; equipment

Microbiology: microbiological specific sample containers, all microbiological supplies; yearly servicing of microscopes, repair/maintenance of autoclaves, microbiological incubators.

(Note: The Microbiology Section is certified by the Illinois Department of Public Health)

IT: computers and peripherals; miscellaneous hardware; software and licenses

Field Sampling: in-line filters, disposable bailers, rental equipment (if needed), replacement probes for pH and specific conductance, depth to water meters, submersible pumps and vehicle repair and maintenance

The current revision of SOP#900-Purchasing, PURCHASING SERVICES and SUPPLIES provides an overview of those processes used to ensure that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality by using approved suppliers and products.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate acceptable quality by signing packing slips or other supply receipt documents after inspection. The purchasing documents contain the data that adequately describes the services and supplies ordered. The description may include type, class, grade, identification, specifications or other technical information.

The supplies received are inspected for breakage, leaks or any other damage. The supplies and chemicals are checked for expiration date, concentration, grade, and storage conditions. The supplies received are stored according to manufacturer's recommendations, laboratory SOPs or test method specifications.

Any documents received with the supplies and services including specifications, certificates of analyses, warranties, maintenance records, calibration records etc are kept on file by the responsible Director or Department Manager.

The purchased supplies and reagents that affect the quality of the tests are not used until they are inspected or otherwise verified as complying with requirements defined in the test method.

9.2 Approval of Suppliers

Each purchasing agent maintains a list of approved suppliers for those items for which they are responsible.

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, the overall quality of their services, their past history and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the management staff.

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 the packing slips or other supply receipt documents.

Section 10

SERVICE TO THE CLIENT
(TNI V1:M2 – Section 4.7)

The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring laboratory performance related to their work. Each request is reviewed to determine the nature of the request and the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients.

10.1 Client Confidentiality

All reports and related information provided to and paid for by clients of PDC Laboratories, Inc. in connection with PDC Laboratories, Inc. are the property of the client. The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization. The term "Confidential Information" means information concerning PDC Laboratories, Inc. which is not generally known to those engaged in similar businesses (realm of public domain) and that is used or obtained by PDC Laboratories, Inc. in connection with its business. Specifics concerning the term "information" and other procedural details may be found in the SOP, CLIENT CONFIDENTIALITY.

No such property will be provided to any other party, by any means (verbal, written, or electronically) or discussed with another party without the expressed consent of the client. PDC Laboratories, Inc. reserves the right to request written authorization to release information. Third party requests for data and information are referred to the client. Data and records identified as proprietary, privileged, or confidential are exempt from disclosure.

No employee shall release, or cause or allow the release of, information to the communications media, except as required by law, concerning the existence or terms of services, including the identification of the client, the samples, or the general description, characteristics, or constituents of the samples, without, in each case, securing the prior consent of the client. Actions contrary to this will result in disciplinary action with possible termination. It is PDC Laboratories, Inc.'s policy to fully comply with any court issued subpoenas for information. Such requests are to be brought to the attention of the Laboratory Vice President or Senior Project Manager for referral/consultation with the company legal representative prior to the release of the information. Affected clients must be advised that such a request (subpoena) has been issued.

When providing information to clients from internal sources that contain other client's information, the identity of the other clients must be withheld. This practice includes preparing QC Summaries, data packages, and any other raw data. To avoid the inadvertent release of Confidential Information, the Director of Quality Assurance or designee should review the information prior to submittal to the client.

In the event of an inadvertent release of information (wrong address on envelope, switched envelopes, incorrect email address, etc.) every effort should be made to have the original information returned to PDC Laboratories, Inc. The source of the inadvertent release will be investigated, the root cause determined, and the resultant corrective action taken, documented and verified.

Electronic transfer of data or any project related information from PDC Laboratories, Inc. via facsimile (fax) or electronic mail systems (e-mail) must be accompanied by the following statement:

> **"This communication including any attachments is for the exclusive and confidential use of the designated recipient and any other distribution or use is unauthorized and strictly prohibited. If you have received this communication in error, please notify the sender by replying to this message and then deleting the message from your system."**

If so notified, the appropriate laboratory representative will decide the further action to be taken.

Note: Disregard of these client confidentiality procedures will result in disciplinary action which may include any or all of the following: verbal warning, written warning, unsatisfactory performance review, salary reduction considerations, termination, or potential legal actions brought in a court of law by outside parties.

10.2 Client Support

Communication with the client, or their representative, is maintained throughout the project to provide proper instruction and for any modification in the testing. Dedicated project managers are available to discuss any technical questions or concerns the client may have.

Clients may request tours of the facility during the bid process, prior to the initiation of a project or during the project. The client, or their representative, is provided reasonable access to laboratory areas for witnessing testing as necessary.

Potential problems, delays or major deviations to the testing are communicated to the client as soon as possible by the overseeing project manager or designee. The form of communication is dependent on the requirements and availability of the client (telephone, email, or text) and the urgency of the situation.

All correspondence between the client and the laboratory that establishes or modifies what is to be done on a project must be documented and retained. Formal requests and subsequent responses are filed in unique client or project specific files. Various forms of documentation may be used on a given project. Project modifications may be documented by placing comments on the chain-of-custody (COC) form, memos placed in the files, or comments placed in the LIMS. Project managers are

encouraged to use telephone logs to document their verbal discussions with clients; however, any form of written documentation such as email is acceptable.

The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

10.3 Client Feedback

The laboratory seeks both negative and positive feedback following the completion of projects and periodically for ongoing projects through the use of review of final reports with the clients as necessary and by the use of surveys to gauge client satisfaction with the laboratory's services. Feedback provides acknowledgement, corrective actions where necessary, and opportunities for continuous improvement.

Negative client feedback is documented as a client complaint (see Section 11 – "Complaints").

Section 11

COMPLAINTS
(TNI V1:M2 – Section 4.8)

The purpose of this Section is to assure that client complaints are addressed and corrected. A complaint is a client's formal expression of dissatisfaction with the performance of one or more of the laboratory's activities. Requests to verify results or analytical data are also included within this definition. The source of the complaint may be either a client or an employee of the laboratory. All client complaints are documented by the person receiving the complaint and are addressed to the Quality Assurance Department. Examples of complaints may include bottle shipment errors, missed sample hold times, calculation errors, data that does not make sense for the analysis performed, incorrect analyses performed, typographical errors, accidentally omitted results or late reports. Complaints provide the laboratory an opportunity to improve laboratory operation and client satisfaction.

Records shall be maintained of all complaints so that the QA Department can track and monitor the complaint process through the investigation and corrective action stages. Lack of documented complaints also prevents management during the managerial review process from determining the suitability of the complaint process and making improvements in laboratory operations and the management system based on an analysis of received complaints.

The complaints are reviewed and investigated by the QA Department and an appropriate action is determined. If it is determined that the complaint has merit, the procedures outlined in Section 14 – Corrective Action are utilized. If it is determined that a complaint is without merit, it is documented, and the client is contacted by the appropriate project manager to explain why no further investigation or corrective action is warranted.

A warranted complaint will be considered resolved when the following conditions are met:

a. all of the facts concerning the complaint have been gathered from the client or party who initiated the complaint, the project files, the project manager, and any employee(s) directly involved,
b. after a review of the facts of the complaint, a decision has been reached and corrective action has been proposed, if necessary, to correct any problems,
c. the proposed corrective action has been taken, and
d. all forms documenting this process have been completed, signed by the appropriate member of management, and filed with the QA Department.

Specific procedural details may be found in the SOP, CLIENT COMPLAINT RESOLUTION.

A complaint such as a concern that data is repeatedly late should be reviewed for preventive action (see Section 15 – "Preventive Action") to minimize a future occurrence.

Section 12

CONTROL OF NON-CONFORMING ENVIRONMENTAL TESTING WORK
(TNI V1:M2 – Section 4.9)

Non-conforming work is work that does not meet acceptance criteria or requirements. Nonconformances can include departures from standard operating procedures or test methods or unacceptable quality control results (see Section 27 – "Quality Assurance for Environmental Testing"). Identification of non-conforming work can come through client complaints, quality control elements, instrument calibration, evaluating consumable materials, staff observation, final report review, management reviews and internal or external audits.

12.1 Exceptionally Permitting Departures from Documented Policies and Procedures

Departures from laboratory procedures are approved by a Department Manager, the responsible Project Manager and by a member of the QA Department. The departure is documented on a Data Exception Report with a concurring signature of from each department. Planned departures from procedures or policies do not require audits or investigations but must be documented as a nonconformance that was approved by management.

Examples of departures may include:

- the required sample volume is not received, and the client wants the analysis completed anyway. The departure would be documented and the data would be qualified if necessary.

- insufficient sample volume is available for a rerun, where holding time has been exceeded, or where sample data are not affected by the nonconformance.

12.2 Non-Conforming Work

The lab policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. Each case needs to be considered on its own merit. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements.

The responsibilities and authorities for the management of non-conforming work are detailed below. The procedure for investigating and taking appropriate corrective actions of non-conforming work is described in Section 14 – "Corrective Actions". Section 14.3 describes procedures for Technical Corrective Actions. Formal corrective action procedures must be followed for non-conforming work that could reoccur (beyond expected random QC element failures) or where there is doubt about the laboratory's compliance to its own policies and procedures.

The investigation and associated corrective actions of non-conforming work involving alleged violations of the company's Ethics and Data Integrity policies must follow the procedures outlined in Section 19 – "Data Integrity Investigations".

The laboratory evaluates the significance of the non-conforming work, and takes corrective action immediately. The client is notified if their data has been impacted. The laboratory allows the release of non-conforming data only with approval by the appropriate Department Manager or the QA Department on a case-by-case basis. Non-conforming data is clearly identified in the final report (see Section 28 – "Reporting the Results") through the use of qualifiers.

The discovery of a nonconformance for results that have already been reported to the client must be immediately evaluated for significance of the nonconformance, its acceptability to the client, and determination of the appropriate corrective action.

Corrective action for routine, non-recurring exceedances is documented on data worksheets, in logbooks, or on Data Exception Reports. More serious corrective actions (non-conforming work that could reoccur or where there is doubt that the laboratory is in compliance with its own policies and procedures) will require a formal investigation and corrective action process that includes documentation through the use of a Corrective Action Form.

12.3 Stop Work Procedures

Personnel **must** notify the appropriate Department Manager of any nonconformance that is a deviation from normal laboratory practices. The Department Manager reviews the significance of the nonconformance and develops a course of action. If data are questionable, the Director of Quality Assurance or designee must be involved in the review and the affected clients are notified by the responsible project manager.

When an investigation of nonconformance indicates that the cause of the nonconformance requires that a method be restricted or not used until modifications are implemented, the Laboratory Vice President, Director of Quality Assurance or Department Manager will immediately notify all personnel of the suspension or restriction. The laboratory will hold all relevant reports to clients pending review. The Director of Quality Assurance or designee must be involved in the resolution of the issue and must verify that the issue is resolved before work may resume. The Department Manager and Director of Quality Assurance will document the issue, root cause and resolution using the corrective action procedures described in Section 14 – "Corrective Action".

The reporting of non-conforming work involving alleged violations of the company's Ethics and Data Integrity policies must be reported to the Director of Quality Assurance or the Laboratory Vice President. Procedures described in Section 19 – "Data Integrity Investigations" are followed.

Resumption of work after work has been stopped is authorized by the Laboratory Vice President, the Director of Quality Assurance or Department Manager. Personnel are notified by the Department Manager when resumption of work is authorized.

Section 13

IMPROVEMENT
(TNI V1:M2 – Section 4.10)

Improvement in the overall effectiveness of the laboratory management system is a result of the implementation of the various aspects of the laboratory's management system: quality policy and objectives (Section 5 – "Management"); internal auditing practices (Section 17 – "Internal Audits"); the review and analysis of data (Section 27 – "Quality Assurance for Environmental Testing"); the corrective action (Section 14 – "Corrective Action") and preventive action (Section 15 – "Preventive Action") process; and the annual management review of the quality management system (Section 18 – "Management Reviews") where the various aspects of the management/quality system are summarized, and evaluated and plans for improvement are developed.

Section 14

CORRECTIVE ACTION
(TNI V1:M2 – Section 4.11)

Corrective action is the action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.

Deficiencies cited in external assessments, internal quality audits, data reviews, client feedback or complaints, control of nonconforming work, failed proficiency testing (PT) samples or managerial reviews are documented and require corrective action. Corrective actions taken are appropriate for the magnitude of the problem and the degree of risk.

14.1 General Procedure

Four basic steps guide the corrective action process:

- Clearly identify the problem: What happened?
    - Be specific. Define the problem or issue as much as possible
    - Ask clarifying questions as needed
        - Why did this occur?
        - What contributed to the problem?
        - How did this happen?
        - Has this occurred before?
        - Why did the previous solution fail?
        - Which one of the quality systems is affected?
- Identify the cause(s): Why did it happen?
    - Brainstorm possible causes. At this point, list all possible causes (do not evaluate or eliminate any).
    - Consider what data can confirm or disprove each possible cause: then collect and analyze that data to eliminate possible causes that are not supported by the data
    - Identify the cause(s) that is the most compelling explanation, based on all available data.
    - Ask “Why?” again!
    - Continue for a minimum of five times
    - Show a logical relationship of each response to the one that preceded it
    - Continue to ask “Why?” until:
        - The Root Cause is reached
        - A problem that is not correctable is reached
        - There is insufficient data to continue
- Develop a plan: What will be done to keep the outcome from recurring?

- Include:
  - Steps to take
  - A timeline
  - Resources that will be needed
  - Person/people responsible for each step

- Monitor the plan: How will the change be validated and verified?

  - Indicate a timeline for each and assign a person/people responsible for each:
    - What assessment or data will be used to determine if the plan is being implemented consistently?
    - What assessment or data will be used to determine if the plan is being effective at addressing the root cause?
    - What assessment or data will be used to determine if the plan is being successful at changing the outcome?

The laboratory uses Data Exception Reports (Figure 14-1), Corrective Action Forms (Figure 14-2) and Proficiency Testing Sample Data Review/Corrective Action Reports (Figures 14-3a and b) to document and track corrective actions.

Department Managers, Project Managers, Directors, members of the Quality Assurance Department, and the Laboratory Vice President are responsible for initiating corrective action on routine data reviews where a nonconformance is found that could reoccur (beyond expected random QC failures) or where there is doubt about the compliance of the laboratory to its own policies and procedures. Department Managers in conjunction with members of the Quality Assurance (QA) Department are responsible for monitoring and recording the corrective action. In addition, the appropriate Project Manager may become involved if the corrective action is client-specific.

14.1.1 Root Cause Analysis

Root Cause Analysis (RCA) is a structured evaluation method that is used to address a problem or a nonconformance in order to get to the “root” or underlying cause of the problem. The method is used to correct or eliminate the cause of a problem and to prevent the problem from recurring. Root Cause Analysis should continue until organizational factors have been identified or until data is exhausted.

Root Cause is the cause or contributing factor that produced the fundamental breakdown or failure of a process which, when corrected, prevents a recurrence of the problem. In other words, once a root cause is identified and fixed, the problem goes away and doesn’t come back. If a poor job is done identifying the root cause of a problem, time and resources are wasted in putting “Band-Aids” on the symptoms of the problem because the “true” problem will never really go away.

Care should be taken when using RCA to discover underlying problems since:

- often there is no clear, obvious cause that immediately jumps out or there are many possible causes such that it becomes difficult to identify the meaningful one,
- some RCA techniques may provide easy answers that are either incomplete or wrong (but easy to find),
- the process may become tedious since one must ask “why” and then to each answer to that question ask “why” again and again until the fundamental cause(s) have been identified,
- blame is an obstacle,
- guidance may be needed to investigate human performance problems,
- there is no way to know for certain that the fundamental root cause has been identified until a corrective action is planned, and
- a perfectly executed RCA may not lead to the desired change the first time.

RCA is a tool to be used to reach the source of a problem but, as with any tool, it requires understanding and skill in applying the various techniques of the method.

Records are maintained by the QA Department of any nonconformance requiring corrective action to show that the root cause(s) was investigated, and includes the results of the investigation.

Where there may be non-systematic errors and as such the initial cause is readily identifiable or expected random failures (e.g. failed quality control), a formal root cause analysis is not performed and the process begins with selection and implementation of corrective action (also see Section 14.3 “Technical Corrective Actions”).

14.1.2 Selection and Implementation of Corrective Actions

Where uncertainty arises regarding the best approach for analysis of the cause of exceedances that require corrective action, appropriate personnel will recommend corrective actions that are appropriate to the magnitude and risk of the problem and that will most likely eliminate the problem and prevent recurrence.

The Laboratory Vice President, appropriate Director or Department Manager ensures that corrective actions are discharged within the agreed upon time frame.

14.1.3 Monitoring of Corrective Action

Members of the QA Department will monitor implementation and documentation of the corrective action to assure that the corrective actions were effective.

14.2 Additional Audits

Where the identification of nonconformances or departures from normal lab procedures cast doubt on the laboratory's compliance with its own policies and procedures or on its compliance with the TNI Standard, the laboratory ensures that

the appropriate areas of activity are audited in accordance with Section 17 – "Internal Audits" as soon as possible.

In many cases, these additional audits are follow-ups after corrective action has been implemented to ensure its effectiveness. These are done when a serious issue or risk to the laboratory has been identified.

14.3 Technical Corrective Action

Sample data associated with a failed quality control are evaluated for the need to be reanalyzed or qualified. Unacceptable quality control results are documented, and if the evaluation requires cause analysis, the cause and solution are recorded (also see Section 12 – "Control of Nonconforming Environmental Testing Work"). Analysts routinely implement corrective actions for data with unacceptable QC measures. First level correction may include re-analysis without further assessment or qualifying the data if re-analysis is not possible. If the test method SOP addresses the specific actions to take, they are followed. Otherwise, corrective actions start with assessment of the cause of the problem.

Corrective action for non-systematic errors or expected random failures is documented on Data Exception Reports. Corrective actions for nonconformances that may reoccur (beyond expected random QC failures) or where there is concern that the laboratory is not in compliance with its own policies and procedures require that a Corrective Action Report be completed (see Section 14.1).

Department Managers and the QA Department review the Corrective Action Reports and suggest improvements, alternative approaches, and procedures where needed.

If the data reported are affected adversely by the nonconformance, the affected data is clearly identified in the report and the client is notified.

Figure 14-1: Data Exception Report

PDC Laboratories, Inc. – Data Exception Report
YEAR – DER – Department – Incident Number

Section 1: Source or Nature of the Nonconformance

Analytical Section: Inorganics ☐ Metals Prep. ☐ Metals ☐ Organics Ext. ☐
GC ☐ HPLC ☐ GC/MS ☐ HRGC/HRMS ☐

Client: _____ Sample #: _____

Method/Parameter: _____ Matrix: _____

Problem Incurred:
Hold time ☐ Duplicate ☐ MS/MSD ☐ Limited Sample ☐ Surrogate ☐
BS ☐ Matrix Interference ☐ Blank ☐ Instrument Problem ☐ Other ☐

Explanation: _____

Analyst: _____ Date: _____

Section 2: Department Manager Investigation/Corrective Action/Resolution

Manager: _____ Date: _____

Section 3: Acknowledgement of Nonconformance and Corrective Action

Depart. Manager: _____ Date: _____
Project Manager: _____ Date: _____
QA Director: _____ Date: _____

Section 4: To be completed by the Project Manager

Problem handled in accordance with project QC guidelines: Yes ☐ No ☐
Data acceptable for release to client: Yes ☐ No ☐
Client Contacted: Yes ☐ No ☐ Contact Name: _____ Date Contacted: _____
Required Action: _____

Project Manager: _____ Date: _____

Section 5: To be completed by QA

Problem handled in accordance with Quality System Procedure: Yes ☐ No ☐
Comments: _____

QA Director: _____ Date: _____

Section 6: Routing (original form to QA if hardcopy)

Raw Data Box ☐ Electronic Folder ☐ Department Manager ☐ Project Manager ☐ QA ☐

Figure 14-2: Corrective Action Report

PDC Laboratories, Inc. – Corrective Action Form
YEAR – CAF – Department – Incident Number

Originated by: **Date:**

Department: **Contact:**

Response Due Date: **Completed:**

A. Departure from Quality System Policy or Procedure and Investigation

Describe the departure (What was the departure from policy? Why?)

B. Departure from Standard Operating Procedure (SOP) and Investigation

Describe the departure (What was the departure from the SOP? Why?)

C. Other Problems and investigation

Describe the situation (How did you know something was wrong?)

Corrective Action Mechanism

List any activities or checks performed to identify the source and resolve the problem.

Documentation of Resolution

What changes have been made to prevent the problem from reoccurring?

Data Qualification

Identify affected samples and qualifier used

QA Verification of Corrective Action

Signature: Date:

Figure 14-3a: PT Sample Data/Corrective Action Report – Organics

PDC Laboratories, Inc.
Proficiency Testing (PT) Sample Data Review/Corrective Action Report
YEAR – STUDY – DRCA – ORG – INCIDENT NUMBER

ORGANICS

Study: _____ Date Response Due: _____

Sample: _____ Parameter: _____

Reported Value: _____ True Value: _____

Acceptance Range: _____

Summary of Sample and QC Data
(Please indicate appropriate answer-pass/fail, % recovery with acceptance criteria)

Analyst: _____ Instrument: _____

Method: _____ Initial Calibration (% RSD or r): _____

ICV: _____ IB: _____ PEM: _____

LPC: _____ S/N: _____ MDLCHK: _____

PRL: _____ BFB: _____ DFTPP: _____

CCV before sample: _____ CCB before sample: _____

CCV after sample: _____ CCB after sample: _____

Method Blank: _____ Blank Spike: _____

Blank Spike Duplicate: _____ MS/MSD Spike: _____

Explanation /Possible Source of Error: _____

_____

_____

_____

Corrective Measures Taken: _____

_____

_____

_____

Department Manager: _____ Date: _____

QA Department: _____ Date: _____

Corrective Action Verified - QA Dept. _____ Date: _____

Figure 14-3b: PT Sample Data/ Corrective Action Report – Inorganics

PDC Laboratories, Inc.

Proficiency Testing (PT) Sample Data Review/Corrective Action Report
YEAR – STUDY – DRCA – INORG – INCIDENT NUMBER

INORGANICS

Study: _____ Date Response Due: _____

Sample: _____ Parameter: _____

Reported Value: _____ True Value: _____

Acceptance Range: _____

Summary of Sample and QC Data
(Please indicate appropriate answer-pass/fail, % recovery with acceptance criteria)

Analyst: _____ Instrument: _____

Method: _____ Initial Calibration (% RSD or r): _____

ICV: _____ ICB: _____

CCV before sample: _____ CCB before sample: _____

CCV after sample: _____ CCB after sample: _____

Method Blank: _____ Blank Spike: _____

Blank Spike Duplicate: _____ Duplicate or MS/MSD Spike: _____

ICS before/after: _____ Post Digestion Spike: _____

Explanation /Possible Source of Error: _____

_____

_____

_____

Corrective Measures Taken: _____

_____

_____

_____

Department Manager: _____ Date: _____

QA Department: _____ Date: _____

Corrective Action Verified - QA Dept. _____ Date: _____

Section 15

PREVENTIVE ACTION
(TNI V1:M2 – Section 4.12)

Preventive action is a pro-active process to identify opportunities for improvement rather than simply a reaction to the identification of problems or complaints. Preventive Action is the next logical step after a permanent root cause corrective action. A root cause corrective action is the action taken to eliminate the error on an affected process. A preventive or systemic corrective action is the action to prevent the error from recurring on <u>any</u> process.

Preventive action includes, but is not limited to: use of control charts to review QC data to identify quality trends, regularly scheduled staff quality meetings to ensure staff is knowledgeable in quality procedures, review of client feedback to look for improvement opportunities, review of proficiency testing data to look for analytes that were nearly missed, annual managerial reviews, scheduled instrument maintenance, and other actions taken to prevent problems.

When improvement opportunities are identified or if preventive action is required, action plans are developed, implemented and monitored to reduce the likelihood of the occurrence of nonconformities.

Procedures for preventive actions include the initiation of such actions and subsequent monitoring to ensure that they are effective.

All personnel have the authority to offer suggestions for improvements and to recommend preventive actions, however management is responsible for implementing preventive action.

A Request For Change (RFC) form and completion instructions are available from the Quality Assurance Department to document the request, the formal review by the Department Managers, Laboratory Vice President and Director of Quality Assurance, and any actions taken.

Section 16

CONTROL OF RECORDS
(TNI V1:M2 – Section 4.13)

Records are a subset of documents, usually data recordings that include annotations, such as daily refrigerator temperatures posted to a laboratory form, lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample-handling and analysis.

The laboratory maintains a record system appropriate to its needs, records all laboratory activities and complies with applicable standards or regulations as required. Records of original observations and derived data are retained to establish an audit trail. Records help establish factors affecting the uncertainty of the test and enable test repeatability under conditions as close as possible to the original.

16.1 Records Maintained

Records of all procedures to which a sample is subjected while in the possession of the laboratory are kept. The laboratory retains all original observations, calculations and derived data (with sufficient information to produce an audit trail), calibration records, personnel records and a copy of the test report for a minimum of five years from generation of the last entry in the records. At a minimum, the following records are maintained by the laboratory to provide the information needed for historical reconstruction:

i) all raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' worksheets and data output records (chromatograms, strip charts, and other instrument response readout records);

ii) a written description or reference to the specific method(s) used, which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value (a copy of all pertinent Standard Operating Procedures);

iii) laboratory sample ID code;

iv) date of analysis;

v) time of analysis is required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., extractions and incubations);

vi) instrumentation identification and instrument operating conditions/parameters (or reference to such data);

vii) all manual calculations (including manual integrations);

viii) analyst's or operator's initials/signature or electronic identification;

ix) sample preparation, including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;

x) test results (including a copy of the final report);

xi) standard and reagent origin, receipt, preparation, and use;

xii) calibration criteria, frequency and acceptance criteria;

xiii) data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;

xiv) quality control protocols and assessment;

xv) electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries;

xvi) method performance criteria including expected quality control requirements;

xvii) proficiency test results;

xviii) records of demonstration of capability for each analyst;

xix) a record of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory record;

xx) correspondence relating to laboratory activities for a specific project;

xxi) corrective action reports;

xxii) preventive action records;

xxiii) copies of internal and external audits including audit responses;

xxiv) copies of all current and historical laboratory SOPs, policies and *Quality Manual*s or Plans;

xxv) sample receiving records (including information on any interlaboratory transfers);

xxvi) sample storage records;

xxvii) data review and verification records;

xxviii) personnel qualification, experience and training records;

xxviv) archive records; and

xxviv) management reviews.

16.2 Records Management and Storage

The laboratory maintains a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage, and reporting. Data is recorded immediately and legibly in permanent black ink (data generated by automated data collections systems is recorded electronically.) Corrections are initialed and dated with the reason noted for corrections (other than transcription errors) as needed. A single line strikeout is used to make corrections so that the original record is not obliterated. Corrections made to electronic documentation are tracked through the audit trail function of the LIMS.

The data stored in the Element DataSystem® (LIMS) is backed-up daily off-site (cloud storage). All other data system back-ups are done in-house daily.

Records, including electronic records, are easy to retrieve, legible, and protected from deterioration or damage; held secure and in confidence; and are available to accrediting bodies for a minimum of five years or as required by regulation or contract. Records that are stored only on electronic media are supported by the hardware and software necessary for their retrieval. Access to protected records is limited to the Corporate IT Manager and to the Laboratory Systems Administrator to prevent unauthorized access or amendment.

Additional information regarding control of data is included in Section 22.5 – “Control of Data”.

The current revision of SOP-GEN-HrdcpyRecStrge, Hardcopy Record Storage, Retrieval and Disposal details the storage, retrieval and disposal procedures for non-electronic records of raw analytical data and the hardcopy records of client report files. Archived records have limited access and are checked out through an access log. Hardcopy quality records are maintained within the QA Department. Electronic versions are stored in a shared network folder on a laboratory file server.

Records less than one and one-half years old are stored on-site at the facility. Records older are stored at a secure off-site facility. Records older than five years are destroyed by a third party service which provides confidential record disposal. However, records deemed to be “historical” may be kept for greater than five years. The record disposal service provides a certificate of records destroyed upon completion of the destruction.

In the event that the laboratory transfers ownership or goes out of business, records are maintained or transferred according to client instructions as per the current revision of SOP-GEN-RcrdTrnsfer, Record Transfer Procedure.

In the event that PDC Laboratories, Inc. purchases another laboratory or is purchased by another laboratory, the transaction will include an agreement that contains a statement detailing who is to retain and be responsible for the analytical records. In the event that PDC Laboratories, Inc. goes out of business, Coulter Companies, Inc. (the laboratory's parent company) will retain the records.

Appropriate regulatory and state legal requirements concerning laboratory records shall be followed.

16.3 Legal Chain of Custody Records

Evidentiary sample data are used as legal evidence. Procedures for evidentiary samples can be found in the current revision of SOP-GEN-InternalCOC, Internal Chain of Custody. In cases where the custody of a sample must be documented, this procedure details the steps taken to provide the means of meeting this objective. A sample is in someone's custody if it is in their physical possession, it is in their view after being in their physical possession, and it was in their physical possession and is now secured so that no one can tamper with it, or it is kept in a secure area restricted to authorized personnel only. All steps must be documented with sample number, container type, date/time of transfer, and initials.

Section 17

AUDITS
(TNI V1:M2 – Section 4.14)

Audits measure laboratory performance and verify compliance with accreditation/ certification and project requirements. Audits specifically provide management with an on-going assessment of the management system. They are also instrumental in identifying areas where improvement in the management/quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system. Section 17.5 discusses the handling of audit findings.

17.1 Internal Audits

Annually, the laboratory performs a series of internal audits as documented in the current revision of SOP-GEN-Audit, Internal Performance and Quality System Audits. These audits verify compliance with the requirements of the management/quality system, including analytical methods, SOPs, the *Quality Manual*, ethics policies, data integrity, other laboratory policies, and the TNI Standard. Additional areas of the management system audited include: complaints, contract review, records storage, training, LIMS/IT, subtracting, preventive action, purchasing, service to the client, and control of non-conforming work.

It is the responsibility of the Director of Quality Assurance to plan and organize audits as required by the schedule and requested by management. These audits are carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited.

In addition to the scheduled internal audits, it may sometimes be necessary to conduct special audits as a follow-up to corrective actions, PT results, complaints, regulatory audits or alleged data integrity issues. These audits address specific issues.

The area audited, the audit findings, and corrective actions are recorded. Audits are reviewed after completion to assure that corrective actions were implemented and effective.

17.2 External Audits

It is the laboratory's policy to cooperate and assist with all external audits, whether performed by clients or an accrediting body. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit.

17.2.1 Confidential Business Information (CBI) Considerations

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

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

17.3 Performance Audits

Performance audits may be Proficiency Test Samples, internal single-blind samples, double-blind samples through a provider or client, or anything that tests the performance of the analyst and method.

Proficiency Test Samples are discussed in Section 27 – "Quality Assurance for Environmental Testing".

17.4 System Audits

The Laboratory's management system is audited though annual management reviews. Refer to Section 18 – "Management Reviews" for further discussion of management reviews.

17.5 Handling Audit Findings

Internal or external audit findings are responded to within the time frame agreed to at the time of the audit. The response may include action plans that could not be completed within the response time frame. A completion date is established by management for each action item and included in the response.

The responsibility for developing and implementing corrective actions to findings is the responsibility of the Director of Quality Assurance and the appropriate department manager. Corrective actions are documented through the corrective action process described in Section 14 – "Corrective Actions".

Audit findings that cast doubt on the effectiveness of the laboratory operation to produce data of known and documented quality or that question the correctness or validity of sample results must be investigated. Corrective action procedures described in Section 14 – "Corrective Action" must be followed. Clients must be notified in writing if the investigation shows the laboratory results have been negatively affected and the clients' requirements have not been met. The client must be notified within three working days of the conclusion of the investigation and formulation of an appropriate corrective action. Laboratory management will ensure that this notification is carried out within the specified time frame.

All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients. See Section 19 (Data Integrity Investigation) for additional procedures for handling inappropriate activity.

Section 18

MANAGEMENT REVIEWS
(TNI V1:M2 – Section 4.15)

Top management reviews the management system on an annual basis and maintains records of review findings and actions.

18.1 Management Review Topics

The following are reviewed to ensure their suitability and effectiveness:

- the suitability of policies and procedures;
- reports from managerial and supervisory personnel;
- the outcome of recent internal audits;
- corrective and preventive actions;
- assessments by external bodies;
- the results of proficiency tests;
- changes in the volume and type of the work;
- client feedback;
- complaints;
- recommendations for improvement;
- other relevant factors, such as quality control activities, resources, and staff training.

These items may be considered during strategic planning and regular management meetings.

18.2 Procedure

Findings and follow-up actions from management reviews are recorded. Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame. Further information is documented in the SOP, QUALITY SYSTEM REVIEW PROCEDURE.

Section 19

DATA INTEGRITY INVESTIGATIONS
(TNI V1:M2 – Section 4.16)

In addition to covering data integrity investigations, this Section covers all topics related to ethics and data integrity policies, procedures and training.

PDC Laboratories, Inc. is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its clients. The elements in PDC Laboratories, Inc.'s Ethics and Data Integrity program include:

- Documented data integrity procedures reviewed, signed and dated by senior staff.
- An Ethics and Data Integrity Agreement signed by all staff at time of employment and maintained by the Quality Assurance Department.
- New employee ethics orientation.
- Annual data integrity refresher training.
- Procedures for confidential reporting of alleged data integrity issues.
- An audit program that monitors data integrity (see Section 17 – "Audits") and procedures for handling data integrity investigations and client notifications.

19.1 Ethics and Data Integrity Procedures

The Ethics and Data Integrity Policy provides an overview of the program. Written procedures that are considered part of the Ethics and Data Integrity program include:

- Ethics and Data Integrity Policy (Appendix A)
- Chromatographic Peak Integration Procedures (SOP-GEN–ManInteg)
- Corrective action procedures (Section 14)
- Control of non-conforming environmental testing work (Section 12)
- Procedures for Data Integrity Investigations (Section 19.4)
- Data recall procedures (Sections 12.2 and 12.3)
- Data integrity training procedures (Section 19.2)
- New employee ethics orientation (third party training)

Senior Management reviews data integrity procedures yearly and updates these procedures as needed.

19.2 Training

Data integrity training is provided as a formal part of new employee orientation and a refresher is given annually for all employees. Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences

including immediate termination, debarment or civil/criminal prosecution. Attendance for required training is monitored through a signature attendance sheet. Computer-based or on-line training is documented through read/understand forms signed, dated and returned to the QA Department upon completion.

An agenda is provided to each trainee prior to the training class. Data integrity training emphasizes the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient. The following topics and activities are covered:

- organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting;
- how and when to report data integrity issues;
- record keeping;
- training, including discussion regarding all data integrity procedures;
- data integrity training documentation;
- in-depth data monitoring and data integrity procedure documentation; and
- specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

When contracted technical or support personnel are used, the appropriate department manager is responsible for ensuring that they are trained to the laboratory's management system and data integrity procedures, competent to perform the assigned tasks, and appropriately supervised.

Topics covered are provided in writing and provided to all trainees.

19.3 Confidential Reporting of Ethics and Data Integrity Issues

PDC Laboratories, Inc. personnel who are aware of, or reasonably suspicious of, any unethical practice or misconduct occurring in the laboratory shall inform the appropriate department manager or director as soon as possible. However, if the employee is not comfortable with discussing the issue with the appropriate manager/director or if the manager/director does not satisfactorily address the concern, the Director of Quality Assurance should be contacted. If an individual desires complete confidentiality, a written statement should be sealed into an envelope and placed into the mailbox of the Director of Quality Assurance.

All questions or concerns will be taken seriously. The Director of Quality Assurance will assure confidentiality and a receptive environment in which to privately discuss a personal ethical dilemma with a staff member or observed unethical practices by other members of the staff. The Director of Quality Assurance will advise the Laboratory Vice President of a need for a detailed investigation

19.4 Investigations

The Director of Quality Assurance will conduct a confidential investigation using qualified technical and management personnel when warranted. The investigation may include interviews, data audits, internal method audits, and surveillance to determine any inappropriate practices. During the investigative process, if it becomes necessary to interview members of staff, a second member of the Senior Staff (Director) may be asked to attend for protection of both the interviewer and interviewee. The second person may also be a member of the Corporate Human Resources (HR) staff.

All data integrity incidents must be documented, including investigative findings, disciplinary actions and corrective actions. However, any disciplinary actions will become part of the employee's HR file, and thereby, be confidential to all except the employee, his supervisor and the HR department. All records of the investigation are kept strictly confidential and are maintained for a period of five years. Confidentiality of documentation is maintained by use of locked filing cabinets or desks and password protected electronic files. A summary of investigation results/disciplinary actions/corrective actions will be maintained for review to verify compliance with the TNI standard by the TNI assessor. However, the names of the individuals involved will be protected due to confidentiality guidelines issued by Human Resources. When an inappropriate practice has an impact on data integrity and reported values, the Laboratory Vice President will be informed and the Senior Project Manager or designee will initiate client contact and data recall if required.

PDC Laboratories, Inc. will not tolerate retaliation against anyone who in good faith asks a question or reports a concern. Any employee who retaliates against other employee for reporting a problem or raising an issue will be subject to discipline. This policy applies regardless of the ultimate outcome.

Section 20

PERSONNEL
(TNI V1:M2 – Section 5.2)

PDC Laboratories, Inc. employs competent personnel based on their education, training, experience and demonstrated skills as required by their position. The laboratory's organization chart can be found in Appendix B.

20.1 Overview

All personnel are responsible for complying with all quality and data integrity policies and procedures that are relevant to their area of responsibility.

All personnel who are involved in activities related to sample analysis, evaluation of results or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to any personnel in training and the trainer is accountable for the quality of the trainees work. Personnel are qualified to perform the tasks they are responsible for based on education, training, experience and demonstrated skills as required for their area of responsibility.

The laboratory has established minimum requirements with respect to education, training and skills of laboratory staff for each general area of responsibility. These requirements are outlined in Table 20-1. Training needs are identified at the time of employment and when personnel are moved to a new position or new responsibilities are added to their job responsibilities. Ongoing training, as needed, is also provided to personnel in their current jobs. The effectiveness of the training must be evaluated before the training is considered complete.

Contracted personnel, when used, must meet the same competency standards and follow the same policies and procedures that laboratory employees must meet.

Table 20-1
Minimum Job Function Requirements

Area of Responsibility	Minimum Education	Minimum Experience
Microbiology	Four year degree in science field or equivalent experience or combination of education and experience	No experience necessary if degreed; minimum of one year experience in laboratory analysis if not degreed
Laboratory Systems Administrator	Two year degree or equivalent	One to two years experience; or equivalent combination of education and experience
QA/QC Coordinator	Four year degree in Chemistry, Biology or related scientific discipline	Two years experience in a chemistry laboratory in two or more departments; or equivalent combination of education and experience

Area of Responsibility	Minimum Education	Minimum Experience
Extraction Supervisor	Four year degree in Chemistry, Biology or related scientific discipline	Two years experience in a chemistry laboratory utilizing organic extraction methods; or equivalent combination of education and experience
Organics – Analyst	Four year degree in Chemistry, Biology or related scientific discipline	One to two years experience in a chemistry laboratory utilizing organic methods; or equivalent combination of education and experience
Organics - Technician	High School diploma or GED	No experience necessary
Metals Supervisor Wet Chemistry Supervisor	Four year degree in Chemistry, Biology or related scientific discipline	Two years experience in a chemistry laboratory utilizing inorganic methods; or equivalent combination of education and experience
Metals – Analyst Wet Chemistry - Analyst	Four year degree in Chemistry, Biology or related scientific discipline	One to two years experience in a chemistry laboratory utilizing inorganic methods; or equivalent combination of education and experience
Metals – Technician Wet Chemistry - Technician	High School diploma or GED	No experience necessary
Facility Support Supervisor	Two year degree or equivalent	Six months to one year of related experience and/or training; or equivalent combination of education and experience
Facility Support Technician	One year certificate or equivalent	Three to six months of related experience and/or training; or equivalent combination of education and experience
Sample Control Supervisor	High School diploma or GED	Two years supervisory experience
Sample Control Technician	High School diploma or GED	No experience necessary
Shipping Supervisor	High School diploma or GED	Two years supervisory experience
Shipping Technician	High School diploma or GED	No experience necessary
Courier Supervisor	High School diploma or GED	Two years supervisory experience
Courier	High School diploma or GED	Minimum of one year experience; possess a valid driver's license; able to pass IL MVR check (safe driving record)
Sampling Supervisor	Two year degree or field experience equivalent	No experience necessary; possess a valid driver's license; able to pass IL MVR check (safe

		driving record); lift 50 pounds
Area of Responsibility	**Minimum Education**	**Minimum Experience**
Sampling Technician	High School diploma or GED	No experience necessary; possess a valid driver's license; able to pass IL MVR check (safe driving record); lift 50 pounds
Project Manager Assistant	High School diploma or GED	No experience necessary
Administrative Assistant	High School diploma or GED	No experience necessary

20.2 Job Descriptions

Electronic versions of job descriptions for positions that manage, perform, or verify work affecting data quality are located in a shared network folder on a laboratory file server. An overview of senior management's responsibilities is included in Section 5 – "Management".

Job descriptions include the specific tasks, minimum education and qualifications, skills, and experience required for each position

20.3 Training

All personnel are appropriately trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained. Training records are used to document management's approval of personnel competency. The date on which authorization and/or competence is confirmed is included.

Training records are maintained by senior management for each employee and include: documentation regarding specific training related to analyses performed, SOP review, source method review, MDL studies, initial demonstration of capability (IDOC) studies, ongoing demonstration of capability (DOC) studies and results of PT samples.

A separate file kept by the QA Department contains proof of education (diploma/transcripts), a signed Ethics and Data Integrity Agreement, training certificates/verifications, and summaries of departmental training records, IDOC and DOC studies, MDL studies and PT results.

20.3.1 Qualification of Trainers

To train another employee on a procedure, a trainer must have hands-on, working knowledge of the procedure and a complete and thorough understanding of the source method and SOP as evidenced by:

1. a training record sign-off for the procedure in their training file,
2. a "read/understood" sign-off for the supporting SOPs,

3. a "read/understood" sign-off for the source method, and
4. recent experience conducting the procedure including a current DOC.

The department manager may evaluate and approve individuals for test procedures based on relevant prior experience and education.

20.3.2 Training for New Staff

New staff members are given the following general laboratory orientation upon arrival:

1. Welcome – Orientation Overview and Agenda,
2. New Employee Payroll Documentation,
3. Anti-Harassment Acknowledgement,
4. Drug Free Workplace Acknowledgement,
5. Family Medical Leave Act Acknowledgement,
6. New Employee Network Sign on and Request Form,
7. Clock In/Out and Uniform & Equipment Forms, and
8. "Brief Lab Tour" – Restrooms and Break Room.

Additional "new employee" topics covered include:

1. Policy and Administration

   a. Employee Identification Register (signs printed and script name with initials)
   b. Ethics & Data Integrity Agreement (sign-off),
   c. Lab Security SOP,
   d. Instructions for Lab Security Systems,
   e. Lab Emergency Contact List,
   f. EEO/Veterans/Disability Form (fill-out),
   g. Funeral Leave Policy/Absence-Illness Policy,
   h. Paid Time Off Policy,
   i. Timesheet & Timecard Policy, Meal Break/Break, Lab Security, Passwords and Password Security Policy,
   j. Confidentiality,
   k. Electronic Communications Policy/Laboratory – New User Sign on Request,
   l. Lab coat and Dress Requirements,
   m. Recycling Program,
   n. Housekeeping Reminder Memo, and
   o. Contact the Health and Safety Officer (HSO) to schedule company physical (if applicable).

2. Provisions

   a. Lab coats,
   b. Locker Assignment, and
   c. Mailbox Assignment.

3. IT Orientation

    a. Computer/Internet Use Policy, and
    b. Computer User Logon Request

4. QA Orientation

    a. Quality Assurance Program – Overview,
    b. Quality Manual (sign-off), and
    c. Copy of applicant's resume and diploma/transcripts for QA employee file

The new employee orientation is documented on the Employee Orientation Checklist that outlines what was covered during the training.

20.3.3 Initial Training

The initial training for a new task contains the following steps:

1. All documentation involved with a new and unfamiliar task is read and understood by the trainee, including but not limited to SOP and source method documents.
2. Training is under direct supervision of a certified senior analyst. During the time the analyst is in training, the trainee may sign laboratory notebooks, logbooks, worksheets, etc. but they must be co-signed by the trainer.
3. The trainee must demonstrate competency in new tasks before they can perform independently, i.e., with a certified analyst not present at the time of testing. An IDOC must be performed to prove competency. Approval of competency is noted by the date and signature of the department manager on the training form.
4. Each step of the training process is documented. Records of certification are maintained by the department manager.
5. The documentation is kept in the employee's training record with a copy forwarded to the QA Department.

20.3.4 Ongoing Training

Staff members are given the following ongoing training, as applicable:

1. The employee attests, through signature, that they have read, understood, and agree to comply with the latest version of the Quality Manual and any SOPs, documented procedures or policies that the employee is responsible for following.
2. At least annually, the analyst demonstrates ongoing capability in each method they perform.
3. The employee attends in-house training relating to job function as applicable.
4. The employee participates in vendor training and workshops.
5. The employee attends refresher data integrity training.

6. The analyst attends health and safety training as required.
7. The staff member gains familiarization with administrative and personnel policies and procedures by HR or designate.

Training documentation is maintained in the employee's training record.

Section 21

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS
(TNI V1:M2 – Section 5.3)

21.1 Environmental

The laboratory facility is designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement.

The laboratory facilities are clean, have adequate temperature and humidity control, and have adequate lighting at the bench top. Since instrument performance can be affected by sources of heat and cold (e.g. direct sunlight), heating/cooling from air conditioner outlets, and drafts, and vibration, care is taken to ensure that effects from these various sources are minimized.

Instrument room temperatures are generally maintained between 50 to 95°F (10 - 35°C) as per instrument manufacturer's recommendations. Temperature fluctuations within a room are kept to a minimum. As the laboratory temperature increases, system reliability decreases. All electronic components generate heat while operating. This heat must be dissipated to the surrounding air for air for the components to continue to operate reliably.

The relative humidity of the operating environment is generally between 20% and 80%, with no condensation. Operating an instrument in an environment with very low humidity can cause the accumulation and discharge of static electricity, which can shorten the life of electronic components. Operating the system in an environment with high humidity can cause condensation, oxidation, and short circuits. It can also cause the accumulation of dust that can block filters on cooling fans.

The facility utilizes an uninterruptible power supply (UPS) with a back-up generator for critical equipment including computers, instrumentation, and ventilation. The UPS continually monitors incoming electrical power and removes the surges, spikes, sags, and other irregularities that are inherent in commercial utility power. The UPS system supplies clean, consistent power that sensitive electronic equipment requires for reliable operation. During brownouts, blackouts, and other power interruptions, batteries provide power to safeguard operation. A diesel laboratory reserve power generator augments the reserve batteries in the event of a sustained power failure.

If the laboratory environment is required to be controlled by a method or regulation, the adherence is recorded. The recording of the room temperature during TCLP extraction with a Min-Max thermometer documents that the required criteria are maintained.

Environmental tests are stopped when the environmental conditions jeopardize the results.

21.2 Work Areas

Work areas may include access and entryways to the laboratory, sample receipt area, sample storage area, sample process area, instrumental analysis area, chemical and waste storage area and data handling and storage area.

Access to, and use of, areas affecting the quality of the environmental tests is controlled by restriction of areas to authorized personnel only. See Section 21.4 below.

The laboratory work spaces are adequate for their use, and appropriately clean to support environmental testing and ensure an unencumbered work area. Laboratory area housekeeping direction falls primarily on the department managers and section supervisors. Detailed dusting and cleaning on laboratory benches, around instruments or equipment is to be performed by the employees responsible for their workspace. Facility support staff may assist in such cleaning, however, they are not to clean without the direct oversight of the employees or supervisory staff in that area.

Laboratory space is arranged to minimize cross-contamination between incompatible areas of the laboratory. The facility houses separate zoned laboratory areas that are served and separately controlled by a variable air volume (VAV) ventilation system. Control of the escape or entrance of air borne contaminants is a result of strategic control and operation of pressure controlled areas. This system includes two separate air handling and make-up air systems. In addition, two laboratories (Organic Volatiles Instrumentation and Total Organic Halides) have their own ventilation systems to minimize volatile air contamination. An assortment of fume hoods, including conventional hoods, slot hoods, canopy hoods, walk-in hoods, and a glove box are utilized to minimize contamination and to protect the staff. The Chemical Hygiene Officer monitors the hood efficiency in accordance with the Chemical Hygiene Plan.

A variety of large coolers, including walk-in style coolers, are available for the separate storage of samples from standards, standards from reagents, and to minimize cross contamination between different sample types. Select coolers are lockable as per client contract requirements with all coolers located in secure areas.

21.3 Floor Plan

A floor plan can be found in Appendix C.

21.4 Building Security

An electronic security system is utilized to control access to the facility. This system enables only authorized personnel to enter the facility through magnetic access keycard-controlled doors while automatically documenting the time of card

use. A security company provides 24 hour monitoring with a direct link to all doors and hallway motion detectors. Upon receipt of an alarm signal, security personnel call the laboratory facility. If the call goes unanswered, the service notifies authorities who respond in less than five minutes. The fire alarm is also tied into the security access monitoring for the purpose of monitoring the system and dispatching the fire department. In the event of a power failure, the alarm system is maintained by the UPS system.

The SOP, Laboratory Security, documents the measures that have been established to provide and ensure the physical security of PDC Laboratories, Inc.

A Visitor's Logbook is maintained for every visitor to sign in and out. Visitors must be accompanied by laboratory personnel when in secure areas. Visitors who need to go beyond the main reception area, the sample receiving area or the shipping area are required to sign a register log in order to gain entry to the rest of the facility. Visitors to PDC Laboratories, Inc. must wear a "Visitor" tag while in the facility. Visitors are the responsibility of the sponsoring laboratory employee. While in the facility, every effort must be made to ensure the safety of the visitor and the security of the facility. Sponsors must also take measures to protect the confidentiality of PDC Laboratories, Inc. and that of its clients. Sponsors must be conscientious to the workplace environment and preserve a productive work atmosphere for all other employees while they host a visitor.

Signs are used to designate secure or restricted areas.

Section 22

ENVIRONMENTAL METHODS AND METHOD VALIDATION
(TNI V1:M2 – Section 5.4 and Sections 1.4, 1.5 and 1.6 of Technical Modules TNI V1:M 3-7)

Methods and/or procedures are available for all activities associated with the analysis of the sample including preparation and testing. For purposes of this Section, "method" refers to both the sample preparation and determinative methods.

Before being put into use, a test method is confirmed by a demonstration of capability or method validation process.

All methods are published or documented. Deviations from the methods are allowed only if the deviation is documented, technically justified, authorized by management and accepted by the client

22.1 Method Selection

A reference method is a method issued by an organization generally recognized as competent to do so. (When ISO refers to a standard method, that term is equivalent to reference method.) When a laboratory is required to analyze a parameter by a specified method due to a regulatory requirement, the parameter/method combination is recognized as a reference method.

The laboratory will use methods that meet the needs of the client. Such methods will be based on the latest edition of the method unless it does not meet the needs of the client or an earlier version is mandated by the applicable regulatory authority.

The laboratory selects methods that are appropriate to the client needs. When the regulatory authority mandates or promulgates methods for a specific purpose, only those methods will be used.

If a method proposed by a client is considered to be inappropriate or out-of-date, the client is informed and the issue resolved before proceeding with analysis of any samples (see Section 7 – Review of Requests, Tenders and Contracts).

If a method is not specified by the client, an appropriate method will be selected based on client needs and available technology. The method selected should be capable of measuring the specific parameter of interest in the concentration range required and with the required precision and accuracy to meet the client's data quality objectives (DQOs). The client will be informed of the selected method and must approve its use before being used to report data.

All communications between the laboratory and the client are documented.

22.2 Laboratory-Developed Methods

If the laboratory develops a method, the process of designing and validating the method is carefully planned and documented. All personnel involved in the method design, development and implementation will be in constant communication during all stages of development.

The general procedure for methods development is outlined as follows:

Key Elements for Methods Development

Element 1: Identification of Scope and Application and Need

The key factor that a developer must establish before proceeding with a method development project is a clearly defined scope and application for the proposed method. Factors to be considered should include type of method (i.e., screening or quantitative), applicable target analytes, appropriate matrices, sensitivity, bias and precision, availability of equipment, and cost. A literature search is performed to determine whether similar methods already exist that can be modified to suit the new need.

Element 2: QC Requirements

When developing a method, the developer needs to identify the appropriate quality control procedures that must be performed to unequivocally demonstrate that the data generated by the method will meet the objectives defined in the scope and intended application(s).

Examples of QC elements include appropriate calibration criteria, tuning criteria, the need for replicate analyses, appropriate surrogates, blanks and spikes. QC criteria specific to the particular method should be well-documented and included in the QC section of the method as well as the method development report.

Element 3: Analytical Approach

A method must be practical, address a need and have the potential for general use in the environmental analytical community.

Element 4: Method/Instrument Sensitivity

The method sensitivity requirements for a proposed new method are influenced by several factors. These include the instrument detection limits, method quantitation limits, and any regulatory requirements for the proposed applications. Therefore, a method must exhibit analytical sensitivity appropriate for its intended application as delineated in the scope of the

method. Pertinent performance information to be included in the methods package should include the instrument or method detection and quantitation limits, i.e. the minimum mass of analyte which can be quantitated (or detected, in the case of screening methods), the instrument or method calibration for all target analytes and information as to whether the calibrations are linear or non-linear. At this stage in the methods development process, the analyst should demonstrate the appropriate analytical parameters and procedure on clean standards of known concentration.

Element 5: Method Optimization and Ruggedness Testing

After determining that the chosen analytical approach should work for its intended application with appropriate sensitivity, the method developer should begin to optimize the method. This task is accomplished using known standards.

The initial parameters should be chosen according to the analyst's best judgment. These are varied systematically to obtain the greatest response, least interference, greatest repeatability, etc. Developers must determine those variables which should not be changed without adversely affecting method performance. Potential operator-sensitive steps, e.g. color development time in colorimetric methods or other timed reactions, also need to be identified at this stage.

Element 6: Accuracy, Precision and Repeatability (Clean Matrix)

Accuracy, or in most cases method bias, is defined as nearness to the true value. Precision is defined as the dispersion of results around the mean value. Repeatability (or long-term precision) is defined as the ability to reproduce a measurement from one week to the next.

Bias is measured by determination of % recovery of target analytes spiked into the matrix of concern. An acceptable spike recovery range for most method development applications is from 80% to 120%. Precision is measured as relative % difference of target analyte concentration(s) between duplicates or duplicate spikes and should be <20%. Repeatability, measured as long-term precision (e.g. weekly), should not vary by more than 15% when the instrument is calibrated using comparable standards on different days.

These are key method performance factors which determine how a method can be used in real world situations. The initial determination of bias, precision and repeatability should be made in a spiked clean matrix which is similar to a real environmental matrix but free from interferences, e.g., reagent water, sand or soil. These values should be obtained using multiple replicates at both high and low spike concentrations.

Element 7: Effect of Interferences

The determination of method interferences, both positive and negative is a key factor in method development. It is a critical element in methods development to determine the effects of potential analytical interferences and to develop techniques to minimize or eliminate these interferences. In chromatographic methods, interferences include co-eluting peaks and/or analyte degradation due to interaction with the injector port, transfer line or columns. In spectroscopic methods, interferences can result from overlapping spectral lines causing either positive or negative signal enhancement.

Method interferences should be determined in a spiked clean matrix. Developers should determine the effects of interferences in a potential new method between target analytes and other compounds reasonably expected to be present in waste matrices.

False negative rates, i.e., the percentage that a method generates a negative result when the sample contains the target analyte at or above the action level and false positive rates, i.e., the percentage that a method generates a positive result when the sample contains the target analytes below the action level, are critical factors which will determine the utility of a potential method for its intended application.

Documentation of interferences should include any co-elution of or with target analytes, any enhancements or suppression of target analyte signals caused by interferences, any necessary or optional cleanup procedures to minimize the effect of interferences, and any matrix-specific difficulties.

Element 8: Matrix Suitability

The previous elements of the methods development process involved the use of either known standards or target analytes spiked into clean matrices, designed to indicate potential method performance in real world matrices. Once the potential new method has passed all of the preliminary tests, it is now ready for the most important demonstration in the entire methods development process, i.e. how it will perform in real world matrices for which it is intended to be used.

The method should be suitable for a variety of matrix types. Matrix types refer to different matrices within a particular medium, e.g. water and soil. Water matrices include groundwater, TCLP leachate and wastewater while appropriate soil matrices include sand, loam and clay. The method should perform adequately in a variety of spiked matrices and then in a variety of well-characterized natural samples. Performance data including matrix, precision bias, quantitation limits, and any other pertinent data should be included in appropriate tables.

Element 9: Quantitation and Detection Limits

The developer should develop estimated method quantitation limits (EQL) and method detection limits (MDL) for the analytes of concern in the matrices of concern.

Method detection and quantitation limits for a determinative method are usually based on a specific sample size and a specific preparation scheme. The limits determined in clean matrices indicate the limits of acceptable performance for the method. Matrix effects may affect the achievable quantitation limits on real world samples. However, the method quantitation limits for the target analytes in the target matrices must meet the analytical requirements of the intended application, as defined in the scope of the method. Quantitation limits for the target analytes in representative matrices should be included in summary tables in the methods, while the rationale for and details of the MDL and EQL concentrations should be included in the supporting documentation.

Element 10: Laboratory Reproducibility (Multiple Operators/Laboratories)

The final stage in the method development process is the determination of laboratory reproducibility. Reproducibility means that multiple operators and multiple laboratories should be able to obtain comparable performance data on split samples using the method. Since all of the previous elements involved single operators or single laboratories, it is necessary to demonstrate that satisfactory method performance is not limited to the individual operator or laboratory that developed the method.

The minimum number of laboratories that are needed to participate in a multi-laboratory method validation is three, with preferably more.

In order to minimize the number of variables involved in method validation, the developer needs to follow a few simple guidelines to demonstrate appropriate multi-laboratory method performance. When validating a sample preparation method, the participating laboratories should only perform the sample preparation procedure. The collected samples should then be sent to one laboratory for analysis. The analysis should be done by a single operator on a single instrument in a single batch to minimize variability inherent to the determinative method. Conversely, if a determinative method is to be validated, the developer should have a single operator perform all of the sample preparation operations in order to minimize operator and laboratory variability inherent to sample preparative procedures. The sample extracts should then be split and sent to the laboratories participating in the validation study for the analytical determination.

Element 11: Document Submission and Workgroup Evaluation

When the method project is completed, the developer must assemble a package of documents describing the project and submit to the TNI Accreditation Body for review/evaluation and for accreditation. This documentation package should include 1) a cover letter requesting the addition of new parameters by the new method to the current parameter list; 2) a copy of the appropriate application page with the requested analytes checked (matrix specific); 3) a copy of the final, signed Standard Operating Procedure (SOP) of the method; 4) a copy of the requisite Method Detection Limit (MDL) study with supporting documentation (standards); 5) a copy of the Initial Demonstration of Capability (IDOC) with supporting documentation (standards); and copies of the results of two Proficiency Testing samples (PTs) analyzed at least 15 days apart. The package may be either hard copy or electronic depending on which Accreditation Body receives the request.

Additional supporting documentation that may be requested may include a data package containing the raw and summarized single laboratory and multi-laboratory data, any specific equipment diagrams and chromatograms, spectra, etc. pertinent to the demonstration of appropriate performance for the intended application of the method, copies of any references listed in the method and any method-specific quality control criteria.

22.3 Method Validation

Validation is the confirmation, by examination and objective evidence, that the particular requirements for a specific intended use are fulfilled.

At a minimum, reference methods are validated by performing an initial demonstration of capability. Additional requirements are discussed for each technology.

All methods that are not reference methods are validated before use. The validation is designed so that the laboratory can demonstrate that the method is appropriate for its intended use. All records (e.g., planning, method procedure, raw data and data analysis) shall be retained while the method is in use. Based on the validation process, the laboratory will make a statement in the Scope and Application section of the SOP of the intended use requirements and whether or not the validated method meets the use requirements.

Method validation and Demonstration of Capability procedures can be found in Appendix G – Chemistry.

22.4 Estimation of Analytical Uncertainty

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

When requested, the laboratory will provide an estimate of the analytical uncertainty as determined by quality control element measurement data as

referenced in the current revision of SOP #900_QA-EstMeasUncert, Estimation of Measurement Uncertainty.

22.5 Control of Data

To ensure that data are protected from inadvertent changes or unintentional destruction, the laboratory uses procedures to check calculations and data transfers (both manual and automated).

22.5.1 Computer and Electronic Data Requirements

The laboratory assures that computers, user-developed computer software, automated equipment, or microprocessors used for the acquisition, processing, recording, reporting, storage, or retrieval of environmental test data are:

- documented in sufficient detail and validated as being adequate for use;
- protected for integrity and confidentiality of data entry or collection, data storage, data transmission and data processing;
- maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of environmental test data; and
- held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records. Different Users of the Element DataSystem® have different permission settings, which allow access to certain areas of the LIMS. Permissions may be set as **View**, **Edit**, or **No Access**. With **View** permission, a User can access a program area, but they will not be able to make any changes to data. With **Edit** permission, a User will be able to access a program area and be able to make changes to the data. If a User's permissions are set to **No Access** for a given program area, that User will not be able to View or Edit that program area; the menu items in those program areas will be greyed-out. Data archive security is addressed in Section 16 – "Control of Records" and building security is addressed in Section 21- "Accommodations and Environmental Conditions".

Commercial off-the shelf software in general use within their designed application range may be considered to be sufficiently validated.

The laboratory uses spreadsheets to calculate final results from the raw data for selected methods such as BOD. To ensure that the spreadsheet formulae are correct, the laboratory tests each set of cells used for input of the data as well as cells used for calculations by comparing the results of the spreadsheet with manually calculated data. The results of this verification are noted by the IT Department. A
The data stored in the Element DataSystem® is backed-up daily off-site (cloud storage). All other data system back-ups are done in-house daily. Access to

protected records is limited to the Corporate IT Manager and to the Laboratory Systems Administrator to prevent unauthorized access or amendment.

22.5.2 Data Reduction

The Element DataSystem® calculates final results from raw data using appropriate "interpreter" programs to provide the results in a reportable format. The test methods provide required concentration units, calculation formulae and any other information used to obtain final analytical results.

The laboratory has manual integration procedures that must be followed when integrating peaks during data reduction as referenced in the current revision of SOP-GEN-ManInteg, Chromatographic Peak Integration Procedures.

The use of significant figures has been set in each individual method during the set-up of Element DataSystem® by the respective department managers and adjusted as needed for various reporting requirements.

All raw data must be retained as stated in the current revision of SOP-GEN-HrdcpyRecStrge, Hardcopy Record Storage, Retrieval and Disposal and it is maintained as described in Section 16 – "Control of Records".

22.5.3 Data Review Procedures

Data review procedures are located in Section 27.4 – "Data Review".

Section 23

CALIBRATION REQUIREMENTS
(TNI V1:M2 – Sect 5.5 and Section 1.7 of Technical Modules TNI V1:M 3-7)

The Microbiology Department is certified through the Illinois Department of Public Health (IDPH) and as such follows 77 Illinois Administrative Code 465,Title 77: Public Health, Chapter 1, Subchapter d, Part 465: Certification and Operation of Environmental Laboratories. References to the Microbiology Department will be set apart in Italics within brackets.

23.1 General Equipment Requirements

The laboratory provides all the necessary equipment required for the correct performance of the scope of environmental testing performed by the laboratory.

All equipment and software used for testing and sampling are capable of achieving the accuracy required for complying with the specifications of the environmental test methods as specified in the laboratory SOPs.

Equipment is operated only by authorized and trained personnel (see Section 20 – "Personnel"*)*.

The laboratory has procedures for the use, maintenance, handling, storage, and transportation of equipment which are readily available to laboratory personnel. Manuals provided by the manufacturers of the equipment provide information on use, maintenance, handling and storage of the equipment. The laboratory maintains a list of major equipment in Table 23-1 that includes information on instrument location. Table 23-2 provides summaries of general planned equipment maintenance. These procedures ensure proper functioning of the equipment and prevent contamination or deterioration. Maintenance of specific instruments may be found in laboratory SOPs or referenced in the specific manufacturers' manuals.

All equipment is calibrated or verified before being placed in use to ensure that it meets laboratory specifications and relevant standard specifications. Depending on the type of equipment or instrument, calibration documentation may be kept with the instrument in the equipment work area or included with data packages.

[The Microbiology Department follows the manufacturer's guidelines for calibration and documents relevant specifications for equipment (e.g. temperature, pH) in the work area or in Microbiology QC notebooks in Room 176.]

Test equipment, including hardware and software, are safeguarded from adjustments that would invalidate the test result measurements by limiting access to the equipment and using password protection where possible (see Section 22.5 – "Control of Data"*)*.

Equipment that has been subject to overloading, mishandling, given suspect results, or shown to be defective or outside specifications is taken out of service. The equipment is isolated to prevent its use or clearly labeled as being out of service until it has been shown to function properly. If it is shown that previous tests are affected, then procedures for nonconforming work are followed and results are documented (see Section 12 – "Control of Nonconforming Environmental Testing Work" and Section 14 – "Corrective Action").

When equipment is needed for a test that is outside of permanent control of the laboratory, the lab ensures the equipment meets the requirements of this manual prior to its use by inspecting or otherwise testing it.

[The Microbiology Department does not use equipment that is outside of the permanent control of the laboratory.]

Each item of equipment and software used for testing and significant to the results is uniquely identified. Records of equipment and software are maintained. This information includes the following:

a. identity of the equipment and its software;

b. manufacturer's name, type identification, serial number or other unique identifier;

c. checks that equipment complies with specifications of applicable tests;

d. current location;

e. manufacturer's instructions, if available, or a reference to their location;

f. dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and the due date of next calibration;

g. maintenance plan where appropriate, and maintenance carried out to date; documentation on all routine and non-routine maintenance activities and reference material verifications; and

h. any damage, malfunction, modification or repair to the equipment.

Table 23-1 Laboratory Equipment (May 2012)			
Name (Quantity)	**Room**	**Brand / Model / Configuration**	**Unique Identifier**
ICP-MS	113	Perkin Elmer/ELAN-6000	ICPMS 6000
ICP-MS	113	Perkin Elmer/DRC-e	ICPMS DRC
ICP	112	Perkin Elmer/Optima 7300 Dual View	ICP 7300
Mercury Analyzer	112	Leeman Hydra AA Automated	HG AA
Microwave Digester	169	CEM Mars	MARS
Microwave Digester	169	CEM Mars	MARS 5
Hot Blocks (2)	169	Environmental Express	---
Turbidity meter	112	HACH	T-1
GC	123	HP 5890/dual ECDs	GC, GE, GF, GG
GC	123	Agilent 6890/dual ECDs	GD, GI, GR
GC	123	Agilent 6890/dual NP detectors	GH
GC	123	HP 5890/FID	GO
GC	123	HP 5890/dual FIDs	GB
HRGC-HRMS	111	Agilent 7890/Waters Autospec Premier	ML
Chiller	133	Thermo Scientific Neslab HX-500	---
GC-MS	123	HP 5890/5971 systems	ME
GC-MS	130	HP 5890/5971 systems	MG, MD
GC-MS	123	HP 5890/5972 systems	MA, MC
GC-MS	130	HP 5890/5972 systems	MB
GC-MS	123	Agilent 6890/5973 system	MK
GC-MS	123	Agilent 7890/5975 systems	MJ
GC-MS	130	Agilent 7890/5975 systems	MH, MI
GC-MS	123	Thermo ISQ GC/MS system	MF
HPLC (3)	123	Agilent 1100 systems	LA, LD, LF
		Diode Array Detectors (3)	
		Pickering Post Column Derivatization (2)	
		Fluorescence Detectors (3)	
HPLC (1)	123	HP 1090 system	LB
		Fluorescence Detector (1)	
		Diode Array Detector (1)	
		Post Column Derivatization (1)	
HPLC (1)	123	Shimadzu LC-10AS system	LC
		SPD-10AV UV Detector (1)	
Concentrators (2)	130	Tekmar 3000	T2, T5
Concentrators (3)	130	EST Encon Concentrators	T7, T8, T9

Table 23-1 Laboratory Equipment (May 2012)			
Name (Quantity)	**Room**	**Brand/Model/Configuration**	**Unique Identifier**
Autosamplers (2)	130	EST Centurion	P9, P10
Autosamplers (2)	130	EST Centurion	P11, P12
Autosamplers (1)	130	Varian Archon	P4
Sonic Disruptors(3)	165	Misonix XL-2020 Dual Head	A, B, C
TurboVaps (4)	165	Biotage TurboVap II Workstations	TV1 – TV4
Nitrogen Evaporator (3)	165	Organomotion N-EVAP Model 111	2, 3, 4
Nitrogen Evaporator	174	Organomotion N-EVAP Model 111	1
Solvent Evaporator (2)	165	Organomotion OA-SYS	B, C
Solvent Evaporator	174	Organomotion OA-SYS	A
SPE Manifolds (2)	165	Supelco Visiprep 12 station manifold	---
SPE Manifold	174	Supelco Visiprep 12 station manifold	---
Vacuum Manifold	174	Supelco Visiprep DL 3 position Dioxin	---
Soxhlet units (6)	174	Liquid-Liquid Soxhlet extraction units	---
SPE extractors (4)	165	Horizon SPEDEX 4790	1, 2, 3, 4
Flatbed Orbital Shaker	165	VWR DS-500	---
Vacuum Manifold	174	Three position Dioxin vacuum manifold	---
Sonic Disruptor	165	Single head	---
Wrist Action Shaker (2)	165	Burrell Model 75	---
3D Floor Shaker	165	Glas-Col	---
Vacuum Pump	165	Vacuubrand ME 1C	---
Vacuum Pump	165	Vacuubrand ME 2	---
Chiller	165	FisherSci	---
Oven	165	S/P TempCon	---
Hot Block	165	Fisher IsoTemp	---
Vacuum Pump	174	KNF	---
Organic HX Analyzer	114	Mitsubishi Sigma 10	TOX-01
Organic HX Analyzer	114	Mitsubishi AOX-200	AOX-1
Preparation Stations (2)	114	MCI TOX 10A	---
Preparation Stations (2)	114	MCI TXA-02	---
Centrifuge	114	Fisher Model 228	---
Vortex Mixer	114	Thermolyne	---
Ion analyzer/pH/Cond	160	Fisher Accumet 50 Dual Electrode	PROBE-01
Flashpoint Tester	160	Fisher Tag Closed Cup	---
Flashpoint tester	160	Koehler Open Cup	---
CN Distillation (3)	160	MIDI-STIL Cyanide Distillation Systems	---
TKN Digestion (2)	160	Buchi TKN Digestion System	D1
TKN Distiller	160	Buchi TKN Distillation System	D2
Ion Chromatograph	146	Dionex ICS-5000	IC-04

Table 23-1 Laboratory Equipment (May 2012)			
Name (Quantity)	**Room**	**Brand / Model / Configuration**	**Unique Identifier**
Ion Chromatograph (2)	146	Dionex ICS-1000	IC-02, IC-03
COD Reactors (3)	160	HACH	CR 1 through 4
G & O Extractor	160	Horizon SPEDEX 3000XL	GO1
G & O Extractor	160	Horizon SPEDEX 3000XL	GO2
Auto Analyzer	114	Lachat QuickChem FIA + 8000	LACH-1
Auto Analyzer	151	Lachat QuickChem FIA + 8000	LACH-2
Ion Analyzer	160	Orion EA 920	---
Ion analyzer/pH/Cond	160	Accumet 25	---
TOC Analyzer	146	OI Analytical 1030/1088 Autosampler	TOC-01
Spectrophotometer	160	Spectronic Unicam Genesys 20	Genesys 20
Spectrophotometer	160	Spectronic Unicam Genesys 10	Genesys 10
DO (BOD) Meter	160	YSI Model 5000	DO-01
DO (BOD) Meter	160	YSI Model 5100	DO-02
Muffle furnace	160	Thermolyne	6018
Auto-Titrator	160	Metrohm	---
Incubator A	176	VWR Scientific 1545	700996
Incubator B	176	VWR Scientific 1545	100104
Incubator C	176	Fisher 307C	1519060787444
Incubator D	160	Blue M 200A	IN-1-6520
Spore Incubator	176	Blue M SW-11TA	S3-587
Hallway Incubator	by 166	Napco Model 6200	1-87-2237-22
Back Fecal Water Bath	160	Precision 51221033	603121288
Front Fecal Water Bath	160	Precision 51221033	604101191
SPC Tempering Bath	176	Napco Model 220	MSR-3
Refrigerator	176	True T-23	716646
pH Meter	176	Fisher Accumet Basic	6356
Conductivity Meter	160	EC 2052	209002
Vacuum Pump 1	176	GE 5KH33GN293KX	J07J230283
Vacuum Pump 2	176	GE 5KH33GN293KX	F07J010064
Vacuum Pump 3	160	GE 5KH33DN16JX	XYJ260109
Vacuum Pump 4	134	GE 5KH33DN16AX	JXD
Quantitray Sealer	160	Idexx 2X 89-10894-04	05623-08-022
Autoclave 1	166	Market Forge STME	68502
Autoclave 2	166	Market Forge STME	C-0913
Lab Blender	160	Waring 1120	2
Stir Plate	176	Fisher 120MR	106
Hot Plate	176	Corning C6R	30296
Balance	160	Mettler PM200	101

Table 23-1 Laboratory Equipment (May 2012)			
Name (Quantity)	**Room**	**Brand/Model/Configuration**	**Unique Identifier**
Balance	176	Oahus EA000D	102
Balance	169	Mettler PM480	104
Balance	167	Mettler PB3002	105
Balance	160	Mettler AG204	107
Balance	160	Mettler AG204	110
Balance	129	Mettler PM600	112
Balance	122	Mettler AG245	114
Balance	165	Mettler BB300	115
Balance	160	Mettler B601	119
Balance	167	Mettler AE160	120
Balance	160	Mettler AE160	122
Balance	160	Mettler XS204	123
Balance	167	Mettler XS2002S	124
Balance	160	Denver Instruments MXX-5001	125
Balance	135	Denver Instruments MXX-601	126
Class 1 Weight	167	20mg -100 g Polished Kit	Metals-002
Class 1 Weight	129	100 mg – 100 g Polished Kit	S1986
Class 1 Weight	176	2000g Polished Weight	300048.1
Class 1 Weight	176	2000g Polished Weight	84200.1
Class 1 Weight	160	50 mg – 50 g Weight Set	94-0585278
Class 1 Weight	160	2mg, 50g Polished Kit	95082195
NIST Thermometer	124	VWR Scientific	1 (B46387)
NIST Thermometer	124	Ertco	2 (1692)
NIST Thermometer	124	Ertco	3 (1675)
NIST Thermometer	124	Ertco	4A (02103)
NIST Thermometer	124	VWR Scientific	5 (B46465)

23.2 Support Equipment

Support Equipment includes, but is not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, volumetric dispensing devices, and thermal/pressure sample preparation devices.

All support equipment is maintained in proper working order. Records are kept for all repair and maintenance activities, including service calls.

[Repair/maintenance for the Microbiology Department is recorded in the Maintenance logbook in Room 176]

All raw data records are retained to document equipment performance. These records include logbooks, data sheets, or equipment computer files.

23.2.1 Support Equipment Maintenance

Regular maintenance of support equipment, such as balances and fume hoods is conducted at least annually.

Maintenance on other support equipment, such as ovens, refrigerators, and thermometers is conducted on an as needed basis.

Records of maintenance to support equipment are documented in Instrument Maintenance Logs. Each piece of support equipment does not necessarily have its *own* logbook but must be documented. Maintenance logbooks may be shared with equipment that is housed in the same laboratory area. Table 23-2 includes a general summary of support equipment maintenance that encompasses organics, inorganics, and microbiology. There may be variation between the departments depending upon the equipment and its intended use and the requirements of the accrediting or certifying body.

[Maintenance information for the Microbiological Department is kept in the "Bacteriology Equipment Maintenance Log"]

Table 23-2 Summary of Support Equipment Calibration And Maintenance

Instrument	Activity	Frequency	Documentation
Balance	1. Clean 2. Check alignment 3. Check with standards 4. Service Contract	1. Before use 2. Before use 3. Daily 4. Annually	Worksheet/log book Post annual service date on balance
ASTM Class 1 Weights	1. Only use for the intended purpose 2. Use plastic forceps to handle 3. Keep in case 4. Re-calibrate	Every 5 years if weight is used only to check working standard weights which are then used for the daily checks.	Keep certificate
Working Standard Weights	Used to check balances before their use.	Daily; Before use	Worksheet / logbook
NIST Traceable Thermometer	Used to calibrate working thermometers; accuracy determined by A2LA-accredited weights and measurement laboratory	Annually	Keep certificate
Thermometers: 1. Glass and electronic 2. Infrared	Check at the temperature used, against a reference NIST certified thermometer Check electronic against new certified electronic thermometer as reference	1. Annually for glass and electronic types 2. Quarterly for IR and dial type	Calibration factor and date of calibration on thermometer and worksheet/log book

Table 23-2 Summary of Support Equipment Calibration And Maintenance			
Instrument	**Activity**	**Frequency**	**Documentation**
pH electrometers	Calibration: 1. pH buffer aliquot are used only once 2. Buffers used for calibration will bracket the pH of the media, reagent, or sample tested. 3. *[Slope between 95-105%]*	Before use *[Daily]* *[Daily]* *[Daily]*	Worksheet/log book
pH probe	Maintenance: Use manufacturer's specifications *[Probe replaced]*	As needed *[Annually or as needed]*	Worksheet/log book
photometer	1. Keep cells clean 2. Service contract. Check wavelength settings with color standards	Annually	Post service date on photometer
Automatic or digital type pipettes	Calibrate for accuracy and precision using reagent water and analytical balance	Weekly	Worksheet/logbook
Refrigerators, Freezers, and BOD incubators	1. Thermometers are immersed in liquid to the appropriate immersion line 2. The thermometers are graduated in increments of 1°C or less	Temperatures are recorded each day in use	Worksheet/log book
Autoclave	1. Use a maximum-temperature-registering thermometer or a continuous recording device. 2. Use spore strips or ampoules. 3. In house maintenance of autoclave or service contract. 4. Hot air ovens must maintain a stable temperature of 170°C - 180°C for at least two hours	1. Each cycle 2. One sterilizing cycle per month. 3. As needed ; at least once per year	Worksheet/log book

Table 23-2 Summary of Support Equipment Calibration And Maintenance			
Instrument	**Activity**	**Frequency**	**Documentation**
Microbiological incubators, and water baths	1. Thermometers in each unit are immersed in liquid to the appropriate immersion line 2. The thermometers will be graduated in increments of 0.5°C (0.2°C increments for tests which are incubated at 44.5°C) or less	Temperature of water baths will be recorded once a day for each day of use and for incubators twice a day for each day in use	Worksheet/log book
DO electrometer	Calibrate as specified in SOP	Before use	Worksheet/log book
DO probe	Maintenance as specified by manufacturer	As needed	Worksheet/log book
[Conductivity meter]	*[Calibrated with traceable low level standard]*	*[Each use]*	*[Worksheet]*
[UV lamp]	*[Bulbs cleaned with ethanol]* *[Output tested to be not less than 70% of original output]*	*[Monthly]* *[Monthly]*	*[Worksheet]* *[Worksheet]*
[Quantitray Sealer]	*[Checked with dye for leaks to ensure good seal]*	*[Monthly]*	*[Worksheet]*

23.2.2 Support Equipment Calibration

All support equipment is calibrated or verified annually over the entire range of use using NIST traceable references where available. The results the calibration of support equipment is within specifications or (1) the equipment is removed from service until repaired, or (2) records are maintained of correction factors to correct all measurements. If correction factors are used this information is clearly marked on or near the equipment.

Support equipment such as balances, ovens, refrigerators, freezers, and water baths are verified with a NIST traceable reference if available, each day prior to use, to ensure operation is within the expected range for the application for which the equipment is to be used.

Volumetric dispensing devices (except Class A glassware and Glass microliter syringes) are checked for accuracy on a quarterly basis.

Table 23-3A Calibration Acceptance Criteria for Support Equipment				
Equipment	**Type of Calibration / Number of Standards**	**Frequency**	**Acceptance Limits**	**Corrective Action**
Analytical Balance	Accuracy determined using A2LA-accredited NIST weights. Minimum of 2 or 3 standards bracketing the weight of interest depending on use. Inspected and calibrated by A2LA accredited person annually.	Daily or before use	± 0.2% or as stated by manufacturer	Clean, check level, insure lack of drafts, and that unit is warmed up, recheck. If fails, call service.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 2.0°C	Replace
Electronic Thermometer	Against new certified electronic thermometer	Yearly	± 1.5°C	Replace
InfraRed Temperature Guns	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use	± 1.5°C	Repair/replace
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic dilutor or dispensing devices)	One delivery by weight. Using DI water, dispense into tared vessel. Record weight with device ID number.	Weekly	± 2% (10 – 100 ul) ± 5% (101 – 1000 ul)	Adjust. Replace.

Table 23-3B Calibration Acceptance Criteria for Microbiological Support Equipment

Equipment	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using A2LA-accredited NIST weights. Minimum of 3 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person	Daily Annually	Balance used to weigh more than 2 g must detect 100 mg at a 150 g load Balance used to weigh less than 2 g must be sensitive to 1 mg at a 10 g load	Clean, check level, insure lack of drafts, and recheck. Have serviced if still unacceptable
Thermometer	Against NIST-traceable thermometer	Annually at appropriate temperature range for intended use	± 1.0°C	Replace
MRT Thermometers	Against NIST-traceable thermometer	Annually at appropriate temperature range for intended use	± 1.0°C	Replace
pH Meter	Calibrated using at least two standards	Daily	Slope (95-105%)	Replace
InfraRed Temperature Guns	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 1.5°C	Repair/replace
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic dilutor or dispensing devices)	One delivery by weight. Using DI water, dispense into tared vessel. Record weight with device ID number.	Weekly	± 2% (10 – 100 ul) ± 5% (101 – 1000 ul)	Adjust. Replace.

Table 23-4 Acceptance Criteria for Microbiological Support Equipment

Equipment Identification	Use	Acceptance Criteria
Incubator A	General microbiological use	35.0°C ± 0.5°C
Incubator B	Heterotrophic Plate Count	35.0°C ± 0.5°C

Table 23-4 Acceptance Criteria for Microbiological Support Equipment		
Equipment Identification	**Use**	**Acceptance Criteria**
Incubator C	Routine Colilert samples	35.0°C ± 0.5°C
Incubator D	Sludges/waste water Quantitrays	35.0°C ± 0.5°C
Spore Incubator	Spore ampules	56-60°C
Hall incubator	Sludge overflow	45.5°C ± 0.2°C
Back Fecal Water bath	Sludges/ waste water MFs	45.5°C ± 0.2°C
Front Fecal Water bath	Pre-warming Colilert samples	45.5°C ± 0.2°C
SPC Tempering Water bath	Melting agar	45°C ± 1°C
Refrigerator	Reagent/ media/sample storage	0 to 5°C
Autoclave	Sterilization	122°C± 1°C

23.3 Analytical Equipment

23.3.1 Maintenance for Analytical Equipment

All equipment is properly maintained, inspected, and cleaned.

Maintenance of analytical instruments and other equipment may include regularly scheduled preventive maintenance or maintenance on an as-needed basis. Instrument malfunction is documented in the specific instrument maintenance logbooks [Bacteriology Equipment Maintenance Log] which become part of the laboratory's permanent records. A description of what was done to repair the malfunction and proof of return to control are also documented in the log. When the equipment is repaired by an outside source, a copy of the repair bill is placed in the logbook to explain what was done. Proof of return to control can be a statement that a QC sample was run and that it passed acceptance criteria.

Table 23-5A Analytical Equipment Maintenance		
Instrument	**Procedure**	**Frequency**
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Insert clean drying tube filled with Magnesium Perchlorate Fill reductant bottle with 10% Stannous Chloride	Daily Daily As required Daily
ICP ICP/MS	Check pump tubing/replace Check liquid argon supply Check fluid level in waste container	Daily Daily Daily

Table 23-5A Analytical Equipment Maintenance		
Instrument	**Procedure**	**Frequency**
ICP ICP/MS (cont.)	Check filters Clean or replace filters Check torch Check sample spray chamber for debris Clean nebulizer	Monthly As required Daily As required As required
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Semi-annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean optics and cells	Daily Daily As required As required As required
IR Spectrophotometer	Clean cell Check/adjust cell alignment	Annually As required
GC/MS	Ion gauge tube degassing Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment	As required As required Annually As required As required` As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check for loose/fray wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	As required As required As required As required As required As required As required As required As required As required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Hall 700A Detector Hall 1000 Detector	Electrolyte change Reactor tube/teflon connecting tube change Clean detector cell	As required by noise As required As required
HPLC	Change guard columns Change lamps	As required As required

Table 23-5A Analytical Equipment Maintenance		
Instrument	**Procedure**	**Frequency**
HPLC (cont.)	Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents Change autosampler rotor/stator	As required As required As required As required As required
Balances	Class "1" traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least annually
Conductivity Meter	0.01 M KCl calibration Conductivity cell cleaning	Daily As required
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Check resistivity Check deionizer light (if present) Monitor for VOA's System cleaning Replace cartridge & large mixed bed resins	Daily, when used Daily, when used Daily, when used As required As required
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	As required Monthly Annually
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily As required
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water Baths	Temperature monitoring Water replaced	Daily Monthly or as needed

Table 23-5B Microbiology Analytical Equipment Maintenance		
Instrument	**Procedure**	**Frequency**
Balances	Class "1" traceable weight check Clean pan Field service	Daily, when used Daily Annually
Conductivity Meter	0.01 M KCl calibration	Daily, when used
Turbidimeter	Check light bulb	Daily, when used

Table 23-5B Microbiology Analytical Equipment Maintenance		
Instrument	**Procedure**	**Frequency**
De-ionized water polisher	Check conductivity Monitor for metals Test for bacteriological suitability Test for bacterial contamination Test for residual chlorine	Daily, Annually Annually Monthly Monthly Monthly
Autoclaves	Replace door seals Field service Monitor temperature Check with spores	As needed Annually, or as needed Each cycle Monthly
Refrigerator	Clean shelves Temperature monitoring Temperature adjustment	As needed Daily As needed
Vacuum Pumps	Lubricated	As needed, if not oil-less
pH meter	Clean/fill electrode Calibration Replace electrode	As needed Daily, when used Annually
Incubators	Temperature monitoring Temperature adjustment Clean shelves	Twice daily As needed As needed
Water Baths	Temperature monitoring Temperature adjustment Water drained and replaced Filters cleaned	Twice daily As needed Weekly Weekly
Quantitray Sealer	Sealer leak check with dye Belts/rollers cleaned Service/replacement	Monthly As needed As needed
UV Lamp	Bulbs cleaned with ethanol Output checked against original	Monthly Quarterly

23.3.2 Instrument Calibration

Generally, procedures and criteria regarding instrument calibrations are provided in the respective method SOPs.

[Instrument calibration documentation for Microbiology may be found in logbooks located in the instrument area (balance, pH meter, thermometers) and follow Standard Methods and IDPH Title 77, Public Health, Chapter 1, Subchapter d, Part 465: Certifications and Operation of Environmental Laboratories provisions.]

Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here.

Section 24

MEASUREMENT TRACEABILITY
(TNI V1:M2 – Section 5.6)

Measurement quality assurance comes in part from traceability of standards to certified materials.

All equipment used affecting the quality of test results are calibrated prior to being put into service and on a continuing basis (see Section 23 – "Calibration Requirements"). These calibrations are traceable to national standards of measurement where available.

If traceability of measurements to SI (Systeme International or International System) units is not possible or not relevant, evidence for correlation of results through interlaboratory comparisons, proficiency testing, or independent analysis is provided.

24.1 Reference Standards

Reference standards are standards of the highest quality available at a given location, from which measurements are derived.

Reference Standards, such as ASTM Class 1 weights, are used for calibration only and for no other purpose unless it is shown that their performance as reference standards will not be invalidated.

Reference standards, such as ASTM Class 1 weights, are calibrated by an entity that can provide traceability to national or international standards. The following reference standards are sent out to be calibrated to a national standard as indicated in Section 23 – "Calibration Requirements"

- Class 1 weights, and
- NIST traceable reference thermometers.

24.2 Reference Materials

Reference materials are substances that have concentrations that are sufficiently well established to use for calibration or as a frame of reference.

Reference materials, where commercially available, are traceable to national standards of measurement, or to Certified Reference Materials, usually by a Certificate of Analysis.

Purchased reference materials require a Certificate of Analysis where available. If a reference material cannot be purchased with a Certificate of Analysis, it is verified by analysis and comparison to a certified reference material and/or demonstration of capability for characterization.

Internal reference materials, such as working standards or intermediate stock solutions, are checked as far as is technically and economically practical. In practice, working standards or intermediate stock solutions are checked against a second source at first time of use. When a second source is not available, a vendor certified different lot is accepted as a second source. In most cases, the analysis of an Initial Calibration Verification (ICV) standard or a Laboratory Control Sample (LCS) can be used as a second source confirmation. Working standards and intermediate stock solutions are given expiration dates when they are prepared based on method or regulatory requirements. These standards are used up or disposed of by the expiration date.

Additional working standards such as working class weights or internal thermometers are checked using the frequency summarized in Table 23-3 in Section 23 – "Calibration Requirements".

24.3 Transport and Storage of Reference Standards and Materials

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials.

Reference standards and materials are stored according to manufacturer's recommendations, method SOP requirements and separately from samples.

24.4 Labeling of Reference Standards, Reagents, and Reference Materials

The laboratory has procedures for purchase, receipt and storage of standards, reagents and reference materials. Purchasing procedures are described in Section 9 – "Purchasing Services and Supplies".

Expiration dates can be extended if the reference standard or material's integrity is verified. The extended date may not be beyond the expiration date of the referenced standards used to re-verify.

24.4.1 Stock Standards, Reagents, Reference Materials and Media

Records for all standards, reagents, reference materials, and media include:

- the manufacturer/vendor name (or traceability to purchased stocks or neat compounds)
- the manufacturer's Certificate of Analysis or purity (if supplied)
- the date of receipt

If the original container does not have an expiration date provided by the manufacturer or vendor it is not required to be labeled with an expiration date. If an expiration date is provided, it must be labeled with that expiration date.

In methods where the purity of reagents is not specified, analytical reagent grade is used. If the purity is specified, that is the minimum acceptable grade. Purity is verified and documented according to Section 9 – "Purchasing Services and Supplies".

24.4.2 Prepared Standards, Reagents, Reference Materials and Media

Standards, reagents, reference materials and media are automatically assigned a unique Standard Number by the Element DataSystem® when they are entered into the LIMs. The standards are further assigned by department. The Standard Pattern used is as follows: YMDDNNN in which Y is a single digit indicating year, month is designed by a letter from "A" to "L", DD indicates the date, and NNN are sequential numbers assigned by the LIMS. For example, 2E29031 represents Standard #31, entered into LIMS on May 29, 2012.

Records for standards, reagents, reference materials, and media preparation include:

- traceability to purchased stock or neat compounds
- reference to the method of preparation
- date of preparation
- an expiration date after which the material shall not be used (unless its reliability is verified by the laboratory)
- preparer's initials (if prepared)

All containers of prepared standards, reagents, or materials are labeled with a unique ID and an expiration date.

Prepared reagents are verified to meet the requirements of the test method through routine blank analysis.

Section 25

COLLECTION OF SAMPLES
(TNI V1:M2 – Section 5.7)

PDC Laboratories, Inc. provides sampling services to a significant portion of their clients. The laboratory's responsibility in the sample collection process when the laboratory does not collect the samples lies in supplying the outside sampler with the necessary coolers, reagent water (if requested), sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

Sampling procedures are described in generic or site-specific sampling plans.

25.1 Sampling Containers

The laboratory offers clean sampling containers for use by clients. Select containers are purchased certified clean from a commercial vendor. These containers are ready for use and require no additional monitoring prior to use. Containers that are purchased "clean" but not certified as well as bottles that are washed at PDC must be verified clean prior to shipment to clients. The verification process is detailed in the current revision of SOP-Gen-BotQC, Bottle QC.

25.1.1 Preparing Container Orders

Containers (containing any required preservatives) are provided to the client upon request.

SOP #900_LOG-SampKitPrep, Sample Kit Request and Preparation details the procedures used for requesting sample kits, general and special packing, cooler sealing, and shipping to the client's sampling site.

25.1.2 Sampling Containers, Preservation Requirements, Holding Times

Sampling container, preservation and holding time requirements can be found in Table 25-1 as well as in the method SOPs.

If preservation or holding time requirements are not met, the procedures in Section 12 – "Control of Nonconforming Environmental Testing Work" are followed.

Table 25-1 Summary of Sampling Container, Preservation and Holding Time Requirements

Parameter Group	Approved Method	Container (Per Sample)	Dechlorinate / Preservation	Holding Time
Drinking Water - Inorganic				
Odor	SM 2150B, 18Ed	500mL Glass	Cool, 0.1-6°C	Immediately
Alkalinity	SM 2320B, 18Ed	1 L Plastic	Cool, 0.1-6°C	14 Days
Corrosivity (Langlier Index)	SM 2330B, 18Ed	**Note A**	**Note A**	**Note A**
Hardness	SM 2340C, 18Ed	500mL Plastic	HNO3 to pH <2	6 Months
Conductivity	SM 2510B, 18Ed	500mL Plastic	Cool, 0.1-6°C	28 Days
Total Dissolved Solids (TDS)	SM 2540C, 18Ed	1 L Plastic	Cool, 0.1-6°C	7 Days
Fluoride	SM 4500F-C, 18Ed	125mL or 1 L Plastic	Cool, 0.1-6°C	28 Days
Hydrogen ion (pH)	SM 4500H-B, 18Ed	100mL Plastic	Cool, 0.1-6°C	Immediately
Nitrate	SM 4500NO3-F, 18Ed	500mL Plastic	**Notes B, C**	**Notes B, C**
Nitrite	SM 4500NO3-F, 18Ed	500mL Plastic	**Notes B, C**	**Notes B, C**
Orthophosphate	SM 4500P-E, 18Ed	16 oz Plastic or Glass	Cool, 0.1-6°C	48 Hours
Total Organic Carbon (TOC)	SM 5310D, 18Ed	40mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Foaming Agent	SM 5540C, 18Ed	1 L Glass or Plastic	H_2SO_4 to pH <2, Cool 0.1 - 6°C	7 Days
UV254	SM5910B, 19Ed	250mL Glass	Cool, 0.1-6°C	48 Hours
Hydrogen Ion (pH)	USEPA 150.1	100mL Plastic	Cool, 0.1-6°C	Immediately
Turbidity	USEPA 180.1	500mL Plastic	Cool, 0.1-6°C	48 Hours
Metals	USEPA 200.7 R4.4	250mL Plastic	HNO3 to pH <2	6 Months
Metals	USEPA 200.8 R5.4	16 or 32 oz Plastic	HNO3 to pH <2	6 Months
Mercury	USEPA 245.1 R3.0	250mL or 1 L Plastic	HNO3 to pH <2	28 Days
Anions	USEPA 300.0 R2.1	500mL Plastic	Cool, 0.1-6°C	**Note D**
Cyanide	USEPA 335.4 R1.0	16 oz Amber Plastic	NaOH to pH >12, Cool 0.1 - 6°C	14 Days
Drinking Water - Organic				
Dioxin (2,3,7,8 TCDD)	USEPA 1613RB	1 L Amber Glass	$Na_2S_2O_3$/0.1 - 6°C	365 Days
EDB & DBCP	USEPA 504.1 R1.1	40mL VOA Vial	$Na_2S_2O_3$/ZHS/0.1 - 6°C	14 Days
Hexachlorocyclopentadiene	USEPA 505 R2.1	40mL VOA Vial	$Na_2S_2O_3$/ZHS/0.1 - 6°C	14 Days
Chlorinated Pesticides	USEPA 508 R3.1	1 L Amber Glass	$Na_2S_2O_3$/0.1 - 6°C	14 Days
Chlorinated Acid Herbicides	USEPA 515.3 R1.0	250mL Amber Glass	$Na_2S_2O_3$/0.1 - 6°C	14 Days
Volatile Organics	USEPA 524.2 R4.1	40mL VOA Vial	HCL to pH <2/0.1 - 6°C	14 Days
SPE Extractable Organics	USEPA 525.2 R2.0	1 L Amber Glass	$Na_2S_2O_3$/0.1 - 6°C	14 Days
Carbamates	USEPA 531.1 R3.1	60mL Amber Glass	$Na_2S_2O_3$/MCAA to pH <3/0.1 - 6°C	28 Days
Glyphosate	USEPA 547	60mL Amber Glass	$Na_2S_2O_3$/0.1 - 6°C	14 Days
Endothall	USEPA 548.1 R1.0	1 L Amber Glass	$Na_2S_2O_3$/0.1 - 6°C	7 Days
Diquat	USEPA 549.2 R1.0	500mL HDPE	$Na_2S_2O_3$/0.1 - 6°C	7 Days
Haloacetic Acids (HAAs)	USEPA 552.2 R1.0	250mL Amber Glass	NH_4Cl	14 Days
Wastewater - Inorganic				
Color	SM 2120B, 18Ed	16 oz Plastic	Cool, 0.1-6°C	48 Hours
Acidity	SM 2310B, 18Ed	32 oz Plastic	Cool, 0.1-6°C	14 Days
Alkalinity	SM 2320B, 18Ed	1 L Plastic	Cool, 0.1-6°C	14 Days
Hardness	SM 2340C, 18Ed	500mL Plastic	HNO3 to pH <2	6 Months
Specific Conductance	SM 2510B, 18Ed	500mL Plastic	Cool, 0.1-6°C	28 Days
Residue (Total)	SM 2540B, 18Ed	1 L Plastic	Cool, 0.1-6°C	7 Days

Table 25-1 Summary of Sampling Container, Preservation and Holding Time Requirements

Parameter Group	Approved Method	Container (Per Sample)	Dechlorinate / Preservation	Holding Time
Residue (TDS)	SM 2540C, 18Ed	1 L Plastic	Cool, 0.1-6°C	7 Days
Residue (TSS)	SM 2540D, 18Ed	1 L Plastic	Cool, 0.1-6°C	7 Days
Residue (Settable Solids)	SM 2540F, 18Ed	1 L Plastic	Cool, 0.1-6°C	48 Hours
Chromium VI	SM 3500Cr-D; 18Ed	16 oz Plastic	Cool, 0.1-6°C	24 Hours
Chlorine	SM 4500Cl-G, 18Ed	16 oz Plastic	Cool, 0.1-6°C	Immediately
Cyanide-amenable to chlorination	SM 4500CN-CG, 18Ed	16 oz Amber Plastic	NaOH to pH >12, Cool 0.1 - 6°C	14 Days
Fluoride	SM 4500F-C, 18Ed	125mL or 1 L Plastic	Cool, 0.1-6°C	28 Days
Hydrogen Ion (pH)	SM 4500H-B, 18Ed	100mL Plastic	Cool, 0.1-6°C	Immediately
Total Kjeldahl Nitrogen	SM 4500NH3-H, 18Ed	500mL Plastic	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Nitrate-Nitrite (sum)	SM 4500NO3-F, 18Ed	500mL Plastic	**Note B**	**Note B**
Orthophosphate (as P)	SM 4500P-E, 18Ed	16 oz Plastic or Glass	Cool, 0.1-6°C	48 Hours
Sulfite	SM 4500SO3B, 18Ed	500mL Plastic	Cool, 0.1-6°C	Immediately
Sulfate	SM 4500SO4D, 18Ed	500mL Plastic	Cool, 0.1-6°C	28 Days
Biochemical Oxygen Demand (BOD)	SM 5210B, 18Ed	32 oz Plastic	Cool, 0.1-6°C	48 Hours
Carbonaceous BOD (cBOD)	SM 5210B, 18Ed	32 oz Plastic	Cool, 0.1-6°C	48 Hours
Chemical Oxygen Demand (COD)	SM 5220D, 18Ed	16 oz Plastic	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Total Organic Carbon (TOC)	SM 5310D, 18Ed	40mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Surfactants	SM 5540C, 18Ed	1 L Glass or Plastic	H_2SO_4 to pH <2, Cool 0.1 - 6°C	7 Days
Oil and Grease	USEPA 1664 RA	1 L Glass	H_2SO_4 or HCL to pH <2, Cool 0.1 - 6°C	28 Days
Turbidity	USEPA 180.1 R2.0	500mL Plastic	Cool, 0.1-6°C	48 Hours
Metals	USEPA 200.7 R4.4	250mL Plastic	HNO3 to pH <2	6 Months
Metals	USEPA 200.8 R5.4	16 or 32 oz Plastic	HNO3 to pH <2	6 Months
Mercury	USEPA 245.1 R3.0	250mL or 1 L Plastic	HNO3 to pH <2	28 Days
Anions	USEPA 300.0 R2.1	500mL Plastic	Cool, 0.1-6°C	**Note D**
Cyanide	USEPA 335.4 R1.0	16 oz Amber Plastic	NaOH to pH >12, Cool 0.1 - 6°C	14 Days
Ammonia	USEPA 350.1 R2.0	16 oz Plastic	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Total Kjeldahl Nitrogen	USEPA 351.1	500mL Plastic	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Nitrate (total)	USEPA 353.2 R2.0	500mL Plastic	**Note C**	**Note C**
Nitrate-Nitrite (sum)	USEPA 353.2 R2.0	500mL Plastic	**Note B**	**Note B**
Phenolics	USEPA 420.4 R1.0	500mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Wastewater - Organic				
Pesticides/PCBs	USEPA 608	1 L Amber Glass	Cool, 0.1-6°C	7 Days
Polynuclear Aromatic Hydrocarbons	USEPA 610	1 L Amber Glass	Cool, 0.1-6°C	7 Days
Volatile Organics	USEPA 624	40mL VOA Vials	$Na_2S_2O_3$/ZHS/HCL to pH <2, Cool 0.1 - 6°C	14 Days
Semi-volatile Organic Compounds	USEPA 625	1 L Amber Glass	Cool, 0.1-6°C	7 Days
Hazardous and Solid Waste - Inorganic				
Ignitability	SW-846 1020A	16 oz Glass	Cool, 0.1-6°C	28 Days
Ignitability of Solids	SW-846 1030	Plastic or Glass	Cool, 0.1-6°C	28 Days
EP Tox	SW-846 1310a	Not specified	Not specified	Not Specified
TCLP (Organic and Inorganic)	SW-846 1311	1 L Glass min.	Cool, 0.1-6°C	14 Days

Table 25-1 Summary of Sampling Container, Preservation and Holding Time Requirements

Parameter Group	Approved Method	Container (Per Sample)	Dechlorinate / Preservation	Holding Time
SPLP (Organic and Inorganic)	SW-846 1312	1 L Glass min.	Cool, 0.1-6°C	14 Days
MEP (Organic and Inorganic)	SW-846 1320	Not specified	Not specified	Not Specified
Metals	SW-846 6010B	250mL Plastic	HNO3 to pH <2	6 Months
Metals	SW-846 6020	16 or 32 oz Plastic	HNO3 to pH <2	6 Months
Chromium VI	SW-846 7196A	16 oz Plastic	Cool, 0.1-6°C	30 Days
Mercury	Sw-846 6010B	16 or 32 oz Plastic	HNO3 to pH <2	28 Days
Mercury	SW-846 7470A	16 or 32 oz Plastic	HNO3 to pH <2	28 Days
Mercury	SW-846 7471A	Plastic or Glass	Cool, 0.1-6°C	28 Days
Cyanide	SW-846 9012A	16 oz Amber Plastic	NaOH to pH >12, Cool 0.1 - 6°C	14 Days
TOX (Total Organic Halides)	SW-846 9020B	250mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
EOX (Extractable Organic Halides)	SW-846 9023	8 oz Glass	Cool, 0.1-6°C	28 Days
Hydrogen Ion (pH)	SW-846 9040B	100mL Plastic	Cool, 0.1-6°C	Immediately
Hydrogen Ion (pH)	SW-846 9045C	100mL Plastic	Cool, 0.1-6°C	Immediately
Anions	SW-846 9056	500mL Plastic	Cool, 0.1-6°C	**Note D**
Total Organic Carbon (TOC)	SW-846 9060	40mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Phenolics	SW-846 9065	500mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Phenolics	SW-846 9066	500mL Amber Glass	H_2SO_4 to pH <2, Cool 0.1 - 6°C	28 Days
Oil & Grease Extractable	SW-846 9071A	8 oz jar	Cool, 0.1-6°C	Not Specified
Paint Filter	SW-846 9095A	1 L Plastic	Cool, 0.1-6°C	6 Months
Reactive Cyanide	SW-846 Chap7/9012A	16 oz Amber Plastic	NaOH to pH >12, Cool 0.1 - 6°C	14 Days
Hazardous and Solid Waste – Organic				
Alcohols	SW-846 8015B	1 L Amber Glass; 2, 4, 9, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Glycols	SW-846 8015B	1 L Amber Glass; 2, 4, 9, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Diesel Range Organics (DRO)	SW-846 8015B	1 L Amber Glass; 2, 4, 9, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Chlorinated Pesticides	SW-846 8081A	1 L Amber Glass; 2, 4, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
PCBs	SW-846 8082	1 L Amber Glass; 2, 4, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Organo Phosphorus Pesticides	SW-846 8141A	1 L Amber Glass; 2, 4, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Herbicides	SW-846 8151A	1 L Amber Glass; 2, 4, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Volatile Organics	SW-846 8260B	40mL VOA Vials	$Na_2S_2O_3$/ZHS/HCL to pH <2, Cool 0.1 - 6°C	14 Days
Volatile Organics	SW-846 8260B	Encore samplers	1 vial – methanol; 2 vials in sodium bisulfate; Cool, 0.1 - 6°C	14 Days
Volatile Organics	SW-846 8260B	TerraCore Samplers	1 vial – methanol; 2 vials no preservative; Cool, 0.1 - 6°C	14 Days
Volatile Organics	SW-846 8260B	4 oz Jars	Cool, 0.1 - 6°C	14 Days
Volatile Organics	SW-846 8260B	4 oz Jars	Cool, 0.1 - 6°C	14 Days
Semi-volatile Organic Compounds	SW-846 8270C	1 L Amber Glass; 2, 4, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Dioxins and Furans	SW-846 8290A	1 L Amber Glass	Cool, 0.1 - 6°C	30 Days
Polynuclear Aromatic Hydrocarbons	SW-846 8310	1 L Amber Glass; 2, 4, or 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days

Table 25-1 Summary of Sampling Container, Preservation and Holding Time Requirements

Parameter Group	Approved Method	Container (Per Sample)	Dechlorinate / Preservation	Holding Time
Formaldehyde	SW-846 8315A	1 L Amber Glass; 2, 4, 9, or 16 oz Jar	Cool, 0.1 - 6°C	3 Days; 3 Days
Acrylamide	SW-846 8316	1 L Amber Glass; 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days
Nitroaromatics	SW-846 8330	1 L Amber Glass; 16 oz Jar	Cool, 0.1 - 6°C	7 Days; 14 Days

Abbreviations:
HCL= Hydrochloric Acid
HNO_3= Nitric Acid
$Na_2S_2O_3$ = Sodium Thiosulfate
ZHS = Zero Head Space
H_2SO_4= Sulfuric Acid
NaOH= Sodium Hydroxide
$C_6H_8O_6$ = Ascorbic Acid
MeOH = Methanol
NH_4Cl = Ammonium Chloride
HDPE = High Density Polyethylene

Note A – Calculation based on pH, TDS, Ca^{+2}, and Alkalinity. Refer to individual parameters for container, preservation, and holding time

Note B – Preservation: Cool, 0.1-6°C, H_2SO_4 to pH<2 for Nitrate/Nitrite; Holding time: Nitrate/Nitrite 28 Days

Note C – Preservation: Cool, 0.1-6°C for Nitrate only or Nitrite only; Holding time for Nitrate only or for Nitrite only is 48 Hours

Note D – Holding time: For F, Cl, Br, SO_4 is 28 Days; 14 Days for NO_3 from chlorinated supplies; 48 Hours for NO_3 (unchlorinated), NO_2 and PO_4

25.2 Sampling Plan

The laboratory uses sampling plans provided by clients or derived from the laboratory's generic plan and customized for the specific sampling site. The plan must include any factors that must be controlled to ensure the validity of the test. Sampling plans and written sampling procedures are used for sampling substances, materials or products for testing. The plan and procedures are made available at the office of the supervisor of the field sampling crew. Active landfill sites will have sampling plans on-site; however, closed facilities do not maintain documents on site.

The laboratory's procedures for dealing with nonconformances are used when the client requests any deviations from the sampling plan or sampling procedures. The requests are documented and included in the final test report.

25.3 Sampling Records

The following relevant sampling data are recorded on field data forms: sampling procedure used, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), the sampling location, field measurements taken, well integrity checklist, containers collected and other comments relevant to the sampling location.

Field sampling records are scanned and stored as electronic files.

Section 26

HANDLING SAMPLES AND TEST ITEMS
(TNI V1:M2 – Section 5.8 and Section 1.7 of Technical Modules TNI V1:M 3-7)

26.1 Sample Receipt

When samples are received at the laboratory, the Chain of Custody (COC) is reviewed, the condition is documented, the samples are given unique identifiers, and they are logged into the sample tracking system – the Element DataSystem® LIMS.

26.1.1 Chain of Custody

The Chains of Custody or sample submission sheets from the field samplers are reviewed. This documentation is completed in the field and provides a written record of the handling of the samples from the time of collection until they are received at the laboratory. Section 25 – "Collection of Samples" outlines what information is needed on this record. The Chain of Custody form also provides information on what type of testing is being requested and can act as an order for laboratory services in the absence of a formal contract. An example Chain of Custody form can be found in Figure 26-1. Chain of Custody and any additional records received at the time of sample submission are maintained by the laboratory. A graphic image of a COC that has been scanned and saved as a .jpg, .bmp or .pdf file format is stored in the Element DataSystem®. Work Order Reports and any other paperwork received at sample receipt are forwarded to the appropriate project manager.

26.1.1.1 Legal Chain of Custody

The laboratory has procedures for legal Chain of Custody services as specified in SOP # 900_LOG-Custody, Evidentiary Custody Procedures. If samples are noted as being used for legal/evidentiary purposes, special Chain of Custody procedures are put into place by the laboratory. Custody seals are sent by the lab if the sampling containers are ordered from the laboratory, shipping records are maintained with the Chain of Custody, internal Chain of Custody is initiated that provides additional documentation of internal handling by analysts and a disposal record is provided.

26.2 Sample Acceptance

Procedures for opening shipping containers and examining samples are provided in SOP # 900_LOG-Login, Sample Receipt and Login.

The laboratory has a sample acceptance policy that is made available to clients. The policy is provided in Figure 26-2 and may be found on the back of the Chain of Custody. It emphasizes the need of providing proper documentation (to include

sample ID, location, date and time of collection, collector's name, preservation type, sample type and any special remarks about the sample), labeling of sample containers to include a unique sample ID, use of appropriate containers, adherence to holding times, and sample volume requirements. In addition the laboratory has nonconformance/corrective action procedures to handle samples that don't meet the requirements above or show signs of damage, contamination or inadequate preservation. Data will be appropriately qualified where samples are reported that do not meet sample acceptance requirements.

The laboratory checks samples for the conditions above, where appropriate, to evaluate sample acceptance. Criteria regarding preservation, holding time and sample volume requirements can be found in Section 25 – "Collection of Samples" Table 25-1. Any discrepancies, missing information, bottle damage, insufficient sample volume, etc. will be noted and the appropriate project manager notified. The project manager will contact the client to obtain this information. The project manager will document this contact and the direction given - 1) the sample is rejected as agreed with the client, 2) the decision to proceed is documented and agreed upon with the client, 3) the condition is noted on the Chain of Custody form and/or lab receipt documents, and 4) the data are qualified in the report.

26.2.1 Preservation Checks

The following preservation checks are performed and documented:

26.2.1.1 *Thermal preservation:*

a. For temperature preservation, the temperature must be within the range of 0.1 -6°C for those samples that require preservation at 4°C.

b. Samples that are delivered to the lab the same day as they are collected are likely not to have reached a fully chilled temperature. This is acceptable if the samples were received on ice and the chilling process has begun.

c. Record on the receipt form if ice is present and the temperature.

Chlorine checks:

d. Samples from potable water supplies are checked for residual chlorine upon initiation of sample preparation as required by method or by client request.

pH checks:

e. The pH of samples requiring acid/base preservation is checked upon initiation of analysis.

26.3 Sample Identification

Samples, including subsamples, extracts and digestates, are uniquely identified in a permanent chronological record to prevent mix-up and to document receipt of all sample containers.

Samples are assigned sequential numbers based on the Work Order coding pattern (YMMNNNN). The work order number references more detailed information kept in the Element DataSystem®. For example, in sample number 2070420-01A, the "2" indicates 2012 (sequence of numbers repeats each decade), "07" indicates month, "0420" represents the next sequential number and "01" represents the sample number. A letter is assigned to the sample number which reflects the specific sample container used. The sample containers are "lettered" as part of the login process.

The following information is included in the Work Order:

- Client and project name
- Project Number
- Date and time of receipt at lab
- Name of person who received the samples
- Unique laboratory identification number
- Name of person making the entries
- Client Project Manager
- Lab Project Manager
- Due date
- Comments

In addition, the following information is maintained and linked to the log-in record:

- Date and time of sampling linked to the date and time of laboratory receipt.
- Unique field identification number linked to the laboratory sample ID.
- Analyses requested (including applicable approved method numbers) linked to the laboratory sample ID.
- Comments regarding rejection (if any).

Documentation received regarding the sample, such as Chain-of-Custodies, is retained electronically after being scanned into the Element DataSystem®. Login summary reports are generated the evening of each work day by the LIMS. The summary report is stored on the X: drive and is used as a reference to previously logged samples and for auditing purposes.

26.4 Sample Aliquots / Subsampling

In order for analysis results to be representative of the sample collected in the field, the laboratory has subsampling procedures as revealed in SOP # 900_QA-CompRedSubsmp, Compositing, Size Reduction and Subsampling.

26.5 Sample Storage

Storage conditions are monitored for any required criteria, verified, and the verification recorded in logbooks.

Samples that require thermal preservation are stored under refrigeration that is +/-2°C of the specified preservation temperature unless regulatory or method specific criteria require something different. For samples with a specified storage temperature of 4°C, storage at 0.1 to 6°C is acceptable.

Samples are held secure, as required. Samples are accessible only to laboratory personnel.

Samples are stored apart from standards, reagents, food or potentially contaminating sources, and such that cross-contamination is minimized. All portions of samples, including extracts, digestates, leachates, or any product of the sample are maintained according to the required conditions.

26.6 Sample Disposal

Samples are retained a minimum of 7 to 14 days after the report is sent out unless other arrangements have been made between the client and the laboratory.

Samples are disposed of according to Federal, State and local regulations. Procedures are described in SOP # 900_QA-Sample Disposal, Sample Disposal for the disposal of samples, digestates, leachates, and extracts.

26.7 Sample Transport

Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. This includes moving bottles within the laboratory. Specific safety procedures are addressed outside of this document.

Sample shipping procedures are described in SOP # 900_LOG-SampKitPrep, Sample Kit Request and Preparation.

Figure 26-1
Example Chain of Custody (Front)

PDC LABORATORIES, INC.
2231 WEST ALTORFER DRIVE
PEORIA, IL 61615

PHONE # 800-752-6651
FAX # 309-692-9689

State where samples collected _____

CHAIN OF CUSTODY RECORD

ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT) - (SAMPLE ACCEPTANCE POLICY ON REVERSE)

1 CLIENT: PROJECT NUMBER: P.O. NUMBER: MEANS SHIPPED:

ADDRESS: PHONE NUMBER: FAX NUMBER: DATE SHIPPED:

CITY: STATE ZIP: SAMPLER (PLEASE PRINT):

CONTACT PERSON: SAMPLER'S SIGNATURE:

MATRIX TYPES: WW-WASTEWATER DW-DRINKING WATER GW-GROUND WATER WWS-SLUDGE MAS-SOLID LCHT-LEACHATE OTHER

2 3 ANALYSIS REQUESTED

4 (FOR LAB USE ONLY): LOGIN # _____ LOGGED BY: _____ LAB PROJ. # _____ TEMPLATE: _____ PROJ. MGR.: _____

2 SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE: GRAB	SAMPLE TYPE: COMP	MATRIX TYPE	BOTTLE COUNT	REMARKS

5 TURNAROUND TIME REQUESTED (PLEASE CIRCLE): NORMAL RUSH
(RUSH DAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE): FAX PHONE E-MAIL
FAX # PHONE # EMAIL ADDRESS

DATE RESULTS NEEDED

6 The sample temperature will be measured upon receipt at the lab. By initialing this area you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area you allow the lab to proceed with analytical testing regardless of the sample temperature. _____

7 RELINQUISHED BY: (SIGNATURE) DATE: TIME: RECEIVED BY: (SIGNATURE) DATE: TIME:

RELINQUISHED BY: (SIGNATURE) DATE: TIME: RECEIVED BY: (SIGNATURE) DATE: TIME:

RELINQUISHED BY: (SIGNATURE) DATE: TIME: RECEIVED AT LAB BY: (SIGNATURE) DATE: TIME:

8 COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT: _____ °C
CHAIN PROPERLY STARTED PRIOR TO RECEIPT: Y OR N
SAMPLE(S) RECEIVED ON ICE: Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION: Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME: Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S): Y OR N
(EXCLUDES TYPICAL FIELD PARAMETERS)
DATE AND TIME TAKEN FROM SAMPLE BOTTLE: _____

PAGE _____ OF _____

Copies: white should accompany samples to PDC Labs. Yellow copy to be retained by the client.

Figure 26-2
Example Chain of Custody – Sample Acceptance Policy (Back)

1. CLIENT NAME: Client's Company name.
ADDRESS: Client's mailing address.
CITY, STATE, ZIP: Client's City, State and Zip Code for mailing.
CONTACT PERSON: Person to receive results.
PROJECT•NUMBER: Client's reference to the project or work involved with these samples.
P.O. NUMBER: Client's invoicing information.
MEANS•SHIPPED: UPS, Federal Express, Postal Service, courier, hand carried, etc.
PHONE•NUMBER: Client's phone number (please include area code).
FAX•NUMBER: Client's fax number (please include area code).
DATE•SHIPPED: Month, date, and year samples were shipped or delivered to the lab.
SAMPLER: Name of sample collector.
SAMPLER'S•SIGNATURE: Signature of sampler collector.
STATE WHERE SAMPLES COLLECTED: Enter the state if different from client address.

2. SAMPLE•DESCRIPTION: The unique sample description you want to appear on the analytical report.
DATE•COLLECTED: Date sample was collected. For composite samples, this is typically the date when the last aliquot was added.
TIME•COLLECTED: Time sample was collected. For composite samples, this is typically the time when the last aliquot was added.
SAMPLE•TYPE: Place an "X" in the box marked "GRAB" if the sample was collected at one time from one specific location. Place an "X" in the box marked "COMP" if the sample is a composite of samples collected at one or more times or locations, and combined to make one sample.
MATRIX•TYPE: From the key above this field. If "OTHER", please identify.
BOTTLE COUNT: Total number of containers submitted for the sample.

3. ANALYSIS REQUESTED: Write the analysis name (or an abbreviation), the name of a group of tests, or the method number you would like us to perform. Examples are Suspended Solids, SS, TCLP Metals, 503 Sludge Regs, Method 8080, etc. Place an "X" in the small boxes that correspond to the sample(s) on which you want these tests performed.
REMARKS: List special instructions about the sample here. This space can also be used for listing additional analysis, or to request an extra copy of the report to be sent to an alternate person/address.

4. To be completed by laboratory personnel.

5. TURNAROUND TIME REQUESTED: Circle "NORMAL" if you want routine 10 working day TAT. If faster results are needed, circle "RUSH" and, if possible, call the lab in advance to schedule this work. Surcharges apply for non routine.
RUSH•RESULTS•VIA: Choose method by which you would like to receive the RUSH results by circling either "FAX" "PHONE" or "E-Mail." List the appropriate number if different from that listed in section 1.

6. Place your initials on the line if you would like the lab to call you, before proceeding with analysis, if the temperature of your sample(s) is outside the 0.1-6.0°C range. Many of the analytical methods, compliance regulations, and lab accreditation rules require that the samples be kept within this range until analyzed. There are ways to help ensure that the samples remain cold during shipping. Contact your project manager for further information.

7. RELINQUISHED BY / RECEIVED BY: This form must be signed each time the sample(s) changes hands. Chain-of-Custody seals are available upon request, if needed.

8. To be completed by laboratory personnel.

Sample Acceptance Policy for Chain of Custody -

Under the National Environmental Laboratory Accreditation Program (NELAP) and other state programs, PDC•Laboratories **MUST** follow specific required procedures when accepting samples. *Your* records of sample collection, handling, and transport are an important part of *our* ability to *efficiently and effectively* meet these laboratory accreditation requirements.

Samples not meeting the accreditation requirements for proper containers, preservation, receipt temperature and documentation/labeling may not be accepted until the proper information is received and discrepancies resolved.

CONTACT YOUR PROJECT MANAGER IF YOU REQUIRE ASSISTANCE.

Samples accepted based upon receiving a completed chain of custody form and purchase order or other documentation authorizing work is or has been provided. Note: Receipt of a Chain of Custody only with samples is considered proper authorization for PDC Laboratories Inc. to analyze samples and obligates client to pay for such services. Work is performed under PDC Laboratories' Standard Terms, Conditions and Operating Procedures unless superceded by specific contract documents.

1. It is recommended to use the sample bottles supplied by PDC Labs. This ensures that the proper bottle types and preservatives are used and adequate volume for analysis is provided. Sample containers should be filled to the neck of the container, with the exception of vials for VOC/VOA/THM and bottles for TOX analysis, which should be filled completely leaving zero headspace. Bottles should not be rinsed with sample, as this will remove any preservative in preserved bottles. The only exception to this if the sample reacts with the preservative in the VOC/VOA/THM vial. As the collection of sample is your responsibility, it is recommended that you have and adhere to a Sampling Plan.
2. Many of the test methods, as well as EPA compliance programs, require samples are kept cool during the shipping process. Failure to do so may cause your results to be unacceptable to any applicable regulatory authorities. In an attempt to keep the sample temperature near 4°C, coolers should contain ice bags. Frozen freezer packs are less effective. It is recommended to pre-cool the samples in an ice bath prior to shipment. This makes the cooling in shipping more effective. The temperature of the samples will be measured upon receipt at the lab. If the temperature is not within the range of 0.1- 6°C, and the client has requested notification, login procedures are stopped until direction is provided from the client. The project manager will contact the client to obtain this information. The project manager will document this contact and the information provided. Any required information not supplied by the client will be indicated in the final report package. Contact your project manager for additional information regarding how to attain this temperature range.
3. Samples should be shipped to the lab as soon as possible. This helps to meet the maximum allowable holding times that are part of each analytical method. If the allowable holding time is exceeded when samples arrive at the lab, login procedures are stopped until direction is provided from the client. The project manager will contact the client to obtain this information. The project manager must document this client contact, and the direction the client gives on the COC, or include other similar documentation in the report package.
4. Chain of Custody (COC) forms must accompany the samples. The purpose of the COC is to identify the sample. Samples must be labeled such that the samples/sample containers can be linked to the COC form. The following information must be included on the COC:•client name and address, sample collector's name, purchase order number, sample description/location, date and time of collection, sample type, matrix, total number of containers, and the requested analysis. Any discrepancies, missing information, bottle damage, insufficient sample volume, etc. will be noted and the appropriate project manager notified. The project manager will contact the client to obtain missing information or resolve discrepancies. The project manager will document this client contact, and the direction given by the client. Any information not ultimately supplied by the client will be noted in the final report package.

Thank you for using PDC Laboratories, Inc.
Please call 800-752-6651 if you have any questions about completing this form.

Section 27

QUALITY ASSURANCE FOR ENVIRONMENTAL TESTING*(TNI V1:M1, V1:M2 – Section 5.9 and Section 1.7 of Technical Modules TNI V1:M 3-7)*

PDC Laboratories, Inc. has procedures for monitoring the validity of the testing it performs. The qualities of test results are recorded in such a way that trends are detectable, and where practicable, are statistically evaluated. To evaluate the quality of test results, the laboratory utilizes: certified reference materials or cultures and/or internal quality control using secondary reference materials, control charting, proficiency testing samples, replicate or confirmation analyses, comparison to historical data, retesting of retained samples and correlation of results for different characteristics of a sample.

In addition to procedures for calibration, the laboratory monitors quality control measurements such as blanks, blank spikes (BS), matrix spikes (MS), duplicates, surrogates and internal standards to assess precision and accuracy. Proficiency Testing samples are also analyzed to assess laboratory performance.

Quality control data are analyzed and, when found to be outside pre-defined criteria, action is taken to correct the problem and to prevent incorrect results from being reported. Data associated with quality control data outside of criteria and still deemed reportable will be qualified so the end user of the data may make a determination of the usability of the data - see Section 28 – "Reporting of Results".

Note: The Microbiology Section is certified by the Illinois Department of Public Health and as such does not fall under the 2009 TNI Standard. However, the Microbiological Section quality control elements are included for reference in this document.

27.1 Essential Quality Control Procedures

The quality control procedures specified in test methods are followed by laboratory personnel. The most stringent of control procedures is used in cases where multiple controls are offered. If it is not clear which is the most stringent, that mandated by test method or regulation is followed.

For test methods that do not provide acceptance criteria for an essential quality control element such as blank spike recovery or where no regulatory criteria exist, acceptance criteria are developed. Acceptance criteria are established from data within the laboratory. Using a minimum of results from 20-30 analysis, the laboratory develops control limits from the mean percent recovery ($\overline{X}$) and standard deviation (S) of the percent recovery. These data are used to establish upper and lower control limits as follows:

$$\text{UPPER CONTROL LIMIT} = \overline{X} + 3\sigma_{n-1}$$
$$\text{LOWER CONTROL LIMIT} = \overline{X} - 3\sigma_{n-1}$$

Note: A minimum control limit of 10% will be used for all surrogate, blank spike, and matrix spike lower control limits.

In some specialized projects, the client may set the criteria recovery for the various quality control elements. These limits are modified by the respective department manager in the Element DataSystem® on an "as-needed" basis.

Written procedures to monitor routine quality controls including acceptance criteria are located in the test method SOPs, except where noted, and include such procedures as:

- use of blank spike samples and blanks to serve as positive and negative controls for chemistry methods;
- use of blank spike samples to monitor test variability of laboratory results;
- use of calibrations, continuing calibrations, certified reference materials and/or PT samples to monitor accuracy of the test method;
- measures to monitor test method capability, such as limit of detection, limit of quantitation, and/or range of test applicability, such as linearity;
- use of regression analysis, internal/external standards, or statistical analysis to reduce raw data to final results;
- use of reagents and standards of appropriate quality and use of second source materials as appropriate;
- procedures to ensure the selectivity of the test method for its intended use;
- measures to assure constant and consistent test conditions, such as temperature, humidity, rotation speed, etc., when required by test method;
- use of sterility checks for equipment, media and dilution water for microbiology; and
- use of positive and negative culture controls for microbiology.

27.2 Internal Quality Control Practices

Analytical data generated with QC samples that fall within all prescribed acceptance limits indicate the test method is deemed to be in control.

QC samples that fall outside QC limits indicate the test method are deemed to be out of control (nonconforming) and that corrective action is required and/or that the data are qualified (see Section 12 – "Control of Nonconforming Environmental Testing Work" and Section 14 - "Corrective Actions").

Detailed QC procedures and QC limits are included in test method standard operating procedures (SOPs). QC limits are also stored in the Element DataSystem® used during the evaluation of data entered into the LIMS.

All QC measures are assessed and evaluated on an on-going basis, so that trends are detected.

27.2.1 General Controls

The following general controls are used:

27.2.1.1 Positive and Negative Controls such as:

a. Blanks (negative)
b. Blank Spikes (positive)
c. Sterility checks and control cultures (positive and negative).

27.2.1.2 Selectivity is assured through:

a. absolute and relative retention times in chromatographic analyses;
b. two-column confirmation when using non-specific detectors;
c. use of acceptance criteria for mass-spectral tuning (found in test method SOPs);
d. use of the correct method according to its scope assessed during method validation; and
e. for microbiology only, use of reference cultures (positive and negative) from a recognized manufacturer (where applicable).

27.2.1.3 Consistency, Variability, Repeatability, and Accuracy are assured through:

a. proper installation and operation of instruments according to manufacturer's recommendations or according to the processes used during method validation;
b. monitoring and controlling environmental conditions (temperature, access, proximity to potential contaminants);
c. selection and use of reagents and standards of appropriate quality; and
d. cleaning glassware appropriate to the level required by the analysis as demonstrated with method blanks.

   Note: SOP #301_WC-GLASSCLEANING, Glassware Cleaning Procedure and SOP #300_GLASS, Organic Department Glassware Cleaning describe the procedures for general glassware cleaning.

e. For microbiology, glassware care includes use of borosilicate glassware, use of detergents designed for laboratory use, testing for alkaline or acid residue with bromothymol blue, and conduct of the Inhibitory Residue test when the detergent is changed, the dishwashing procedure is changed, a new lot of detergent is used or annually, whichever is more frequent.
f. following SOPs and documenting any deviation, assessing for impact, and treating data appropriately;

g. testing to define the variability and/or repeatability of the laboratory results, such as replicates;

h. use of measures to assure the accuracy of the test method, including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, or other measures; and

i. use of duplicate plate counts on positive samples (microbiology only).

27.2.1.4 Test Method Capability (also see Section 22 – "Environmental Methods and Method Validation") is assured through:

a. establishment of the limit of detection where appropriate;

b. establishment of the limit of quantitation or reporting level; and/or

c. establishment of the range of applicability such as linearity.

27.2.1.5 Data reduction is assured to be accurate by:

a. selection of appropriate formulae to reduce raw data to final results such as regression;

b. following specific procedures for data reduction such as manual integration procedures;

c. periodic review of data reduction processes to assure applicability; and

d. microbiological calculations, data reduction, and statistical interpretations specified by each test method.

27.2.1.6 Sample Specific controls are used to evaluate the effect of sample matrix on the performance of the selected analytical method (not a measure of laboratory performance):

Examples:

- Matrix Spike and Matrix Spike Duplicate (MS/MSD)
- Surrogate Spikes
- Sample Duplicates

27.2.1.7 The following tables summarize the key elements of a quality control system for a laboratory performing chemistry and microbiology testing.

Table 27-1 Essential Quality Control Elements for Chemistry

Item	Frequency	Acceptance Criteria	Corrective action
Negative Control (Method Blank)	1/batch	Method specific or reporting limit	Qualify data and take corrective action
Positive Control (Blank Spike)	1/batch	Method specific or determined by lab	Reprocess, reanalyze, or qualify data.

Table 27-1 Essential Quality Control Elements for Chemistry			
Item	**Frequency**	**Acceptance Criteria**	**Corrective action**
Matrix Spike; Matrix Spike Duplicates *Note : Samples are designed as data quality indicators for a specific sample using the designated method. These controls alone are not used to judge a laboratory's performance.*	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data.
Surrogate spikes *See note above.*	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data
Matrix Duplicates *See note above.*	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data
Continuing Calibration Verification	Per method requirement	Method specific or determined by the laboratory	Reanalyze standard immediately; Corrective action
Initial calibration Verification	Start of each analytical run	Method specific or determined by laboratory	Reanalyze standard immediately; Corrective action

Table 27-2 Essential Quality Control Requirements for Microbiology – All Methods			
Item	**Frequency**	**Acceptance Criteria**	**Corrective Action[2]**
Sterility check containers	One container (bottle) for each lot or batch sterilized (NSGM)	No growth	Investigate cause If necessary reject the lot Notify supplier
Sterility check dilution water	One per batch of dilution water (NSGM)	No growth	Investigate cause If necessary reject the batch
Positive control[1]	Pure culture of target organisms/ each lot and batch of medium (prior to first use of medium)	Positive reaction	Investigate cause If necessary reject the medium
Negative control[1]	Pure culture of non-target organisms/each lot and batch of medium (prior to first use of medium)	Negative reaction	Investigate cause If necessary reject the medium

Table 27-2 Essential Quality Control Requirements for Microbiology – All Methods			
Item	**Frequency**	**Acceptance Criteria**	**Corrective Action[2]**
Duplicate colony counts (For numeric results only)	Quarterly on one positive sample for each month performed.	Same analyst <5% difference between counts Two analysts <10% difference between counts	Investigate cause Qualify data
1) Microorganisms may be single use preparations or cultures maintained by documented procedures that demonstrate the continued purity and viability of the organism. 2) Corrective Action may include the need to retrain. 3) NSGM: Non-selective growth media			

Table 27-3 Essential Quality Control Requirements for Microbiology – Filtration Methods Only			
Item	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Sterility check	Each lot of media prior to first use. Also done on containers, reagents and materials prior to first use. Use NSGM for containers, reagents and materials.	No growth	Investigate cause If necessary reject unacceptable lots
Method blank	Beginning/end of each run Select one: - 1 for every 10 samples - UV sterilize after each sample filtration Done as part of the test, use method media.	No growth	Investigate cause Reject data if beginning blank is contaminated
Filter lot comparison	Five filters for each new lot of membrane filters are compared to five filters from the old lot (NSGM)	T-statistic from student's T-test less than 2.78	Investigate cause If necessary reject the lot
Target organism verification (D.3.4.b)	Method specific	Confirmation of reaction	Investigate cause

Table 27-4 Essential Quality Control Requirements for Microbiology – Pour Plate Methods Only			
Item	**Frequency**	**Acceptance Criteria**	**Corrective action**
Method Blank	Minimum of one plate per batch Done as part of test, use method media	Internally defined 0 cfu/plate	Investigate cause, qualify/ reject data

Table 27-5 Stock Cultures		
Item	**Frequency**	**Handling**
Reference cultures	Single use	Preserved and handled per mfg. specifications
Reference culture Reference stock	Culture stocks to make working stocks	Preserved and not refrozen Handling per mfg specs
Working stocks	Not transferred more than five times. Not sub-cultured to replace reference stocks	

27.2.2 Specific Controls

27.2.2.1 Method Blanks

Method blanks are processed along with and under the same conditions as the associated samples to include all steps in the method. A method blank must be analyzed at a minimum of one per preparation batch. When no separate preparation method is used the batch is defined as the environmental samples that are analyzed with the same method and personnel, using the same lots of reagents, not to exceed the analysis of twenty environmental samples, not including method blanks, blank spikes, matrix spikes and matrix duplicates. The matrix of the method blank must be similar to the associated samples and be free from any analytes of interest. Method blanks are not required for some analyses such as pH, conductivity, flashpoint, etc.

Contaminated blanks are identified according to the acceptance limits in the test method SOPs or laboratory documentation.

The laboratory identifies a blank as contaminated when analyte results are greater than the reporting limit AND greater than 1/10 of that found in any sample, or where the contamination affects the sample results according to test method requirements or client objectives.

When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem.

Data that are unaffected by the blank contamination (non-detects or other analytes) are reported unqualified.

Sample data that are suspect due to the presence of a contaminated blank are reanalyzed, qualified, or voided.

27.2.2.2 Blank Spikes

Blank Spikes (BS) are prepared from analyte free water or other clean matrix, and spiked with verified and known amounts of analytes for the purpose of establishing precision or bias measurements.

Blank Spikes are analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent. The standard frequency of BS preparation and analysis is one per analytical batch or as otherwise stated in a laboratory SOP. Exceptions would be for those analytes where no spiking solution is available, such as TSS, TDS, Total Volatile Solids, Total Solids, pH, color, odor, or turbidity**.** When no separate preparation method is used the batch is defined as the environmental samples that are analyzed with the same method and personnel, using the same lots of reagents, not to exceed the analysis of twenty environmental samples, not including method blanks, blank spikes, matrix spikes and matrix duplicates.

The analytes to be spiked in the BS are specified in the test method SOP. In some cases a client may specify a list of analytes for spiking and the request is handled using the laboratory's nonconformance procedures.

The results of laboratory control samples (BS) are calculated in percent recovery or other appropriate statistical technique that allows comparison to established acceptance criteria. The laboratory documents the calculation in the test method SOP and as follows:

$$\%R = \frac{AV}{TV} \times 100$$

Where
AV = Analyzed Value
TV = True Value

The individual BS is compared to the acceptance criteria as published in the mandated test method, or where there are no established criteria, the laboratory established limits as described above.

27.2.2.3 Matrix Spikes and Matrix Spike Duplicates

Matrix Spikes and Matrix Spike Duplicates (MS/MSD) are environmental samples fortified with a known amount of analyte to help assess the effect of the matrix on method performance.

The laboratory procedure for MS/MSD includes spiking appropriate analytes at appropriate concentrations, calculating percent recoveries and relative percent difference (RPD), and evaluating and reporting the results. The procedure can be found in the test method SOP and as follows:

$$\%R = \frac{AV}{TV} \times 100$$

Where

AV = Spike Result – Sample Result
TV = True Value

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

Where:

S=Sample Concentration
D=Duplicate Concentration

Where there are no established criteria, acceptance criteria are established from data within the laboratory based on blank spike recoveries. Using a minimum of results from 20-30 analyses, the laboratory develops control limits from the mean percent recovery ($\overline{X}$) and standard deviation (S) of the percent recovery. These data are used to establish upper and lower control limits for MS/MSD as follows:

UPPER CONTROL LIMIT = $\overline{X} + 3\sigma_{n-1}$
LOWER CONTROL LIMIT = $\overline{X} - 3\sigma_{n-1}$

For MS/MSD results outside established criteria corrective action is documented or the data are reported with appropriate data qualifying codes. Only the data from the spiked sample is qualified.

27.2.2.4 Surrogate Spikes

Surrogate spikes are substances with chemical properties and behaviors similar to the analytes of interest used to assess method performance in individual samples. Surrogates are added to all samples (in test methods where surrogate use is appropriate) prior to sample preparation or extraction.

Surrogate recovery results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory uses data generated within the laboratory. Using a minimum of results from 20-30 analyses, the laboratory develops control limits from the mean percent recovery ($\overline{X}$) and standard deviation (S) of the percent recovery. These data are used to establish upper and lower control limits for MS/MSD as follows:

UPPER CONTROL LIMIT = $\overline{X} + 3\sigma_{n-1}$
LOWER CONTROL LIMIT = $\overline{X} - 3\sigma_{n-1}$

<u>Note</u>: A minimum of 10% will be used for all surrogate lower control limits.

For surrogate results outside established criteria, data are evaluated to determine the impact. Corrective actions may include use of a qualifier, re-analysis, re-extraction and analysis, or discussion with the client as appropriate.

27.3 Proficiency Test Samples or Interlaboratory Comparisons

27.3.1 Compliance to Accreditation Requirements

The laboratory analyzes at least two TNI-compliant PT samples per calendar year for each accreditation Fields of Proficiency Testing (FoPT) for which the laboratory is accredited. An exception is made for analytes where there is no PT available from any PTPA approved PT provider at least twice per year. In these cases the lab will run the PTs in the minimum time frame the PTs are available and not at all if they are not available.

The successive PTs are analyzed at least five months apart and no more than 7 months apart unless the PT is being used for corrective action to maintain or reinstate accreditation, in which case the dates of successive PT samples for the same accreditation FoPT is at least fifteen days apart.

27.3.2 PT Sample Handling, Analysis and Reporting

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

Proficiency Testing (PT) samples are treated as typical samples in the normal production process where possible, including the same analysts, preparation, calibration, quality control and acceptance criteria, sequence of analytical steps, number of replicates, and sample log-in. PT samples are not analyzed multiple times unless routine environmental samples are analyzed multiple times. Where PT samples present special problems in the analysis process, they will be treated as laboratory samples where clients have special requests.

The type, composition, concentration and frequency of quality control samples analyzed with the PT samples are the same as with typical samples.

Prior to the closing date of a study, laboratory personnel do not:

- Subcontract analysis of a PT sample to another laboratory being run for accreditation purposes.
- Knowingly receive and analyze a PT for another laboratory being run for accreditation purposes.
- Communicate with an individual from another laboratory concerning the analysis of the PT sample.
- Attempt to find out the assigned value of a PT from the PT Provider.

The laboratory maintains low level methods and techniques that require the use of low level PTs. These PTs are analyzed and reported in the same manners as other PTs.

The laboratory evaluates and reports analytical results as follows:

a. For instrument technology that employs a multi-point calibration, the laboratory evaluates the analytical result to the value of the lowest calibration standard established for the test method used to analyze the PT sample. The working range of the calibration under which the PT sample is analyzed is the same range as used for routine environmental samples.

   A result for any FoPT at a concentration above or equal to the lowest calibration standard is reported as the resultant value.

   A result for any FoPT at a concentration less than the lowest calibration standard is reported as less than the value of the lowest calibration standard.

b. For instrument technology (such as ICP-AES or ICP-MS) that employ standardization with a zero point and a single point calibration standard, the laboratory shall evaluate the analytical result to the limit of quantitation (LOQ) established for the test method used to analyze the PT sample. The LOQ is the same as used for routine environmental samples.

   A result for any FoPT at a concentration above or equal to the LOQ is reported as the resultant value.

   A result for any FoPT at a concentration less than the LOQ is reported as less than the value of the LOQ.

The laboratory reports the analytical results for FoPTs to the PT provider on or before the closing date of the study using the reporting format specified by the provider.

On or before the closing date of the study, the laboratory authorizes the PT provider to release the laboratory's final evaluation report directly to the laboratory's Primary accrediting body as well as any other accrediting/certifying agency.

The laboratory institutes corrective action procedures for failed PT samples following the guidelines in Section 14 – "Corrective Action".

Retention of PT records is similar to that maintained for regular environmental samples. In addition the lab maintains a copy of the online data entry summary when the PT results are submitted online.

27.4 Data Review

The laboratory reviews all data generated in the laboratory for compliance with method, laboratory and, where appropriate, client requirements.

Initially, the analyst reviews data for acceptability of quality control measures and accuracy of the final result(s). After the initial review, the analyst considers all manual transfers and calculations of data in detail and checks all electronic transfers of data.

27.4.1 Review of Manually Recorded Data

For those analyses that do not lend themselves to the electronic transfer of data, the information required for traceability of the results is recorded in paper-based logbooks. Data are recorded in the logbook promptly at the time of analysis in black ink. The analyst reviews the required QC elements and sample data at the time of analysis. Upon completion, the analyst signs and dates the logbook to indicate that they have performed the steps indicated and that the analysis meets acceptance criteria or has exceptions that are noted in the comments section. Careful attention is paid to ensure that all required columns are filled in as necessary. A reviewer checklist is completed and signed/dated. The results are manually entered into the Element DataSystem®.

The Data Entry/Review Tables (DETs) used by the Element DataSystem® employ various colors and symbols to indicate problems and status settings of data and calculated results. If the DET does not show any values or entries in a color (other than black), then there are no flagged or out-of-range values. The use of a placeholder column within the Element DataSystem® is used as a reminder that an ancillary action has been completed, such as pH verification. If no value is entered, a red-flag appears that a data response is needed. The DET may show one or more other colors that indicate various problems with the data.

For example:

- Black: Default color, indicates no problems with data
- Orange: Indicates the final result equals or exceeds one or more preset flag levels. The flag levels that are exceeded will also be colored orange.
- Red: Indicates a QC value is missing, a flag level is exceeded or required data is missing. The missing or inappropriate QC value will also be colored red.
- Purple: Indicates that a result that was in red has been qualified.

The analyst reviews the data in the Element DataSystem® and qualifies the data as appropriate. The data is released to a project manager who performs a final review to ensure that the data is coherent, that QC results are acceptable, QC

exceptions are appropriately flagged and results are in line with historical values, if known.

27.4.2 Review of Electronically Transferred Data

Electronic bench sheets have been created in the Element DataSystem® to take the place of traditional paper-based logbooks. These bench sheets guide the analyst in recording all of the information required for the traceability of the analysis. The bench sheets include space for recording quality control measurements and standards documentation for the QC elements. Data are recorded on the bench sheets promptly at the time of the preparation or analysis. Proper documentation procedures must be used. Analysts review sample data and the QC information at the time of analysis and indicate if the QC parameters met the acceptance criteria. The analyst will note on the bench sheet any exceptions that are found in the "Comments" section of the bench sheet.

During data transfer from an instrument, an electronic data file is generated by the instrument and saved in the Element DataSystem®. The data file is loaded into a program that converts the data in a format that can be read by the LIMS. During data processing, the program checks the quality control measurements for acceptability. Quality control analyses that do not meet the QC criteria are qualified by the analyst.

The Data Entry/Review Tables (DETs) used by the Element DataSystem® employ various colors and symbols to indicate problems and status settings of data and calculated results. If the DET does not show any values or entries in a color (other than black), then there are no flagged or out-of-range values. The DET may show one or more other colors that indicate various problems with the data.

For example:

- Black: Default color, indicates no problems with data
- Orange: Indicates the final result equals or exceeds one or more preset flag levels. The flag levels that are exceeded will also be colored orange.
- Red: Indicates a QC value is missing and a flag level is exceeded. The missing or inappropriate QC value will also be colored red.
- Purple: Indicates that a result that was in red has been qualified.

The analyst reviews the data in the Element DataSystem® and qualifies the data as appropriate. The data is released to a project manager who performs a final review to ensure that the data is coherent, that QC results are acceptable, QC exceptions are appropriately flagged and results are in line with historical values, if known.

Section 28

REPORTING THE RESULTS
(TNI V1:M2 – Section 5.10)

The result of each test performed is reported accurately, clearly, unambiguously, and objectively and complies with all specific instructions contained in the test method.

Laboratory results are reported in a test report that includes all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used.

Data are reported without qualification if they are greater than the lowest calibration standard, lower than the highest calibration standard, and without compromised sample or method integrity. The test reports may be issued as hardcopy or by electronic data transfer provided that the requirements of the TNI Standard are met.

Note: The Microbiology Section is certified by the Illinois Department of Public Health (IDPH) and as such does not fall under the 2009 TNI Standard. The Microbiology Section maintains reports specific to the program requirements of their certifying agency.

28.1 Test Reports

The standard report format has been designed to accommodate each type of test performed and to minimize the potential for misunderstanding or misuse.

The Element DataSystem® report generating function contains a drop-down list of available reports. The most common report issued is the PDC_1.rpt. Other formats are available based on client requirements.

For routine reporting, the system is queried daily for login groups by project manager that are “reportable”. A list of reportable logins is generated and presented on the screen. A draft report is generated for each login for review. At this time any corrections to sample descriptions, dates, times, comments, etc. can be made as needed. Any questions or issues based on the draft reports are taken to the appropriate department manager to be addressed.

After reviewing a draft of all available reports, the project manager returns to the list and highlights those logins that are ready to report either “as is” or “as corrected”. The project manager then chooses the “spool” options and reviews the parameters. The spool process generates the PDC_1 report format for each highlighted login in an electronic file. The report files (in PDF format) are staged by the Element DataSystem® and either printed for mailing or emailed to the contacts and any other report recipients that are specified in client reporting options for each project.

Reports can also be individually generated and manually printed or emailed when needed. This is typically done when a client calls and needs a report immediately and the project manager is not prepared to spool all available reports.

Each test report generated contains the following information unless not required by the client requirements:

a. a title, “Laboratory Results”;

b. the name and mailing address of the laboratory, the laboratory telephone number, fax number and name of the client’s project manager or designee of the project manager;

c. unique identification of the test report, such as a workorder number, on each page and a pagination system that ensures that each page is recognized as part of the test report and a clear identification of the end of the report, such as 3 of 10;

d. the name and address of the client;

e. the identification of the method used;

f. a description and unambiguous identification of the sample(s) tested, including the client identification code;

g. the date of sample receipt when it is critical to the validity and application of the results, date and time of sample collection, dates the tests were performed, the time of analysis if the required holding time for either activity is less than or equal to 72 hours;

h. reference to the sampling plan and procedures used by the laboratory where these are relevant to the validity or application of the results is not found on the standard report but may be added under “Notes” or in a separate narrative;

i. the test results, units of measurement, an indication of when results are reported on any basis other than as received (e.g. dry weight), failures identified (Appendix F – Data Qualifiers);

j. the name, function, and signature or an equivalent electronic identification of the person authorizing the test report, and the date of issue;

k. where relevant, a statement to the effect that the results relate only to the samples;

l. Any non-accredited tests or parameters shall be clearly identified as such to the client when claims of accreditation to this Standard are made in the analytical report or in the supporting electronic or hardcopy deliverables (PDC_1 cert.rpt); and

m. a statement that the report shall not be reproduced except in full without written approval of the laboratory.

28.2 Supplemental Test Report Information

When necessary for interpretation of the results or when requested by the client, test reports may include the following additional information:

a. deviations from, additions to, or exclusions from the test method, information on specific test conditions, such as environmental conditions, and any non-standard conditions that may have affected the quality of the results, and any information on the use and definitions of data qualifiers;

b. a statement of compliance/non-compliance when requirements of the management system are not met, including identification of test results that did not meet the laboratory and regulatory sample acceptance requirements, such as holding time, preservation, etc.;

c. where applicable and when requested by the client, a statement on the estimated uncertainty of the measurement;

d. where appropriate and needed, opinions and interpretations. When opinions and interpretations are included, the basis upon which the opinions and interpretations are documented. Opinions and interpretations are clearly marked as such in the test report. Opinions may be used as needed on some microbiology reports – which do not fall under the TNI Standard. (A narrative can be used for explanation but any opinion or interpretation is limited to comparison with a regulatory limit.

e. additional information which may be required by specific methods or client;

f. qualification of results with values outside the calibration range (E qualifier) as appropriate.

In addition to the items above, for test reports that include copies of field log sheets, the following is provided when necessary for the interpretation of the results:

a. the date of sampling (on COC form and field log sheets);

b. unambiguous identification of the material sampled;

c. the locations of the sampling based on client provided monitoring point descriptions;

d. a reference to the sampling plan and procedures used when requested (sampling technique information such as bailer, bladder pump, mitertial pump, etc. is included on field log form);

e. details of any environmental conditions during sampling that may affect the interpretations of the test results (on field log sheets);

f. any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned (comments/observations on field log sheets).

28.3 Environmental Testing Obtained from Subcontractors

Test results obtained from tests performed by subcontractors are clearly identified on the test report by subcontractor name and/or accreditation number.

The subcontractors report their results in writing or electronically. A copy of the actual report received from the subcontractor on their letterhead is attached to the PDC report in its entirety.

28.4 Electronic Transmission of Results

All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of the TNI Standard and associated procedures to protect the confidentiality and proprietary rights of the client (see Section 22- "Environmental Methods and Method Validation").

28.4.1 Electronic Data Deliverables

Industry standard formats and client –specific custom formats for electronic data deliverables are available in the Element DataSystem® as requested by the client.

28.5 Amendments to Test Reports

Amendments to a test report after it has been issued are made only in the form of another document or data transfer. All supplemental reports meet all the requirements for the initial report and the requirements of this *Quality Manual*.

Amended test reports include the title, "Revised Laboratory Results" or the statement, "Revised Report" appended to the "Notes" section via the use of the narrative function of Element to assure they can be differentiated from other test reports. The report requirements of the client dictate which format is used.

When it is necessary to issue a complete new report, the new report is uniquely identified and contains a reference to the original that it replaces.

Appendix A

Ethics and Data Integrity Policy Overview

The mission of PDC Laboratories, Inc. is to generate and report data of known and documented quality in a fashion that meets our clients' requirements. Our policy is to use good professional practices, to maintain quality, to uphold the highest quality of service and to comply with the TNI Standard. In support of this mission, our quality assurance program has been implemented as an integral part of laboratory management and practice. The PDC Laboratories, Inc. Quality Manual (QM) describes the standard practices and requirements that have been established to assure the quality of the laboratories' services. It describes the requirements, implementation, management and review of these practices. The Laboratory Vice President, directors, department managers, section supervisors and staff members are individually obligated to comply with its stated requirements, responsibilities and objectives.

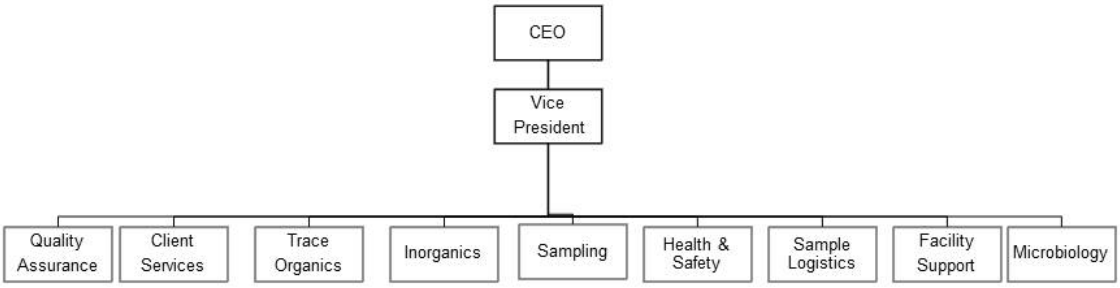
The PDC Laboratories, Inc. management is committed to comply with the TNI Standard and will continually improve the effectiveness of the management system that results from implementation of the Standard in its entirety. Each staff member must familiarize themselves with the quality documentation and to implement the quality policies and procedures in their work. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority.

The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality.

Appendix B

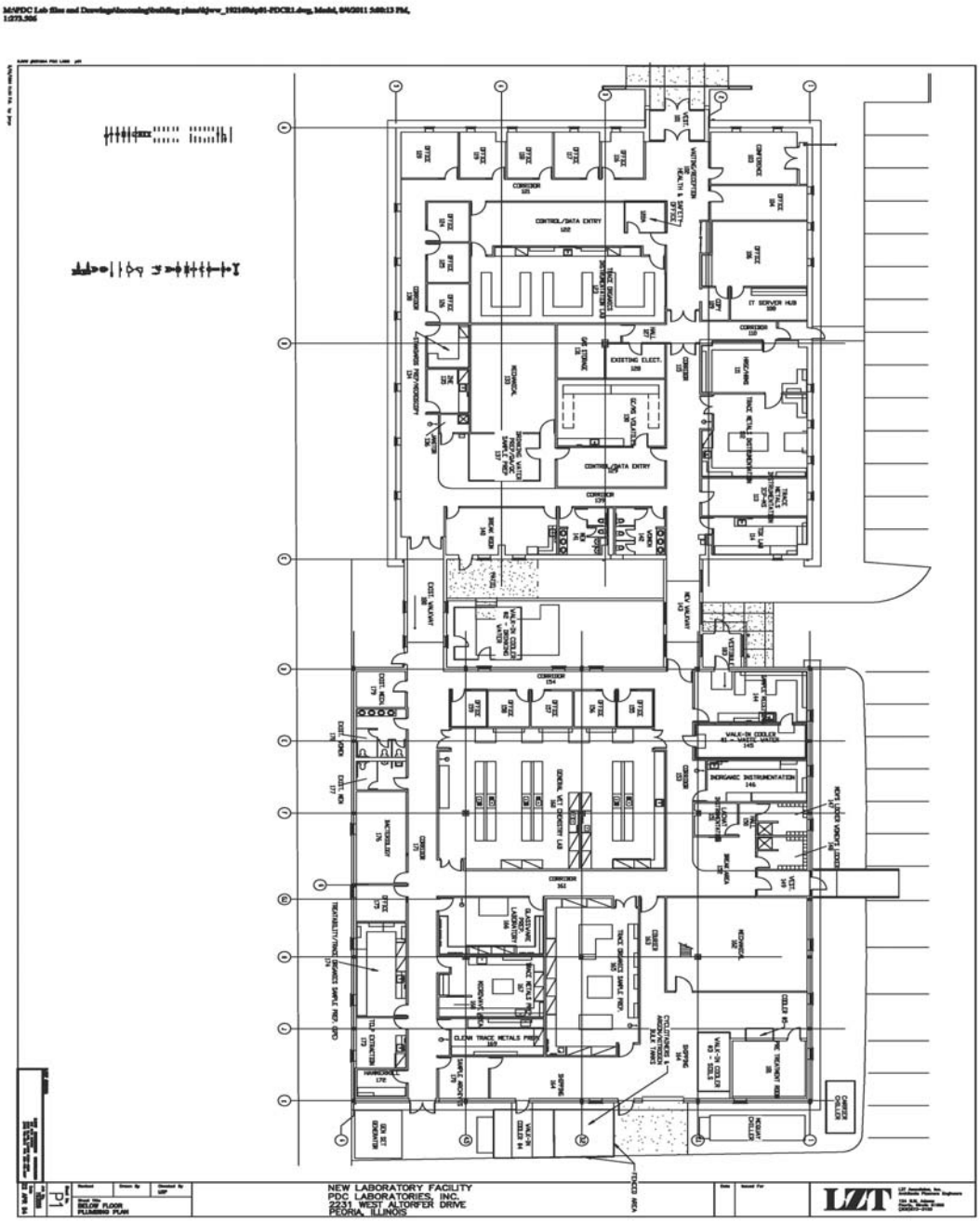
General Laboratory Organization Chart

(The most current chart can be obtained from the Quality Assurance Department.)



Appendix C

Laboratory Floor Plan



Appendix D

Terms and Definitions

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents.

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.

Accreditation Body (AB): The territorial, state or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.

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 that are due to sampling and analytical operations; a data quality indicator.

Aliquot: A measured portion of a sample, or solution taken for sample preparation or analysis

Analysis Date: The calendar date of analysis associated with the analytical result reported for an accreditation or experimental field of proficiency testing.

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.

Analyte: The specific component measured in a chemical analysis

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

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).

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.

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.

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).

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. Blanks include:

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 the 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.

Calibration Blank: An aliquot of the standard diluent (water or organic solvent) that is not carried through the sample preparation scheme. It is analyzed to verify that the analytical system is free from contamination. Also referred to an Instrument Blank.

Equipment Blank: A sample of analyte-free media which has been used to rinse common sampling equipment to check the effectiveness of decontamination procedures.

Field Blank: Blank that is prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken and analyzed to determine the level of contamination introduced in to the sample due to sampling technique and environmental factors.

Trip Blank: An aliquot of laboratory pure water that accompanies the sample containers to the sampling site and returns to the laboratory. Used for volatile samples. The holding time for a trip blank begins when samples are collected. Trip blanks do not need to be analyzed if VOC, GRO and/or PVOC compounds are not detected in any of the associated water samples.

Storage Blank: An aliquot of laboratory pure water stored and analyzed with samples at the laboratory. It is a test for contamination in sample storage.

Blank Spike (BS): 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 and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. Also called a Laboratory Control Sample (LCS)

Blank Spike Duplicate (BSD): A replicate blank spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. Also called a Laboratory Control Sample Duplicate (LCSD)

Blind Sample: A sample known by the submitter, that is submitted in such a way that the analyst does not know its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Breakdown: A measure of the decomposition of certain analytes (DDT and Endrin) into by-products

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

Support equipment calibration: The values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

Method calibration: The values realized by standards are typically established through the use of reference materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

Calibration Factor: A measure of the gas chromatographic response of a target analyte to the mass injected. The calibration factor is analogous to the Relative Response Factor (RRF) used in gas chromatograph/mass spectrometer (GC/MS) volatile and semivolatile fraction analyses.

Calibration Standard: A substance or reference material used for calibration.

Certified Reference Material (CRM): Reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.

Chain of Custody Form: Record that documents the possession of samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. See also Legal Chain of Custody Protocols.

Check Standard: A standard of known value used to verify titrant strength and/or used to determine that the method is in control when a blank spike or calibration curve is not used.

Completeness: The percentage of measurements made which are judged to be valid measurements. The completeness goal is to generate sufficient amount of valid data based on project needs.

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.

Continuing Calibration Verification Standard (CCV): A standard used to verify the continued acceptability of the initial calibration curve. A continuing calibration verification standard must be repeated at the beginning and end of each analytical batch and every 10-20 samples, whichever is more frequent depending on the method requirements.

Control Chart: A graphical plot of test results with respect to time or sequence of measurements together with limits within which they are expected to lie when the system is in a state of statistical control.

Control Limit: the limits shown on a control chart beyond which it is highly improbable that a point could lie while the system remains in a state of statistical control.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent reoccurrence.

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 criteria).

Data Quality Objectives (DQO): During the planning phase of a project requiring laboratory support, the data user must establish the quality of data required from the investigation. Such statements of data quality are known as DQOs. DQOs are qualitative and quantitative statements of the data which are required to support specific decisions or regulatory actions. DQOs must take into account sampling considerations as well as analytical protocols.

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more useful form.

Demonstration of Capability (DOC): A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

Document Control: the act of ensuring that documents (and revisions there to) 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 is performed.

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Field of Proficiency Testing (FoPT): Analytes for which a laboratory is required to successfully analyze a PT sample in order to obtain or maintain accreditation, collectively defined as: matrix, technology/method, analyte

Finding: An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.

Headspace: Any area in a container not completely filled by the sample, thus allowing gases to collect in that space

Holding Time: The maximum time that can elapse between two (2) specified activities.

Initial Calibration Verification Standard (ICV): A standard used to verify the accuracy of calibration standards. Prepared from a second source than that of the calibration standards, its known value is measured against the calibration curve determining the integrity of the working standards. Also referred to as an external verification standard or a check standard.

Instrument Detection Limit (IDL): A statistically determined detection limit to estimate an instrument's sensitivity (the smallest signal that can be distinguished from background noise). The IDL is obtained by analyzing seven consecutive standards, without preparation, if possible, at a concentration of three to five times the estimated IDL. These standards must meet criteria of bias and precision.

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Laboratory Control Sample (LCS): Refer to Blank Spike (BS)

Laboratory Control Sample Duplicate (LCSD): Refer to Blank Spike Duplicate (BSD)

Legal Chain of Custody Protocols: Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.

Limit(s) of Detection (LOD): A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility.

Limit(s) of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

Linear Dynamic Range (LDR): The concentration range over which the instrument response to an analyte is linear.

Matrix: The substrate of a test sample.

Matrix Duplicate: A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision. Precision results are reported as relative percent difference (RPD).

Matrix Interference: The influence of the sample matrix or sample components upon the ability to qualitatively identify or quantitatively measure compounds in environmental samples.

Matrix Spike (MS): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (MSD): A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Measurement System: A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).

Method: A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method Detection Limit (MDL): The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is determined from the analysis of a sample in a given matrix containing the analyte. MDLs are determined by analyzing a minimum of seven consecutive standards that have been processed through all preparatory steps. These standards must meet criteria of bias and precision.

Method Reporting Limit (MRL): The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e., the lowest standard in a calibration curve).

Method of Standard Addition (MSA): A method in which small increments of a substance under measurement are added to a sample to establish a response function, and by extrapolation, to determine the amount of the substance originally present in the sample.

Modals: Words used to signify requirements in a specification, method or procedure.

May: denotes permitted action, but not required action (truly optional).

Must: denotes an absolute requirement that has to be met (required)

Shall: denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should: denotes a guideline or recommendation whenever noncompliance with the specification is permissible (recommended).

Narrative: The portion of the data package which includes laboratory, contract, case and sample number identifications, and descriptive documentation of any problems encountered in processing the samples along with corrective action taken and problem resolution.

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.

National Environmental laboratory Accreditation program (NELAP): The overall National Environmental Laboratory Accreditation program of which NELAC is part.

National Institute of Standards and Technology (NIST): A federal agency of the US Department of Commerce's Technology Administration that is designated as the United States National Metrology Institute (NMI).

Negative Control: measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Parallax Error: Type of error that occurs when the scale of the glass measuring device is not viewed from a perpendicular position. Looking down on the meniscus causes it to appear higher that where it really is. Looking up at the meniscus causes it to appear lower than it really is.

Post Digestion Spike: The addition of a known amount of standard after digestion.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.

Primary Accreditation Body (Primary AB): the accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.

Procedure: A specified way to carry out an activity or process. Procedures can be documented or not.

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.

Proficiency Testing Program (PT 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.

Proficiency Testing Provider (PTP): A person or organization accredited by the TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT program.

Proficiency Testing Provider Accreditor (PTPA): An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers.

Proficiency Test Sample (PT Sample): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.

Proficiency Testing Study (PT Study): A single complete sequence of circulation of proficiency testing samples to all participants in a proficiency test program.

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed.

Quality Assurance (QA): An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Control (QC): The overall system of technical activities that measures the attributes and performance of a process, item , or service against defined standard to verify that they meet the stated requirements established by the client; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality Control Sample (QCS): A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.

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.

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 quality assurance (QA) and quality control (QC) activities.

Quality System Matrix: These matrix definitions are to be used for purposes of batch and quality control requirements:

Air and Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, ground water effluents, and TCLP or other extracts.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.

Non-Aqueous Liquid: Any organic liquid with <15% Settleable solids.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Solids: Includes solids, sediments, sludges and other matrices with >15% settleable solids

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.

Reference Material: Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or at a given location.

Retention Time: The time elapsed from sample injection on a gas or ion chromatograph until the specific compound elutes or exits from the chromatographic column on the detector. Each analyte has a characteristic retention time on a specific column allowing this information to be used to qualitatively identify the analytes in the sample.

Sample: A portion of material supplied by the client for analysis.

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment according to a procedure.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Standard Operating Procedures (SOPs): A written document that details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.

Stock Solution: A solution containing an analyte that is prepared using a reference material traceable to EPA, the National Institute of Science and Technology (NIST), or a source that will attest to the purity and authenticity of the reference material.

Surrogate Compound: A compound that behaves similarly, with respect to the analytical method, as the analytes of interest but is not normally found in environmental samples. Often surrogates are isotopic homologues of target analytes. Surrogate(s) are added to all blanks, samples and QC samples prior to preparation and analysis. Recovery of surrogates is used to assess method performance.

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

The NELAC Institute (TNI): A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community.

Toxic Equivalency Factor (TEF): Values assigned to each 2, 3, 7, 8-substituted dioxin and furan to approximate their toxicity in relation to 2, 3, 7, 8-TCDD.

Toxic Equivalency Quotient (TEQ): The total of each 2, 3, 7, 8-substituted dioxin and furan multiplied by the corresponding TEF. The TEQ is used to assess a sample's toxicity by expressing the results of all dioxins and furans detected as 2, 3, 7, 8-TCDD.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Validation: The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification: Confirmation by examination and objective evidence that specified requirements have been met.

> 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.

Working range: The difference between the Limit of Quantitation (LOQ) and the upper limit of the measurement system calibration.

ACRONYMS

A list of acronyms used in this document and their definitions are:

A

AB – Accrediting Body
ANSI – American National Standards Institute
ASQC – American Society for Quality Control
ASTM – American Society for Testing and Materials

B

BFB - Bromofluorobenzene
BLK - Blank
BOD - Biological Oxygen Demand
BS - Blank Spike
BSD - Blank Spike Duplicate
BTEX - Benzene, Toluene, Ethylbenzene, Xylenes

C

°C – degrees Celsius
cal – calibration
CAS – Chemical Abstract Service
CCC - Calibration Check Compounds
CCV – Continuing Calibration Verification (Standard)
CDD - Chlorinated Dibenzo-p-dioxin (tetra- through octa-)
CDF - Chlorinated Dibenzofuran (tetra- through octa-)
CERLA - Comprehensive Environmental Response, Compensation, and Liability Act
CFR - Code of Federal Regulations
CLP - Contract Laboratory Program (USEPA)
COC – Chain of Custody
COD - Chemical Oxygen Demand
CRM - Certified Reference Material
CVAA - Cold Vapor Atomic Absorption
CWA - Clean Water Act

D

DFTPP - Decafluorotriphenyl phosphine
DO - Dissolved Oxygen
DOC - Demonstration of Capability
DQO - Data Quality Objectives
DRO - Diesel Range Organics

E

ECD - Electron Capture Detector
EDB - Ethylene Dibromide
EDL - Estimated Detection Limit
EMPC - Estimated Maximum Possible Concentration
EPA - Environmental Protection Agency

F

FID	-	Flame Ionization Detector
FoPT	-	Field of Proficiency Testing

G

GALP	-	Good Automated Laboratory Practices
GC	-	Gas Chromatograph
GC/MS	-	Gas Chromatography/Mass Spectrometry
g/L	-	grams per liter
GLP	-	Good Laboratory Practices
GRO	-	Gasoline Range Organics

H

HAZMAT	-	Hazardous Materials
HPLC	-	High Performance Liquid Chromatography
HVAC	-	Heat, Ventilation and Air Conditioning System

I

IC	-	Ion Chromatography
ICP	-	Inductively Coupled Plasma (Spectrometry)
ICP-MS	-	Inductively Coupled Plasma Mass Spectrometry
ICS	-	Interference Check Standard
ICV	-	Initial Calibration Verification (Standard)
IDC	-	Initial Demonstration of Capability
IDL	-	Instrument Detection Limit
ISO/IEC	-	Inter. Organization for Standardization/Inter. Electrochemical Commission
ISTD	-	Internal Standard

L

LCD	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
LDR	-	Linear Dynamic Range
LFB	-	Laboratory Fortified Blank
LIMS	-	Laboratory Information Management System
LOD	-	Limit of Detection
LUST	-	Leaking Underground Storage Tank

M

M	-	molecular ion
MB	-	Method Blank
MBAS	-	Methylene Blue Active Substances
MDL	-	Method Detection Limit
mg/kg	-	milligrams per kilogram
mg/L	-	milligrams per liter
MRL	-	Method Reporting Limit
MS	-	Matrix Spike
MSA	-	Method of Standard Additions
MSD	-	Matrix Spike Duplicate

MTBE - Methyl Tertiary Butyl Ether
m/z - mass-to-charge ratio

N

NELAC - National Environmental Laboratory Accreditation Conference
NELAP - National Environmental Laboratory Accreditation Program
NIST - National Institute of Standards and Technology
NPDES - National Pollutant Discharge Elimination System
NTU - Nephlometric Turbidity Unit

P

PAH - Polynuclear Aromatic Hydrocarbons
PCB - Polychlorinated Biphenyl
PCDD - Polychlorinated dibenzo-p-dioxins; refers to methods' full dioxin analyte list
PCDF - Polychlorinated dibenzo-p-furans; refers to methods' full furan analyte list
PFK - Perfluorokerosene
PNA - Polynuclear Aromatics
ppb - Parts per Billion
ppm - Parts per Million
ppq - Parts per Quadrillion
ppt - Parts per Trillion (ng/L; pg/g)
PT - Proficiency Test(ing)
PTP - Proficiency Testing Provider
PVOC - Petroleum Volatile Organic Compounds

Q

QA - Quality Assurance
QC - Quality Control
QCS - Quality Control Sample
QM - Quality Manual

R

RCRA - Resource Conservation and Recovery Act
RF - Response Factor
RPD - Relative Percent Difference
RRF - Relative Response Factor
RRT - Relative Response Time
RSD - Relative Standard Deviation

S

SARA - Superfund Amendments and Reauthorization Act
SDG - Sample Delivery Group
SDWA - Safe Drinking Water Act
SOC - Synthetic Organic Chemicals
SOP - Standard Operating Procedure
SPCC - System Performance Check Compounds
SPK - Spike
SPLP - Synthetic Precipitation Leaching Procedure
STD - Standard
SW-846 - Test Methods for Evaluating Solid Waste

T

TCLP	-	Toxicity Characteristic Leaching Procedure
TDS	-	Total Dissolved Solids
TEF	-	Toxic Equivalency Factor
TEQ	-	Toxic Equivalency Quotient
TNI	-	The NELAC Institute
TOC	-	Total Organic Carbon
TOX	-	Total Organic Halides
TRPH	-	Total Recoverable Petroleum Hydrocarbons
TSS	-	Total Suspended Solids
THMs	-	Trihalomethanes
TTHM	-	Total Trihalomethanes

U

ug/Kg	-	Micrograms per Kilogram
ug/L	-	Micrograms per Liter
UV/Vis	-	Ultraviolet/Visible Wavelength

V

VOC	-	Volatile Organic Compounds

W

WET	-	Whole Effluent Toxicity test
WG	-	Work Group

Z

ZHE	-	Zero Headspace Extractor

Appendix E

Laboratory Accreditation / Certification / Recognition

PDC Laboratories, Inc. maintains the following certifications and accreditations with numerous state and national entities:

Organization	Certificate Number	Matrix
Illinois Department of Public Health	17553	Microbiology
Indiana State Department of Health	C-IL-04	DW
Indiana State Department of Health	M-IL-04	Microbiology
Iowa Department of Natural Resources	240	DW; WW; SW; UST
State of Arkansas Department of Environmental Quality	12-020-0	WW; SW
State of Illinois Environmental Protection Agency	002960	DW; WW; SW
State of Kansas Department of Health and Environment	E-10338	DW; WW; SW
State of Missouri Department of Natural Resources	870	DW
State of Missouri Department of Natural Resources	870	Microbiology
State of Wisconsin Department of Natural Resources	998284430	DW; WW; SW

Legend

DW = Drinking water;
WW = Wastewater;
SW = Solid waste;
UST = Underground Storage Tanks

Copies of certificates and parameter lists for each organization are available upon request.

If accreditation is terminated or suspended, the laboratory will immediately cease to use the certificate number reference in any way and inform clients impacted by the change.

Appendix F

Data Qualifiers
(as reflected in Element DataSystem® on November 15, 2012)

Qualifier	Definition
_<0.1	<0.1
>240000	>240000
_>24200	>24200
_A	Absent
_G-	_G-
_I	Invalid
_P	Present
_S	Satisfactory
_TNTC	TNTC
_U	Unsatisfactory
>160	>160
>160000	>160000
>200	>200
>201	>201
>2420	>2420
>60000	>60000
>73	>73
>BOD	>[Custom Value]
2	Values are both under [Custom Value] mg/L and within 1 MRL of each other
A	Absent

Qualifier	Definition
A1	The presence of this analyte was confirmed using a second column but there was a disparity (> 40% RPD) between the two sets of results with no apparent chromatographic anomalies. The lower of the two results was reported.
B	Present in the method blank at [Custom Value].
B1	Blank contamination suspected and the sample result is less than MRL
B2	Contamination does not impact data since sample result is greater than ten times the contamination level.
C	The blank spike failed to meet the required acceptance criteria.
D	Result obtained through analysis of a sample dilution.
E	Concentration exceeds the instrument calibration range
F	Internal standard area failed to meet the required acceptance criteria in repeat instrumental analyses. Results should be interpreted as estimated concentrations.
Fail	Fail
G	The Method of Standard Additions [MSA] was used to quantify the concentration.
H	Test performed after the expiration of the appropriate regulatory/advisory maximum allowable hold time
HS	Headspace present
J	Estimated value; value between the MDL and MRL.
K	Filtered Only – Not Tumbled
M	Analyte failed to meet the required acceptance criteria for duplicate analysis
NA	Not Analyzed
NO	NO
NR	Not Required
O	[Custom Value]

Qualifier	Definition
P	Present
Pass	Pass
Pc	Chemical preservation discrepancy noted at the time of analysis
Pt	Thermal preservation discrepancy noted
Q1	MS Failed %R
Q2	MSD failed %R
Q3	MS/MSD both failed %R
Q4	The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.
R	MS/MSD Failed %RPD
S	Surrogate compound diluted below a reliable quantitation level.
Sub	Subcontracted
T	Surrogate recovery failed to meet the required acceptance criteria in the initial analysis. Sample was re-extracted (if applicable) and re-analyzed, and the surrogate recovery was outside of the required acceptance criteria on the second analysis, also.
U	Parameter was analyzed for, but not detected above the reporting limit.
V	Verification standard recovery failed to meet the required acceptance criteria on repeat instrumental analyses.
W	Surrogate recovery failed to meet the required acceptance criteria in initial analysis. Sample was re-extracted (if applicable) beyond the maximum allowable hold time, and re-analyzed.
X	[Custom Value]
YES	YES

Appendix G

Chemistry

G.1 Method Validation

A reference method is a method issued by an organization generally recognized as competent to do so. When a laboratory is required to analyze a parameter by a specific method due to a regulatory requirement, the parameter/method combination is recognized as a reference method. Reference methods are validated by determining the LOD and/or LOQ by procedures outlined below and determining precision and bias by using the demonstration of capability procedures.

Before any non-standard or laboratory-developed methods are used in the laboratory, the laboratory determines the data quality that must be used to ensure that the data are acceptable for the intended use. Based on the intended use, the laboratory establishes quality control acceptance criteria for precision, accuracy and selectivity (if applicable). In addition, the action level (compliance level, project decision level, etc.) is used to establish the LOQ and/or LOD.

Specific procedures for the validation of laboratory-developed methods may be found in Section 22.2 of this QAM.

a. Limit of Detection (LOD)

The Limit of Detection (LOD) is the laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility.

If the laboratory does not report values below the Limit of Quantitation (LOQ) or the lowest calibration standard, if the laboratory is not required to report to the LOD, or if the method does not require a LOD study, a LOD is not required.

LODs are not required for any component for which spiking solutions or quality control samples are not available. These include, for example: residual chlorine, solids (gravimetric), BOD/cBOD, titrimetric procedures, ignitability, reactivity, and corrosivity.

The laboratory will select methods with LODs that are expected to meet the intended data use. When the method or applicable regulation specifies a LOD study, only the specified method will be used.

LODs are determined in samples that represent the quality system matrices to be evaluated. All sample processing/preparation steps and all determinative steps are used to validate the method for all targeted analytes. The representative quality system matrix will be free from the target analytes of interest or interfering analytes that impact the LOD.

When providing compliance data under 40 CFR Part 136 or equivalent delegated state program, the laboratory follows the procedures outlined in 40 CFR Part 136 Appendix B, and uses the method detection limit (MDL) derived from this procedure as the LOD. The laboratory documents the process used to derive the LOD and retains all the supporting data. Alternate means of determining the LOD may include dilution of a standard until it is no longer detected (the LOD is the level that was last detected) or establishing the LOD at a concentration that is five times the signal-to-noise ratio.

The laboratory uses the current version of the SOP, Guidelines for Performing Detection Limit (MDL) Studies to determine the LOD for a method.

Once the LOD has been determined the validity of the LOD is verified by a detection (value above zero) for each target analyte in a quality control sample of a representative quality system matrix. The concentration of the analytes in the sample will be no more than 3 times the derived LOD unless the test contains multiple analytes. In the latter case, the concentration of the target analytes will be no greater than 4 times the LOD. This verification will be performed on each instrument that is used for the test.

LODs are performed or repeated:

- before reporting the LOD for a given analyte,
- any time there is a change that affects how the method is performed, or
- when there is a change in instrumentation that affects the sensitivity of the analysis.

LODs are verified annually for each quality system matrix/technology/analyte combination, if required.

b. Limit of Quantitation

The Limit of Quantitation (LOQ) is an estimate of the minimum amount of a substance that can be reported with a specified degree of confidence.

If a LOD study is not performed, concentration values less than the LOQ are not reported but are appropriately qualified.

LOQs are not required for components or properties for which spiking solutions or QC samples are not available. These include, for example: residual chlorine, solids (gravimetric), BOD/cBOD, titrimetric procedures, ignitability, reactivity, and corrosivity.

A LOQ study includes all sample processing and analysis steps in the analytical method. The study is performed in each quality system matrix for which the test will be performed. The procedure is documented and all supporting data are retained. The resulting LOQ will be above the LOD (if determined).

The LOQ is established by the low calibration standard. Alternately, the LOQ is no less than 3 times the method detection level (MDL) or 10 times the LOD.

The laboratory will verify the LOQ by the analysis of a QC sample containing the analytes of concern at a concentration of 1 to 2 times the derived (claimed) LOQ. The LOQ is considered verified if recovery of each analyte is within the laboratory's acceptance limits, or the client's data quality objectives.

The LOQ will be verified annually for each quality system matrix, technology and analyte unless the LOD was determined or verified.

c. Precision and Bias

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms.

Bias is the systematic error that contributes to the difference between the mean of a significant number of test results and the accepted reference value.

Precision and bias using non-reference, modified reference or laboratory-developed methods are established using the procedure outlined below and compared to the criteria established by the client (when requested), the method, or the laboratory.

Precision and bias are determined by using the demonstration of capability procedures. Samples are processed through all phases of the method (sample preparation, cleanup, analysis, etc.) and are evaluated across the analytical calibration range of the method. This study is performed for all quality system matrices for which the test is to be used.

d. Selectivity

Selectivity is the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances.

The laboratory evaluates selectivity through procedures defined in the test method SOPs. These procedures may include mass spectral tuning, second column confirmation, ICP inter-element interference checks, chromatography retention time windows, sample blanks, spectrochemical or fluorescence profiles, co-precipitation evaluations, and electrode response factors.

G.2 Demonstration of Capability

Demonstration of Capability (DOC): A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

Before reporting any data with a given method, a satisfactory DOC is performed. Thereafter, each analyst demonstrates continuing proficiency through the procedures outlined in Ongoing Demonstration of Capability.

In cases where a laboratory analyzes samples using a method that has been in use by the laboratory for at least one year prior to applying for accreditation, and there have been no significant changes in instrument type, personnel, or method, the ongoing DOC shall be acceptable as an initial DOC. The laboratory shall have records on file to demonstrate that an initial DOC is not required.

a. Initial Demonstration of Capability (IDOC)

An IDOC is performed:

- before using any method,
- each time there is a change in instrument type, personnel or method, or
- if the laboratory or analysts has not performed the method in a twelve-month period.

The IDOC(s) for each analyst is documented in department training records. The document identifies the analyst(s) involved in preparation and/or analysis; matrix; analyte(s), class of analyte(s), or measured parameter(s); the method(s) performed; the laboratory-specific SOP used for analysis (including revision number); the date(s) of analysis; and a summary of the results used to calculate the mean recovery and standard deviations.

All raw data, preparation records, and calculations for each IDOC are retained and are available for review.

When the method specifies a procedure to be followed, only that specified procedure will be used. If the method or regulation does not specify an initial DOC procedure, the following general procedure is used:

i. The analyte (s) shall be diluted in a volume of clean quality system matrix (a sample in which no target analytes or interferences are present at concentrations that will impact the results of a specific method) sufficient to prepare four (4) aliquots at the concentration specified, or if unspecified, to a concentration of one (1) to four (4) times the limit of quantitation.

ii. At least four (4) aliquots shall be prepared and analyzed according to the method(s) either concurrently or over a period of days.

iii. Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations of the sample (in the same

units) for each parameter of interest. When it is not possible to determine mean and standard deviations, such as for presence/absence and logarithmic values, the laboratory shall assess performance against established and documented criteria.

iv. Compare the information from (iii) above to the corresponding acceptance criteria for precision and accuracy in the method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). If all parameters meet the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters does not meet the acceptance criteria, the performance is unacceptable for that parameter.

v. When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst shall proceed according to a) or b) below.

a. Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with (ii) above.
b. Beginning with (ii) above, repeat the test for all parameters that failed to meet criteria.

vi. Repeated failure, however, confirms a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with (ii).

vii. When an analyte not currently found on the laboratory's list of accredited analytes is added to an existing method, an initial demonstration shall be performed for that analyte.

b. <u>Ongoing Demonstration of Capability</u>

After the demonstration of capability is completed, on-going proficiency is maintained and demonstrated at least annually. Each analyst is expected to consistently meet the QC requirements of the method, the laboratory SOP, client requirements and/or the TNI Standard. Ongoing DOCS are documented in department training files, and all records related to the demonstration are retained.

The on-going demonstration may be one of the following:

i. acceptable performance of a blind sample (single blind to the analyst);

Note: Successful analysis of a blind performance sample on a similar method using the same technology (e.g., GC/MS volatiles by purge and trap for Methods 524.2, 624 or 5030/8260) would only require documentation for one of the tests.

ii. another initial DOC;

iii. at least four (4) consecutive laboratory control samples with acceptance levels of precision and accuracy. The laboratory shall determine the acceptable limits for precision and accuracy prior to analysis. The laboratory shall tabulate or be able to readily retrieve four (4) consecutive passing LCSs for each method for each analyst each year;

iv. a documented process of analyst review using QC samples. QC samples can be reviewed to identify patterns for individuals or groups of analysts and determine if corrective action or retraining is necessary;

v. if (i) through (iv) are not technically feasible, then analysis of real-world samples with results within a predefined acceptance criteria (as defined by the laboratory or method) shall be performed.

G.3 Calibration

Section 23.2.2 includes information on calibration of support equipment. This Section covers calibration of analytical equipment.

Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here or in laboratory SOPs. Generally, procedures and criteria regarding instrument calibrations are provided in the individual method SOPs.

G.3.1 Initial Instrument Calibration

- Records:

  Initial instrument calibration documentation includes calculations, integrations, acceptance criteria, and associated statistics referenced in the test method SOP.

  Sufficient raw data records are collected to allow reconstruction of the initial instrument calibration. These include, at a minimum, calibration date, test method, instrument, analysis date, analyte names, analysts signature or initials, concentration and response, calibration curve or response factor, or unique equation or coefficient used to reduce instrument responses to concentration. Calibration date and expiration date (when recalibration is due) is documented for equipment requiring calibration, where practicable (see Section 23.1).

- Number of Standards and Concentrations:

  The method SOP specifies the number of calibration standards to use.

  The lowest calibration standard is the lowest concentration for which quantitative results can be reported without qualification. The lowest calibration standard is at

or below the Limit of Quantitation (LOQ) and is greater than the Limit of Detection. Results that are less than the LOQ are considered to have increased uncertainty, and are either reported with a qualifier code or explained in a case narrative.

The highest calibration standard is the highest concentration for which quantitative results can be reported. Data reported exceeding the highest calibration standard without dilutions is considered to have increased uncertainty and are reanalyzed and reported as a dilution of the sample.

- Evaluation, Verification and Corrective Action

All initial instrument calibrations are verified with a standard obtained from a second source traceable to a national standard when commercially available. If a second source is not available, a standard prepared from a different lot may be used.

Criteria for the acceptance of an initial instrument calibration is established (e.g., correlation coefficient or relative percent difference) and defined in the method SOP. The criteria used are appropriate to the calibration technique.

Where appropriate, the laboratory has manual integration procedures, described in the current version of the SOP, Chromatographic Peak Integration Procedures, which are adhered to when evaluating calibration data.

Any samples that are analyzed after an unacceptable initial calibration are re-analyzed or the data are reported with qualifiers, appropriate to the scope of the unacceptable condition (see Section 12 – "Control of Nonconforming Environmental Testing").

Quantitation is always determined from the initial calibration unless the test method or applicable regulations require quantitation from the continuing instrument calibration verification.

Corrective actions are performed when the initial calibration results are outside acceptance criteria. Calibration points are not dropped from the middle of the curve unless the cause is determined and documented. If the cause cannot be determined, the calibration curve is re-prepared. If the low or high calibration point is dropped from the curve, the working curve is adjusted and sample results outside the curve are qualified.

G.3.2 Continuing Instrument Calibration

- Records

The calculations and associated statistics for continuing instrument calibration are included or referenced in the test method SOP.

Sufficient raw data records are retained to allow reconstruction of the continuing instrument calibration verification. Continuing instrument calibration verification

records connect the continuing verification date to the initial instrument calibration.

Where appropriate, the laboratory has manual integration procedures described in the current version of the SOP, Chromatographic Peak Integration Procedures, which are adhered to when evaluating calibration data.

- Frequency

  Calibration is verified for each compound, element, or other discrete chemical species. For multi-component analytes, such as aroclors, chlordane, toxaphene, or total petroleum hydrocarbons, a representative chemically related substance or mixture is used.

  Calibration verifications are performed:

  - at the beginning and end of each analytical batch, except for instances when an internal standard is used. For methods employing internal standards, one verification is performed at the beginning of the analytical batch. Some methods have more frequent CCV requirements (see specific method SOPs). Many inorganic methods require the CCV to be analyzed after every 10 samples.
  - whenever it is expected that the analytical system may be out of calibration or might not meet verification acceptance criteria.
  - when the time period for calibration or the most recent calibration verification has expired.
  - for all analytical systems that have a calibration verification requirement. Requirements can be found in the method SOPs. Many inorganic methods require the CCV to be analyzed after every 10 samples.

- Evaluation, Verification and Corrective Actions

  The validity of the initial calibration is verified prior to sample analysis by use of continuing instrument calibration verification (CCV) standard.

  Criteria for the acceptance of a continuing calibration verification is established (e.g., correlation coefficient or relative percent difference) and defined in the test method SOP. The criteria used are appropriate to the calibration technique.

  Where appropriate, the laboratory has manual integration procedures, described in the current version of the SOP, Chromatographic Peak Integration Procedures, which are adhered to when evaluating calibration data.

  Corrective action is initiated for CCV results that are outside of acceptance criteria (see Section 12 – “Control of Nonconforming Environmental Testing”).

G.3.3 Unacceptable Continuing Instrument Calibration Verifications

If routine corrective action for continuing instrument calibration verification fails to produce second consecutive (immediate) calibration verification within acceptance criteria, then a new calibration is performed or acceptable performance is demonstrated after corrective action with two consecutive calibration verifications.

For any samples analyzed on a system with an unacceptable calibration, some results may be useable if qualified and under the following conditions:

a. If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, then those sample results that are non-detects may be reported as non-detects.
b. If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, then those exceeding the regulatory limit may be reported.

Quality Assurance Manual

Effective Date: March 15, 2015

1. Policy Statement

The purpose of this Quality Manual is to outline the Quality Management Systems used by Verity Environmental Testing, Inc. (Verity) doing business as Consulting Analytical Services International (CaSi) to maintain ongoing compliance of its laboratory operations. It is the policy of Verity/CaSi that quality assurance activities be implemented to assure that all laboratory data generated are of known and documented quality. Further, that data generated meet the data quality requirements of both our clients and regulatory agencies or other governmental authorities.

2. Laboratory Organization and Personnel

Verity Environmental Testing, Inc. is an S Corporation incorporated in the State of Missouri. Verity Environmental Testing, Inc. purchased the assets and ongoing operations of Consulting Analytical Services International, Inc. in March of 2015 and these operations continue to do business under this name. Verity/CaSi provides services to industry, municipalities, government agencies, engineers and consultants, and the private sector. The firm is engaged in analytical testing and consultation in a variety of fields including drinking water, surface water, groundwater, wastewater, solid waste, soil, pollution control, hazardous wastes, and quality assurance. All executive management at Verity/CaSi hold degrees in chemistry and have more than 25 years of combined experience in laboratory operations, analytical testing, and quality in regulated environments. Verity/CaSi also employs degreed bench chemists to ensure accurate and quality testing results.

3. Training Requirements

Sampling personnel receive a minimum of 16 hours of field training by experienced field sampling personnel. The training will include topics such as:

- Calibration and use of field measurement devices
- Calibration and use of automatic sampling equipment
- Sample collection, preservation, documentation and packaging/shipping
- Chain of Custody and log sheet documentation

All laboratory personnel receive both generalized laboratory practices training as well as specific training in the proper procedures for the particular analyses and methodologies being performed. Personnel must demonstration initial capability for these procedures and perform acceptably by analyzing laboratory control samples.

4. Documentation & Records

Documentation includes the following:

- Field log sheets including field calibration and programming records
- Chain of custody and shipping records
- Analytical summaries including calibration and QC checks
- Data validation report
- Final report

Verity/CaSi maintains copies of all testing records for a period of seven (7) years following issuance of final reports, unless other arrangements have been made in writing.

5. Laboratory Facilities

Verity/CaSi laboratory facilities occupy approximately 2,200 square feet and are located in Greene County, Missouri at 3378 S. Scenic Avenue, Suite A. The facility consists of a wet lab, an instrument lab, a microbiological lab, a warehouse, office space, and a front entryway. Facilities shall be suitable in design and construction and must be maintained in a cleanly manner to minimize sources of potential contamination. The laboratory analyzes water, wastewater, soil, sludge, foods, and other samples utilizing methods published in Title 40 Code of Federal Regulations.

6. Records and Reports

All communications with clients are confidential. Efforts are made to report results to the client in the format most usable by the client. Both hard copy and electronic communications are available and any communication is held to the same requirements for confidentiality.

All laboratory-generated information regarding a specific client's results will be available for inspection by that client or an approved representative of that client. Arranged laboratory audits by clients are welcomed in an effort to assure the quality of the analytical results generated for the client. All testing records will be retained for a period of seven (7) years following issuance of final reports, unless other arrangements have been made in writing.

Before reporting analytical results reports will be reviewed by the QA officer. Any deficiencies will be returned to the analyst for correction.

7. Sample Receipt Procedures

Verity/CaSi personnel will verify that all of the samples listed in the chain of custody were received and that the sample descriptions listed on the chain of custody match the sample descriptions on the sample containers. The temperature of the sample will be measured and recorded on the chain of custody. The integrity of each sample is determined by comparing sample labels with the chain of custody and by visual checks of the container for possible damage. Any problems noted are recorded either on the chain of custody or on a separate sheet which is subsequently stapled to the chain of custody. Verity/CaSi will retain the original chain of custody form and return a copy to the client.

Samples will be logged according to the naming scheme of the client and will be assigned an internal Verity/CaSi identification number. This assigned internal identification number will follow the sample throughout processing, analyses, and reporting to ensure proper traceability. Data will be reported for samples according to the client-provided naming scheme. Modifications to the client's naming scheme in company documents will be undertaken only to identify the client specifically. This will avoid confusion if more than one client uses similar naming schemes.

Any deficiencies in the sample will be noted and communicated to the client as the samples are received. Attention should be given to sampling times and dates and specific due dates are noted. If there is a problem with the holding times of the samples, the laboratory will notify the client as soon as practical. Any chain of custody requirements of the client will be complied with and a copy of the form will be retained in the company's records for that client.

8. Sample Storage

After samples are received and logged, they will be stored at 4°C until processed and/or analyzed. Samples will be segregated from standards, laboratory spike solutions, or chemical reagents. Holding times will be determined from those published in Title 40 Code of Federal Regulations, or as directed by the client. If samples are not analyzed within these limits, the client will be notified, and analytical results will be flagged on the final report. Samples will be properly stored in the laboratory facility and be under control of the laboratory for fourteen (14) days following report completion, unless prior arrangements are made in writing.

9. Quality Control

All analyses will be completed with specific quality control checks in place. These checks shall consist of:

- **Calibration samples**
  A standard curve, including a blank, shall be prepared for each analytical method. Each sample batch will include a Method Blank (MB) and Laboratory Control Sample (LCS) to verify conformance with the established standard curve.

- **Calibration check standards**
  A Check Standard will be analyzed to ensure process control for approximately every ten (10) samples in a batch, or as required by methods published in Title 40 Code of Federal Regulations.

- **Replicate and duplicate samples**
  Replicate or Duplicate samples will be analyzed with each sample batch.

- **Matrix spike**
  Approximately ten percent of all samples will be spiked with the analyte being measured at an appropriate concentration. The spiked sample must meet control criteria. If spike recovery is not acceptable, the data will be flagged and the client will be informed of matrix interferences or incompatibility of testing methodology.

- **Laboratory bench sheets**
  As samples are analyzed for a particular parameter the raw data (i.e. absorbance, transmittance, weight, volume, colony count, etc.) will be entered into the laboratory bench sheet for each analytical run. This sheet will also contain the information for all standards, blanks and QC samples. After completion of a run, the raw data will be entered into Excel spreadsheet to make determinations of the concentrations of the unknown samples versus a standard curve. After printing the results of this spreadsheet, the original laboratory bench sheet is filed by parameter in a three ring binder and reviewed by the QA officer. The QA officer will also review the printed data sheet to ensure proper calculation of the results. The results will be stored electronically and in hard copy in laboratory file cabinets.

  No pencils, erasures, or correction fluid will be allowed on any forms. Errors will be crossed out with a single line, initialed, dated, and the correct value written next to the error.

- **Method detection limits**
  The method detection limit is the smallest concentration of analyte that can be measured and reported within 99 percent confidence that the concentration is greater than zero. MDL's are determined by the procedure outlined in Standard Methods for the Examination of Water and Wastewater, most recent edition.

- **Practical quantitation limits (PQL)**
  The practical quantitation limit is the smallest concentration of analyte that can be reported with some degree of confidence. PQL's are generated from the same data used to determine

the MDL's. The PQL may vary on a project-by-project basis, but it is generally 5-10 times the MDL.

10. Standard Operating Procedures & Analytical Testing Methods

Verity/CaSi Standard Operating Procedures (SOPs) incorporate by reference Good Laboratory Practices published in Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, inclusive of sections 1010 Introduction, 1020 Quality Assurance, 1030 Data Quality, 1040 Method Development and Evaluation, 1050 Expression of Results, 1060 Collection and Preservation of Samples, 1070 Laboratory Apparatus, Reagents, and Techniques, 1080 Reagent Grade Water, 1090 Safety.

Analytical testing methods are utilized from the following sources:

- Methods for Chemical Analysis of Water and Wastes (MCAWW) EPA/600/4-79-20-Revised March 1983.
- Standard Methods for the Examination of Water and Wastewater, 20th edition 1998 APHA, AWWA and WEF.
- Laboratory analyses are performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication SW-846, 3rd Edition, September, 1986, and the latest promulgated update.

Reagents and components used in sample and standard preparation:

- Reagents are purchased from scientific supply companies. All reagents shall be of sufficient quality to produce accurate and valid testing results. All purchased standards will be NIST traceable, where possible. Chemicals are dated on the container at the time of receipt and when opened for the first time. Reagents or working standards that are prepared in house shall be dated when prepared and initialed by the preparer. This information is recorded in a bound book and books are archived. Published shelf life and storage requirements will be strictly adhered to. Chemicals will be segregated according to chemical classes.

- Reagent Grade Water: Elga Purelab *Ultra Analytic* polishing system is preceded by Modulab reverse osmosis system, preceded by water softening unit, preceded by carbon cartridge and 1 micron prefilter. The units produce Type II Reagent Grade Water, 18.2 megohms/cm resistivity, and 1 ppb Total Organic Carbon (TOC). Resistivity and TOC are recorded daily and records are archived. The polishing system is sanitized monthly, and programming requires exchange of filters every six months, or sooner if indicated by product water less than 17 megohms/cm.

Laboratory glassware and plasticware is cleaned with Contrad-70 professional laboratory high alkaline detergent (or similar), at least triple rinsed with tap water, then at least triple rinsed with deionized water.

Lab ware may be acid washed and rinsed with deionized water, or may be dried at 103°C in preparation for metals or organic samples respectively. Alternatively, EPA Certified Pre-cleaned lab ware may be used. Lab ware is stored inverted in drawers or capped until use to prevent ambient contamination.

All waste containers are kept in secondary containment. Waste minimization is undertaken in all cases. Laboratory treatment of corrosive wastes is undertaken in cans or containers in compliance with federal, state and local requirements. Any sample that may not be disposed to the sanitary sewer or to the sanitary landfill will be returned to the client for proper disposal. A laboratory spill kit, and fire extinguisher are maintained in the laboratory.

11. Instrument/Equipment Use, Inspection, and Maintenance

The maintenance recommendations of manufacturers are followed for all equipment. Routine care includes daily housekeeping. All instrument manuals are kept on file in the laboratory or office. Repairs to instruments are undertaken by the manufacturer or other certified personnel, where possible. If automated equipment is not operational, samples may be subcontracted or analyzed using equivalent manual methods until equipment is repaired or a loaner instrument is obtained.

Major Instrumentation & Equipment requiring calibration/verification:

- Thermo Electron Corp. AquaMate spectrophotometer with 2 nm bandwidth, range 325-1100 nm. Spectrophotometer completes a self-test on start up. Calibration is checked with reference samples each run.
- Varian Vista-PRO axial ICP-Atomic Emission Spectrometer is maintained according to operation manual. Performance is verified with independent NIST traceable standards each sample run and records archived. ICP-AES completes self-test upon start up. Additional start up procedures include wavelength calibration, torch alignment, zero order, and refractometer galvonometer zero. Instrument performance parameters are recorded at the beginning of each run, and records archived. Calibration is checked with reference samples each run, and continuing calibration standards every 8-10 samples.
- Dionex DX-500 Ion Chromatograph with IP25 isocratic pump, CD20 conductivity detector, AS50 autosampler, and LC25 chromatography oven is maintained according to operation manual. Performance is verified with independent NIST traceable standards each sample run and records archived.
- Horizon Technology SPE-DEX 3000XL Automated Solid Phase Extraction System with Speed-Vap III Solvent Evaporation System for “oil & grease” analysis. Systems are maintained according to operation manuals. Performance is verified with independent NIST traceable standards each sample run and records archived.

- Lachat Instruments MICRO DIST® digital Microscale Distillation System is maintained according to operation manual. Temperature is verified with an NIST Traceable thermometer, semiannually.
- Ohaus Galaxy 110 Analytical Balance, accuracy to 0.1 milligrams. Ohaus Precision Plus Top Loading Balance accurate to 0.01 grams. Accuracy should be checked with an NIST traceable standard weight.
- Precision Thelco and Blue M Gravity Convection Laboratory Ovens. Temperature maintained at 103-105°C, recorded daily and records archived.
- Equatherm BOD Incubator. Temperature is maintained at 20.0°C, recorded daily, and records archived.
- Blue M Water Bath Incubator. Temperature maintained at 44.5°C, recorded daily, and records archived.
- Elconap Constant Temperature Dry Incubator maintained at 35°C, recorded daily, and records archived.
- Hanna Instruments HI2020 pH Meter with digital readout in pH, temperature, & millivolts. Automatic temperature compensation. Standardized prior to sample measurement daily, verification standard employed, values recorded and archived.
- Orion portable pH Meter with digital readout in pH, millivolts. Automatic temperature compensation. Standardized prior to sample measurement.
- Idexx Quanti-Tray Model 2X Total Coliform and E. coli tray sealer.
- Yellow Springs Instrument (YSI) Dissolved Oxygen Meter with dual 0-10, and 0-20 scale readout. With a stirring oxygen probe. Meter calibrated prior to each use by the air calibration method.
- Stereomaster binocular wide field dissecting scope with 15X and 45X objectives for optically-enhanced visual microbial colony counting.
- Adjustable volumetric pipettes are checked gravimetrically monthly.

12. Deviations from Policy or Procedure

Verity/CaSi will make every effort to follow its documented policies and procedures. If for any reason a procedure is modified the date of modification will be noted and the procedure will be updated. Initial demonstration of capability will be performed on the modified method as well as a determination of method detection limits. The QA officer will approve all method modifications before the modification is implemented. If a client project is affected by a proposed major modification, that client will be notified of the change and the anticipated effect(s) for the client.

13. Analytical Data Reduction, Validation, and Reporting

Upon completion of analysis, all quality control samples are checked for compliance against all applicable QC requirements. Samples analyzed in a run that are out of compliance will be re-analyzed. After valid results are obtained, data is entered into electronic storage and the entry checked for accuracy. Data reports are reviewed for completeness and accuracy by the QA Officer before being released to clients.

The format and mode of transmission of reports are determined in consultation with the client. Verity/CaSi will comply with all reasonable requests in the reporting of analytical results and will endeavor to maintain recent versions of computer software in order to make electronic reporting convenient for clients.

14. Corrective Actions

If any results are suspect upon review, all phases of the analysis will be investigated. If discrepancies cannot be resolved, the sample(s) in question will be re-analyzed, as long as the holding time has not been exceeded and the sample is still in the possession of Verity/CaSi. If sample holding time is exceeded or the sample is no longer in possession of Verity/CaSi, the results will be flagged with a notation of discrepancy.

15. Performance Evaluations and Audits

Verity/CaSi participates in the U.S. Environmental Protection Agency DMR-QA Laboratory Performance Evaluation and Water Pollution (WP) Evaluation program. Records of performance may be obtained from the Region VII EPA Office, and copies are archived at our offices.

Verity/CaSi is currently a contract laboratory for the Missouri Department of Natural Resources (MO-DNR), performing Fecal Coliform and E. coli analyses by membrane filtration and Idexx Quanti-Tray methods, respectively.

Client system audits of facilities and procedures are welcomed by reservation.

ATTACHMENT E

PROJECT MANAGEMENT PLAN

REMEDIAL ACTION OPTIMIZATION WORK PLAN

Former Tronox Facility
2800 High Street, Springfield, Missouri

Attachment E

PROJECT MANAGEMENT PLAN

REMEDIAL ACTION OPTIMIZATION

Former Tronox Facility
2800 West High Street, Springfield, Missouri
RCRA Permit Number MOD007129406

August 5, 2016

RAO PROJECT MANAGEMENT PLAN

This document presents the project management plan (PMP) for the Remedial Action Optimization Work Plan, and other investigations that may occur, at the former Tronox wood-treating facility in Springfield, Missouri. Facility work will be managed by the Greenfield Multistate Trust (Multistate Trust), and implemented through their designated contractors. The Multistate Trust, Environmental Works, Inc, (EWI), and EarthCON are the primary team members. Project management of the Facility work includes selecting, scheduling, coordinating, and communicating with team personnel, subcontractors, vendors and laboratories throughout work implementation. Project management includes ensuring technical requirements, standards and schedules of the work plan are maintained, with appropriate notifications to the Multistate Trust for changes in scope or schedule. The purpose of this PMP is to:

- Establish the management and overall technical approaches to be used throughout the Facility work;
- Specify the organization and define roles and responsibilities of each organizational member; and
- Provide procedures for agency, client, vendor and subcontractor communication and reporting; and,

1.1 Remedial Optimization Planned Technical Approach and Methodologies

Remedial optimization work will be performed in a phased approach to meet the project objectives, with specific work in subsequent actions modified as appropriate based on results of the previous phase of work. Intended actions will provide data to update the conceptual site model and appropriately evaluate risk to human health and the environment; these results will form the basis for the evaluation of corrective measures performance. The overall technical approach supports flexibility for changes in investigation activities, and management and communication procedures will remain the same regardless of changes in technical activities

Overall, project management and controls will be exercised to complete efficient and effective Facility work within the expected timeframes by (1) proactively managing schedule and resources, (2) ensuring quality work products, and (3) providing a vehicle for effective decision making, communication, milestone tracking, and reporting.

1.2 Facility Project Team Organization

This section describes lines of authority, responsibility, and communication as they pertain to project management and implementation for Facility work. Personnel are identified who impact the development and implementation of Facility work, and their roles and responsibilities are defined. Intended subcontractors and vendors involved in work operations are also specified.

1.2.1 Organizations, Roles and Responsibilities

U.S. Environmental Protection Agency (U.S. EPA)

Mr. Mike Dandurand, P.E.
Role: Missouri State Coordinator
U.S. EPA Region VII
ART Division/RCAP Branch, 901 North 5th Street, Kansas City, KS 66101

Missouri Department of Natural Resources (MDNR)

Mr. Don Dicks, Environmental Engineer
Role: Project Manager
MDNR Hazardous Waste Program
P.O. Box 176, Jefferson City, MO 65102

Greenfield Environmental Multistate Trust Group, LLC. (Multistate Trust)

Ms. Lauri Gorton, P.E., R.G.
Role: Director of Environmental Programs and Senior Strategist
Greenfield Environmental Multistate Trust, LLC
2166 East Estes Street, Milwaukee, WI 53207

Ms. Tasha Lewis
Role: Portfolio Manager
Greenfield Environmental Multistate Trust, LLC
2824 E. Donner Drive, Phoenix, AZ 850412

Ms. Amber Igoe
Role: Project Manager
Greenfield Environmental Multistate Trust, LLC
3669 Longfellow Road, Tallahassee Florida 2311

All communication between regulatory agencies and all documents, plans, reports and other correspondence will be directed through the Multistate Trust.

Attached Figure 1.0 presents the project team organizational structure, personnel, roles, and lines of communication and data transfer for Facility work.

1.2.2 Vendor and Subcontractors

The following subcontractors and vendors will be utilized for various technical services in the course of Facility work.

Drilling and Sampling	Laboratory and Surveying	Professional Services
Sunbelt Environmental Services (well installations) Springfield, MO	Eurofins Laboratory (sample analyses) Lancaster, PA	Gary L. Smythe, P.E. (professional engineer services) Smythe Consulting Springfield, MO
Dakota Technologies (TarGOST®) Fargo, ND	PDC Laboratory (waste analysis) Springfield, MO	Tim Sterling, C.I.H. (industrial hygienist, SSHP) Novis Sterling LLC Springfield, MO
	Anderson Engineering (surveying) Springfield, MO	Dr. Kevin Mickus (geophysics surveys) Missouri State University Springfield, MO

If needed, additional subcontractors will be determined using competitive bidding protocols as appropriate, with approval for use by the Multistate Trust, and with notification given to MDNR and U.S. EPA before the commencement of field activities. All subcontracted firms will provide internal project management as appropriate for their responsibilities.

1.3 Communication, Quality Control, and Reporting

The following communication and reporting deliverables and timelines are planned to ensure effective communication and dissemination of information during Facility work. As field tasks are being implemented, this plan will ensure that findings are relayed in a timely fashion to the Multistate Trust for further communication with the regulatory agencies.

1.3.1 Communication Management

The following methods of communication and information updates will be utilized during Facility work:

Status meetings, Multistate Trust and EWI: Via teleconference, video conference, emailed status reports a minimum of once a month. More frequent status updates will occur during elevated field activity. Applicable subject materials will be distributed at least one day prior to the meeting, to include updated Microsoft Project Schedule (MPP and PDF versions). Meeting notes to include topics, key discussion points, and action items and responsibilities will be completed and disseminated to all participants within one day of the meeting.

Monthly progress reports, to Multistate Trust from EWI: Facility work status, budget tracking, and progress will be submitted electronically within 10 working days at the end of each month, utilizing the Trust's Financial Summary Report and Monthly Status Report forms.

Monthly progress reports, to MDNR from Multistate Trust: Required SFI periodic reports will be prepared from EWI progress reports and submitted to MDNR per MHWMF Permit requirements, or as directed by MDNR.

Special status reports, to Multistate Trust from EWI: Reports of activity findings of specific technical activity, significant observations, appraisals of site conditions, or changes in well integrity or remedial system operations and maintenance will be electronically sent via email within 24 hours of occurrence, or conveyed via telephone with follow-up email.

Weekly planning and after-action meetings, EWI internal: EWI will hold team task scoping and planning meetings, including evaluation of on-going or completed activities, at least once per week. Additional meetings will be held for changing conditions. Meeting discussions and plans will be documented and immediately provided to team members.

Planned software for deliverables will be Microsoft Word, Microsoft Excel, Microsoft Project, and AutoCAD Version 14. For task management and tracking, EWI will also utilize Visual Task Manager (VTM, an EWI proprietary software). EWI will employ established quality management protocol to ensure accurate and high quality deliverables. This involves internal technical review by a Principal level person of all work products, schedule, budget, and work progress reports.

During field activities, EWI will obtain daily work and expenditure updates from all subcontractors to enable close tracking against planned tasks and schedule milestones.

The Multistate Trust will provide periodic public service announcements as appropriate to inform and update the community on the status of the investigation (see Multistate Trust's Community Involvement Plan for additional information).

1.3.2 Final Facility Work Report

In addition to status reporting related to periodic communication, a comprehensive final report on the remedial action optimization work will be prepared. The final report will be written following completion of tasks specified in an approved work plan, evaluation of all data collected, and will be submitted in draft form to the Multistate Trust for review. A final draft will be submitted by the Multistate Trust to MDNR for review and finalization. The report will document all field work activities, data evaluation, and conclusions regarding the delineation status of impacted media, potential exposure risks and preliminary evaluation of those exposure pathways. An updated CSM will be included. Report recommendations will include any follow-up actions needed and any potential changes to the corrective action program.

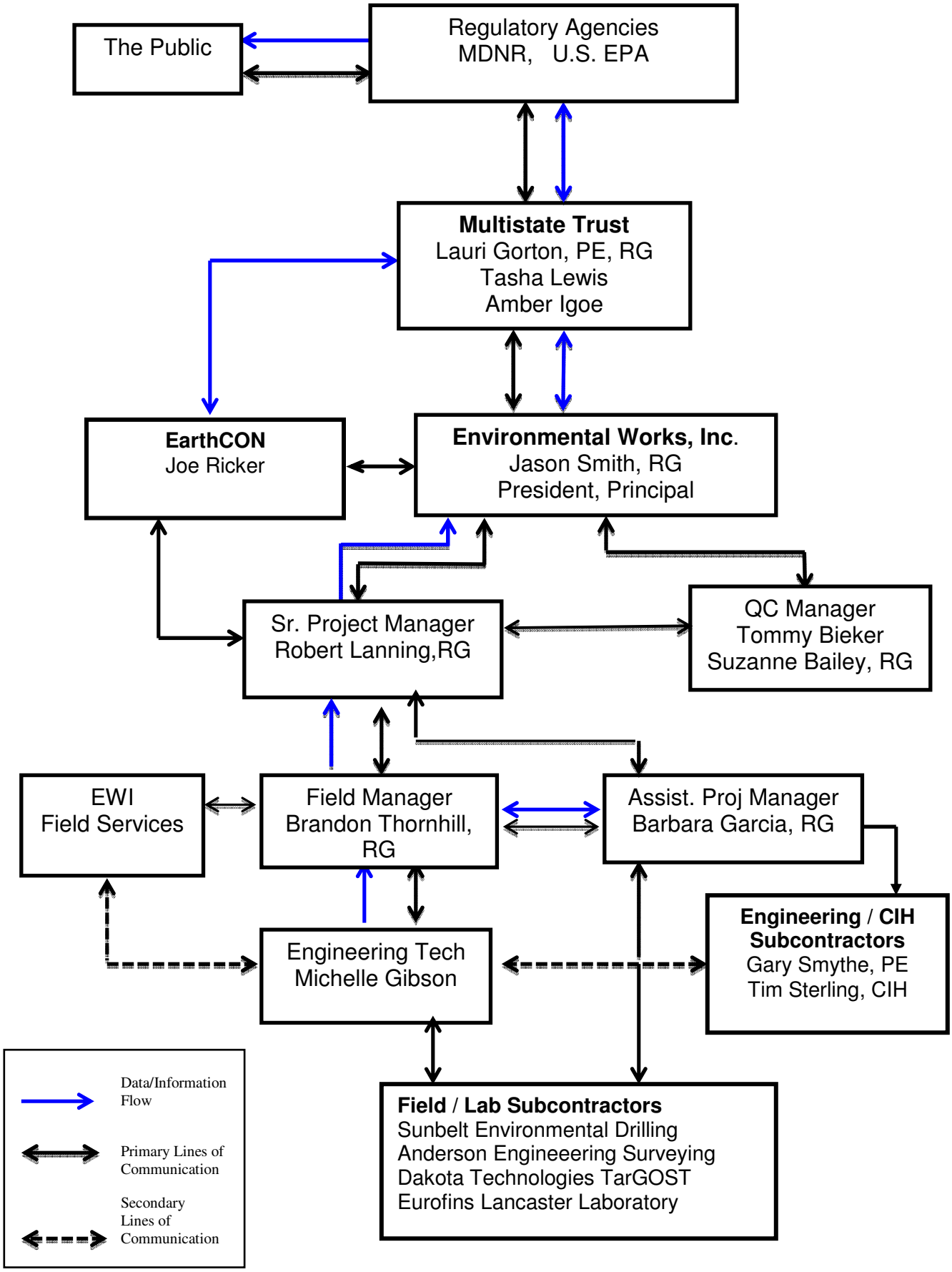



Figure 1.0 - Project Organizational Chart