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FINAL TIER II SAMPLING AND ANALYSIS PLAN FOR LONG-TERM MONITORING SITE
SS03 AND SS09 FORMER RICHARD GEBUR AIR FORCE BASE MCRCO KANSAS CITY
MO
5/1/2013
RESOLUTION CONSULTANTS

**FINAL
TIER II SAMPLING AND ANALYSIS PLAN**

**LONG-TERM MONITORING
SITES SS 003 and SS 009
FORMER RICHARDS-GEBAUR AIR FORCE BASE
KANSAS CITY, MISSOURI**

Version Number: 0

Prepared For:



**Department of the Navy
Naval Facilities Engineering Command, Midwest
201 Decatur Avenue, Building 1A
Great Lakes, Illinois 60088**

Contract Number: N62470-11-D-8013

CTO F279

Prepared By:



**Resolution Consultants
A Joint Venture of AECOM & EnSafe
1500 Wells Fargo Building
440 Monticello Avenue
Norfolk, Virginia 23510**

May 2013

SAP WORKSHEET #1: TITLE AND APPROVAL PAGE

SAMPLING AND ANALYSIS PLAN for Tier II

May 2013

**Long-Term Monitoring
Sites SS 003 and SS 009
Former Richards-Gebaur Air Force Base
Kansas City, Missouri**

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Date 5/21/2013



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EXECUTIVE SUMMARY

Resolution Consultants has prepared this Sampling and Analysis Plan (SAP) for Long-Term Monitoring (LTM) efforts at the former Richards-Gebaur Air Force Base in Kansas City, Missouri. Two areas of concern at the former Air Force Base are managed by the Department of the Navy (Navy): Site SS 003, which is occupied by the United States Marine Corps (USMC), and Site SS 009, which is a part of a Base Realignment and Closure (BRAC) action undertaken by the Navy. Because the Department of the Navy (Navy) is the lead agency for the two sites, this SAP was prepared under the Comprehensive Long-Term Environmental Action Navy Contract No. N62470-11-D-8013 Contract Task Order F279 issued to Resolution Consultants on February 15, 2013.

A Record of Decision (ROD) for Operable Units (OU) 1 and 2 at the former Richards-Gebaur Air Force Base was signed by the (United States Air Force in 2004 [AFRPA], June 2004). The selected remedy for all of the sites at the base with groundwater contamination (OU 2) was emplacement of land use controls (LUCs) and LTM of site conditions, including groundwater volatile organic compound (VOC) concentrations and plume stability. The LTM plan, developed in 2005 (AFRPA, March 2005), established the monitoring well locations, the groundwater sampling frequency, the sampling and analysis protocols, reporting requirements, and monitoring duration for OU 2 sites.

In 2011, the USMC and the Navy assumed responsibility for the environmental restoration activities at Sites SS 003 and SS 009 from the Air Force. The Air Force maintained control of the remaining sites at the base. This SAP therefore includes only Sites SS 003 and SS 009. The LTM Plan (AFRPA, March 2005) provides the basis for the SAP.

The previous SAP was prepared for the Air Force in 2009 and included all sites at the base. In 2011, the previous SAP was amended by Resolution Consultants for the 2011 monitoring event due to time constraints. This new SAP provides the information necessary to conduct future monitoring events at SS 003 and SS 009 in accordance with Navy guidelines, along with United States Environmental Protection Agency (USEPA) and Missouri Department of Natural Resources (MDNR) requirements.

Site SS 003, Oil Saturated Area, is located in the southern part of the former base, situated south of Building 703. The site was used to store waste oil products generated by vehicle maintenance from the mid-1950s to the late 1980s (United States Air Force [USAF], July 1994). The site is currently houses the Marine Corps Reserve Center (MCRC) and is used as a vehicle maintenance and storage facility known as the Humvee Area.

Site SS 009, Fire Valve Area is located on relatively level ground in the southeastern portion of the installation and consists of two parcels. One parcel of the SS 009 site consists of several buildings including Building 605. The other parcel of Site SS 009 is located southeast of Building 605 and is currently vacant. The majority of Site SS 009 is currently owned by the Kansas City Port Authority, with the exception of Building 614, which is owned by Heart-n-Hand Ministries, Inc., a non-profit organization. Site SS 009 was part of the Civil Engineering Complex and was in use by the Air Force from 1955 until 1994 (CH2M Hill, December 2000). During this time, Building 605 was used for various purposes, including a carpenter shop, roads and grounds shop, and sanitation shop.

As a result of the past storage and handling of solvents, VOCs are present in groundwater at both sites at concentrations slightly above remedial action goals. Impacted soils were removed from both sites prior to implementation of the groundwater LTM. No concentrations of solvents remain in soils at either site in excess of remedial action cleanup goals (RACGs).

The Remedial Investigation (RI) performed at SS 003 in 1999 to 2000 identified an area of chlorinated solvent groundwater contamination encompassing approximately 2.7 acres (CH2M Hill, December 2000). The source of the groundwater contamination is unknown, but is suspected to have originated from historical activities at the former waste oil storage area. The contaminant of concern (COC) in groundwater at SS-003 is trichloroethene (TCE).

At SS 009, an approximately 0.7-acre area of groundwater impacted by chlorinated solvents was identified during the RI (CH2M Hill, December 2000) and subsequent monitoring events. The source of the groundwater contamination was not determined, but is believed to be related to spills in the drainage swale adjacent to the fire valve located at the Site. Contaminant of concern (COCs) in groundwater that have been detected above RACGs are 1,1-dichloroethene (DCE); cis-1,2-DCE; tetrachloroethene (PCE); TCE; and vinyl chloride (VC).

As specified in the Final ROD, Air Force Real Property Agency (AFRPA, June 2004), the remedial action for Sites SS 003 and SS 009 involve LTM and LUC inspection activities. LUCs were imposed to preclude extraction and any use of the contaminated groundwater at each of the OU 2 sites. The LTM program for groundwater is required to support the LUCs and allow systematic, periodic evaluation of site groundwater quality to help ensure that the established LUC boundaries fully encompass the contaminant plumes and remain protective of human health and the environment. Results from the LTM activities are also being used to determine when the site LUCs may be terminated.

SS 009 currently has seven monitoring wells in the LTM program. SS 003 currently has eight monitoring wells in the LTM program, including monitoring well MW-011, which was installed in

November 2009 to replace monitoring well MW-008. The TCE concentration in the previous upgradient monitoring well MW-008 was above the RACG for three consecutive groundwater monitoring events; therefore, monitoring well MW-011 was installed to reestablish the upgradient perimeter of the plume at Site SS 003. The monitoring wells at the two sites have previously been sampled annually under the LTM program; however, the monitoring frequency has been reduced to biennial at both SS 003 and SS 009.

This Tier II SAP outlines the organization, objectives, planned activities, and data review/reporting procedures associated with LTM efforts. Approval for the Tier II SAP was obtained from Naval Facilities Engineering Command Atlantic (NAVFAC LANT) on March 18, 2013 via email correspondence. A copy of this approval is provided in Appendix A of this document. Protocols for sample collection, handling, and storage, chain-of-custody, laboratory and field analyses, data validation, and reporting are included herein. This SAP, however, does not include specifics regarding LUC activities, as they consist of visual inspections and no analytical data are generated. This SAP adheres to applicable United States Department of the Navy (Navy), USEPA Region 7, and MDNR requirements, regulations, guidance, and technical standards, as appropriate. This includes the Department of Defense, Department of Energy, and USEPA Interagency Data Quality Task Force environmental requirements regarding federal facilities, as specified in the Uniform Federal Policy Quality Assurance Project Plan guidance (Intergovernmental Data Quality Task Force [IDQTF], March 2005) and the Navy's SAP guidance. Field activities conducted under this SAP will be conducted in accordance with Resolution Consultants' Standard Operating Procedures and a Site-Specific Health and Safety Plan.

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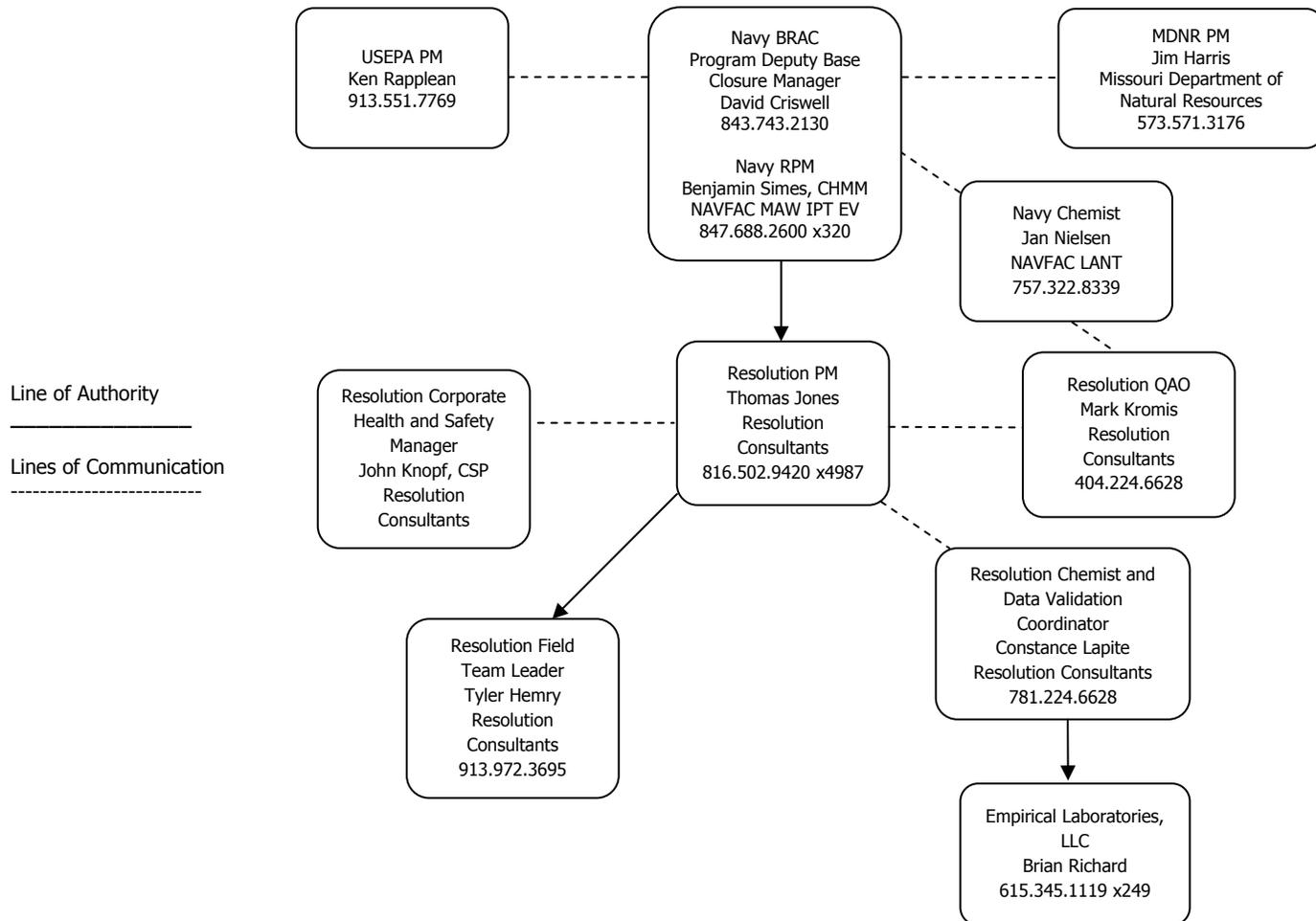
Acronyms and Abbreviations

°C	Degrees Celsius
AFCA	Air Force Conversion Agency
AFCEE	Air Force Center for Engineering and the Environment
AFRPA	Air Force Real Property Agency
amsl	above mean sea level
BRAC	Base Closure and Realignment Commission
BTOC	Below top of casing
CAS	Chemical Abstracts Service
CD-ROM	Compact disk read-only memory
CHMM	Certified hazardous materials manager
COC	Contaminant of concern
CSM	Conceptual site model
CSP	Certified safety professional
CTO	Contract Task Order
DCE	dichloroethene
DNAPL	Dense non-aqueous phase liquids
DO	Dissolved oxygen
DoD	Department of Defense
DoD ELAP	Department of Defense Environmental Laboratory Accreditation Program
DoD QSM	Department of Defense Quality Systems Manual
DoN	Department of the Navy
DVM	Data validation manager
EB	Equipment blank
EICP	Extracted ion current profile
EMLB	Empirical Laboratories, LLC
ft	feet
FTL	Field Team Leader
FTMR	Field Task Modification Request
GC	Gas chromatograph
HCl	Hydrochloric acid
HSM	Health and Safety Manager
ICAL	Initial calibration

IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigative derived waste
IRP	Installation Restoration Program
J	Data validation qualifier (estimated, detect)
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LLC	Limited liability corporation
LNAPL	Light nonaqueous phase liquid
LOQ	Limit of quantitation
LUC	Land use control
LTM	Long-Term Monitoring
MAW	Military Air Wing
MAW IPT EV	Military Air Wing Integrated Product Team Environmental
MCL	Maximum contaminant level
MCRC	Marine Corps Reserve Center
MDNR	Missouri Department of Natural Resources
mL	Milliliters
MOA	Memorandum of Agreement
MS	Mass spectrometry
MS	Matrix spike
MSD	Matrix spike duplicate
MS/MSD	Matrix spike/matrix spike duplicate
NA	Not applicable
NAVFAC LANT	Naval Facilities Engineering Command Atlantic
NAVFAC MW	Naval Facilities Engineering Command Midwest
NIRIS	Naval Installation Restoration Information Solution
No.	Number
ORP	Oxidation-reduction potential
OU	Operable Unit
PAL	Project action limit
PCE	Tetrachloroethene
PID	Photoionization detector
PM	Project manager
PMP	Pump
POC	Point of contact

PSQ	Principal study question
PT	Proficiency testing
QA	Quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality control
QSM	Quality Systems Manual
RACG	Remedial Action Cleanup Goal
RI	Remedial Investigation
ROD	Record of Decision
RPD	Relative percent difference
RPM	Remedial project manager
SAP	Sampling and Analysis Plan
SOP	Standard operating procedure
SSO	Site safety officer
TB	Trip blank
TCE	Trichloroethene
TPH	total petroleum hydrocarbon
UFP	Uniform Federal Policy
µg/L	Microgram per liter
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USMC	United States Marine Corps
VC	Vinyl chloride
VOC	Volatile organic compounds

SAP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART



Line of Authority

 Lines of Communication
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Notes:

- BRAC = Base Closure and Realignment Commission
- CHMM = Certified Hazardous Materials Manager
- CSP = Certified Safety Professional
- HSM = Health and Safety Manager
- MDNR = Missouri Department of Natural Resources
- MAW IPT EV = Military Air Wing Integrated Product Team Environmental

- NAVFAC LANT = Naval Facilities Engineering Command Mid-Atlantic
- NAVFAC MW = Naval Facilities Engineering Command Midwest
- PM = Project Manager
- RPM = Remedial Project Manager
- QAO = Quality Assurance Officer
- USEPA = United States Environmental Protection Agency

SAP WORKSHEET #6: COMMUNICATION PATHWAYS

The communication pathways for this Sampling and Analysis Plan (SAP) are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	Navy RPM	Benjamin Simes	847.688.2600 x320	The Navy RPM informs regulatory agency of work progress on a periodic basis.
Progress Reports	Resolution Consultants PM Resolution Consultants FTL Navy RPM	Thomas Jones Tyler Henry Benjamin Simes	816.502.9420 x4987 913.972.3695 847.688.2600 x320	The Resolution Consultants FTL verbally provides field updates to the Resolution Consultants PM on a daily basis. PM provides a weekly update to the Navy RPM either by phone message and/or e-mail each Friday afternoon that field activities are taking place. The Navy RPM communicates with the Navy BRAC Program Deputy Base Closure Manager.
Gaining Site Access	Resolution Consultants FTL MCRC Point of Contact Heart N Hand Executive Director Port Authority of Kansas City MO	Tyler Henry Ronald Phelps Rick Dawson Zoraya Lara	913.972.3695 816.843.3745 816.322.1133 816.559.3722	The Resolution Consultants FTL will contact the MCRC point of contact, the Heart N Hand Executive Director, and the Port Authority of Kansas City, MO, verbally or via e-mail at least 3 days prior to commencement of field work to arrange for access to the site for all field personnel.
Obtaining Utility Clearances for Intrusive Activities	Resolution Consultants FTL MCRC Point of Contact Heart N Hand Executive Director Port Authority of Kansas City MO	Tyler Henry Ronald Phelps Rick Dawson Zoraya Lara	913.972.3695 816.843.3745 816.322.1133 816.559.3722	The Resolution Consultants FTL will coordinate verbally or via e-mail with MCRC point of contact, the Heart N Hand Executive Director, and the Port Authority of Kansas City, MO, at least 14 days in advance of site access to initiate the utility clearance process for all intrusive sampling locations.
Stop Work due to Safety Issues	Resolution Consultants FTL/SSO Resolution Consultants PM Resolution Consultants HSM Navy RPM MCRC Point of Contact Heart N Hand Executive Director Port Authority of Kansas City MO	Tyler Henry Thomas Jones John Knopf Benjamin Simes Ronald Phelps Rick Dawson Zoraya Lara	913.972.3695 816.502.9420 x4987 901.937.4255 847.688.2600 x320 816.843.3745 816.322.1133 816.559.3722	Any field team member who observes an unsafe situation has the authority to stop work. The responsible party verbally informs the Resolution Consultants FTL/SSO, HSM, PM, onsite personnel, and subcontractors within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours. If a subcontractor is the responsible party, the subcontractor project manager must verbally inform the Resolution Consultants SSO within 15 minutes, and the Resolution Consultants SSO will then follow the procedure listed above.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
SAP Changes prior to Field/ Laboratory work	Resolution Consultants PM Navy RPM Navy BRAC Program Deputy Base Closure Manager	Thomas Jones Benjamin Simes David Criswell	816.502.9420 x4987 847.688.2600 x320 843.743.2130	Any change of the approved SAP will be made only upon authorization of the Navy RPM, the Navy BRAC Program Deputy Base Closure Manager, and regulatory agencies. The Resolution Consultants PM is responsible for initiating any SAP change requests via the communication channels described for the Navy and regulatory agencies: The Resolution Consultants PM will document the proposed changes via a FTMR form within 5 days and send the Navy RPM a concurrence letter within 7 days of identifying the need for change if necessary. SAP amendments will be submitted by the Resolution Consultants PM to the Navy RPM for review and approval. The Navy RPM will coordinate approval with the Navy BRAC Program Deputy Base Closure Manager.
SAP Changes in the Field	Resolution Consultants FTL Resolution Consultants PM Navy RPM Navy BRAC Program Deputy Base Closure Manager	Tyler Henry Thomas Jones Benjamin Simes David Criswell	913.972.3695 816.502.9420 x4987 847.688.2600 x320 843.743.2130	The Resolution Consultants FTL informs Resolution Consultants PM verbally within same day that the issue is discovered; Resolution Consultants PM informs Navy RPM via e-mail within 24 hours; Resolution Consultants PM sends a concurrence letter to Navy RPM and Navy BRAC Program Deputy Base Closure Manager, if warranted, within 7 calendar days and Navy RPM and Navy BRAC Program Deputy Base Closure Manager signs the letter within 5 business days of receipt. Scope change is to be implemented before work is executed. Document the change on a FTMR form (within 2 business days) or SAP amendment (within timeframe agreed to by Project Team).
Field Corrective Actions	Resolution Consultants FTL Resolution Consultants PM Navy RPM Navy BRAC Program Deputy Base Closure Manager	Tyler Henry Thomas Jones Benjamin Simes David Criswell	913.972.3695 816.502.9420 x4987 847.688.2600 x320 843.743.2130	The Resolution Consultants FTL informs Resolution Consultants PM verbally within same day; Resolution Consultants PM informs Navy RPM via e-mail within 24 hours that corrective actions have been implemented. The Navy RPM communicates with the Navy BRAC Program Deputy Base Closure Manager. Corrective actions will be documented in weekly progress reports.
Recommendations to stop work and initiate work upon corrective action	Resolution Consultants FTL Resolution Consultants PM Resolution Consultants QAO Navy RPM Navy BRAC Program Deputy Base Closure Manager	Tyler Henry Thomas Jones Mark Kromis Benjamin Simes David Criswell	913.972.3695 816.502.9420 x4987 404.965.9723 847.688.2600 x320 843.743.2130	The Resolution Consultants FTL informs Resolution Consultants PM verbally within same day; Resolution Consultants PM informs Navy RPM and via e-mail within 24 hours that corrective actions have been implemented. The Navy RPM communicates with the Navy BRAC Program Deputy Base Closure Manager. Corrective actions will be documented in weekly progress reports.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Sample Receipt and Laboratory Quality Variances	Empirical PM Resolution Consultants Project Chemist Resolution Consultants FTL Resolution Consultants PM	Brian Richard Constance Lapite Tyler Henry Thomas Jones	615.345.1119 x249 781.224.6628 913.972.3695 816.502.9420 x4987	The Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants project chemist and Resolution Consultants FTL immediately upon receipt of any chain of custody/sample receipt variances for clarification or direction from the Resolution Consultants FTL or Project Chemist. The Resolution Consultants FTL will notify (verbally or via e-mail) the Resolution Consultants PM within 1 business day, if corrective action is required. The Resolution Consultants PM will notify (verbally or via e-mail) the Laboratory PM, Resolution Consultants project chemist and the Resolution Consultants FTL within 1 business day of any required corrective action.
Analytical Corrective Actions	Empirical PM Resolution Consultants Project Chemist	Brian Richard Constance Lapite	615.345.1119 x249 781.224.6628	The laboratory shall notify the Resolution Consultants project chemist of any analytical data anomaly within 1 business day of discovery. After the laboratory receives guidance from Resolution Consultants project chemist, the laboratory shall initiate any corrective action to prevent further anomalies.
Analytical Data Quality Issues	Empirical PM Resolution Consultants Project Chemist Resolution Consultants FTL Resolution Consultants PM Navy RPM Navy BRAC Program Deputy Base Closure Manager	Brian Richard Constance Lapite Tyler Henry Thomas Jones Benjamin Simes David Criswell	615.345.1119 x249 781.224.6628 913.972.3695 816.502.9420 x4987 847.688.2600 x320 843.743.2130	The laboratory PM notifies (verbally or via e-mail) the Resolution Consultants project chemist within 1 business day of when a significant issue related to laboratory data is discovered. Resolution Consultants project chemist notifies Resolution Consultants PM and FTL within 1 business day. Resolution Consultants chemist notifies the Resolution Consultants PM and FTL verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. Resolution Consultants PM or FTL verbally advises the Navy RPM within 24 hours of notification from the project chemist. The Navy RPM communicates with the Navy BRAC Program Deputy Base Closure Manager. The Navy RPM will engage the NAVFAC chemist to ensure the issues with this project can be evaluated to determine impact to other DoD projects.
Reporting Data Validation Issues/Data Validation Corrective Actions	Resolution Consultants Project Chemist/DVM Resolution Consultants FTL Resolution Consultants PM	Constance Lapite Tyler Henry Thomas Jones	781.224.6628 913.972.3695 816.502.9420 x4987	If a Resolution Consultants Data Validator identifies non-usable data during the data validation process that requires corrective action, the Resolution Consultants PM or FTL will coordinate with the Resolution Consultants DVM to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the Resolution Consultants PM or FTL.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Empirical Laboratory PM Resolution Consultants Project Chemist/DVM Resolution Consultants PM Navy RPM Navy BRAC Program Deputy Base Closure Manager Missouri Department of Natural Resources PM	Brian Richard Constance Lapite Thomas Jones Benjamin Simes David Criswell Jim Harris	615.345.1119 x249 781.224.6628 816.502.9420 x4987 847.688.2600 x320 843.743.2130 573.571.3176	<p>If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants project chemist within 1 business day of when the issue is discovered.</p> <p>The Resolution Consultants project chemist will notify (verbally or via e-mail) Resolution Consultants PM within 1 business day of the need for corrective action if the non-usable data are a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the effected samples.</p> <p>If a Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process, the PM will be notified verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data.</p> <p>The Resolution Consultants PM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met. The Resolution Consultants PM will notify (verbally or via e-mail) the Navy RPM on any problems with the laboratory or analysis that could significantly affect the usability of the data or project failures that impact the ability to complete the scope of work. The Navy RPM communicates with the Navy BRAC Program Deputy Base Closure Manager. The Navy RPM will engage the NAVFAC LANT chemist to ensure issues with this project can be evaluated to determine impact to other DoD projects. Such notification will be made within 1 business day of when the issue is discovered. The Navy RPM will notify the MCDRC PM when any significant corrective action is taken.</p>

Notes:

DoD = Department of Defense
 DVM = Data validation manager
 FTL = Field team leader
 FTMR = Field Task Modification Request
 HSM = Health and safety manager
 MCRC = Marine Corps Reserve Center
 MDRC = Missouri Department of Natural Resources

NAVFAC LANT = Naval Facilities Engineering Command Mid-Atlantic
 PM = Project manager
 QAO = Quality assurance officer
 RPM = Remedial project manager
 SAP = Sampling and analysis plan
 SSO = Site safety officer

SAP WORKSHEET #9: PROJECT PLANNING SESSION PARTICIPANTS SHEET

Project/Site Name: Marine Corps Reserve Center Sites SS 003 and SS 009			
Site Location: Former Richards-Gebaur AFB, Kansas City, Missouri			
Date of Session: January 8, 2013			
Scoping Session Purpose: Site visit and meeting to discuss SAP development, groundwater monitoring, and options on vapor mitigation system design			
Name	Title	Affiliation	E-mail Address
Benjamin Simes	Remedial Project Manager	NAVFAC Midwest	benjamin.simes@navy.mil
Janice Nielsen	Chemist	NAVFAC LANT	janice.nielsen@navy.mil
Thomas Jones	Contract Task Order (CTO) Manager	Resolution Consultants	thomas.f.jones@aecom.com
Gretchen Jameson	Deputy CTO Manager	Resolution Consultants	gretchen.jameson@aecom.com

Resolution Consultants met with the Navy Remedial Project Manager and Chemist at the MCRC to discuss development of this SAP, to discuss the monitoring frequency at Sites SS 003 and SS 009, and to obtain the necessary information for the design of a vapor mitigation system. The proposed vapor mitigation system will be installed in the utility sump chase under Building 704. The following topics were covered: proposed design of the vapor mitigation system, the preparation of this SAP, and the LTM sampling schedule.

Comments/Decisions:

The following topics were discussed and decisions reached during the meeting:

1. **Topic:** SAP completion.

Decision: A Tier II SAP for SS 003 and SS 009 will be prepared and finalized prior to the next groundwater monitoring event. The previous SAP was prepared for the air force in 2009. In 2011, the previous SAP was amended by Resolution Consultants for the 2011 monitoring event due to time constraints. The new SAP pertains only to the LTM performed under the Navy at the MCRC (SS 003 and SS 009). The SAP does not include work associated with the proposed vapor mitigation system.

2. **Topic:** Sampling frequency of the LTM program for Sites SS 003 and SS 009.

Decision: LTM is to continue as planned in May 2013. Based on recent monitoring results and the Decision Rules established in the LTM Plan (AFRPA, March 2005), the LTM program will be modified. Monitoring frequency at Sites SS 003 and SS 009 will be reduced from annual to biennial monitoring.

3. **Topic:** Design of the proposed vapor mitigation system was discussed. Locations of the sump and access points to the utility sump chase were inspected.

Decision: Activities associated with the vapor mitigation system will include design and installation only. Performance monitoring will not be conducted.

SAP WORKSHEET #10: CONCEPTUAL SITE MODEL

This worksheet presents general background information and the current conceptual site model (CSM) for Sites SS 003 and SS 009. The LTM Plan (AFRPA, June 2004) provides the basis of the sampling and analysis program at Sites SS 003 and SS 009.

10.1 Introduction

The LTM program is required in accordance with the selected LUC remedy described in the Final ROD (Operable Units 1 and 2) (AFRPA, June 2004) for the former Richards-Gebaur Air Force Base, signed September 2004 by USAF, the USEPA, and the MDNR. The LTM frequency has been changed from an annual basis to a biennial basis at Sites SS 003 and SS 009. LTM activities at Sites SS 003 and SS 009 are being conducted to support the LUCs and allow systematic, periodic evaluation of site groundwater quality to help ensure that the established LUC boundaries fully encompass the contaminated plumes and provide data to support terminating LUCs when RACGs are achieved.

10.2 Site Description

Sites SS 003 and SS 009 are located at the former Richards-Gebaur Air Force Base in Kansas City, Missouri (Figure 10-1). Site SS 003, Oil Saturated Area is located in the southern part of the former base, situated near the southeast corner of the intersection of East 155th Street and Bales Avenue and south of Building 703. The majority of the Site consists of Building 704 and the surrounding parking lot. SS 003 is paved and flat, and a grassy swale runs parallel to the west and south fence lines. An aerial view and site diagram of SS 003 are presented as Figures 10-2 and 10-3, respectively. The Site was used to store waste oil products generated by vehicle maintenance from the mid-1950s to the late 1980s (USAF, July 1994). The Site is currently occupied by the USMC and houses the MCRC. The Site is used as a vehicle maintenance and storage facility known as the Humvee Area. The adjacent fenced area located south of the Humvee Area is used for base facility maintenance operations.

Site SS 009, Fire Valve Area (Figures 10-4 and 10-5) is located on relatively level ground in the southeastern portion of the installation and consists of two parcels. One parcel of the SS 009 site is located between Westover Road and Andrews Road and consists of several buildings including Building 605. The other parcel of Site SS 009 is located southeast of Building 605 and is situated between Andrews Road and Scope Creek. This parcel contains the former Navy dental clinic and is vacant. Site SS 009 was part of the Civil Engineering Complex and was in use by the Air Force from 1955 until 1994 (CH2M Hill, December 2000). During this time, Building 605 was used for various purposes, including a carpenter shop, roads and grounds shop, and sanitation shop.

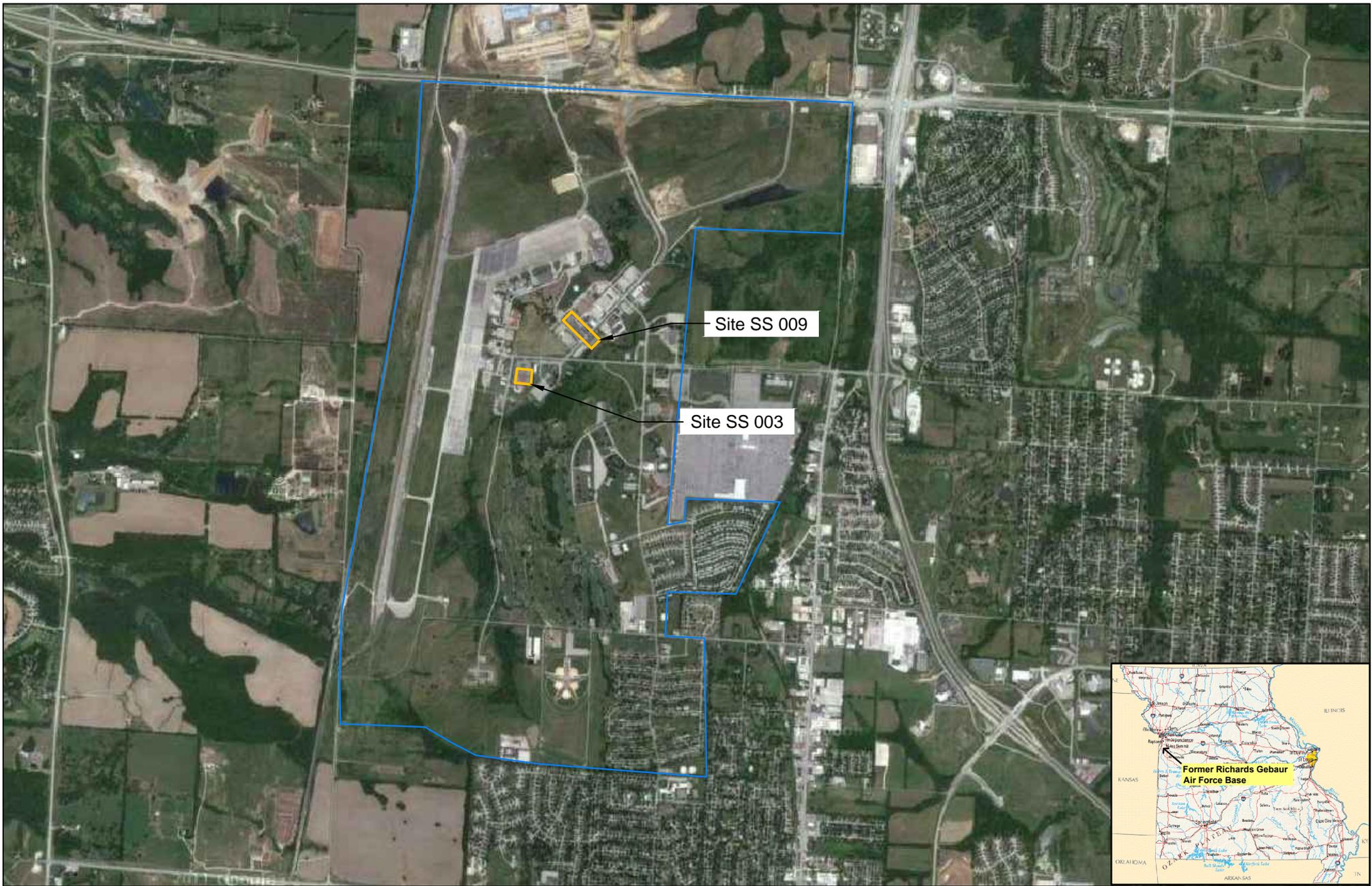


Figure 10-1: Site Location Map

Former Richards-Gebaur AFB
Kansas City, Missouri

Tier II Sampling and Analysis Plan



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Boundary of former RG AFB

Site Boundary

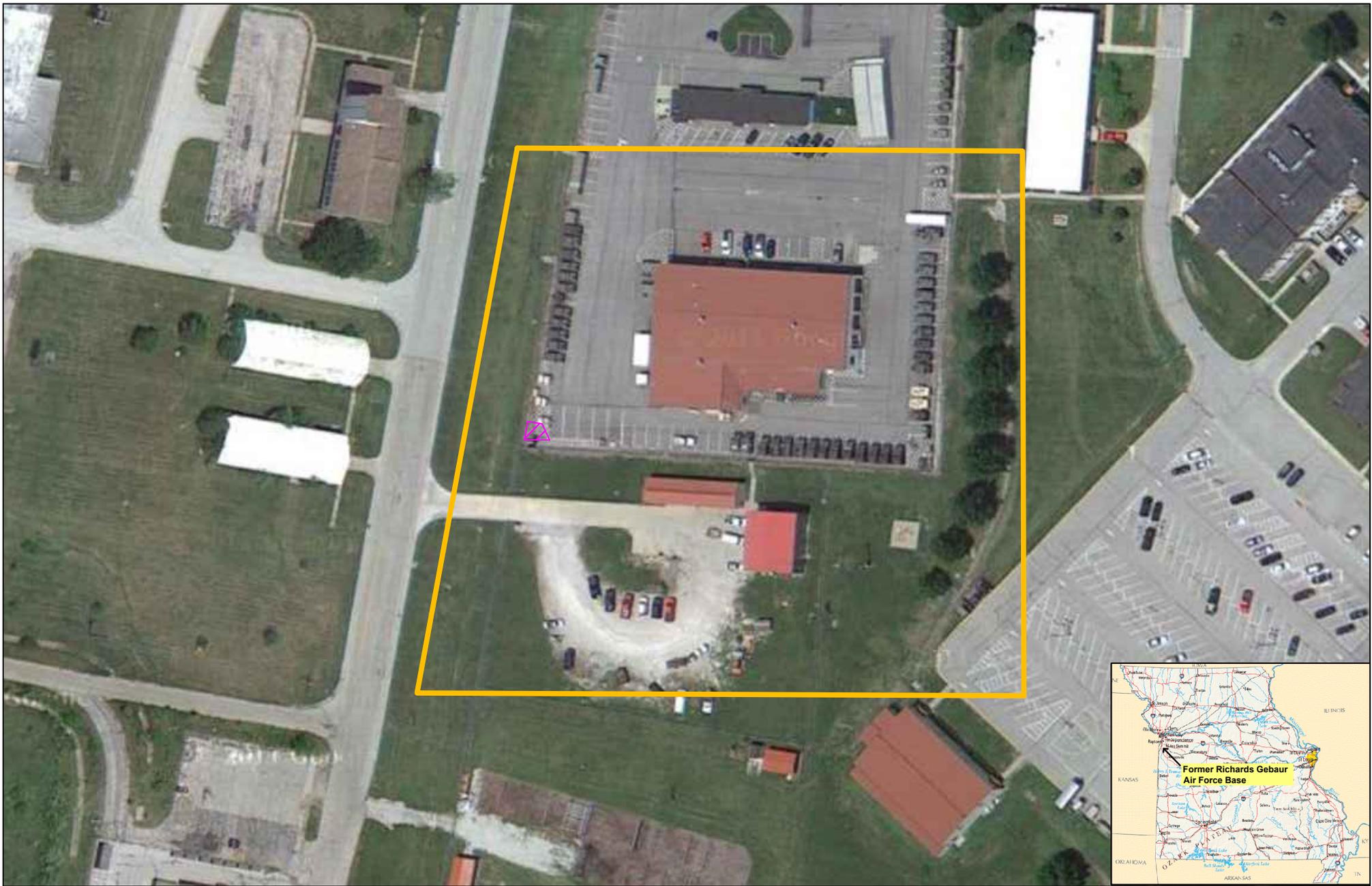


Figure 10-2: Site SS 003 Aerial View

Former Richards-Gebaur AFB
Kansas City, Missouri

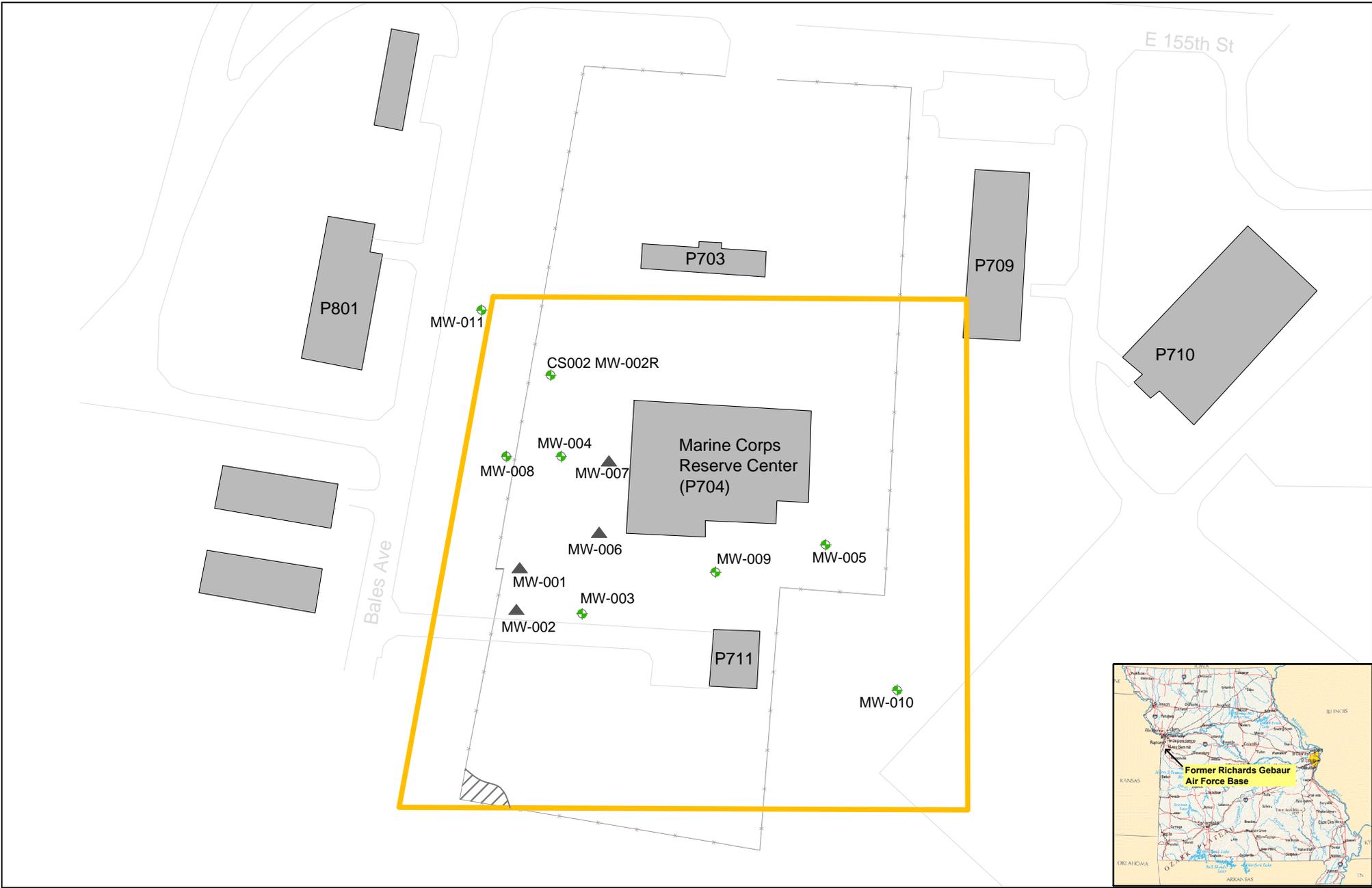
Tier II Sampling and Analysis Plan



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SITE SS 003 LUC Boundary
1992 Soil Excavation Area



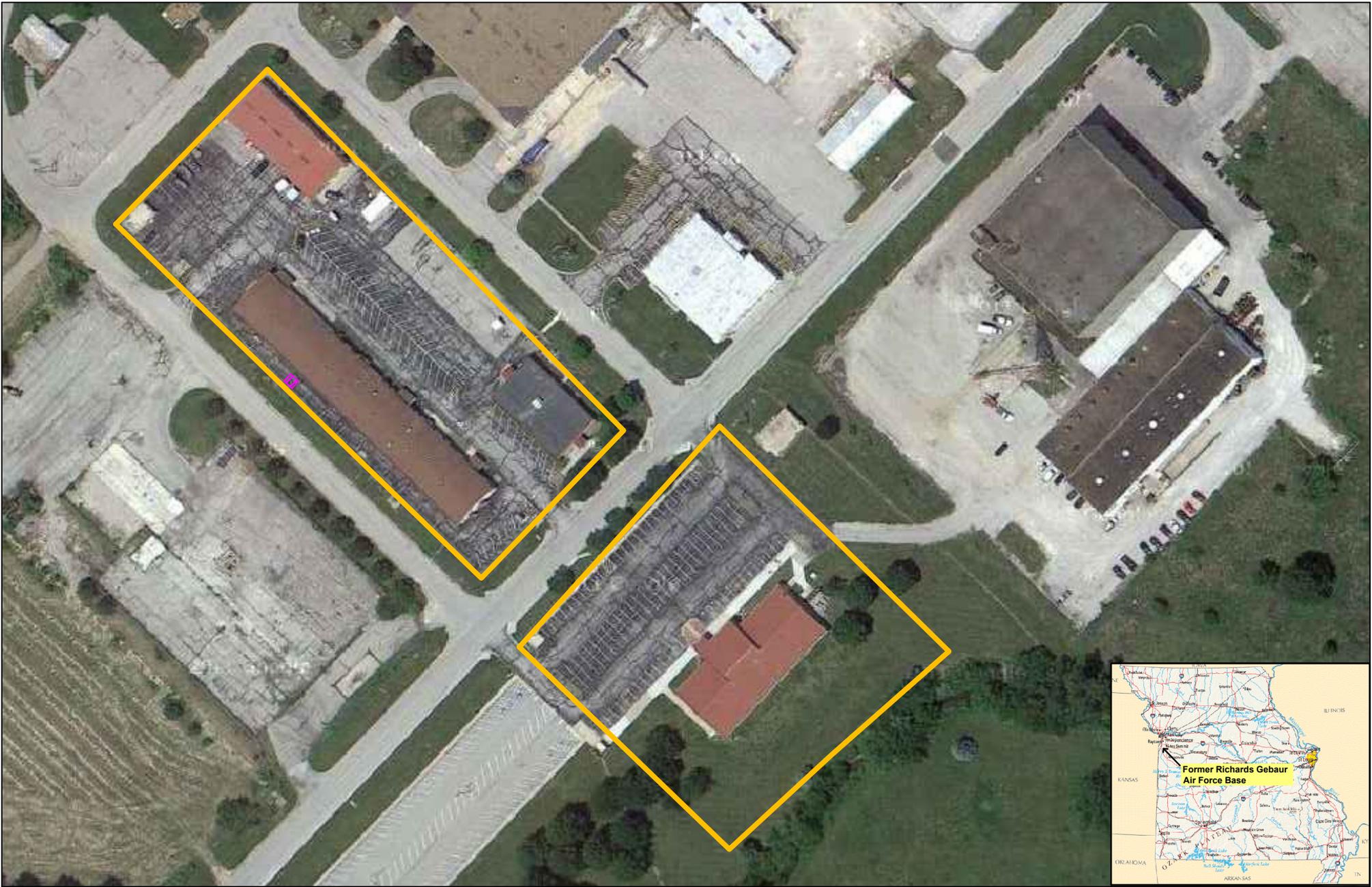
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- ▲ Contingency Monitoring Well
- ◆ Overburden LTM Well Location
- *—*— Fence Line
- LUC Boundary for Property Transferred to U.S. Navy in 2005
- MW-014 Monitoring Well
- ▨ 1991-1992 Soil Excavation Area

Figure 10-3: Site SS 003 Site Diagram

Former Richards-Gebaur AFB
Kansas City, Missouri

Tier II Sampling and Analysis Plan



LEGEND

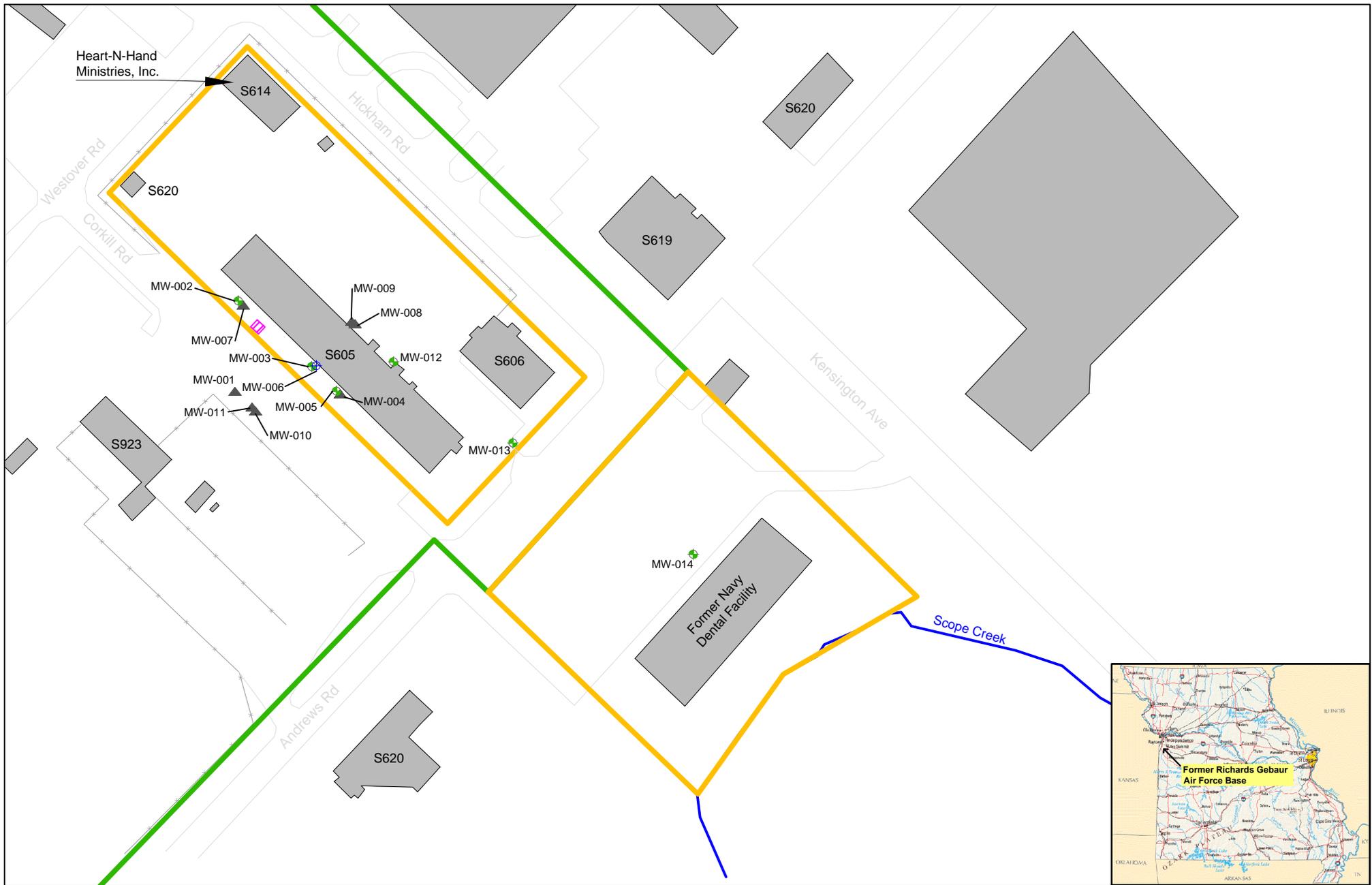


SITE SS 009 LUC Boundary
 1992 Soil Excavation Area

Figure 10-4: Site SS 009 Aerial View

Former Richards-Gebaur AFB
 Kansas City, Missouri

Tier II Sampling and Analysis Plan



LEGEND

- ▲ Contingency Monitoring Well
- ⊕ Bedrock LTM Well Location
- ⊕ Overburden LTM Well Location
- MW-014 Monitoring Well
- Fence Line
- Stream
- ▭ LUC Boundary for Property Transferred to U.S. Navy in 2005
- ▭ LUC Boundary for Property Transferred to Kansas City in 2005
- ▨ 1991-1992 Soil Excavation Area

Figure 10-5: Site SS 009 Site Diagram

Former Richards-Gebaur AFB
Kansas City, Missouri

Tier II Sampling and Analysis Plan

Currently, Site SS 009 is part of a Base Realignment and Closure (BRAC) action undertaken by the Navy.

10.3 Physical Setting

Details of the physical setting of Sites SS 003 and SS 009 were provided in the RI (CH2M Hill, December 2000), the ROD (AFRPA, June 2004), and the LTM Plan (AFRPA, March 2005). A brief description is provided below.

The former Richards-Gebaur AFB is located in west-central Missouri, roughly 18 miles south of downtown Kansas City and 3 miles east of the Kansas-Missouri state line. The topography of the former base is gently rolling, with ground surface elevations ranging from 960 feet above mean sea level (amsl) on the northeast side of the former base to 1,125 feet amsl on the south property margin. The former base lies on a broad plateau called the Blue Ridge, with the Blue River bordering to the west and the Little Blue River to the east. The Blue and Little Blue Rivers are approximately 3 and 2 miles from the site, respectively. The rivers discharge to the Missouri River approximately 20 miles north of the base.

Borings advanced during the RI at SS 003 documented 15 to 20 feet of low- to medium-plasticity silty clay overburden underlain by up to 10 feet of weathered Lane Shale bedrock (CH2M Hill, December 2000). Groundwater flow is typically to the east at a low velocity (estimated to be less than 10 feet per year during the RI). The monitoring well network is provided in Figure 10-3.

At Site SS 009, borings were advanced during the RI that documented 10 to 13 feet of low to medium-plastic silty clays and weathered shale underlain by 6 to 8 feet of limestone (CH2M Hill, December 2000). The shale corresponds to the Lane Shale Formation and the limestone is identified as the Raytown Limestone Member of the Iola Formation. Groundwater flow is to the east at a low velocity on the order of less than 1 foot per year (CH2M Hill, December 2000). A site diagram for SS 009 that includes the monitoring well network is provided in Figure 10-5.

10.4 Site History

Richards-Gebaur Air Force base was originally established in 1953 as Grandview Air Force base and originally encompassed approximately 2,400 acres. It closed on September 30, 1994, and at that time Richards-Gebaur Air Force base was comprised of 429 acres of land that included 244 acres in the main cantonment area and 185 acres at the Belton Training Complex. Operable Unit (OU) 2 was established to address groundwater contamination issues on the 429 acres of land that remained under Air Force control. A Memorandum of Agreement (MOA) was signed in 1998 providing for the transfer of responsibilities of the Installation Restoration Program (IRP) from the Air Force to the USMC (USAF and Department of the Navy [DoN], Air Force Conversion Agency

[AFCA] and USMC, 1998). The property was formally transferred to the USMC in January of 2005. In 2011, the USMC and the Navy assumed responsibility for the environmental restoration activities at Sites SS 003 and SS 009 from the Air Force.

The LTM and LUC remedy for all of the sites at Richards-Gebaur was selected and implemented by the Air Force, USEPA and MDNR in 2004 as documented in the Final ROD (AFRPA, June 2004). The LTM plan (AFRPA, March 2005), established the monitoring well locations, the groundwater sampling frequency, the sampling and analysis protocols, reporting requirements, and monitoring duration for OU 2 sites. The Navy will continue to follow the guidelines and procedures described in the ROD for Sites SS-003 and SS-009.

Site SS 003 houses the MCRC, which consists primarily of a vehicle maintenance and storage facility known as the Humvee Area, office space, and vacant buildings. Site SS 009, which falls under BRAC, is not occupied by the USMC. Building 614, located in the northeastern corner of the Site and consists of approximately 0.378 acres, was purchased in 2011 by Heart-N-Hand Ministries, Inc., a private non-profit organization. The building is used by the non-profit organization for warehousing purposes. The remaining portion of the property was acquired in 2012 by the Kansas City Port Authority, which is currently leasing the property as office space. Currently, Metropolitan Community College is leasing a portion of Building 605 as classroom space, which is in use approximately 4 hours/weekday. The remainder of the Port Authority-owned portion of SS 009 is currently vacant.

10.5 Previous Studies and Corrective Action

Details of the investigations and corrective actions performed at Sites SS 003 and SS 009 were provided in the RI (CH2M Hill, December 2000) and the ROD (AFRPA, June 2004). A brief summary of the activities is provided below.

Investigations at SS 003 in 1986 (Ecology and Environment, July 1998) and 1989 (O'Brien & Gere, October 1991) identified a small area of total petroleum hydrocarbon (TPH) contamination in soil at the Site, as shown in Figure 10-6. Approximately 42 cubic yards of contaminated soils were removed from the Site in 1991 and 1992 (Burns & McDonnell, September 1992). Additional sampling conducted during the RI in 1999 to 2000 (CH2M Hill, December 2000) did not identify any additional soil contamination. This RI identified an area of chlorinated solvent groundwater contamination encompassing approximately 0.27 acres. The source of the groundwater contamination has never been identified, but is suspected to have originated from historical activities at the former waste oil storage area (AFRPA, June 2004). The COC in groundwater at

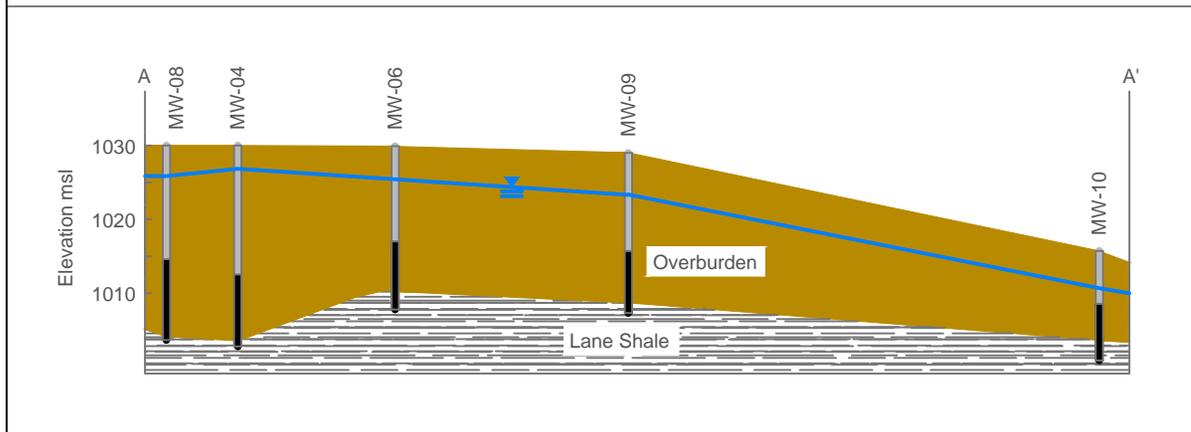
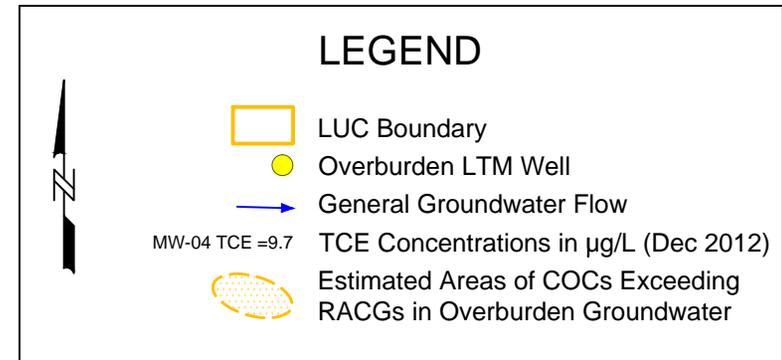
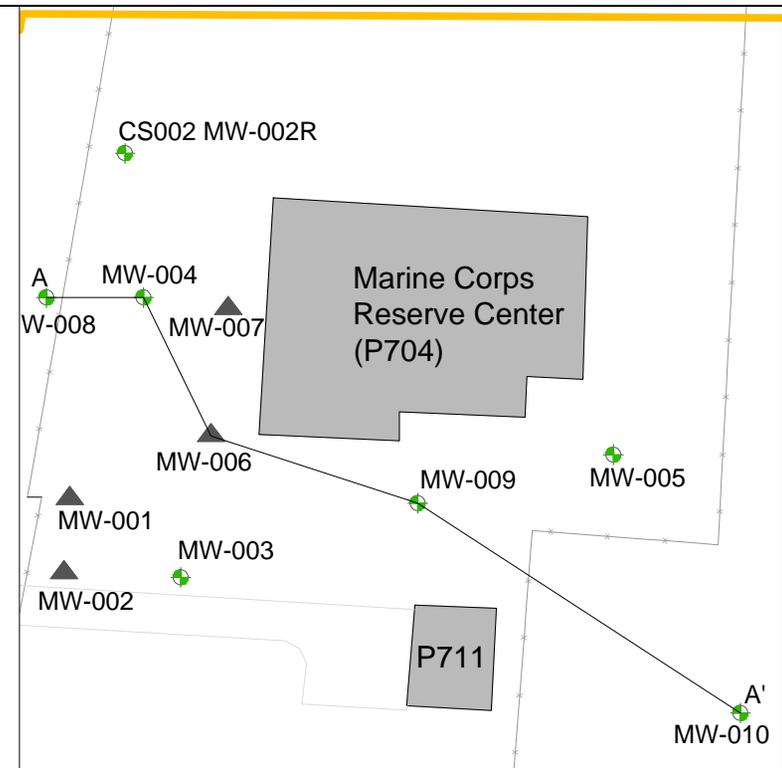
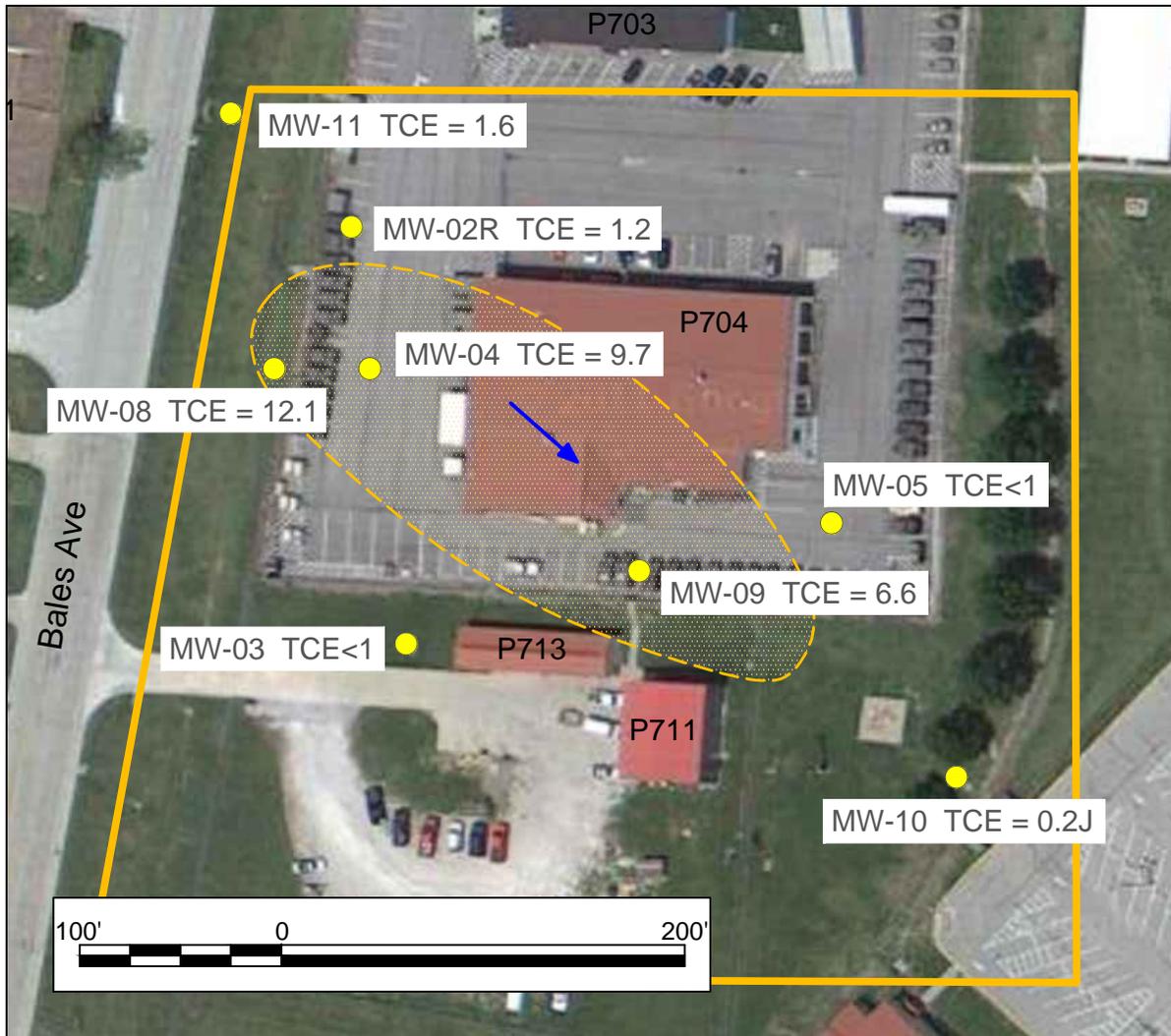


Figure 10-6: Site SS 003 Oil Saturated Area Conceptual Site Model

Former Richards-Gebaur AFB
Kansas City, Missouri

Tier II Sampling and Analysis Plan

SS 003 is TCE, which has historically been detected at concentrations above the remedial action cleanup goal (RACG). The highest groundwater concentrations have generally been located west and south of Building 703.

At SS 009, petroleum-contaminated soils were discovered in 1992 during repair of an underground water valve on Site. Approximately 10 cubic yards of petroleum-contaminated soils were excavated from the Site in 1993 (Tetra Tech, September 1995). The location of the excavation is shown in Figure 10-4. Supplemental investigations did not identify additional soil contamination; however, an approximately 0.68-acre area of groundwater impacted by chlorinated solvents was identified during a subsequent investigation (AFRPA, June 2004). COCs in groundwater that have been detected above RACGs are 1,1-dichloroethene (DCE); cis-1,2-DCE; tetrachloroethene (PCE); TCE; and VC. The source of this chlorinated solvent groundwater contamination was theorized to be related to spills that entered the drainage swale near a fire valve (Tetra Tech, September 1995). Groundwater contamination originated under Building 605 and extended southeast to an area near Andrews Road (Figure 10-5).

The LTM monitoring program at Site SS 003 consists of eight monitoring wells (MW-002R, MW-003, MW-004, MW-005, MW-008, MW-009, MW-010 and MW-011). The wells in the monitoring program are based on the 2005 LTM Plan (AFRPA, March 2005) and include two wells (MW-002R and MW-011) that were subsequently added to the program based on the LTM Plan Decision Rules. There are four monitoring wells (MW-001, MW-002, MW-006 and MW-007) at Site SS 003 that are contingency wells and are not included in the LTM program. Groundwater samples are analyzed for monitoring well locations are depicted on Figure 10-3.

The LTM Plan (AFRPA, March 2005) also established a long term monitoring network for Site SS 009, which consists of seven monitoring wells: MW-002, MW-003, MW-005, MW-006, MW-012, MW-013, and MW-014 (Figure 10-5).

RACGs used in conjunction with the LTM Program at Sites SS 003 and SS 009 were developed during the 2002 Feasibility Study (CH2M HILL, November 2002). The established RACGs are the federal Maximum Contaminant Levels (MCLs) (USEPA, April 2012). Additional details of the SS 003 and SS 009 sampling programs are provided in Worksheet #17.

10.6 Conceptual Site Exposure Model

The CSM for Sites SS 003 and SS 009 is presented in the following sections. The CSM is supported by Figures 10-6 and 10-7 for Sites SS 003 and SS 009, respectively.

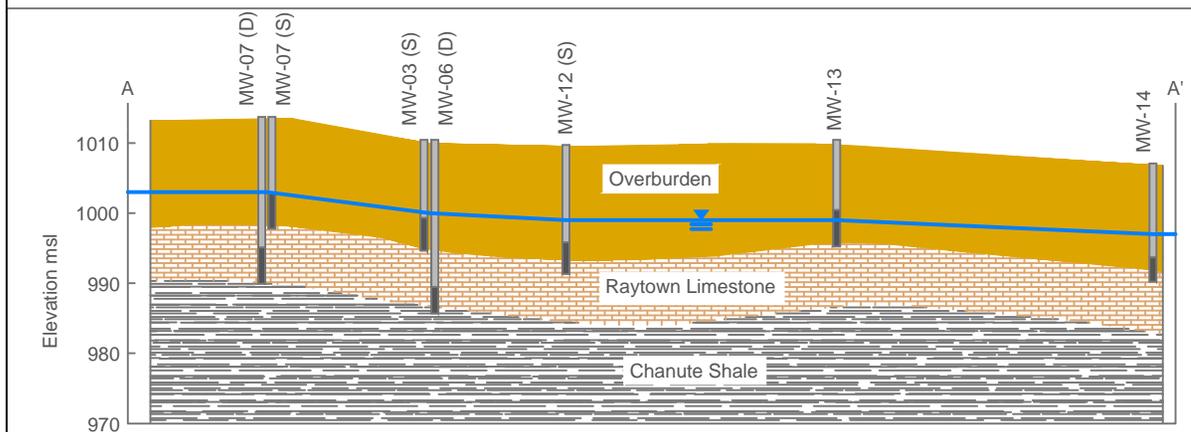
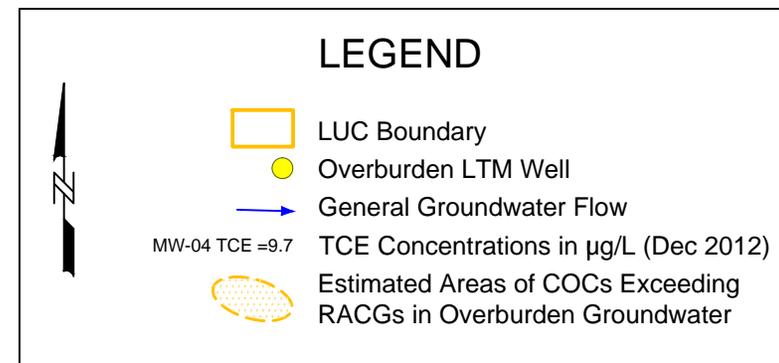
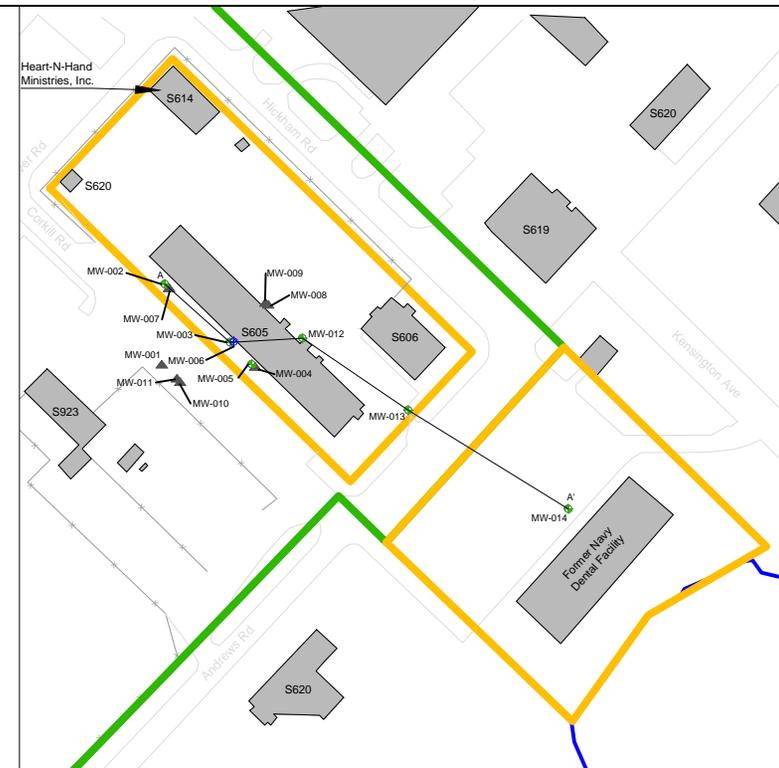
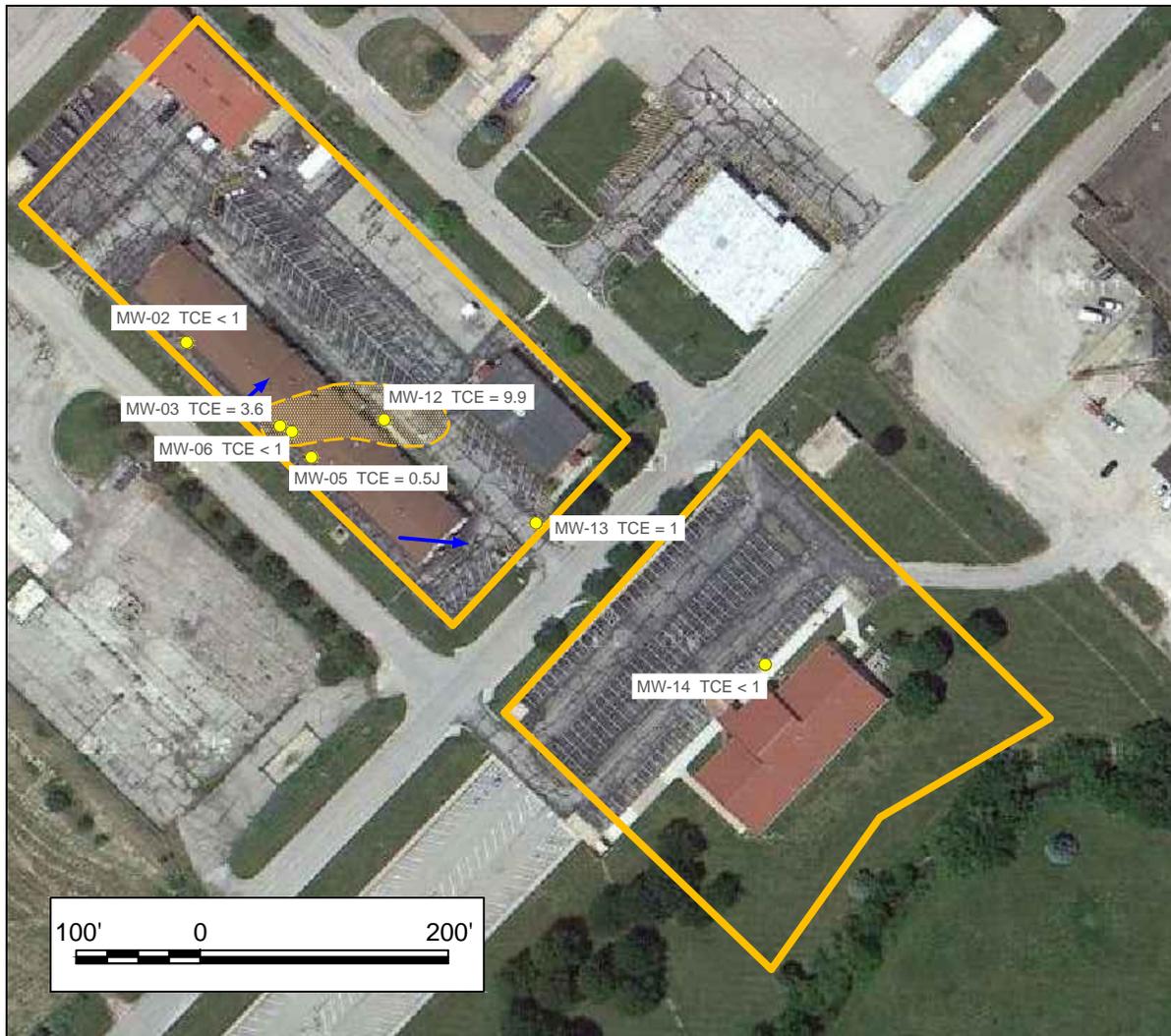


Figure 10-7: Site SS 009 Fire Valve Area Conceptual Site Model

Former Richards-Gebaur AFB
Kansas City, Missouri

Tier II Sampling and Analysis Plan

10.6.1 Source of Contaminants

Groundwater at both Sites is contaminated with chlorinated solvents including PCE, TCE and their daughter products. The most likely source of the chlorinated solvent contamination at SS 003 and SS 009 originated from the past storage and handling of solvents that were routinely used to clean oily machinery and parts when the base was operational. Impacted soils were removed from both sites prior to implementation of the groundwater LTM (Burns & McDonnell, September 1992 and Tetra Tech, September 1995). No concentrations of solvents exist in soils at either Site in excess of RACGs.

10.6.2 Nature and Extent of Contamination

As indicated above, all known soil contamination at Sites SS 003 and SS 009 above RACGs has been removed. Graphical representations of the nature and extent of groundwater contamination at Sites SS 003 and SS 009 are shown on Figures 10-6 and 10-7, respectively.

10.6.3 Fate and Transport Mechanisms

A fate and transport pathway describes mechanisms whereby contaminants are transported from the source to a human or ecological receptor. Preliminary fate and transport mechanisms are summarized below and will be refined during the investigation.

Historical releases of chlorinated solvents may have originated from past storage and handling of solvents that were routinely used to clean oily machinery and parts when the base was operational. Spills to the ground surface may have been transported via surface runoff or infiltration mechanisms. SS 003 and SS 009 are paved and flat. Based on previous investigations, there is no indication that off-site areas have been impacted by historical operations via surface runoff from SS 003 or SS 009. Due to highly disturbed soils and permeable backfill material near the surface at these Sites, it is more likely that surface spills would have infiltrated to subsurface soil. Any groundwater movement through the Site SS 003 and SS 009 is expected to originate from upgradient sources.

Because of the low-flow groundwater conditions that predominate at the Base and the absence of known active contaminant sources, groundwater contamination has not traveled far at Sites SS 003 and SS 009. A spike in TCE concentrations at the formerly upgradient monitoring well MW-008 in 2005 and 2006 resulted in the addition of two monitoring wells to the monitoring program: existing monitoring well MW-002R as a cross-gradient well and monitoring well MW-011 as the new upgradient well. Nevertheless, the areas of contaminated groundwater at both Sites have remained relatively stable over the past several years.

SAP WORKSHEET #11: DATA QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

11.1 Problem Statement

Past operations at Sites SS 003 and SS 009 resulted in chlorinated solvent contamination of the local shallow groundwater aquifer. LUCs have been placed on both sites to protect human health and the environment; groundwater must be monitored to continually assess the chlorinated solvent plumes (stable, expanding, decreasing, etc.) and to determine when LUCs may be terminated.

11.2 Goals of the Study

The LTM program for groundwater will support the LUCs and allow systematic, periodic evaluation of site groundwater quality to help ensure that the established LUC boundaries fully encompass the contaminant plumes and remain protective of human health and the environment (AFRPA, June 2004). Goals of the ongoing LTM program are:

- To assess whether site groundwater concentrations of COCs have fallen below the RACGs, thus allowing the site LUCs to be terminated and the sites to be closed; and
- To determine whether groundwater contamination plumes are increasing or decreasing in size, migrating off-site or remaining stable.

Findings will provide information to support the development, evaluation, and selection of appropriate response alternatives, if necessary.

Principal study questions (PSQs) developed to define decision statements to resolve the problems are as follows:

PSQ1: Are fixed analytical laboratory results for the groundwater samples from sites SS 003 and SS 009 above the RACGs?

PSQ2: Based on the LTM results, do the contaminant plumes remain contained within the SS 003 and SS 009 LUC boundaries?

PSQ3: What additional actions will be taken should consecutive LTM results indicate that contaminant migration is occurring?

11.3 Information Inputs

Data that are required to resolve the problem described in Section 11.1 are as follows:

- **Chemical Data:** LTM groundwater samples from Sites SS 003 and SS 009 will be collected and analyzed as specified in combined Worksheets #18, 19, 20, and 30. Concentrations of detected analytes will be compared to Project Action Limits (PALs), as identified in Worksheet #15. Chemical data will be projected onto Site maps to assist in identifying contaminant sources and determining the extent of contamination. Chemical data from previous LTM events and historical studies may be used in the evaluation. Chemical data will serve as the primary tool to support decisions.
- **Project Action Limits:** PALs for groundwater consist of RACGs, which are based on the federal MCLs. Chemical data will be compared to PALs, as detailed on Worksheet #15, as an initial screening value to determine if follow up actions are necessary.
- **Geologic/Hydrogeologic Information:** Depth to groundwater will be measured at monitoring wells to provide information regarding the potentiometric surface.
- **Groundwater Stabilization Parameters:** Parameters, including pH, temperature, specific conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity, will be used to confirm groundwater samples are representative of the formation being investigated. Field parameters may also be used to evaluate degradation processes at the Site.

11.4 Study Area Boundaries

Sites SS 003 and SS 009 have defined horizontal boundaries as determined by the LTM (Figures 10-3 and 10-5, respectively). Vertical boundaries at the sites consist of the shallow groundwater aquifer, which extends from near the ground surface to approximately 20 feet below grade. The monitoring event in December 2011 confirmed that impacted groundwater above cleanup goals at both Sites SS 003 and SS 009 remain within the limits of the LUC boundaries. In the event that plume migration is found to be occurring, additional monitoring wells may be installed at the Site in question to assess the lateral extent of contamination. This SAP will be revised or appended, as necessary to reflect any changes to the monitoring program. If necessary, the LUC boundaries will be reassessed and expanded to ensure that the groundwater contamination remains encompassed by the LUC area. In addition, to continue to protect human health and the environment, the frequency of monitoring may be adjusted based on site-specific

risk considerations (AFRPA, June 2004). The temporal boundaries of the investigation include the estimated duration of field activities, as described herein. Seasonal variations are not anticipated to affect this program.

11.5 Analytical Approach

Groundwater samples at sites SS 003 and SS 009 have been collected on an annual basis for the LTM program. COCs at both sites are PCE; TCE; cis-1,2-DCE; 1,1-DCE and VC. Based on the Decision Rules specified below and developed in the LTM Plan (AFRPA, March 2005), sampling at Sites SS 003 and SS 009 has changed from an annual basis to a biennial basis.

The decision rules that apply to the LTM networks at OU 2 Sites were established in the LTM Plan (AFRPA, March 2005) and were derived primarily from the Air Force Center for Engineering and the Environment (AFCEE) Long Term Monitoring Optimization Guide (AFCEE, 1997). Additional decision rules were developed consensually between MDNR, USEPA, and the Air Force to ensure that the LTM plan meets the remedial action objectives for sites with contaminated groundwater at the former Richards-Gebaur Air Force Base. The decision rules were developed to apply for the entire duration of LTM and are divided into three categories: LTM Sampling Frequency; Addition, Elimination and Replacement of LTM Wells; and LTM Program Termination. The decision rules applicable to Sites SS 003 and SS 009 are provided below.

Long Term Monitoring Sampling Frequency

- If VOC concentrations in downgradient monitoring wells, and perimeter monitoring wells that have historically exhibited no detectable levels of VOCs, exceed the RACG, the monitoring frequency for the well will be increased to, or maintained at, a semiannual frequency. If two successive subsequent semiannual events show concentrations have declined to levels once again below the relevant RACG, or a new monitoring well is installed, the original monitoring frequency will be resumed.
- If VOC concentrations in perimeter monitoring wells (upgradient and cross-gradient) exceed twice the standard deviation over the mean for the previous eight (if available, minimum of four) sampling events, and the resulting value exceeds the RACG, the monitoring frequency will be increased to, or maintained at, a semiannual level. If two successive subsequent semiannual events show concentrations have declined to levels once again below the relevant action trigger, or a new monitoring well is installed, the original monitoring frequency will be resumed.

- If there is lack of adequate groundwater for sampling at a monitoring well, which is instrumental in defining the contaminant plume during a monitoring event, the monitoring frequency for that well will be increased to, or maintained at, an annual frequency until a representative sample is obtained. Annual sampling will be conducted in the Spring, typically the wettest season of the year.

Addition, Elimination and Replacement of Long Term Monitoring Wells

- If VOC concentrations in downgradient monitoring wells, and perimeter monitoring wells that have historically exhibited no detectable levels of VOCs, continue to exceed the RACG for two successive semiannual sampling events a new monitoring well will be installed a minimum distance of 50 feet from the affected downgradient monitoring well.
- If VOC concentrations in perimeter monitoring wells (upgradient and cross-gradient) continue to exceed twice the standard deviation over the mean resulting in a value that exceeds the RACG for two successive semiannual sampling events then an existing well, a minimum of 50 feet distant from the affected perimeter monitoring well, will be identified for monitoring. If no existing wells meet this criterion, a new monitoring well will be installed a minimum distance of 50 feet from the affected perimeter well.
- If lack of adequate groundwater for sampling persists over two successive annual monitoring events, the monitoring well will be eliminated from the LTM network. As described in the following two bullet points, additional action may be taken if the well is instrumental in defining the contaminant plume.
- If monitoring wells are eliminated from the LTM network because of damage or a lack of adequate groundwater for sampling, thereby causing the contaminant plume to become poorly defined by the remaining monitoring wells, then replacement wells will be installed at the appropriate location. The Air Force will provide recommendations for elimination and/or replacement of the well to the MDNR and USEPA for review and comment.
- If a damaged monitoring well or a well with lack of adequate groundwater is not instrumental in defining the contaminant plume, then the well will be abandoned and eliminated from the LTM Program following communication with the regulatory agencies.
- If a monitoring well is located within the confines of a stable or shrinking plume and is not a well where the maximum concentration of a contaminant has consistently been found, the

well will be considered redundant and, following communication with the agencies, may be eliminated from the LTM program.

- If the monitoring well is located upgradient of a stable or shrinking plume and has not had contaminant concentrations measured above RACGs for two successive LTM events, the well will be considered as unnecessary to monitor plume movement and, following communication with the agencies, may be eliminated from the LTM program.
- Once a site is closed in accordance with the requirements of the ROD, the monitoring wells at the site will be abandoned in accordance with Geological Survey and Resource Assessment Division Missouri Well Construction Rules.

Long Term Monitoring Program Termination

If the maximum concentration of all contaminants of concern for the site decline below the RACGs the sampling frequency will be increased to, or maintained at, a semiannual frequency. If two consecutive semiannual sampling events document that compliance with RACGs is being maintained, the site warrants no further monitoring in accordance with the ROD.

11.6 Decision Performance Criteria

The objective of this section is to complete the following:

- Identify potential sources of study error (i.e., field error, analytical error)
- Establish and identify the methods used to reduce potential sources of error.
- Determine how decision errors will be managed during the project

Sampling Strategy — The sampling design was developed to continue ongoing LTM efforts and further evaluate LNAPL and increasing naphthalene at select monitoring wells. Judgmental sampling will be used to place soil borings and temporary monitoring wells. This sampling approach was determined to be the most appropriate due to the availability of previous sampling data at the site.

Sources of Error — Sources of error may be divided into two main categories: sampling errors and measurement errors. A sampling error occurs when the sampling design, planning, and implementation do not provide for a representative range of heterogeneity at the site. A measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The USEPA identifies the combination of all these errors as a “total study error” (USEPA, February 2006). One objective of the investigation is to reduce the

total study error so that decision-makers can be confident that the data collected accurately represent the chemical characteristics of the site.

Managing Decision Error — The investigation will utilize decision-error minimization techniques in sampling design, sampling methodologies, and laboratory measurement. Possible decision errors will be minimized during the field investigation by using the following methods:

- Use standard field sampling methodologies (as discussed in Worksheets #18 and #21).
- Use applicable analytical methods and standard operating procedures (SOPs) for sample analysis by a competent analytical laboratory accredited through the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).
- Confirm analytical data to identify and control potential laboratory error and sampling error by using spikes, blanks, and replicated samples.

Decision errors associated with judgmental sampling are based on sample design and measurement errors. Assuming that the best possible professional judgment was used to develop the judgmental sampling plan (i.e., position sampling locations), the most important decision errors will be associated with field and laboratory techniques involved in the collection and analysis of the data.

Field Data Logs — All sample information will be transcribed into a field logbook and/or onto field data sheets.

Analytical Laboratory Sample Management — The sample matrix, number of samples, and number and type of laboratory quality assurance (QA)/quality control (QC) samples are summarized in the worksheets #18, 19, 20, and 30. Also included on this combined worksheet are details on the analytical group, sample volumes, sample container specifications, preservation requirements, and maximum and holding times.

The laboratory will provide electronic data deliverable files, portable document format files of the data deliverables for all project data, and a hard copy of data deliverables for all results. Designated samples will be used to obtain necessary subsamples for laboratory QC measurements (i.e., analytical sample duplicate and sample matrix spike/matrix spike duplicate [MS/MSD]). Tasks will be completed using the laboratory SOPs.

Resolution Consultants will provide data validation services and verify and evaluate the usability of the data as described in Worksheets #34 through #36.

Portable document format copies of all analytical data packages will be stored on compact disk read-only memory (CD-ROM), archived in the NAVFAC Midwest Administrative Record, and uploaded onto the Naval Installation Restoration Information Solution (NIRIS) system at the close of the project. All other data generated in the field and reports generated for the project will be stored as computer readable data files by Resolution Consultants.

11.7 Data Collection Plan

The LTM program at Site SS 003 consists of eight monitoring wells (MW-002R, MW-003, MW-004, MW-005, MW-008, MW-009, MW-010 and MW-011). At Site SS 009, the LTM program consists of seven monitoring wells: MW-002, MW-003, MW-005, MW-006, MW-012, MW-013, and MW-014. Groundwater samples from both Sites will be analyzed for the VOCs 1,1-DCE, cis-1,2-DCE, PCE, TCE and VC. The sample design and rationale is presented in Worksheet #17.

SAP WORKSHEET #12: FIELD QUALITY CONTROL SAMPLES

Matrix: Groundwater

Analytical Group: Chlorinated Volatile Organic Compounds

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria
Trip Blanks	Chlorinated Volatile Organic Compounds	One per sample cooler	Accuracy/Bias	No target compounds > 1/2 LOQ (> LOQ for common laboratory contaminants) and no target compounds > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Equipment Rinsate Blank		One per 20 field samples per matrix per sampling equipment ⁽¹⁾	Accuracy/Bias	No target compounds > 1/2 LOQ (> LOQ for common laboratory contaminants) and no target compounds > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Cooler Temperature Indicator		One per sample cooler	Accuracy/Representativeness	Temperature ≤ 6 degrees Celsius
Field Duplicates		One per 20 field samples	Precision	RPD ≤ 30% if both results are ≥ 2 x LOQ
Matrix Spike/Matrix Spike Duplicate		One pair per 20 field samples	Accuracy/Bias/ Precision	Percent recoveries: QC acceptance criteria specified in DoD QSM Version 4.2; RPD ≤ 30%

Notes:

- (1) = Equipment rinsate blanks will be collected if decontamination is required and will not apply if dedicated equipment is used
- DoD QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010, or most recent version at the time of sampling
- QC = Quality Control
- RPD = Relative percent difference
- LOQ = Limit of quantitation
- PAL = Project action limit
- RPD = Relative percent difference

SAP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

This worksheet presents the design and rationale of the sampling and analysis program to be conducted under this plan as part of the LTM program. The sampling plan was originally developed in the LTM Plan (AFRPA, March 2005) and has had some minor modifications in terms of the LTM well locations, based on the Decision Rules provided in Worksheet #11.

A summary table, presenting the sample identification numbers, depth, relevant SOPs, and applicable laboratory and field analyses, is included as combined Worksheet #18, 19, 20, and 30. SOPs for field activities are summarized in Worksheet #21 and included as Appendix A.

Samples collected will be submitted to Empirical Laboratories, LLC in Nashville, Tennessee for chemical analyses. Analytical methods are identified in Worksheet #23. Laboratory SOPs are listed in Worksheet #23. The total numbers of sample analyses to be performed for each target analyte or analytical group are identified in combined Worksheets #18, 19, 20, and 30. Combined Worksheets #18, 19, 20, and 30 present a summary of the sample analyses, container types and volumes, preservation requirements, and holding times.

Planned field QC samples will include field duplicates and equipment rinsate blanks. Worksheet #12 presents the field QC sample summary. Additional sample volume will be collected as necessary for laboratory QC analysis of matrix spike (MS) and matrix spike duplicate (MSD) samples.

Prior to collecting groundwater samples, depth to groundwater and the thickness of LNAPL, if present, will be measured to the nearest 0.01 foot at each monitoring well location. Groundwater samples will be collected using USEPA low-flow sampling protocol at Sites SS 003 and SS 009. At Site SS 003, samples will be collected from existing monitoring wells MW-002R, MW-003, MW-004, MW-005, MW-008, MW-009, MW-010 and MW-011, as presented on Figure 10-3. At Site SS 009, samples will be collected from existing monitoring wells MW-002, MW-003, MW-005, MW-006, MW-012, MW-013, and MW-014, as presented on Figure 10-5. To confirm that groundwater samples are representative of the formation being investigated, field measurements of water level/drawdown, temperature, pH, specific conductance, ORP, DO, and turbidity will be recorded. Groundwater samples will be submitted to Empirical Laboratories, LLC in Nashville, Tennessee for analysis of the VOCs PCE; TCE; 1,1-DCE; cis-1,2-DCE; and VC by USEPA Method 8260B.

SAP WORKSHEET #14: PROJECT TASKS

Field Project Implementation (Field Project Instructions)

This project consists of long-term groundwater monitoring at sites SS 003 and SS 009. Activities conducted as part of the groundwater monitoring program are presented in this section. Project-specific SOPs and field forms for field tasks referenced in this worksheet are identified by title in Worksheet #21 and copies of each SOP are provided in Appendix A. Project tasks are as follows:

The LTM program includes the following tasks:

- Field tasks, including:
 - Mobilization/demobilization
 - Field instrument calibration
 - Monitoring well inspection and gauging
 - Groundwater sample collection
 - Quality control tasks
 - Investigative derived waste tasks
 - Decontamination
 - Field documentation
- Analytical tasks
- Data handling and management
- Data review and validation
- Data tracking and control
- Data storage, archiving, and retrieval
- LTM report

These tasks are summarized in the following sections. The Resolution Consultants SOPs and field documents referenced in this and other worksheets are included in Appendix A.

Field Tasks

Mobilization/Demobilization — Mobilization will consist of the delivery, assembly, and secure storage of necessary equipment, materials, and supplies. The Resolution Consultants FTL or designee will coordinate with MCRC point of contact (POC) Ronald Phelps to identify appropriate locations for the temporary storage of equipment and supplies as necessary.

Demobilization will consist of the prompt and timely removal of equipment, materials, and supplies from the site at the completion of fieldwork. Demobilization also includes the cleanup and removal of waste generated during the investigation.

Field Instrument Calibration — Field Instrument Calibration procedures are described in SOP-3-24. Field instruments will consist of a PID to monitor total volatile organic compounds in the well headspace and breathing zone for health and safety purposes; and a YSI Water Quality Meter and turbidimeter to measure temperature, pH, specific conductance, oxidation-reduction potential, dissolved oxygen and turbidity as part of low-flow groundwater sampling. At a minimum, field equipment will be calibrated at the beginning of the day and calibration will be checked at the end each day. Documentation of field equipment calibration is required.

Well Inspection and Gauging — Prior to commencing sampling activities for any wells in the network, all wells in the zone of influence will be inspected and gauged in accordance with SOP 3-14 and the requirements presented in this section. Measurements and observations will be recorded in accordance with the SOP. Well security and condition will be inspected and recorded. Measurements of water level and well depth will be made using an electronic water level meter and recorded. Water levels will be measured from the notch located at the top of the well casing. If well casings are not notched, measurements will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file. The point of measurement will be recorded.

Following water level measurement, the total depth of the well from the top of the casing will be determined using a weighted tape or electronic sounder. The water level depth will then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. The depth and water column will be recorded.

Light nonaqueous phase liquid (LNAPL) has not been detected at any of the sites under consideration; therefore, is not expected to be encountered. Dense non-aqueous phase liquids (DNAPL) are not expected to be encountered. However, if either LNAPL or DNAPL are suspected, the thickness of the layer will be measured and recorded.

Groundwater Sampling — Groundwater samples will be collected using USEPA's low-flow (low stress) sampling protocol in accordance with SOP-3-14. Sampling will be conducted using submersible bladder pumps with Teflon bladders and Teflon discharge lines. Water quality parameters, excepting turbidity, will be monitored using a YSI water quality meter with an in-line flow-through cell attached to the pump discharge. Aliquots for the measurement of turbidity will be taken from the pump discharge. Measurements will be made every 3 to 5 minutes until parameters have stabilized. If the water-quality parameters do not stabilize within two hours of monitoring, samples will be collected and the event documented. The tubing intake will be placed in the center of the saturated screened interval. See combined Worksheet #18, 19, 20, and 30 for

designated sample identifications, well-screen intervals, analyses, the required bottle types, preservation, target analytes, analytical methods, and holding times for this investigation. Sample handling will be in accordance with SOP-3-03 and SOP-3-04.

Quality Control Samples — Field QC samples, including field duplicates, trip blanks, and equipment rinsate blanks, will be collected as outlined in combined Worksheet #18, 19, 20, and 30.

Decontamination — Decontamination of reusable sampling equipment will be conducted prior to sampling and between samples at each location, in accordance with SOP-3-06. An area for a temporary decontamination pad and a source of potable water will be arranged by the FTL through the MCRC POC.

Investigative-Derived Waste — Investigative derived waste (IDW) will be managed in accordance with the SOP-3-05. IDW may consist of personal protective equipment, decontamination fluids, and purged groundwater. IDW will be containerized in adequately labeled 55-gallon department of transportation approved drums. Pending characterization data, the drums will be temporarily staged onsite, as instructed by the MCRC POC. Based on characterization results, IDW will be appropriately disposed into the sanitary sewer upon approval from the City of Kansas City, Missouri. Personal protective equipment, including gloves, wipes, discarded paper towels, and disposable equipment (i.e., tubing), will be bagged and properly discarded to a solid waste dumpster, as identified by the MCRC POC.

Analytical Laboratory Tasks — Chemical analysis of groundwater will be performed by Empirical Laboratories, Inc., under subcontract to Resolution Consultants. Empirical is DoD ELAP-accredited, as documented on certificates in Appendix B. Analyses will be performed in accordance with analytical methods identified in Worksheet #23 and combined Worksheet #18, 19, 20, and 30. Empirical will strive to meet the PALs shown in Worksheet #15 and will perform chemical analyses following laboratory-specific SOPs cited on Worksheet #23. Empirical will provide full deliverables consisting of summary forms of quality control information and raw data.

Data Handling and Management — The principal data generated for this project will be from field data and laboratory analytical data. Upon completion of field activities, all secondary data from field sampling forms will be organized by date and entered into Excel for electronic archiving/data evaluation. The field forms, chain of custody, air bills, and logbooks will be placed in the project files after the completion of the field program. The field logbooks for this project will be used only for this site, and will also be categorized and maintained in the project files after the completion of the field program. All project records will be maintained in a secure location. After data are validated, the electronic data results will be uploaded into the

Resolution Consultants database for use in data evaluation and subsequent report preparation. The project database will be located on a secure network, which is password protected. The Resolution Consultants PM (or designee) is responsible for the overall tracking and control of data generated for the project.

Data Review and Validation — Following receipt of analytical laboratory results, Resolution Consultants will verify data completeness as specified on Worksheet #34. To determine whether the analytical results meet the project quality objectives, the data will undergo validation, as cited in Worksheets #34 through #36. After the data are validated, the reviewer will then prepare a technical memorandum presenting changes in the data, if necessary, and the rationale for making such changes. The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, and documentation to support data qualification. All data that requires qualification will be flagged with an appropriate qualifying symbol.

Data Tracking and Control — The Resolution PM (or designee) is responsible for the overall tracking and control of data generated for the project. Data are tracked from generation to archiving in the project specific files. The project chemist (or designee) is responsible for tracking the samples collected and shipped to the contracted laboratory. Upon receipt of the data packages from the analytical laboratory, the project chemist will oversee the data validation effort, which includes verifying that the data packages are complete and that results for all samples have been delivered by the analytical laboratory. Resolution Consultants shall submit all Administrative Record Files, Site Files, and Post Decision Files in accordance with the specifications defined in the NAVFAC Environmental Restoration Recordkeeping Manual. Additionally, Resolution Consultants will update and manage the project related documents, data, and maps in NIRIS. Project related spatial data including maps, models, and associated collected or created data will also be uploaded into NIRIS. All documentation submittals for NIRIS will be coordinated with the Navy RPM.

Data Storage, Archiving, and Retrieval — Final validated environmental data and reports will be uploaded and stored in the NIRIS database. After the data are validated, the data packages are entered into the Resolution Consultants Navy CLEAN file system and archived in secure files. The field records including field log books, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Resolution Consultants FTL to be entered into the Navy CLEAN file system before archiving in secure project files. Project files are audited for accuracy and completeness. Project files will be kept in a secured, limited access area and at the completion of the Navy contract; records will be stored by Resolution Consultants and eventually transferred to the Navy.

LTM Reports — LTM reports will be prepared following each groundwater sampling event at Sites SS 003 and SS 009. The LTM reports will describe field activities, summarize findings, and present any recommendations to the LTM program. Final reports will be uploaded and stored in the NIRIS database.

SAP WORKSHEET #21: FIELD SOPS REFERENCE TABLE

Field SOPS Reference Table					
SOP Reference Number	Title/Author	Revision Date or Version Number	Location of SOP (if not included in the SAP)	Any planned deviation for Project Work	Comments
3-02	Field Log Books/Resolution Consultants	May 2012	Appendix A	No	
3-03	Record Keeping, Sample Labeling, and Chain-of-Custody Procedures/Resolution Consultants	May 2012	Appendix A	No	
3-04	Sample Handling, Storage, and Shipping Procedures/Resolution Consultants	May 2012	Appendix A	No	
3-05	Investigative Derived Waste Management/Resolution Consultants	May 2012	Appendix A	No	
3-06	Equipment Decontamination (Water levels only)/Resolution Consultants	May 2012	Appendix A	No	
3-14	Monitoring Well Sampling/Resolution Consultants	May 2012	Appendix A	No	
3-20	Operation and Calibration of a Photoionization Detector/Resolution Consultants	May 2012	Appendix A	No	
3-24	Water Quality Parameter Testing/Resolution Consultants	June 2012	Appendix A	No	

Notes:

SAP = Sampling and analysis plan
 SOP = Standard operating procedure

SAP WORKSHEETS #18, 19, 20, AND 30: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE

Site SS 009 and Site SS 003 2013 Long-Term Groundwater Monitoring Former Richards-Gebaur Air Force Base MCRC Kansas City, Missouri May 2013 Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270 I Nashville, TN 37228 Brian Richard 615.345.1119 x249				Analysis Group:		Chlorinated Volatile Organic Compounds	
				Preparation and Analytical Method:		SW-846 Method 8260B	
				Analytical Laboratory SOP Reference:		Empirical, LLC SOP 202	
				Data Package Turnaround Time:		14 Days	
				Container Type/Volume Required:		3 — 40mL glass vials	
				Preservative:		HCl pH<2 and Cool to ≤ 6°C; no headspace	
				Holding Time (Preparation/Analysis) ¹ :		14 days	
Site	Matrix	Well ID	Sample ID	Northing ⁵	Easting ⁵	Screen Interval (ft BTOC)	
SS 003	Groundwater	SS003-MW-002R	SS003-MW-002R-GW13	974725	2773326	12.1 – 22.1	1
	Groundwater	SS003-MW-003	SS003-MW-003-GW13	974514.22	2773352.74	20.2 – 34.2	1
	Groundwater	SS003-MW-004	SS003-MW-004-GW13	974652.77	2773334.40	14.0 – 23.5	1
	Groundwater	SS003-MW-005	SS003-MW-005-GW13	974574.46	2773565.02	16.5 – 26.5	1
	Groundwater	SS003-MW-008	SS003-MW-008-GW13	974652.44	2773285.86	13.8 – 23.8	1
	Groundwater	SS003-MW-009	SS003-MW-009-GW13	974550.30	2773468.60	15.3 – 25.3	1
	Groundwater	SS003-MW-010	SS003-MW-010-GW13	974446.80	2773629.90	10.6 – 18.6	1
	Groundwater	SS003-MW-011	SS003-MW-011-GW13	974781	2773266	19.2 – 29.7	1
	Field Duplicate ²	SS003-MW-010	SS003-DP01-GW13	974446.80	2773629.90	10.6 – 18.6	1
	Trip Blank ³	NA	TB01-GW13	NA	NA	NA	1
	Equipment Blank ⁴	NA	EB-PMP-01-GW13	NA	NA	NA	1
	Matrix Spike ²	SS003-MW-003	SS003-MW-003-GW13	974514.22	2773352.74	20.2 – 34.2	1
Matrix Spike Duplicate ²	SS003-MW-003	SS003-MW-003-GW13	974514.22	2773352.74	20.2 – 34.2	1	
SS 009	Groundwater	SS009-MW-002	SS009-MW-002-GW13	975643.76	2774368.22	8.0 – 13.0	1
	Groundwater	SS009-MW-003	SS009-MW-003-GW13	975569.21	2774443.66	8.2 – 13.2	1
	Groundwater	SS009-MW-005	SS009-MW-005-GW13	975542.18	2774471.37	8.6 – 13.6	1
	Groundwater	SS009-MW-006	SS009-MW-006-GW13	975567.56	2774445.61	17.6 – 23.1	1
	Groundwater	SS009-MW-012	SS009-MW-012-GW13	975575.60	2774533.50	13.9 – 18.9	1
	Groundwater	SS009-MW-013	SS009-MW-013-GW13	975487.00	2774664.80	8.7 – 13.7	1
	Groundwater	SS009-MW-014	SS009-MW-014-GW13	975365.10	2774863.00	9.8 – 14.8	1
	Field Duplicate ²	SS009-MW-006	SS009-DP02-GW13	975567.56	2774445.61	17.6 – 23.1	1

Site SS 009 and Site SS 003 2013 Long-Term Groundwater Monitoring Former Richards-Gebaur Air Force Base MCRC Kansas City, Missouri May 2013 Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270 I Nashville, TN 37228 Brian Richard 615.345.1119 x249				Analysis Group:		Chlorinated Volatile Organic Compounds	
				Preparation and Analytical Method:		SW-846 Method 8260B	
				Analytical Laboratory SOP Reference:		Empirical, LLC SOP 202	
				Data Package Turnaround Time:		14 Days	
				Container Type/Volume Required:		3 — 40mL glass vials	
				Preservative:		HCl pH<2 and Cool to $\leq 6^{\circ}\text{C}$; no headspace	
				Holding Time (Preparation/Analysis)¹:		14 days	
Site	Matrix	Well ID	Sample ID	Northing ⁵	Easting ⁵	Screen Interval (ft BTOC)	
	Trip Blank ³	NA	TB02-GW13	NA	NA	NA	1
	Equipment Blank ⁴	NA	EB-PMP-02-GW13	NA	NA	NA	1
	Matrix Spike	SS009-MW-003	SS009-MW-003-GW13	975569.21	2774443.66	8.2 – 13.2	1
	Matrix Spike Duplicate ²	SS009-MW-003	SS009-MW-003-GW13	975569.21	2774443.66	8.2 – 13.2	1

Notes:

- ¹ Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared / extracted.
- ² The location of the matrix spike/matrix spike duplicate and field duplicates are subject to change. Two sets will be collected, one from each of the two sites. In addition, if use of a bailer is required, an effort will be made to collect one set from a location where a pump is used and the other will be collected from a location where a bailer is used.
- ³ One trip blank per cooler of samples shipped will be submitted.
- ⁴ Two equipment blanks will be collected (EB-PMP-01-GW13 and EB-PMP-02-GW13).
- ⁵ State Plane NAD83 Missouri West-2403 U.S. Survey Feet Northing and Easting as reported in Table A-1 of *Former Richards-Gebaur AFB Annual Report* (HydroGeoLogic, Inc., 2011)

BTOC	=	Below top of casing
°C	=	Degrees Celsius
EB	=	Equipment blank
HCl	=	Hydrochloric acid
mL	=	Milliliters
MS	=	Matrix spike
MSD	=	Matrix spike duplicate
NA	=	Not Applicable
PMP	=	Pump
SOP	=	Standard operating procedure
TB	=	Trip blank

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

Matrix:	Groundwater						
Analytical Group:	Chlorinated Volatile Organic Compounds						
Analyte	CAS No.	Project Action Level (µg/L)	Project AL Reference	Project Quantitation Limit Goal (µg/L) ¹	Laboratory Limit of Quantitation ² (µg/L)	Laboratory Limit of Detection ² (µg/L)	Laboratory Method Detection Limit ² (µg/L)
tetrachloroethene	127-18-4	5	ROD RACG (MCL)	1.0	1.00	0.50	0.25
trichloroethene	79-01-6	5	ROD RACG (MCL)	1.0	1.00	0.50	0.25
1,1-dichloroethene	75-35-4	7	ROD RACG (MCL)	1.0	1.00	0.50	0.25
cis-1,2-dichloroethene	156-59-2	70	ROD RACG (MCL)	1.0	1.00	0.50	0.25
vinyl chloride	75-01-4	2	ROD RACG (MCL)	1.0	1.00	0.50	0.25

Notes:

¹ Project Quantitation Limit Goal is equivalent to the reporting limits obtained from the most recent round of groundwater sampling.

² LOQ, LOD, and DLs are provided by Empirical Laboratories, LLC.

- AL = action level
- CAS = Chemical Abstracts Service
- No. = number
- RACG = Remedial Action Cleanup Goal
- ROD = Record of Decision
- µg/L = microgram per liter

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE

Laboratory Name and Address: Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270, Nashville, TN 37228

Laboratory Point of Contact: Brian Richard

Phone Number: 615.345.1119 x249

EMLB SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Yes/No)
202	GC/MS Volatiles by EPA Method 624 & SW846 Method 8260B Including Appendix IX Compounds R24	Definitive	Water/Volatiles	GC/MS	No	No

Notes:

- EMLB = Empirical Laboratories, LLC
- GC = Gas chromatograph
- MS = Mass spectrometry
- QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010 (and subsequent revisions)
- SOP = Standard operating procedure

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE

Matrix		Groundwater				
Analytical Group		Chlorinated Volatile Organic Compounds				
Analytical Method		SW-846 8260B				
SOP Reference		SOP 202				
<i>QC SAMPLE</i>	Frequency/ Number	Method/SOP — QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per preparatory batch	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 in DoD QSM Version 4.2).	Correct problem; reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 in DoD QSM V4.2).
Surrogates	All field and QC samples	QC acceptance criteria specified in DoD QSM Version 4.2	Reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2
LCS	One LCS per preparatory batch	QC acceptance criteria specified in DoD QSM Version 4.2	Reanalyze all associated samples if sufficient sample is available. If insufficient sample, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2
Internal Standards	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect MS or GC for malfunctions. Reanalyze all samples with internal standard failures if sufficient sample is available. If reanalysis confirms matrix interference, report sample and narrate. If insufficient sample, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	Retention time ± 30 seconds; EICP area within -50% to +100% of midpoint of ICAL
MS/MSD	One per preparatory batch per matrix	For matrix evaluation, use LCS recovery criteria; RPD ≤30%.	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	For matrix evaluation, use LCS recovery criteria; RPD ≤30%.

Notes:

DoD QSM = Department of Defense Quality Systems Manual
 EICP = Extracted ion current profile
 GC = Gas chromatograph
 ICAL = Initial calibration
 LCS = Laboratory control sample
 LOQ = Limit of quantitation
 MS = Mass Spectrometer
 MS/MSD = Matrix spike/matrix spike duplicate
 RPD = Relative percent difference

SOP = Standard operating procedure
 QA = Quality assurance
 QC = Quality control

SAP WORKSHEETS #34 — 36: DATA VERIFICATION AND VALIDATION (STEPS I AND IIA/IIB) PROCESS TABLE

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Verification (Step I) Chain-of-custody forms Sample Login/ Receipt	On the day of sample receipt, review the sample shipment for completeness, integrity, and sign accepting the shipment. During the login process, sample condition will be assessed and sample labels will be checked against the chain-of-custody form. Sample condition and any discrepancies identified will be recorded on the sample receipt forms, and will be communicated to the Resolution Consultants Project Chemist or her designee within one day of sample receipt. Resolution of the discrepancies will be documented in communications or on the sample receipt form. Copies of the communications and sample receipt forms will be included in the data deliverable. The samples will be logged in at every storage area and work station required by the designated analyses. Internal chains of custody will be included in the data deliverable.	Laboratory sample custodians and analysts, Empirical Laboratory	Internal
Verification (Step I) Chain-of-custody forms	During data validation, check that the chain-of-custody form was signed/dated by the sampler relinquishing the samples and by the laboratory sample custodian receiving the samples for analyses. Discrepancies will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Verification (Step I) SAP sample tables	At the conclusion of the sampling event, verify that all proposed samples listed in the SAP tables have been collected and are documented on the project chain-of-custody forms. Report this information to the CTO Manager.	FTL or designee, Resolution Consultants	External
Verification (Step I) Sample log sheets and field notes	At the end of each field day, verify that information recorded in the log sheets and field notes are accurate and complete. Document the confirmation in the FTL field logbook.	FTL or designee, Resolution Consultants	External
Verification (Step I) Field QC samples	At the end of each field day, check that field QC samples described in Worksheet #12 and listed in Worksheet #20 were collected as required. Document the confirmation in the FTL field logbook.	FTL or designee, Resolution Consultants	External
Verification (Step I) Analytical data package	Prior to releasing data deliverables, each section manager will verify the completeness of the analytical data package for the analysis conducted by the laboratory section according to the laboratory standard operating procedures. Prior to release to the client, the laboratory project manager (or designee) will sign the case narrative for each data package, confirming that the deliverables from each laboratory section are present and the deliverable is complete.	Laboratory project manager, Empirical Laboratory	Internal
Verification (Step I) Analytical data package	At the start of data validation, verify the data package for completeness. Missing information will be requested from the laboratory and validation (if performed) will be suspended until missing data are received. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Verification (Step I) Electronic data deliverables	During data validation, verify the electronic data against the chain-of-custody and hard copy data package for accuracy and completeness. Confirmation of this check will be noted in the data quality assessment report.	Data validator, Resolution Consultants	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Validation (Step IIa) Chain-of-custody	During data validation, examine the traceability of the data from time of sample collection until reporting of data by comparing the sample identification presented on the chain-of-custody to the sample identifiers presented in the data package. Ensure that the custody and integrity of the samples were maintained from collection to analysis and the custody records are complete and any deviations are recorded by checking the chain-of-custody form and sample receipt documentation. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Step IIa) Holding Times	During data validation, review the laboratory's sample receipt forms to confirm that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times. If holding times were not met, confirm that deviations were documented. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Steps IIa/IIb) Laboratory data results for accuracy	During data validation, confirm that the laboratory QC samples were analyzed and that the measurement performance criteria, listed in Worksheet #28, were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed, as listed in Worksheet #12, and that the analytical QC criteria were met. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Steps IIa/IIb) Field and laboratory duplicate analyses for Precision	During data validation, check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSDs. Ensure compliance with the precision goals listed in Worksheet #12 and 28. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Steps IIa/IIb) Sample results for representativeness	During data validation, check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Steps IIa/IIb) Project action limits	During data validation, assess and document the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant, on the other target compounds reported as undetected. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Steps IIa/IIb) Data quality assessment report	During data validation, summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Present tabular data including the final validation qualifiers resulting from validation and summarize data qualification outliers. Determine if the data met the measurement performance criteria and determine the impact of any deviations on the technical usability of the data. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External
Validation (Steps IIa/IIb) SAP QC sample documentation	During data validation, confirm that all QC samples specified in the SAP were collected and analyzed and that the associated results were within acceptance limits. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Validation (Step IIb) Analytical data deviations	After validation is complete, determine the impact of any deviation from sampling or analytical methods and laboratory SOP requirements and matrix interferences effect on the analytical results. Confirmation of this check will be noted in the LTM report.	Project chemist, Resolution Consultants	External
Validation (Step IIb) Project quantitation limits for sensitivity	After validation is complete, confirm that the project detection limits were achieved. Confirmation of this check will be noted in the LTM report.	Project chemist, Resolution Consultants	External
Validation (Steps IIa/IIb) Groundwater — VOCs	During data validation, assess VOC data using the criteria specified in Worksheets # 12, 15, 19, and 28 and the DoD QSM Version 4.2. The analyte list will be verified against Worksheet #15. <i>USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review</i> (June 2008) will be used to apply qualifiers to data. For the method requirements, such as surrogates, that are not addressed by the 2008 Guidelines, qualifiers will be applied consistent with the <i>USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review</i> (October 1999).. Confirmation of this check will be noted in the data quality assessment report.	Data validators, Resolution Consultants	External

Notes:

DoD QSM = Department of Defense Quality Systems Manual
 FTL = Field team leader
 LCS/LCSD = Laboratory control sample/laboratory control sample duplicate
 MS/MSD = Matrix spike/Matrix Spike duplicate
 QC = Quality control

RPD = Relative percent difference
 SAP = Sampling and analysis plan
 SOP = Standard operating procedure
 VOCs = Volatile organic compounds
 USEPA = U.S Environmental Protection Agency

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USEPA, February 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4. EPA/240/B-06/001, Office of Environmental Information, Washington, D.C.*

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Appendix A

Approval for Tier II Sampling and Analysis Plan

Jameson, Gretchen

From: Jones, Thomas F (Kansas City)
Sent: Tuesday, March 19, 2013 8:39 AM
To: Lapite, Constance; Jameson, Gretchen
Subject: FW: KCMO MCRC SAPs

Please proceed with one single SAP document to cover both sites SS003 and SS009.

Thomas Jones, P.G.
Project Manager, AECOM Environment
O 816.502.9420 ext. 4987 C 816.522.6621

-----Original Message-----

From: Simes, Benjamin W CIV NAVFAC MW, EV [<mailto:benjamin.simes@navy.mil>]
Sent: Tuesday, March 19, 2013 8:37 AM
To: Jones, Thomas F (Kansas City)
Subject: RE: KCMO MCRC SAPs

Yes

Benjamin Simes, CHMM
Environmental Scientist
NAVFAC MW IPT EV
201 Decatur Avenue, Building 1A
Great Lakes, IL 60088-2801
F 847-688-6567
P 847-688-2600x 320

-----Original Message-----

From: Jones, Thomas F (Kansas City) [<mailto:Thomas.F.Jones@aecom.com>]
Sent: Tuesday, March 19, 2013 8:35 AM
To: Simes, Benjamin W CIV NAVFAC MW, EV
Subject: FW: KCMO MCRC SAPs

Good morning, Ben. Based on our previous conversations I believe that you wanted to see just one SAP document to cover both SS003 and SS009. We are progressing along to complete the SAP but I wanted to confirm this before we got all the way to end and had to change something. Thank you.

Thomas Jones, P.G.
Project Manager, AECOM Environment
O 816.502.9420 ext. 4987 C 816.522.6621

-----Original Message-----

From: Nielsen, Janice L CIV NAVFAC LANT, EV [<mailto:janice.nielsen@navy.mil>]
Sent: Monday, March 18, 2013 4:57 PM

To: Kromis, Mark; Bowers, Kenneth A CIV NAVFAC LANT, EV
Cc: Jones, Thomas F (Kansas City)
Subject: RE: KCMO MCRC SAPs

Good Afternoon All: I approved the Tier II for both SAPs. This can be either in one document or two depending on the RPMs desires. Jan

Jan Nielsen
EV33 Restoration Engineering
NAVFAC LANT
757.322.8339
757.617.0987 (Mobile)

-----Original Message-----

From: Kromis, Mark [<mailto:Mark.Kromis@aecom.com>]
Sent: Monday, March 18, 2013 11:05
To: Bowers, Kenneth A CIV NAVFAC LANT, EV; Nielsen, Janice L CIV NAVFAC LANT, EV
Cc: Jones, Thomas F (Kansas City)
Subject: RE: KCMO MCRC SAPs

Ken,

Sure did. My apologize, as when I sent the email out 2100 on Friday I had forgotten that Jan would be out of the office until 3/19/13. Both the BRAC and ER sites are in the LUC/LTM phase.

There are two sites at the MCRC that have groundwater contaminated with chlorinated solvents and associated degradation by products.

- Site SS09: this site is a part of the BRAC program and will be the base bid for the task order. The base bid should include two annual events for the LTM/LUC Inspections and the preparation of two Annual Long Term Monitoring Reports. The Contaminants of Concern (CoCs) at the site are PCE, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride.
- Site SS03: this site is part of the ERN program and shall be priced as an option to the Site SS09 base bid. The option should only be for one year. The only CoC at this site is TCE.

Tom,

I know that Jan gave you authorization to use the Tier II format, was that for both the BRAC and the ERN sites? Are the regulators on board to with using the Tier II SAP for both the BRAC and ENR sites?

v/r

Mark

Mark Kromis, CHMM
NAVFAC Atlantic CLEAN, Program Chemist
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Appendix B

Site Specific Field Standard Operating Procedures and Field Forms

Logbooks

Procedure 3-02

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 In order to keep the logbook clean, store it in a clean location and use it only when outer gloves used for PPE have been removed.

3.0 Terms and Definitions

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Data Form

A data form is a predetermined format utilized for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

4.0 Training and Qualifications

- 4.1 The **Contract Task Order (CTO) Manager** or **designee** is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The **CTO Manager** shall review the field logbook on at least a monthly basis. The **CTO Manager** or **designee** is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.
- 4.2 A knowledgeable individual such as the **Field Manager**, **CTO Manager**, or **Program Quality Manager** shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.
- 4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.4 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures and that the logbook is completed properly and daily. The **Field Manager** is also responsible for submitting copies to the **CTO Manager**, who is responsible for filing them and submitting a copy (if required by the CTO Statement of Work).
- 4.5 The **logbook user** is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The **logbook user** is also responsible for safeguarding the logbook while having custody of it.

4.6 All **field personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Field logbooks shall be bound field notebooks with water-repellent pages.

5.2 Pens shall have indelible black ink.

6.0 Procedure

6.1 The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

6.2 Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names of all samples collected in the logbook even if they are recorded elsewhere.

6.3 Enter field descriptions and observations into the logbook, as described in Attachment 1, using indelible black ink.

6.4 Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all on-site activities and entries made in logbooks/forms;
- Site name and description;
- Site location by longitude and latitude, if known;
- Weather conditions, including temperature and relative humidity;
- Fieldwork documentation, including site entry and exit times;
- Descriptions of, and rationale for, approved deviations from the work plan (WP) or field sampling plan;
- Field instrumentation readings;
- Names, job functions, and organizational affiliations of on-site personnel;
- Photograph references;
- Site sketches and diagrams made on site;
- Identification and description of sample morphology, collection locations, and sample numbers;
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers;
- Sample naming convention;
- Field quality control (QC) sample information;
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations;

- Meeting information;
- Important times and dates of telephone conversations, correspondence, or deliverables;
- Field calculations;
- PPE level;
- Calibration records;
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number);
- Equipment decontamination procedures and effectiveness;
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested; and
- User signatures.

6.5 The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

6.6 At least at the end of each day, the person making the entry shall sign or initial each entry or group of entries.

6.7 Enter logbook page numbers on each page to facilitate identification of photocopies.

6.8 If a person's initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

6.9 At least weekly and preferably daily, the **preparer** shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

7.0 Quality Control and Assurance

7.1 Review per Section 4.2 shall be recorded.

8.0 Records, Data Analysis, Calculations

8.1 Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

8.2 Deviations from this procedure shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

9.1 Attachment 1 – Description of Logbook Entries

9.2 Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1

Description of Logbook Entries

Logbook entries shall be consistent with Section A.1.4 *Field Documentation SOPs* of the UFP-QAPP Manual (DoD 2005) and contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as indicated in the field sampling plan.
Weather	Indicate general weather and precipitation conditions.
Level of PPE	Record the level of PPE (e.g., Level D).
Methods	Indicate method or procedure number employed for the activity.
Sample Numbers	Indicate the unique numbers associated with the physical samples. Identify QC samples.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom the samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity.
Narrative (including time and location)	<p>Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself.</p> <p>It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.</p>
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

Recordkeeping, Sample Labeling, and Chain-of-Custody

Procedure 3-03

1.0 Purpose and Scope

- 1.1 The purpose of this standard operating procedure is to establish standard protocols for all field personnel for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

Not applicable.

3.0 Terms and Definitions

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Chain-of-Custody

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

4.0 Training and Qualifications

- 4.1 The **CTO Manager** is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The **CTO Manager** shall review COC forms on a monthly basis at a minimum.
- 4.2 The **CTO Manager** and **Program Quality Manager** are responsible for evaluating project compliance with the Project Procedures Manual.
- 4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.4 The **Laboratory Project Manager** or **Sample Control Department Manager** is responsible for reporting any sample documentation or COC problems to the **CTO Manager** or **CTO Laboratory Coordinator** within 24 hours of sample receipt.
- 4.5 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures. The **CTO Laboratory Coordinator** is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analysis plan. The **CTO Manager** or **CTO Laboratory Coordinator** is responsible for notifying the **laboratory, data managers, and data validators** in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with

the laboratory and must be made in accordance with a respective contract (e.g., CLEAN remedial action contract).

- 4.6 All **field personnel** are responsible for following these procedures while conducting sampling activities. **Field personnel** are responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

5.0 Procedure

This procedure provides standards for documenting field activities, labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

5.1 Recordkeeping

The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events. Field logs such as soil boring logs and ground-water sampling logs will also be used. These procedures are described in Procedure 3-02, *Logbooks*.

5.2 Sample Labeling

Affix a sample label with adhesive backing to each individual sample container. Place clear tape over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, being smeared, and to prevent loss of information on the label. Record the following information with a waterproof marker on each label:

- Project name or number (optional);
- COC sample number;
- Date and time of collection;
- Sampler's initials;
- Matrix (optional);
- Sample preservatives (if applicable); and
- Analysis to be performed on sample (this shall be identified by the method number or name identified in the subcontract with the laboratory).

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

5.3 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Maintain custody of samples in accordance with the U.S. Environmental Protection Agency (EPA) COC guidelines prescribed in EPA *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD)*; *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01); Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*; and *Test Methods for Evaluating Solid Waste* (EPA SW-846)

A description of sample custody procedures is provided below.

5.3.1 Sample Collection Custody Procedures

According to the U.S. EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one's actual physical possession or view;
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal);
- It is retained in a secured area with restricted access; and
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Place custody seals on sample containers immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody. Place custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials; and
- Date and time that the sample/cooler was sealed.

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment 1.

Field personnel shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 7.4, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The **samplers** will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the **person delivering the samples for transport** will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the **sampler** and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, **both parties** shall sign and date the accompanying carbon copy COC forms, and the **individual relinquishing the samples** shall retain a copy of each form. One exception is when the samples are shipped; the **delivery service personnel** will not sign or receive a copy because they do not open the coolers. The **laboratory** shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment 2.

5.3.2 Laboratory Custody Procedures

The following custody procedures are to be followed by an **independent laboratory** receiving samples for chemical analysis; the procedures in their Naval Facilities Engineering Service Center-evaluated Laboratory Quality Assurance Plan must follow these same procedures. A **designated sample custodian** shall take custody of all samples upon their arrival at the analytical laboratory. The **custodian** shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The **custodian** will also measure the temperature of the temperature blank in the coolers upon arrival using either a National Institute for Standards and Technology calibrated thermometer or an infra-red temperature gun. The **custodian** shall note the condition of the samples including:

- If the samples show signs of damage or tampering;
- If the containers are broken or leaking;
- If headspace is present in sample vials;
- If proper preservation of samples has occurred (made by pH measurement, except volatile organic compounds [VOCs] and purgeable total petroleum hydrocarbons [TPH] and temperature). The pH of VOC and purgeable TPH samples will be checked by the **laboratory analyst** after the sample aliquot has been removed from the vial for analysis; and
- If any sample holding times have been exceeded.

All of the above information shall be documented on a sample receipt sheet by the **custodian**.

Discrepancies or improper preservation shall be noted by the **laboratory** as an out-of-control event and shall be documented on an out-of-control form with corrective action taken. The out-of-control form shall be signed and dated by the **sample control custodian** and **any other persons** responsible for corrective action. An example of an out-of-control form is included as Attachment 4.

The **custodian** shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4 degrees Celsius (soil samples for VOC analysis are to be stored in a frozen state until analysis). The unique laboratory number for each sample, COC sample number, client name, date and time received, analysis due date, and storage shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The **custodian** shall sign the shipping bill and maintain a copy.

Laboratory personnel shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

5.4 **Completing COC/Analytical Request Forms**

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment 2 is an example of a generic COC/analytical request form that may be used by **field personnel**. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Attachment 3 is an example of a completed site-specific COC/analytical request form, with box numbers identified and discussed in text below.

COC forms tailored to each CTO can be drafted and printed onto multi-ply forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; TAT; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all VOC analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

Box 2 **Bill To:** List the name and address of the person/company to bill only if it is not in the subcontract with the laboratory.

Box 3 **Sample Disposal Instructions:** These instructions will be stated in the Master Service Agreement or each CTO statement of work with each laboratory.

Shipment Method: State the method of shipment (e.g., hand carry or air courier via FedEx or DHL).

Comments: This area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis (e.g., a specific metals list, samples expected to contain high analyte concentrations).

Box 4 **Cooler No.:** This will be written on the inside or outside of the cooler and shall be included on the COC. Some laboratories attach this number to the trip blank identification, which helps track samples for VOC analysis. If a number is not on the cooler, field personnel shall assign a number, write it on the cooler, and write it on the COC.

QC Level: Enter the reporting quality control (QC) requirements (e.g., Full Data Package, Summary Data Package).

Turnaround time (TAT): TAT will be determined by a sample delivery group (SDG), which may be formed over a 14-day period, not to exceed 20 samples. Once the SDG has been completed, standard TAT is 21 calendar days from receipt of the last sample in the SDG. Entering NORMAL or STANDARD in this field will be acceptable. If quicker TAT is required, it shall be in the subcontract with the laboratory and reiterated on each COC to remind the laboratory.

Box 5 **Type of Containers:** Write the type of container used (e.g., 1-liter glass amber, for a given parameter in that column).

Preservatives: Field personnel must indicate on the COC the correct preservative used for the analysis requested. Indicate the pH of the sample (if tested) in case there are buffering conditions found in the sample matrix.

Box 6 **Sample Identification (ID) Number:** This is typically a five-character alphanumeric identifier used by the contractor to identify samples. The use of this identifier is important since the laboratories are restricted to the number of characters they are able to use. Sample numbering shall be in accordance with the project-specific sampling and analysis plan.

Description (Sample ID): This name will be determined by the location and description of the sample, as described in the project-specific sampling and analysis plan. This sample identification should not be submitted to the laboratory, but should be left blank. If a computer COC version is used, the sample identification can be input, but printed with this block black. A cross-referenced list of the COC Sample Number and sample identification must be maintained separately.

Date Collected: Record the collection date in order to track the holding time of the sample. Note: For trip blanks, record the date it was placed in company with samples.

Time Collected: When collecting samples, record the time the sample is first collected. Use of the 24-hour military clock will avoid a.m. or p.m. designations (e.g., 1815 instead of 6:15 p.m.). Record local time; the laboratory is responsible for calculating holding times to local time.

Lab ID: This is for laboratory use only.

-
- Box 7 **Matrix/QC:** Identify the matrix (e.g., water, soil, air, tissue, fresh water sediment, marine sediment, or product). If a sample is expected to contain high analyte concentrations (e.g., a tank bottom sludge or distinct product layer), notify the laboratory in the comment section. Mark an "X" for the sample(s) that have extra volume for laboratory QC matrix spike/matrix spike duplicate (MS/MSD) purposes. The sample provided for MS/MSD purposes is usually a field duplicate.
- Box 8 **Analytical Parameters:** Enter the parameter by descriptor and the method number desired (e.g., BTEX 8260B, PAHs 8270C, etc.). Whenever practicable, list the parameters as they appear in the laboratory subcontract to maintain consistency and avoid confusion.
- If the COC does not have a specific box for number of sample containers, use the boxes below the analytical parameter, to indicate the number of containers collected for each parameter.
- Box 9 **Sampler's Signature:** The person who collected samples must sign here.
- Relinquished By:** The person who turned over the custody of the samples to a second party other than an express mail carrier, such as FedEx or DHL, must sign and date here.
- Received By:** Typically, a representative of the receiving laboratory signs and dates here. Or, a field crew member who delivered the samples in person from the field to the laboratory might sign here. A courier, such as FedEx or DHL, does not sign here because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are to be sent to a subcontractor.
- Relinquished By:** In the case of subcontracting, the primary laboratory will sign and date the Relinquished By space and fill out an additional COC to accompany the samples being subcontracted.
- Received By (Laboratory):** This space is for the final destination (e.g., at a subcontracted laboratory). A representative of the final destination (e.g., subcontracted laboratory) must sign and date here.
- Box 10 **Lab No. and Questions:** This box is to be filled in by the laboratory only.
- Box 11 **Control Number:** This number is the "COC" followed by the first contractor identification number in that cooler, or contained on that COC. This control number must be unique (i.e., never used twice). Record the date the COC is completed. It should be the same date the samples are collected.
- Box 12 **Total # of Containers:** Sum the number of containers in that row.
- Box 13 **Totals:** Sum the number of containers in each column. Because COC forms contain different formats depending on who produced the form, not all of the information listed in items 1 to 13 may be recorded; however, as much of this information as possible shall be included.
-

6.0 Quality Control and Assurance

- 6.1 Recordkeeping, sample labeling, and chain-of-custody activities must incorporate quality control measures to ensure accuracy and completeness.
- 6.2 Deviations from this procedure or the project-specific CTO work plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

7.0 Records, Data Analysis, Calculations

- 7.1 The COC/analytical request form shall be faxed approximately daily to the **CTO Laboratory Coordinator** for verification of accuracy. Following the completion of sampling activities, the sample

logbook and COC forms will be transmitted to the **CTO Manager** for storage in project files. The **data validators** shall receive a copy also. The original COC/analytical request form shall be submitted by the **laboratory** along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

- 7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in the records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or References

- 8.1 Attachment 1 – Chain-of-Custody Seal
- 8.2 Attachment 2 – Generic Chain-of-Custody/Analytical Request Form
- 8.3 Attachment 3 – Sample Completed Chain-of-Custody
- 8.4 Attachment 4 – Sample Out-of-Control Form
- 8.5 Environmental Protection Agency, United States (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Interim Final. EPA/540/G-89/004. Office of Emergency and Remedial Response. October.
- 8.6 EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.
- 8.7 EPA. 1997. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846. 3rd ed., Final Update IIIA. Office of Solid Waste.
- 8.8 Water Resources Control Board, State of California. 1988. *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*. August.
- 8.9 Procedure 3-02, *Logbooks*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1

Chain-of-Custody Seal

CHAIN-OF-CUSTODY SEAL

<i>[LABORATORY]</i>	SAMPLE NO.	DATE	SEAL BROKEN BY
	SIGNATURE		DATE
	PRINT NAME AND TITLE (<i>Inspector, Analyst or Technician</i>)		

Attachment 2 Generic Chain-of-Custody/Analytical Request Form

M901378

CHAIN OF CUSTODY RECORD												Page ____ of ____	
Client/Project Name:				Project Location:				Analysis Requested					
Project Number:				Field Logbook No.:									
Sampler: (Print Name)/Affiliation:				Chain of Custody Tape No.:									
Signature:				Send Results/Report to:									
Field Sample No./ Identification	Date	Time	Grab	Comp	Sample Container (Size/Mat)	Sample Type (Liquid, Sludge, Etc.)	Preservative	Field Filtered				Lab I.D.	Remarks
Relinquished by: (Print Name)				Date:	Received by: (Print Name)				Date:	Analytical Laboratory (Destination):			
Signature:				Time:	Signature:				Time:				
Relinquished by: (Print Name)				Date:	Received by: (Print Name)				Date:				
Signature:				Time:	Signature:				Time:				
Relinquished by: (Print Name)				Date:	Received by: (Print Name)				Date:				
Signature:				Time:	Signature:				Time:	Serial No.			

Attachment 4 Sample Out-of-Control Form

OUT OF CONTROL FORM	Status	Date	Initial
	Noted OOC		
	Submit for CA*		
	Resubmit for CA*		
	Completed		

Date Recognized:	By:	Samples Affected (List by Accession AND Sample No.)
Dated Occurred:	Matrix	
Parameter (Test Code):	Method:	
Analyst:	Supervisor:	
1. Type of Event (Check all that apply)	2. Corrective Action (CA)* (Check all that apply)	
<input type="checkbox"/> Calibration Corr. Coefficient <0.995	<input type="checkbox"/> Repeat calibration	
<input type="checkbox"/> %RSD>20%	<input type="checkbox"/> Made new standards	
<input type="checkbox"/> Blank >MDL	<input type="checkbox"/> Reran analysis	
<input type="checkbox"/> Does not meet criteria:	<input type="checkbox"/> Sample(s) redigested and rerun	
<input type="checkbox"/> Spike	<input type="checkbox"/> Sample(s) reextracted and rerun	
<input type="checkbox"/> Duplicate	<input type="checkbox"/> Recalculated	
<input type="checkbox"/> LCS	<input type="checkbox"/> Cleaned system	
<input type="checkbox"/> Calibration Verification	<input type="checkbox"/> Ran standard additions	
<input type="checkbox"/> Standard Additions	<input type="checkbox"/> Notified	
<input type="checkbox"/> MS/MSD	<input type="checkbox"/> Other (please explain)	
<input type="checkbox"/> BS/BSD		
<input type="checkbox"/> Surrogate Recovery		
<input type="checkbox"/> Calculations Error		
<input type="checkbox"/> Holding Times Missed		
<input type="checkbox"/> Other (Please explain)	Comments:	

3. Results of Corrective Action	
<input type="checkbox"/>	Return to Control (indicated with)
<input type="checkbox"/>	Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____.

Analyst:	Date:
Supervisor:	Date:
QA Department:	Date:

Sample Handling, Storage, and Shipping

Procedure 3-04

1.0 Purpose and Scope

- 1.1 This standard operating procedure describes the actions to be used by personnel engaged in handling, storing, and transporting samples. The objective is to obtain samples of actual conditions with as little alteration as possible.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 Avoid lifting heavy coolers with back muscles; instead, use leg muscles or dollies.
- 2.2 Wear proper gloves, such as blue nitrile and latex, as defined in the project-specific health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

- 4.1 The **Contract Task Order (CTO) Manager** and the **Laboratory Project Manager** are responsible for identifying instances of non-compliance with this procedure and ensuring that future sample transport activities comply with this procedure.
- 4.2 The **Field Manager** is responsible for ensuring that all samples are shipped according to this procedure.
- 4.3 **Field personnel** are responsible for the implementation of this procedure.
- 4.4 The **Program Quality Manager** is responsible for ensuring that sample handling, storage, and transport activities conducted during all CTOs comply with this procedure.
- 4.5 All **field personnel** are responsible for the implementation of this procedure.

5.0 Procedure

5.1 Handling and Storage

Immediately following collection, label all samples according to Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into self-sealing bags. Place the sample containers in an insulated cooler with frozen gel packs (e.g., "blue ice") or ice in double, sealed self-sealing bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. Place an absorbent material (e.g., proper absorbent cloth material) on the bottom of the cooler to contain liquids in case of spillage. Fill all empty space between sample containers with Styrofoam® "peanuts" or other appropriate material. Prior to shipping, wrap glass sample containers on the sides, tops, and bottoms with bubble wrap or other appropriate padding and/or surround them in Styrofoam to

prevent breakage during transport. Pack all glass containers for water samples in an upright position, never stacked or on their sides. Prior to shipment, replace the ice or cold packs in the coolers so that samples will be maintained as close to 4 degrees Celsius (°C) as possible from the time of collection through transport to the analytical laboratory. Ship samples within 24 hours or on a schedule allowing the laboratory to meet holding times for analyses. The procedures for maintaining sample temperatures at 4°C pertain to all field samples.

5.2 **Shipping**

Follow all appropriate U.S. Department of Transportation regulations (e.g., 49 Code of Federal Regulations [CFR], Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized below.

5.2.1 **Hazardous Materials Shipment**

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assumed hazardous unless enough evidence exists to indicate it is non-hazardous. If not suspected to be hazardous, shipments may be made as described in the Section 5.2.2 for non-hazardous materials. If hazardous, follow the procedures summarized below.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Perform hazardous materials identification by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment 2.

All **persons shipping hazardous materials** must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials (49 CFR HM-126F Subpart H). The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. **Carriers**, such as commercial couriers, must also be trained. Modes of shipment include air, highway, rail, and water.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment 1 shows an example of proper package markings. Refer to a copy of 49 CFR each time hazardous materials/potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172; however, other labeling and packing requirements must still be followed. Attachment 2 shows the volume or weight for different classes of substances. A "Dangerous Goods in Excepted Quantities" label must be completed and attached to the associated shipping cooler (Attachment 3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment 4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid (HNO₃), sulfuric acid (H₂SO₄), and sodium hydroxide (NaOH) added to water samples if their pH or percentage by weight criteria is met. These samples may be shipped as non-hazardous materials as discussed below.

5.2.2 **Non-Hazardous Materials Shipment**

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, place two copies of the chain-of-custody form inside a self-sealing bag and tape it to the inside of the insulated cooler. Then, seal the cooler with waterproof tape and label it with "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Place chain-of-custody seals on the coolers as discussed in Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*.

5.2.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the United States from locations outside the continental United States is controlled by the U.S. Department of Agriculture (USDA) and is subject to their inspection and regulation. A "USDA Soil Import Permit" is required to prove that the receiving analytical laboratory is certified by the USDA to receive and properly dispose of soil. In addition, all sample coolers must be inspected by a **USDA representative**, affixed with a label indicating that the coolers contain environmental samples, and accompanied by shipping forms stamped by the **USDA inspector** prior to shipment.

In addition, the U.S. Customs Service must clear samples shipped from U.S. territorial possessions or foreign countries upon entry into the United States. As long as the commercial invoice is properly completed (see below), shipments typically pass through U.S. Customs Service without the need to open coolers for inspection.

Completion and use of proper paperwork will, in most cases, minimize or eliminate the need for the USDA and U.S. Customs Service to inspect the contents. Attachment 5 shows an example of how paperwork may be placed on the outside of coolers for non-hazardous materials. For hazardous materials, refer to Section 5.2.1.

In summary, tape the paperwork listed below to the outside of the coolers to accompany sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need only be attached to one cooler, provided that the **courier** agrees. All other coolers in the shipment need only to be taped and have the address and chain-of-custody seals affixed.

1. **Courier Shipping Form & Commercial Invoice:** See Attachment 6 and Attachment 7 for examples of the information to be included on the commercial invoices for soil and water, respectively. Place the courier shipping form and commercial invoice inside a clear, plastic, adhesive-backed pouch that adheres to the package (typically supplied by the courier) and place it on the cooler lid as shown in Attachment 5.
2. **Soil Import Permit (soil only):** See Attachment 8 and Attachment 9 for examples of the soil import permit and soil samples restricted entry labels, respectively. The **laboratory** shall supply these documents prior to mobilization. The USDA often stops shipments of soil without these documents. Staple together the 2-inch × 2-inch USDA label (described below) and soil import permit, and place them inside a clear plastic pouch. The **courier** typically supplies the clear, plastic, adhesive-backed pouches that adhere to the package.

Placing one restricted entry label as shown in Attachment 5 (covered with clear packing tape) and one stapled to the actual permit is suggested.

The USDA does not control water samples, so the requirements for soil listed above do not apply.

3. **Chain-of-Custody Seals:** The **laboratory** should supply the seals. **CTO personnel** must sign and date these. At least two seals should be placed in such a manner that they stick to both the cooler lid and body. Placing the seals over the tape (as shown in Attachment 5), then covering it with clear packing tape is suggested. This prevents the seal from coming loose and enables detection of tampering.
4. **Address Label:** Affix a label stating the destination (laboratory address) to each cooler.
5. **Special Requirements for Hazardous Materials:** See Section 5.2.1.

Upon receipt of sample coolers at the laboratory, the **sample custodian** shall inspect the sample containers as discussed in Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

6.0 Quality Control and Assurance

- 6.1 Sample handling, storage, and shipping must incorporate quality control measures to ensure conformance to these and the project requirements.

7.0 Records, Data Analysis, Calculations

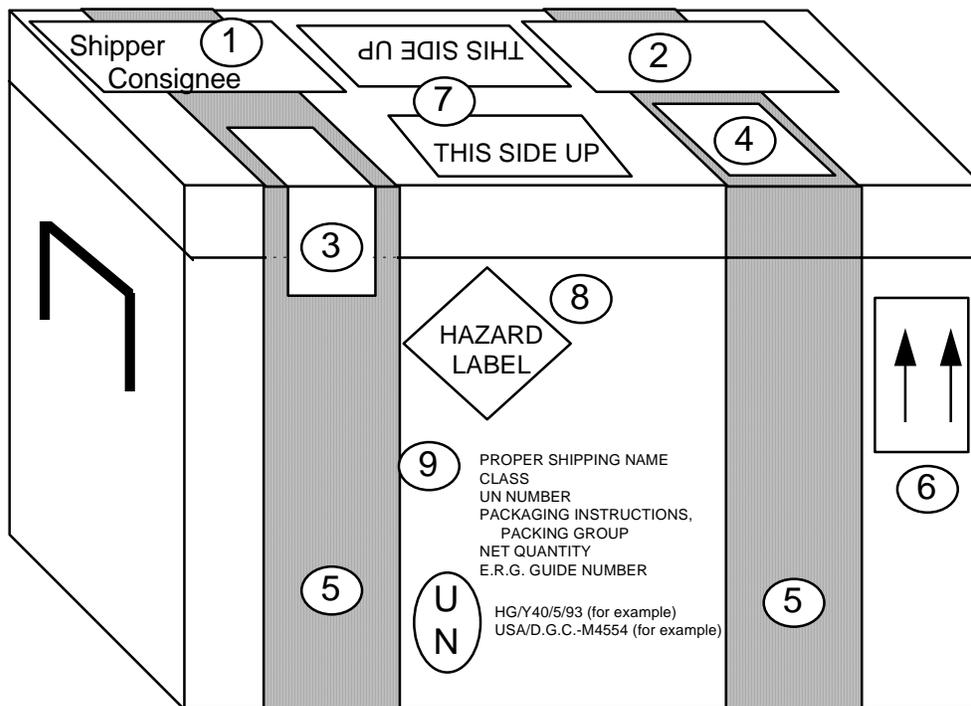
- 7.1 Maintain records as required by implementing these procedures.
- 7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or Reference

- 8.1 Attachment 1 – Example Hazardous Material Package Marking
- 8.2 Attachment 2 – Packing Groups
- 8.3 Attachment 3 – Label for Dangerous Goods in Excepted Quantities
- 8.4 Attachment 4 – SW-846 Preservative Exception
- 8.5 Attachment 5 – Non-Hazardous Material Cooler Marking Figure for Shipment from Outside the Continental United States
- 8.6 Attachment 6 – Commercial Invoice – Soil
- 8.7 Attachment 7 – Commercial Invoice – Water
- 8.8 Attachment 8 – Soil Import Permit
- 8.9 Attachment 9 – Soil Samples Restricted Entry Labels
- 8.10 NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.
- 8.11 Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1 Example Hazardous Material Package Marking



- | | |
|--|---|
| ① AIR BILL/COMMERCIAL INVOICE | ⑥ DIRECTION ARROWS STICKER - TWO REQUIRED |
| ② USDA PERMIT (Letter to Laboratory from USDA) | ⑦ THIS SIDE UP STICKERS |
| ③ CUSTODY SEAL | ⑧ HAZARD LABEL |
| ④ USDA 2" X 2" SOIL IMPORT PERMIT | ⑨ HAZARDOUS MATERIAL INFORMATION |
| ⑤ WATERPROOF STRAPPING TAPE | ⑩ PACKAGE SPECIFICATIONS |

Attachment 2 Packing Groups

PACKING GROUP OF THE SUBSTANCE	PACKING GROUP I		PACKING GROUP II		PACKING GROUP III	
CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK	Packagings		Packagings		Packagings	
	Inner	Outer	Inner	Outer	Inner	Outer
1: Explosives	----- Forbidden ^(Note A) -----					
2.1: Flammable Gas	----- Forbidden ^(Note B) -----					
2.2: Non-Flammable, non-toxic gas	----- See Notes A and B -----					
2.3: Toxic gas	----- Forbidden ^(Note A) -----					
3. Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1 Self-reactive substances	Forbidden		Forbidden		Forbidden	
4.1: Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2: Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2 Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3: Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1: Oxidizers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2: Organic peroxides ^(Note C)	See Note A		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1: Poisons - Inhalation toxicity	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - oral toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - dermal toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2: Infectious substances	----- Forbidden ^(Note A) -----					
7: Radioactive material ^(Note D)	----- Forbidden ^(Note A) -----					
8: Corrosive materials	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9: Magnetized materials	----- Forbidden ^(Note A) -----					
9: Other miscellaneous materials ^(Note E)	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

Note A: Packing groups are not used for this class or division.

Note B: For inner packagings, the quantity contained in receptacle with a water capacity of 30 mL. For outer packagings, the sum of the water capacities of all the inner packagings contained must not exceed 1 L.

Note C: Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.

Note D: See 6.1.4.1, 6.1.4.2, and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.

Note E: For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.

Attachment 3 Dangerous Goods in Excepted Quantities

DANGEROUS GOODS IN EXCEPTED QUANTITIES							
This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.							

Signature of Shipper							
_____				_____			
Title				Date			

Name and address of Shipper							
This package contains substance(s) in Class(es) (check applicable box(es))							
Class:	2	3	4	5	6	8	9
	<input type="checkbox"/>						
and the applicable UN Numbers are:							

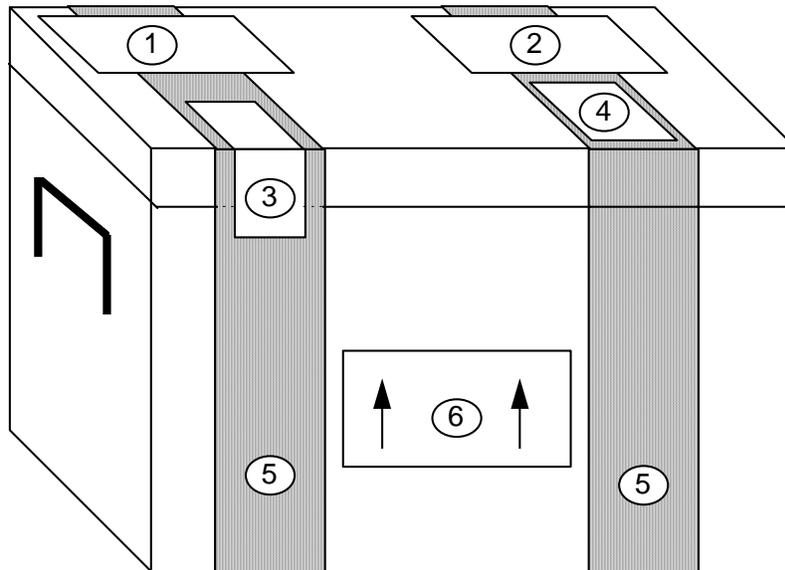
Attachment 4

SW-846 Preservative Exception

Measurement	Vol. Req. (mL)	Container ²	Preservative ^{3,4}	Holding Time ⁵
MBAS	250	P, G	Cool, 4°C	48 Hours
NTA	50	P, G	Cool, 4°C	24 Hours

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.
 2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
 3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
4. When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.
 6. Should only be used in the presence of residual chlorine.

Attachment 5 Non-Hazardous Material Cooler Marking Figure for Shipment from Outside the Continental United States



- ① AIR BILL/COMMERCIAL INVOICE
- ② USDA PERMIT (Letter to Laboratory from USDA)
- ③ CUSTODY SEAL
- ④ USDA 2" X 2" SOIL IMPORT PERMIT
- ⑤ WATERPROOF STRAPPING TAPE
- ⑥ DIRECTION ARROWS STICKER - TWO REQUIRED

Attachment 6 Commercial Invoice – Soil

DATE OF EXPORTATION <i>1/1/94</i>				EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CJO #>				
SHIPPER/EXPORTER (complete name and address) <i>Joe Smith Ogden c/o <hotel name> <hotel address></i>				CONSIGNEE <i>Sample Receipt <Lab Name> <Lab Address></i>				
COUNTRY OF EXPORT <i>Guam, USA</i>				IMPORTER - IF OTHER THAN CONSIGNEE				
COUNTRY OF ORIGIN OF GOODS <i>Guam, USA</i>								
COUNTRY OF ULTIMATE DESTINATION <i>USA</i>								
INTERNATIONAL AIR WAYBILL NO.				<div style="border: 1px solid black; width: 200px; height: 20px; margin: 0 auto;"></div> (NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)				
MARKS/NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	<i>3</i>	<i>coolers</i>	<i>Soil samples for laboratory analysis only</i>				<i>\$1.00</i>	<i>\$3.00</i>
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	<i>3</i>							<i>\$3.00</i>
Check one <input type="checkbox"/> F.O.B. <input type="checkbox"/> C&F <input type="checkbox"/> C.I.F.								

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden

Joe Smith

1/1/94

Name/Title

Signature

Date

Attachment 7 Commercial Invoice – Water

DATE OF EXPORTATION <i>1/1/94</i>				EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CJO #>				
SHIPPER/EXPORTER (complete name and address) <i>Joe Smith Ogden c/o <hotel name> <hotel address></i>				CONSIGNEE <i>Sample Receipt <Lab Name> <Lab Address></i>				
COUNTRY OF EXPORT <i>Guam, USA</i>				IMPORTER - IF OTHER THAN CONSIGNEE				
COUNTRY OF ORIGIN OF GOODS <i>Guam, USA</i>								
COUNTRY OF ULTIMATE DESTINATION <i>USA</i>								
INTERNATIONAL AIR WAYBILL NO.					(NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)			
MARKS/NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	<i>3</i>	<i>coolers</i>	<i>Water samples for laboratory analysis only</i>				<i>\$1.00</i>	<i>\$3.00</i>
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	<i>3</i>							<i>\$3.00</i>
Check one <input type="checkbox"/> F.O.B. <input type="checkbox"/> C&F <input type="checkbox"/> C.I.F.								

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden

Joe Smith

1/1/94

Attachment 8 Soil Import Permit



**UNITED STATES
DEPARTMENT OF
AGRICULTURE**

Animal and Plant
Health Inspection
Service

Plant Protection and
Quarantine

Soil Permit

Columbia Analytical Services
(Lee Wolf)
1317 S. 13th Avenue
Kelso, Washington 98626
TELEPHONE: (360) 577-7222

Issued To:

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a compliance agreement (PPQ Form 519) has been completed and signed. Compliance Agreements and Soil permits are non-transferable. If you hold a Soil Permit and you leave your present employer or company, you must notify your local USDA office promptly.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry.
4. To be used only for analysis and only in the facility of the permittee at Columbia Analytical Services, located in Kelso, Washington.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by Plant Protection and Quarantine.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

Permit Number: S-52239

Expiration Date: JUNE 30, 2006

Deborah M. Knott
Approving Official DEBORAH M. KNOTT

WARNING: Any alteration, forgery, or unauthorized use of this Federal form is subject to civil penalties of up to \$250,000 (7 U.S.C. s 7754(b)) or punishable by a fine of not more than \$10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s 1001).

PPQ FORM 525B (8/94)

Pt. 1 - PERMITTEE

Attachment 9

Soil Samples Restricted Entry Labels

<hr/> <p>U.S. DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE PLANT PROTECTION AND QUARANTINE HYATTSVILLE, MARYLAND 20782</p> <p>SOIL SAMPLES RESTRICTED ENTRY</p> <hr/> <p>The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.</p> <hr/> <p>For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.</p> <hr/> <p>PPQ FORM 550 <i>Edition of 12/77 may be used</i> (JAN 83)</p>

Investigation Derived Waste Management

Procedure 3-05

1.0 Purpose and Scope

This standard operating procedure (SOP) describes activities and responsibilities of the United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command, Atlantic (NAVFAC Atlantic) with regard to management of investigation-derived waste (IDW). The purpose of this procedure is to provide guidance for the minimization, handling, labelling, temporary storage, inventory, classification, and disposal of IDW generated under the ER Program. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of removal or remedial actions. The information presented will be used to prepare and implement work plans (WPs) for IDW-related field activities. The results from implementation of WPs will then be used to develop and implement final IDW disposal plans.

If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to IDW then those procedures may be added as an appendix to the project specific SAP.

This procedure applies to all Navy ER projects performed in the NAVFAC Atlantic Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager or Technical Director, and documented.

This procedure was developed to serve as management-approved professional guidance for the management of IDW generated under the ER Program. It focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure.

2.0 Safety

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the CTO WP and/or direction from the **Site Safety Officer (SSO)**.

All **Field Personnel** responsible for IDW management must adhere to the HASP and must wear the PPE specified in the site-specific HASP. Generally, this includes, at a minimum, steel-toed boots or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). If safe alternatives are not achievable, discontinue site activities immediately.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

- 4.1 The **CTO Manager** is responsible for ensuring that IDW management activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks.
- 4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.3 The **Field Manager** is responsible for ensuring that all IDW is managed according to this procedure.
- 4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

The equipment and supplies required for implementation of this SOP include the following:

- Containers for waste (e.g., [U.S. Department of Transportation] DOT approved 55-gallon open and closed top drums) and material to cover waste to protect from weather (e.g., plastic covering);
- Hazardous /non-hazardous waste drum labels (weatherproof);
- Permanent marking pens;
- Inventory forms for project file;
- Plastic garbage bags, zip lock storage bags, roll of plastic sheeting; and
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the HASP.

6.0 Procedure

The following procedures are used to handle the IDW.

6.1 Drum Handling

- 6.1.1 IDW shall be containerized using DOT approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., United Nations Code 1A2 or 1H2). Typically 55-gallon drums are used, however small drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums.
- 6.1.2 Recycled drums should not be used for hazardous waste, PCBs or other regulated shipments. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system versus longer-term drum storage.
- 6.1.3 For long-term IDW storage at other project locations, the DOT approved drums with removable lids are recommended. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids.
- 6.1.4 If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.
- 6.1.5 To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum, and segregate the paper towel or rag used to remove the material with visibly soiled PPE and

disposable sampling equipment. Label all IDW drums and place them on pallets prior to storage.

6.2 Labelling

- 6.2.1 Containers used to store IDW must be properly labelled. Two general conditions exist: 1) from previous studies or on-site data, waste characteristics are known to be either hazardous or nonhazardous; or 2) waste characteristics are unknown until additional data are obtained.
- 6.2.2 For situations where the waste characteristics are known, the waste containers should be packaged and labelled in accordance with state regulations and any federal regulations that may govern the labelling of waste.
- 6.2.3 The following information shall be placed on all non-hazardous waste labels:
- Description of waste (i.e., purge water, soil cuttings);
 - Contact information (i.e., contact name and telephone number);
 - Date when the waste was first accumulated.
- 6.2.4 The following information shall be placed on all hazardous waste labels:
- Description of waste (i.e., purge water, soil cuttings);
 - Generator information (i.e., name, address, contact telephone number);
 - EPA identification number (supplied by on-site client representative);
 - Date when the waste was first accumulated.
- 6.2.5 When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words "waste characterization pending analysis" and the following information included on the label:
- Description of waste (i.e., purge water, soil cuttings);
 - Contact information (i.e., contact name and telephone number);
 - Date when the waste was first accumulated.
- 6.2.6 Once the waste has been characterized, the label should be changed as appropriate for a nonhazardous or hazardous waste.
- 6.2.7 Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it also may be helpful to include labels on the top of the containers to facilitate organization and disposal.
- 6.2.8 Each container of waste generated shall be recorded in the field notebook used by the person responsible for labelling the waste. After the waste is disposed of, either by transportation off-site or disposal on-site in an approved disposal area, an appropriate record shall be made in the same field notebook to document proper disposition of IDW.

6.3 **Types of Site Investigation Waste**

Several types of waste are generated during site investigations that may require special handling. These include solid, liquid, and used PPE, as discussed further below.

Solid Waste

Soil cuttings from boreholes will typically be placed in containers unless site specific requirements allow for soil cuttings to be placed back into the borehole after drilling is complete. Drilling mud generated during investigation activities shall be collected in containers. Covers should be included on the containers and must be secured at all times and only open during filling activities. The containers shall be labelled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged on prescribed forms and kept in the project file.

Non-hazardous solid waste can be disposed on-site in the designated site landfill or in a designated evaporation pond if it is liquefied. Hazardous wastes must be disposed off-site at an approved hazardous waste landfill.

Liquid Waste

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labelled in accordance with this SOP. Non-hazardous liquid waste can be disposed of in one of the designated lined evaporation ponds on-site. Hazardous wastes must be handled separately and disposed off-site at an approved hazardous waste facility.

Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. If not, all PPE should be disposed as non-hazardous waste in the designated on-site landfill. Trash that is generated as part of field activities may be disposed of in the landfill as long as the trash was not exposed to hazardous media.

6.4 **Waste Accumulation On-Site**

6.4.1 Solid, liquid, or PPE waste generated during investigation activities that are classified as nonhazardous or "characterization pending analysis" should be disposed of as soon as possible. Until disposal, such containers should be inventoried, stored as securely as possible, and inspected regularly, as a general good practice.

6.4.2 Solid, liquid, or PPE waste generated during investigation activities that are classified as hazardous shall not be accumulated on-site longer than 90 days. All hazardous waste containers shall be stored in a secured storage area. The following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labelling of waste;
- Secondary containment to contain spills;
- Spill containment equipment must be available;
- Fire extinguisher;
- Adequate aisle space for unobstructed movement of personnel.

- 6.4.3 Weekly storage area inspections shall be performed and documented to ensure compliance with these requirements. Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated.

6.5 Waste Disposal

- 6.5.1 Solid, liquid, and PPE waste will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.
- 6.5.2 All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. All wastes classified as hazardous will be disposed of at a licensed treatment storage and disposal facility or managed in other approved manners.
- 6.5.3 In general, waste disposal should be carefully coordinated with the facility receiving the waste. Facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements.

6.6 Regulatory Requirements

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- Code of Federal Regulations (CFR), Title 40, Part 261;
- CFR, Title 49, Parts 172, 173, 178, and 179.

6.7 Waste Transport

A state-certified hazardous waste hauler shall transport all wastes classified as hazardous. Typically, the facility receiving any waste can coordinate a hauler to transport the waste. Shipped hazardous waste shall be disposed of in accordance with all RCRA/USEPA requirements. All waste manifests or bills of lading will be signed either by the client or the client's designee.

7.0 Quality Control and Assurance

- 7.1 Management of IDW must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

- 8.1 Maintain records as required by implanting the procedures in this SOP.
- 8.2 Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

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1997a. *Sending Wastes Off Site? OSC and RPM Responsibilities under the Off-Site Rule*. EPA/540-F-97-006, Office of Solid Waste and Emergency Response. September.

1997b. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*. 3rd ed., Final Update IIIA. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

1998. *Management of Remediation Waste under RCRA*. EPA/530-F-98-026. Office of Solid Waste and Emergency Response. October.

(No Date). *Compliance with the Off-Site Rule During Removal Actions*. Office of Regional Counsel (Region 3). Hendershot, Michael.

NAVFAC NW Standard Operating Procedure Number I-D-1, *Drum Sampling*.

NAVFAC NW Standard Operating Procedure Number I-F, *Equipment Decontamination*.

NAVFAC NW Standard Operating Procedure Number III-D, *Logbooks*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Equipment Decontamination

Procedure 3-06

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes methods of equipment decontamination, to be used for activities where samples for chemical analysis are collected or where equipment will need to be cleaned before leaving the site or before use in subsequent activities.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

It is the responsibility of the **Site Safety Officer (SSO)** to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally the decontamination area is located within the transition zone, upwind of intrusive activities, and serves as the washing area for both personnel and equipment to minimize the spread of contamination into the clean zone. Typically, for equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing cleaning solvents as described in this procedure or the Contract Task Order (CTO) Work Plan (WP) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

All **Field Personnel** responsible for equipment decontamination must adhere to the site-specific health and safety plan (HSP) and must wear the personal protective equipment (PPE) specified in the site-specific HSP. Generally this includes, at a minimum, Tyvek® coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). Air monitoring by the **SSO** may result in an upgrade to the use of respirators and cartridges in the decontamination area; therefore, this equipment must be available on site. If safe alternatives are not achievable, discontinue site activities immediately.

In addition to the aforementioned precautions, the following sections describe safe work practices that will be employed.

2.1 Chemical Hazards associated with Equipment Decontamination

- Avoid skin contact with and/or incidental ingestion of decontamination solutions and water.
- Utilize PPE as specified in the site-specific HSP to maximize splash protection.
- Refer to material safety data sheets, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE including skin and respiratory).
- Take the necessary precautions when handling detergents and reagents.

2.2 Physical Hazards associated with Equipment Decontamination

- To avoid possible back strain, it is recommended to raise the decontamination area 1 to 2 feet above ground level.
- To avoid heat stress, over exertion, and exhaustion, it is recommended to rotate equipment decontamination among all site personnel.

- Take necessary precautions when handling field sampling equipment.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

- 4.1 The **CTO Manager** is responsible for ensuring that decontamination activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.
- 4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.
- 4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedure

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample groundwater, surface water, sediment, waste, wipe, asbestos, and unsaturated zone, is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- Location where the decontamination procedures will be conducted
- Types of equipment requiring decontamination
- Frequency of equipment decontamination
- Cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- Method for containing the residual contaminants and wash water from the decontamination process
- Use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsections describe standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 Decontamination Area

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

5.2 Types of Equipment

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels,

hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

5.3 **Frequency of Equipment Decontamination**

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Down-hole drilling equipment, however, may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, decontaminate the drilling tools prior to drilling deeper. Initiate groundwater sampling by sampling groundwater from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 **Cleaning Solutions and Techniques**

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment and rinse it with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution; (2) rinse with potable water; (3) spray with laboratory-grade isopropyl alcohol; (4) rinse with deionized or distilled water; and (5) spray with deionized or distilled water. If possible, disassemble equipment prior to cleaning. Add a second wash at the beginning of the process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. This recirculation may be done using a relatively long (typically 4 feet) large-diameter pipe (4-inch or greater) equipped with a bottom cap. Fill the pipe with the decontamination fluids, place the pump within the capped pipe, and operate the pump while recirculating the fluids back into the pipe. The decontamination sequence shall include: (1) detergent and potable water; (2) potable water rinse; (3) potable water rinse; and (4) deionized water rinse. Change the decontamination fluids after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent; however, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals. Decontamination solvents to be used during field activities will be specified in the CTO WP.

Rinse equipment used for measuring field parameters, such as pH (indicates the hydrogen ion concentration – acidity or basicity), temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh

detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 **Containment of Residual Contaminants and Cleaning Solutions**

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate items, such as auger flights, which can be placed on metal stands or other similar equipment, on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Store clean equipment in a separate location to prevent recontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers as described below.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them on site in secured containers, such as U.S. Department of Transportation-approved drums, until their disposition is determined by laboratory analytical results. Label containers in accordance with Procedure 3-05, *IDW Management*.

6.0 **Quality Control and Assurance**

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. These quality control measures provide "after-the-fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

7.0 **Records, Data Analysis, Calculations**

Any project where sampling and analysis is performed shall be executed in accordance with an approved sampling and analysis plan. This procedure may be incorporated by reference or may be incorporated with modifications described in the plan.

Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 **Attachments or References**

- 8.1 ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites*. ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.
- 8.2 NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.
- 8.3 Procedure 3-05, *IDW Management*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Monitoring Well Sampling

Procedure 3-14

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes the actions to be used during monitoring well sampling activities and establishes the method for sampling groundwater monitoring wells for water-borne contaminants and general groundwater chemistry. The objective is to obtain groundwater samples that are representative of aquifer conditions with as little alteration to water chemistry as possible.
- 1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).
- 1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. All field sampling personnel responsible for sampling activities must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the well sampling tasks. Conduct preliminary area monitoring of sampling wells to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor phase and liquid matrix through the use of appropriate personal protective equipment (PPE).
- 2.2 Observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves and rubberized steel-toed boots. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations. Refer to the project-specific HASP for the required PPE.
- 2.3 Physical Hazards associated with Well Sampling
 - To avoid lifting injuries associated with pump and bailers retrieval, use the large muscles of the legs, not the back.
 - Stay clear of all moving equipment, and avoid wearing loose fitting clothing.
 - When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
 - To avoid slip/trip/fall conditions as a result of pump discharge, use textured boots/boot cover bottoms.
 - To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
 - Be aware of restricted mobility due to PPE.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Potential interferences could result from cross-contamination between samples or sample locations. Minimization of the cross-contamination will occur through the following:

- The use of clean sampling tools at each location as necessary.
- Avoidance of material that is not representative of the media to be sampled.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that monitoring well sampling activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all field sampling personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Manager** is responsible for ensuring that all field sampling personnel follow these procedures.

5.2.4 **Field sampling personnel** are responsible for the implementation of this procedure.

5.2.5 The field sampler and/or task manager is responsible for directly supervising the groundwater sampling procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

6.0 Equipment and Supplies

6.1 Purging and Sampling Equipment

- Pump (Peristaltic, Portable Bladder, Submersible)
- Polyethylene or Teflon bladders (for portable bladder pumps)
- Bladder pump controller (for portable bladder pumps)
- Air compressor (for portable bladder pumps)
- Nitrogen cylinders (for portable bladder pumps)
- 12-volt power source
- Polyethylene inlet and discharge tubing (except for VOC analysis which requires Teflon tubing)
- Silicone tubing appropriate for peristaltic pump head
- Teflon bailer appropriately sized for well

- Disposable bailer string (polypropylene)
- Individual or multi-parameter water quality meter(s) with flow-through cell to measure temperature, pH, specific conductance, dissolved oxygen (DO), oxidation reduction potential (ORP), and/or turbidity
- Turbidity meter
- Water level meter
- Oil/water interface probe

6.2 General Equipment

- Sample kit (i.e., bottles, labels, preservatives, custody records and tape, cooler, ice)
- Sample Chain-of-Custody (COC) forms
- Sample Collection Records
- Sample packaging and shipping supplies
- Waterproof marker or paint
- Distilled/deionized water supply
- Water dispenser bottles
- Flow measurement cup or bucket
- 5-gallon buckets
- Instrument calibration solutions
- Stopwatch or watch
- Disposable Nitrile gloves
- Paper towels
- Trash bags
- Zipper-lock bags
- Equipment decontamination supplies
- Health and safety supplies (as required by the HASP)
- Approved plans such as: project-specific HASP and Sampling and Analysis Plan (SAP)
- Well keys or combinations
- Monitoring well location map(s)
- Field project logbook/pen

7.0 Calibration or Standardization

- 7.1 Field instruments will be calibrated daily according to the requirements of the SAP and manufacturer's specifications for each piece of equipment. Equipment will be checked daily with the calibration solutions at the end of use of the equipment. Calibration records shall be recorded in the field logbook or appropriate field form.
- 7.2 If readings are suspected to be inaccurate, the equipment shall be checked with the calibration solutions and/or re-calibrated.

8.0 Procedure

8.1 Preparation

8.1.1 Site Background Information

Establish a thorough understanding of the purposes of the sampling event prior to field activities. Conduct a review of all available data obtained from the site and pertinent to the water sampling. Review well history data including, but not limited to, well locations, sampling history, purging rates, turbidity problems, previously used purging methods, well installation methods, well completion records, well development methods, previous analytical results, presence of an immiscible phase, historical water levels, and general hydrogeologic conditions.

Previous groundwater development and sampling logs give a good indication of well purging rates and the types of problems that might be encountered during sampling, such as excessive turbidity and low well yield. They may also indicate where dedicated pumps are placed in the water column. To help minimize the potential for cross-contamination, well purging and sampling and water level measurement collection shall proceed from the least contaminated to the most contaminated well as indicated by previous analytical results. This order may be changed in the field if conditions warrant it, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

8.1.2 Groundwater Analysis Selection

Establish the requisite field and laboratory analyses prior to water sampling. Decide on the types and numbers of quality assurance/quality control (QA/QC) samples to be collected (refer to the project-specific SAP), as well as the type and volume of sample preservatives, the type and number of sample containers, the number of coolers required, and the quantity of ice or other chilling materials. The field sampling personnel shall ensure that the appropriate number and size sample containers are brought to the site, including extras in case of breakage or unexpected field conditions. Refer to the project-specific SAP for the project analytical requirements.

8.2 Groundwater Sampling Procedures

Groundwater sampling procedures at a site shall include:

- 1) An evaluation of the well security and condition prior to sampling;
- 2) Decontamination of equipment;
- 3) Measurement of well depth to groundwater;
- 4) Assessment of the presence or absence of an immiscible phase;
- 5) Assessment of purge parameter stabilization;
- 6) Purging of static water within the well and well bore; and
- 7) Obtaining a groundwater sample.

Each step is discussed in sequence below. Depending upon specific field conditions, additional steps may be necessary. As a rule, at least 24 hours should separate well development and well sampling events. In all cases, consult the State and local regulations for the site, which may require more stringent time separation between well development and sampling.

8.2.1 Well Security and Condition

At each monitoring well location, observe the conditions of the well and surrounding area. The following information may be noted on a Groundwater Sample Collection Record (Attachment 1) or in the field logbook:

- Condition of the well's identification marker.
- Condition of the well lock and associated locking cap.
- Integrity of the well – well pad condition, protective outer casing, obstructions or kinks in the well casing, presence of water in the annular space, and the top of the interior casing.
- Condition of the general area surrounding the well.

8.2.2 Decontamination of Equipment

Where possible, dedicated supplies should be used at each well location to minimize the potential for cross-contamination and minimize the amount of investigation derived waste (IDW) fluids resulting from the decontamination process. If decontamination is necessary, establish a decontamination station before beginning sampling. The station shall consist of an area of at least 4 feet by 2 feet covered with plastic sheeting and be located upwind of the well being sampled. The station shall be large enough to fit the appropriate number of wash and rinse buckets, and have sufficient room to place equipment after decontamination. One central cleaning area may be used throughout the entire sampling event. The area around the well being sampled shall also be covered with plastic sheeting to prevent spillage. Further details are presented in SOP 3-06, Equipment Decontamination.

Decontaminate each piece of equipment prior to entering the well. Also, conduct decontamination prior to sampling at a site, even if the equipment has been decontaminated subsequent to its last usage. Additionally, decontaminate each piece of equipment used at the site prior to leaving the site. It is only necessary to decontaminate dedicated sampling equipment prior to installation within the well. Do not place clean sampling equipment directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment that has been certified by the manufacturer as being decontaminated can be placed in the well without on-site decontamination.

8.2.3 Measurement of Static Water Level Elevation

Before purging the well, measure water levels in all of the wells within the zone of influence of the well being purged. The best practice, if possible, is to measure all site wells (or wells within the monitoring well network) prior to sampling. If the well cap is not vented, remove the cap several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

Measure the depth to standing water and the total depth of the well to the nearest 0.01 foot to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). If not already present, mark an easily identified reference point for water level measurements which will become the measuring point for all water level measurements. This location and elevation must be surveyed.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate in order to obtain a measurement to the nearest 0.01 foot reliably. An electronic water level meter will usually be appropriate for this measurement; however, when the groundwater within a particular well is highly contaminated, an inexpensive weighted tape measure can be used to determine well depth to prevent adsorption of contaminants onto the meter tape. The presence of light, non-aqueous phase liquids (LNAPLs) and/or dense, non-aqueous phase liquids (DNAPLs) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.

At each location, measure water levels several times in quick succession to ensure that the well has equilibrated to atmospheric conditions prior to recording the measurement. As stated above, measure all site wells (or wells within the monitoring well network) prior to sampling whenever possible. This will provide a water level database that describes water levels across the site at one time (a synoptic sampling). Prior to sampling, measure the water level in each well immediately prior to purging the well to ascertain that static conditions have been achieved prior to sampling.

8.2.4 Detection of Immiscible Phase Layers

Complete the following steps for detecting the presence of LNAPL and DNAPL before the well is purged for conventional sampling. These procedures may not be required for all wells. Consult the project-specific SAP to determine if assessing the presence of LNAPL and/or DNAPL is necessary.

- 1) Sample the headspace in the wellhead immediately after the well is opened for organic vapors using either a PID or an organic vapor analyzer, and record the measurements.
- 2) Lower an interface probe into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record the measurements.
- 3) Confirm the presence or absence of an immiscible phase by slowly lowering a clear bailer to the appropriate depth, then visually observing the results after sample recovery.
- 4) In rare instances, such as when very viscous product is present, it may be necessary to utilize hydrocarbon- and water-sensitive pastes for measurement of LNAPL thickness. This is accomplished by smearing adjacent, thin layers of both hydrocarbon- and water-sensitive pastes along a steel measuring tape and inserting the tape into the well. An engineering tape showing tenths and hundredths of feet is required. Record depth to water, as shown by the mark on the water-sensitive paste, and depth to product, as shown by the mark on the product-sensitive paste. In wells where the approximate depth to water and product thickness are not known, it is best to apply both pastes to the tape over a fairly long interval (5 feet or more). Under these conditions, measurements are obtained by trial and error and may require several insertions and retrievals of the tape before the paste-covered interval of the tape encounters product and water. In wells where approximate depths of air-product and product-water interfaces are known, pastes may be applied over shorter intervals. Water depth measurements should not be used in preparation of water table contour maps until they are corrected for depression by the product.
- 5) If the well contains an immiscible phase, it may be desirable to sample this phase separately. Section 8.2.6 presents immiscible phase sampling procedures. It may not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPLs or DNAPLs. Consult the **CTO Manager** and **Program Quality Manager** if this situation is encountered.

8.2.5 Purging Equipment and Use

General Requirements

The water present in a well prior to sampling may not be representative of in situ groundwater quality and shall be removed prior to sampling. Handle all groundwater removed from potentially contaminated wells in accordance with the IDW handling procedures in SOP 3-05, IDW Management. Purging shall be accomplished by methods as indicated in the project-specific SAP or by those required by State requirements. For the purposes of this SOP, purging methods will be described by removing groundwater from the well using low-flow techniques.

According to the U.S. Environmental Protection Agency (EPA) (EPA, 1996), the rate at which groundwater is removed from the well during purging ideally should be less than 0.2 to 0.3 liters/minute. EPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated

corrosion or reaction products in the well. EPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

Realistically, the purge rate should be low enough that substantial drawdown in the well does not occur during purging. In addition, a low purge rate will reduce the possibility of stripping volatile organic compounds (VOCs) from the water, and will reduce the likelihood of increasing the turbidity of the sample due to mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The field sampler shall ensure that purging does not cause formation water to cascade down the sides of the well screen. Wells should not be purged to dryness if recharge causes the formation water to cascade down the sides of the screen, as this will cause an accelerated loss of volatiles. This problem should be anticipated based on the results of either the well development task or historical sampling events. In general, place the intake of the purge pump in the middle of the saturated screened interval within the well to allow purging and at the same time minimize disturbance/overdevelopment of the screened interval in the well. Water shall be purged from the well at a rate that does not cause recharge water to be excessively agitated unless an extremely slow recharging well is encountered where complete evacuation is unavoidable. During the well purging procedure, collect water level and/or product level measurements to assess the hydraulic effects of purging. Sample the well when it recovers sufficiently to provide enough water for the analytical parameters specified. If the well is purged dry, allow the well to recover sufficiently to provide enough water for the specified analytical parameters, and then sample it.

Evaluate water samples on a regular basis during well purging and analyze them in the field preferably using in-line devices (i.e., flow through cell) for temperature, pH, specific conductivity, dissolved oxygen (DO), and oxidation-reduction (redox) potential. Turbidity should be measured separately (outside of the flow-through cell) with a nephelometer or similar device.

Readings should be taken every 2 to 5 minutes during the purging process. These parameters are measured to demonstrate that the natural character of the formation waters has been restored.

Purging shall be considered complete per the requirements set forth in the project-specific SAP, State requirements, or when three consecutive field parameter measurements of temperature, pH, specific conductivity, DO and ORP stabilize within approximately 10 percent and the turbidity is at or below 10 nephelometric turbidity units (NTU) or within $\pm 10\%$ if above 10 NTU. This criterion may not be applicable to temperature if a submersible pump is used during purging due to the heating of the water by the pump motor. Enter all information obtained during the purging and sampling process into a groundwater sampling log. Attachment 1 shows an example of a groundwater sampling log and the information typically included in the form. Whatever form is used, all blanks need to be completed on the field log during field sampling.

Groundwater removed during purging shall be stored according to the project-specific SAP or per SOP 3-05, IDW Management.

Purging Equipment and Methods

Submersible Pump

A stainless steel submersible pump may be utilized for purging both shallow and deep wells prior to sampling the groundwater for semivolatile and non-volatile constituents, but are generally not preferred for VOCs unless there are no other options (e.g., well over 200 feet deep). For wells over 200 feet deep, the submersible pump is one of the few technologies available to feasibly accomplish purging under any yield conditions. For shallow wells with low yields, submersible pumps are generally inappropriate due to overpumpage of the wells (<1 gallon per minute), which causes increased aeration of the water within the well.

Steam clean or otherwise decontaminate the pump and discharge tubing prior to placing the pump in the well. The submersible pump shall be equipped with an anti-backflow check valve to limit the amount of

water that will flow back down the drop pipe into the well. Place the pump in the middle of the saturated screened interval within the well and maintain it in that position during purging.

Bladder Pump

A stainless steel bladder pump can be utilized for purging and sampling wells up to 200 feet in depth for volatile, semivolatile, and non-volatile constituents. Use of the bladder pump is most effective in low to moderate yield wells and are often the preferred method for low-flow sampling. When sampling for VOCs and/or SVOCs, Teflon bladders should be used. Polyethylene bladders may be used when sampling for inorganics.

Either compressed dry nitrogen or compressed dry air, depending upon availability, can operate the bladder pump. The driving gas utilized must be dry to avoid damage to the bladder pump control box. Decontaminate the bladder pump prior to use.

Centrifugal, Peristaltic, or Diaphragm Pump

A centrifugal, peristaltic, or diaphragm pump may be utilized to purge a well if the water level is within 20 feet of ground surface. New or dedicated tubing is inserted into the midpoint of the saturated screened interval of the well. Water should be purged at a rate that satisfies low-flow requirements (i.e., does not cause drawdown). Centrifugal, peristaltic, or diaphragm pump are generally discouraged for VOCs sampling; however, follow methods allowed per the project-specific SAP or State requirements.

Air Lift Pump

Airlift pumps are not appropriate for purging or sampling.

Bailer

Avoid using a bailer to purge a well because it can result in overdevelopment of the well and create excessive purge rates. If a bailer must be used, the bailer should either be dedicated or disposable. Teflon-coated cable mounted on a reel is recommended for lowering the bailer in and out of the well.

Lower the bailer below the water level of the well with as little disturbance of the water as possible to minimize aeration of the water in the well. One way to gauge the depth of water on the reel is to mark the depth to water on the bailer wire with a stainless steel clip. In this manner, less time is spent trying to identify the water level in the well.

8.2.6 Monitoring Well Sampling Methodologies

Sampling Light, Non-Aqueous Phase Liquids (LNAPL)

Collect LNAPL, if present, prior to any purging activities. The sampling device shall generally consist of a dedicated or disposable bailer equipped with a bottom-discharging device. Lower the bailer slowly until contact is made with the surface of the LNAPL, and to a depth less than that of the immiscible fluid/water interface depth as determined by measurement with the interface probe. Allow the bailer to fill with LNAPL and retrieve it.

When sampling LNAPLs, never drop bailers into a well and always remove them from the well in a manner that causes as little agitation of the sample as possible. For example, the bailer should not be removed in a jerky fashion or be allowed to continually bang against the well casing as it is raised. Teflon bailers should always be used when sampling LNAPL. The cable used to raise and lower the bailer shall be composed of an inert material (e.g., stainless steel) or coated with an inert material (e.g., Teflon).

Sampling Dense, Non-Aqueous Phase Liquids (DNAPL)

Collect DNAPL prior to any purging activities. The best method for collecting DNAPL is to use a double-check valve, stainless steel bailer, or a Kemmerer (discrete interval) sampler. The sample shall be collected by slow, controlled lowering of the bailer to the bottom of the well, activation of the closing device, and retrieval.

Groundwater Sampling Methodology

The well shall be sampled when groundwater within it is representative of aquifer conditions per the methods described in Section 8.2.5. Prior to sampling the flow-through cell shall be removed and the samples collected directly from the purge tubing. Flow rates shall not be adjusted once aquifer conditions are met. Additionally, a period of no more than 2 hours shall elapse between purging and sampling to prevent groundwater interaction with the casing and atmosphere. This may not be possible with a slowly recharging well. Measure and record the water level prior to sampling in order to monitor drawdown when using low-flow techniques and gauge well volumes removed and recharged when using non-low-flow techniques.

Sampling equipment (e.g., especially bailers) shall never be dropped into the well, as this could cause aeration of the water upon impact. Additionally, the sampling methodology utilized shall allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers, minimizing exposure to sunlight, and immediately placing the sample on ice once collected.

Sampling equipment shall be constructed of inert material. Equipment with neoprene fittings, polyvinyl chloride (PVC) bailers, Tygon® tubing, silicon rubber bladders, neoprene impellers, polyethylene, and Viton® are not acceptable when sampling for organics. If bailers are used, an inert cable/chain (e.g., fluorocarbon resin-coated wire or stainless steel wire or cable) shall be used to raise and lower the bailer. Dedicated equipment is highly recommended for all sampling programs.

Submersible Pumps

The submersible pump must be specifically designed for groundwater sampling (i.e., pump composed of stainless steel and Teflon, sample discharge lines composed of Teflon) and must have a controller mechanism allowing the required low-flow rate. Adjust the pump rate so that flow is continuous and does not pulsate to avoid aeration and agitation within the sample discharge lines. Run the pump for several minutes at the low-flow rate used for sampling to ensure that the groundwater in the lines was obtained at the low-flow rate.

Bladder Pumps

A gas-operated stainless steel bladder pump with adjustable flow control and equipped with a Teflon bladder and Teflon-lined tubing can be effectively utilized to collect a groundwater sample and is considered to be the best overall device for sampling inorganic and organic constituents. If only inorganics are being sampled, polyvinyl bladders and tubing may be used. Operate positive gas displacement bladder pumps in a continuous manner so that they minimize discharge pulsation that can aerate samples in the return tube or upon discharge.

When using a compressor, take several precautions. If the compressor is being powered by a gasoline generator, position the generator downwind of the well. Ground fault circuit interrupters (GFCIs) should always be used when using electric powered equipment. Do not connect the compression hose from the compressor to the pump controller until after the engine has been started.

When all precautions are completed and the compressor has been started, connect the compression hose to the pump controller. Slowly adjust the control knobs to discharge water in the shortest amount of time while maintaining a near constant flow. This does not mean that the compressor must be set to discharge the water as hard as possible. The optimal setting is one that produces the largest volume of purge water per minute (not per purge cycle) while maintaining a near constant flow rate.

Prior to sampling, adjust the flow rate (purge rate) to yield 100 to 300 mL/minute. Avoid settings that produce pulsating streams of water instead of a steady stream if possible. Operate the pump at this low flow rate for several minutes to ensure that drawdown is not occurring. At no time shall the sample flow rate exceed the flow rate used while purging.

For those samples requiring filtration, it is recommended to use an in-line high capacity filter after all non-filtered samples have been collected.

Peristaltic Pumps:

A peristaltic pump is a type of positive displacement pump that moves water via the process of peristalsis. The pump uses a flexible hose fitted inside a circular pump casing. A rotor with cams compresses the flexible tube as the rotor turns, which forces the water to be pumped to move through the tube. In peristaltic pumps, no moving parts of the pump are in contact with the water being pumped. Displacement is determined by tube size, so delivery rate can only be changed during operation by varying pump speed. Peristaltic pumps are simple and quite inexpensive for the flow rates they provide.

There are several methods available for transferring the sample into the laboratory containers. The selected method may vary based on State requirements and should be documented in the project-specific SAP. Samples typically can be collected directly from the discharge end of the Teflon tubing, after it has been disconnected from the flow through cell. For volatile analyses, the sampler should make sure that the pump is set such that a smooth laminar flow is achieved. In all cases, the project team should consult their local regulatory requirements and document the selected sample collection procedure in the project-specific SAP.

Bailers

A single- or double-check valve Teflon or stainless steel bailer equipped with a bottom discharging device can be utilized to collect groundwater samples. Bailers have a number of disadvantages, however, including a tendency to alter the chemistry of groundwater samples due to degassing, volatilization, and aeration; the possibility of creating high groundwater entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Therefore, use bailers for groundwater sampling only when other types of sampling devices cannot be utilized for technical, regulatory, or logistical reasons.

Dedicated or disposable bailers should always be used in order to eliminate the need for decontamination and to limit the potential of cross-contamination. Each time the bailer is lowered to the water table, lower it in such a way as to minimize disturbance and aeration of the water column within the well.

8.2.7 Sample Handling and Preservation

Many of the chemical constituents and physiochemical parameters to be measured or evaluated during groundwater monitoring programs are chemically unstable and require preservation. The U.S. EPA document entitled, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods (SW-846)* (EPA 1997), includes a discussion of appropriate sample preservation procedures. In addition, SW-846 provides guidance on the types of sample containers to use for each constituent or common set of parameters. In general, check with specific laboratory or State requirements prior to obtaining field samples. In many cases, the laboratory will supply the necessary sample bottles and required preservatives. In some cases, the field sampling personnel may add preservatives in the field.

Improper sample handling may alter the analytical results of the sample. Therefore, transfer samples in the field from the sampling equipment directly into the container that has been prepared specifically for that analysis or set of compatible parameters as described in the project-specific SAP. It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Collect groundwater samples and place them in their proper containers in the order of decreasing volatility and increasing stability. A preferred collection order for some common groundwater parameters is:

1. VOCs and total organic halogens (TOX)

2. Dissolved gases, total organic carbon (TOC), total fuel hydrocarbons
3. Semivolatile organics, pesticides
4. Total metals, general minerals (unfiltered)
5. Dissolved metals, general minerals (filtered)
6. Phenols
7. Cyanide
8. Sulfate and chloride
9. Nitrate and ammonia
10. Radionuclides

When sampling for VOCs, collect water samples in vials or containers specifically designed to prevent loss of VOCs from the sample. The analytical laboratory performing the analysis shall provide these vials. Collect groundwater from the sampling device in vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. Fill the vial above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that has high concentrations of dissolved gasses. In these cases, the field sampling personnel shall document the occurrence in the field logbook and/or sampling worksheet at the time the sample was collected. Likewise, the analytical laboratory shall note in the laboratory analysis reports any headspace in the sample container(s) at the time of receipt by the laboratory.

Special Handling Considerations

In general, samples for organic analyses should not be filtered. However, high turbidity samples for PCB analysis may require filtering. Consult the project-specific SAP for details on filtering requirements. Samples shall not be transferred from one container to another because this could cause aeration or a loss of organic material onto the walls of the container. TOX and TOC samples should be handled in the same manner as VOC samples.

When collecting total and dissolved metals samples, the samples should be collected sequentially. The total metals sample is collected from the pump unfiltered. The dissolved metals sample is collected after filtering with a 0.45-micron membrane in-line filter. Allow at least 500 mL of effluent to flow through the filter prior to sampling to ensure that the filter is thoroughly wetted and seated in the filter capsule. If required by the project-specific SAP, include a filter blank for each lot of filters used and always record the lot number of the filters.

Field Sampling Preservation

Preserve samples immediately upon collection. Ideally, sampling containers will be pre-preserved with a known concentration and volume of preservative. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. Guidance for the preservation of environmental samples can be found in the U.S. EPA *Handbook for Sampling and Sample Preservation of Water and Wastewater* (EPA 1982). Additional guidance can be found in other U.S. EPA documents (EPA 1992, 1996).

Field Sampling Log

A groundwater sampling log provided as Attachment 1 shall document the following:

- Identification of well

- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield
- Purge volume and pumping rate
- Time that the well was purged
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data
- Field observations on sampling event
- Name of sampler
- Weather conditions

9.0 Quality Control and Assurance

- 9.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP. The goal of the QA program should be to ensure precision, accuracy, representativeness, completeness, and comparability in the project sampling program.
- 9.2 Quality control (QC) requirements for sample collection are dependent on project-specific sampling objectives. The project-specific SAP will provide requirements for sample preservation and holding times, container types, sample packaging and shipment, as well as requirements for the collection of various QC samples such as trip blanks, field blanks, equipment rinse blanks, and field duplicate samples.

10.0 Data and records management

- 10.1 Records will be maintained in accordance with SOP 3-03, Recordkeeping, Sample Labelling, and Chain-of-Custody. Various forms are required to ensure that adequate documentation is made of the sample collection activities. These forms may include:
- Sample Collection Records;
 - Field logbook;
 - Chain-of-custody forms; and
 - Shipping labels.

- 10.2 Sample collection records (Attachment 1) will provide descriptive information for the purging process and the samples collected at each monitoring well.
- 10.3 The field logbook is kept as a general log of activities and should not be used in place of the sample collection record.
- 10.4 Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes.
- 10.5 Shipping labels are required is sample coolers are to be transported to a laboratory by a third party (courier service).

11.0 Attachments or References

Attachment 1 – Groundwater Sampling Collection Record

ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites*. ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.

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EPA. 1996. *Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA/540/S-95/504. Office of Solid Waste and Emergency Response. April.

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NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.

SOP 3-03, *Recordkeeping, Sample Labelling, and Chain-of-Custody*.

SOP 3-05, *IDW Management*.

SOP 3-06, *Equipment Decontamination*.

<i>Author</i>	<i>Reviewer</i>	<i>Revisions (Technical or Editorial)</i>
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Attachment 1 Groundwater Sample Collection Record



Well ID:

Groundwater Sample Collection Record

Client: _____	Date: _____	Time: Start _____ am/pm
Project No: _____		Finish _____ am/pm
Site Location: _____		
Weather Conds: _____	Collector(s): _____	

1. WATER LEVEL DATA: (measured from Top of Casing)

- a. Total Well Length _____ c. Length of Water Column _____ (a-b) Casing Diameter/Material _____
- b. Water Table Depth _____ d. Calculated Well Volume (see back) _____

2. WELL PURGEABLE DATA

- a. Purge Method: _____
- b. Acceptance Criteria defined (see SAP or Work Plan)
- Minimum Required Purge Volume (@ _____ well volumes) _____
 - Maximum Allowable Turbidity _____ NTUs
 - Stabilization of parameters _____ %
- c. Field Testing Equipment used:
- | | Make | Model | Serial Number |
|--|------|-------|---------------|
| | | | |
| | | | |
| | | | |

Time (min)	Volume		pH s.u.	Spec. Cond. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Flow Rate (ml/min)	Drawdown (m)	Color/Odor/etc.
	Removed (gal)	Temp. (°C)								

- d. Acceptance criteria pass/fail
- | | Yes | No | N/A |
|-------------------------------------|--------------------------|--------------------------|--------------------------|
| Has required volume been removed | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Has required turbidity been reached | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Have parameters stabilized | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- If no or N/A - Explain below.

(continued on back)

3. SAMPLE COLLECTION: Method: _____

Sample ID	Container Type	No. of Containers	Preservation	Analysis Req.	Time

Comments _____

Signature _____ Date _____

Operation and Calibration of a Photoionization Detector

Procedure 3-20

1.0 Purpose and Scope

1.1 Purpose and Applicability

- 1.1.1 This standard operating procedure (SOP) describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.
- 1.1.2 PIDs routinely used by field personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

- 1.2.1 The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.
- 1.2.2 The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.
- 1.2.3 Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive-biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.
- 1.2.4 In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

1.3 Specifications

- 1.3.1 Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.

2.0 Safety

- 2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety Officer (SSO)**.
- 2.2 Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

3.0 Terms and Definitions

None.

4.0 Interferences

- 4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.
- 4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.
- 4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.
- 4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

- 5.2.1 The CTO Manager is responsible for ensuring that the operation and calibration activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the operation and calibration shall have the appropriate education, experience, and training to perform their assigned tasks.
- 5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.
- 5.2.3 The Field Manager is responsible for ensuring that all operation and calibration activities are conducted according to this procedure.
- 5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated;

- Regulator for calibration gas cylinder;
- Approximately 6 inches of Teflon® tubing;
- Tedlar bag (optional);
- Commercially-supplied zero grade air (optional);
- "Magic Marker" or "Sharpie" or other waterproof marker;
- Battery charger;
- Moisture traps;
- Spare lamps;
- Manufacturer's instructions; and
- Field data sheets or logbook/pen.

7.0 Procedure

7.1 Preliminary Steps

- 7.1.1 Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

7.2 Calibration

- 7.2.1 The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.
- 7.2.2 Calibrate the instrument according to the manufacturer's instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.
- 7.2.3 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 7.4).

7.3 Operation

- 7.3.1 Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.
- 7.3.2 Calibrate the instrument as described in Section 7.2, following the manufacturer's instructions. Record the calibration information in the field records.
- 7.3.3 The instrument is now operational. Readings should be recorded in the field records.
- 7.3.4 When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a "bump" test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.
- 7.3.5 At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 7.2) except that no adjustment will be made to the instrument. Record the information in the field records.

- 7.3.6 Recharge the battery after each use (Section 7.4).
- 7.3.7 When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

7.4 **Routine Maintenance**

- 7.4.1 Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.
- 7.4.2 All routine maintenance should be performed in a non-hazardous environment.

7.5 **Troubleshooting Tips**

- 7.5.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.
- 7.5.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.
- 7.5.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.
- 7.5.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.
- 7.5.5 A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.
- 7.5.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.
- 7.5.7 When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or "flooded". Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

8.0 **Quality Control and Assurance**

- 8.1 The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.
- 8.2 Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within $\pm 10\%$. If the instrument responds outside this tolerance, it must be recalibrated.
- 8.3 Checks of the instrument response (Section 7.5) should be conducted periodically and documented in the field records.

9.0 **Records, Data Analysis, Calculations**

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number;
- Instrument manufacturer, model, and identification number;

- Operator's signature;
- Date and time of operation;
- Calibration gas used;
- Calibration check at beginning and end of day (meter readings before adjustment);
- Span setting after calibration adjustment;
- Meter readings (monitoring data obtained);
- Instances of erratic or questionable meter readings and corrective actions taken; and
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 7.5) or similar test.

10.0 Attachments or References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Standard Operating Procedure SOP-3-24
Water Quality Parameter Testing for Groundwater Sampling

1.0 PURPOSE

This standard operating procedure (SOP) represents minimum standard of practice. State and federal requirements may vary, and this SOP does not replace state and federal requirements that must be consulted before work begins. Further, if a project-specific work plan has been created, the work plan should be considered the ruling document. This SOP may be modified to meet specific regulatory, client, or project specific criteria.

If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to water quality parameter testing, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan (SAP).

2.0 SCOPE

This procedure provides guidance for expected sampling methods and protocols by all personnel related to the measurement of water quality parameters.

Field measurements of water quality parameters are commonly performed to evaluate surface water and groundwater. These tests are often performed to evaluate basic water quality parameters, to evaluate natural attenuation parameters, and to assess the presence of pore water entering a well.

As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

3.1 Barometric Pressure (BP)

The density of the atmosphere, which varies according to altitude and weather conditions.

3.2 Conductivity/Specific Conductance

A measure of the ability of water to pass electrical current, which increases with the amount of dissolved ionic substances (i.e., salts). Conductivity is inversely related to the resistance of a solution and is measured in units of mhos per centimeter (mhos/cm) (inverse ohms/cm, Siemens/cm). The conductivity of water increases with increasing temperature.

Specific Conductance is corrected for 25 degrees Celsius (°C); for this reason, it is best to record Specific Conductance. If Conductivity is recorded, the temperature of the sample MUST recorded.

3.3 Dissolved Oxygen (DO)

The amount of oxygen present in water and available for respiration. DO is typically measured in milligrams per liter (mg/L). Oxygen is less soluble in warm and salty waters, so the instrument compensates the apparent percent saturation for changes in temperature and conductivity. Most probes measure the current resulting from the electrochemical reduction of oxygen (at a gold cathode) diffusing through a selective membrane. Because oxygen is being removed from the sample to perform the measurement, sample flow is required to prevent false low readings due to depletion of oxygen in the solution in front of the probe. Optical DO probes do not remove oxygen from the sample and are less affected by salts. The common range of DO in groundwater is 0.0 to 3.0 mg/L. Measurements outside of this range suggest that the meter may not be operating correctly.

3.4 Nephelometric Turbidity Unit (NTU)

The measurement of light passing through a sample based on the scattering of light caused by suspended particles.

3.5 pH

A measure of acidity and alkalinity of a solution using a logarithmic scale on which a value of 7 represents neutrality, lower numbers indicate increasing acidity, and higher numbers are increasingly basic.

3.6 Oxidation-Reduction Potential (ORP)

Also known as redox or eH, ORP is a measurement of the potential for a reaction to occur, which generally indicates the oxygen status of a sample. The probe consists of a platinum electrode, the potential of which is measured with respect to a reference electrode that rapidly equilibrates with the potential of the sample solution. A positive value indicates that oxygen is present. A negative value indicates an anaerobic environment or reducing condition. For this reason, negative ORP readings should be associated with DO readings of less than 0.5 mg/l; with negative ORP readings the water may exhibit a sulfur odor or gray color. Positive ORP readings should be associated with DO readings greater than 0.5 mg/L and lack of sulfur odors. Because of the complex relationship between ORP and temperature, no compensation is attempted; it is thus best to report both the ORP and temperature of a water sample.

3.7 Total Dissolved Solids

A measure of the quantity of materials in water that are either dissolved or too small to be filtered.

3.8 Turbidity

Measure of the clarity of water in NTUs. Potable water typically has NTU values between 0.0 and 0.3 NTUs, depending on the state or regulatory program.

4.0 RESPONSIBILITIES

The CTO Manager, or designee, is responsible for ensuring that these standard groundwater sampling activities are followed and shall review all groundwater sampling forms at the conclusion of a sampling event. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks. The QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all project field staff follows these procedures.

Field sampling personnel are responsible for the implementation of this procedure. Personnel are required to be knowledgeable of the procedures in this SOP. Training and familiarization with this SOP shall be documented in the training file for each employee. The field sampler and/or Field Manager is responsible for directly supervising the calibration procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the CTO Manager, QA Manager, or Technical Director and then documented in the field logbook and associated report or equivalent document.

5.0 PROCEDURES

5.1 Purpose

The procedures will vary depending on parameters being measured, method of sampling, and the method of measurement used. The information here is a general guidance and the site-specific documents and manufacturer manuals supersede these procedures.

5.2 Cautions

Improper use of water quality testing equipment could result in equipment damage or compromised sampling results. Personnel should be trained to operate the test equipment being used for a field operation and should be trained in the proper techniques for collecting and

logging water quality parameters. Personnel should also be able to recognize problems with test equipment and have someone available for basic troubleshooting and repair.

5.3 Interferences

During field testing, water quality data that is documented from field testing equipment may be influenced by certain outside factors that are unrelated to the actual site water quality. Such parameters and equipment include the following:

pH Meters

- Coatings of oils, greases, and particles may impair the electrode's response. Pat the electrode bulb dry with lint-free paper or cloth and rinse with de-ionized water. For cleaning hard-to-remove films, use isopropyl alcohol very sparingly so that the electronic surface is not damaged.
- Poorly buffered solutions with low specific conductance (less than 200 microsiemens per centimeter) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

Dissolved Oxygen

- Dissolved gases (e.g., hydrogen sulfide, halogens, sulfur dioxide) are a factor with the performance of DO probes. The effect is less pronounced on optical DO meters. Meter type and potential interferences should be considered based on potential sulfate/sulfide or nitrate/nitrite reducing environments.
- Exposure of the sample to the atmosphere will cause elevated DO measurements.

Turbidity Meter

- If the weather is warm and humidity is high, condensation may collect on the cuvet. To avoid this, allow the sample to warm and dry the outside of the cuvet before making the measurement. One method used to accomplish this is to place the cuvet against one's body (armpits work well).

Temperature

- Sample temperature will change rapidly when there are significant differences between the sample and ambient air.

5.4 Apparatus and Materials

Field personnel shall consult the site work plan and SAP to review the equipment requirements for the sampling procedures to be followed during the sampling effort. The specific apparatus and materials required will depend on the water quality parameters being monitored. Table 1 shows the common equipment used in water quality parameter testing.

Table 1
Water Quality Parameter Testing — Common Equipment

Water Quality Parameter Instrument	Calibration Standards Required	Other Equipment
pH Meter	Yes - 2 or 3 Point Standards depending on groundwater range. Calibration must cover the range to be measured. If samples are above or below typical buffer standards (4, 7 and 10), special order buffers that fall outside groundwater pH range.	Container or flow thru cell for holding sample
Specific Conductance	Yes	Container or flow thru cell for holding sample
ORP Meter	Yes	Container or flow thru cell for holding sample
Turbidity Meter	Yes	Container or flow thru cell for holding sample
DO	No	Container or flow thru cell for holding sample
Thermometer	No	Container or flow thru cell for holding sample
Flow Rate	No	Calibrated Container

Notes:

- ORP = Oxidation-Reduction Potential
- DO = Dissolved Oxygen

5.5 Instrument or Method Calibration

Most monitoring instruments require calibration before use, and this calibration must be conducted in the field under the ambient climatic conditions that will be present during field sampling. Calibration of monitoring instruments shall be performed in accordance with the manufacturer's specifications and recorded in the provided form in Attachment 1. Site-specific instrument calibration requirements should be specified in the SAP. The following minimum calibration requirements apply to the various types of meters used to gather water quality measurements.

Initial Calibration (IC): Before use, the instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a

calibration standard. An IC is performed in preparation for the first use of an instrument or if a calibration verification does not meet acceptance criteria.

Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following IC by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

Continuing Calibration Verification (CCV): After use, the instrument or meter calibration is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter.

5.5.1 Calibration Checks

Calibration checks are conducted by measuring a known standard. They must be completed after calibration and should be performed at least one other time (i.e., after lunch) and anytime suspect measurements are encountered. Table 2 provides general acceptance ranges to be used during calibration checks. If a meter is found to be outside of the acceptance range, the meter **must** be recalibrated. If the meter remains out of range, the project manager and/or the supplier of the meter should be contacted to determine alternative measures.

**Table 2
Calibration Check Acceptance Limits**

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature
pH	±0.2 Standard pH Units
Specific Conductance	±5% of the standard
Turbidity	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard

Notes:

- mg/L = milligrams per liter
- mv = millivolts
- NTU = nephelometric turbidity units

5.5.2 Possible and Suspected Ranges

The concentration for each parameter range should be known so that concentrations outside of the range can be noted. Table 3 presents the maximum range of the parameter in groundwater. The table also presents the suspected range. Measurements outside of the maximum/minimum range should be considered in error and the measurement method should be checked. Concentrations outside the normal range should be treated as suspect but may be the result of contaminant impact. For example, a pH of 2.0 would be out of the normally suspected range for groundwater but not at a site impacted with an acid.

**Table 3
Minimum and Maximum Result Ranges**

Parameter	Units	Possible Min	Possible Max	Normal Min	Normal Max	Notes
Dissolved Oxygen	mg/L	0.0	14.6 (0°C)	0.0	5	The colder the sample, the higher the DO reading.
			10.1 (15°C)			DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color.
			8.3 (2°C)			DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
pH	SU	0	14	5	9	pH values exceeding 10 could indicate grout contamination
ORP	mv					DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color.
						DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
Specific Conductance	µS/cm			varies	varies	
Temperature	°C	0	100	5	30	
Turbidity	NTU	0	Greater than 1,000	0	Greater than 1,000	50 NTU or greater suggests cloudiness.

Notes:

- mg/L = milligrams per liter
- °C = degrees Celsius
- DO = dissolved oxygen
- SU = standard units
- ORP = oxidation reduction potential
- mv = millivolts
- mS/cm = micro Siemens per cm
- NTU = nephelometric turbidity units

5.5.3 Field Instruments and Calibration Criteria

The calibration acceptance criteria for each instrument are summarized in Table 4 along with special considerations related to each field instrument.

**Table 4
 Calibration Check Acceptance Limits**

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility.
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature.
pH	±0.2 Standard pH Units
Specific Conductance	±5% of the standard
Turbidity	0.1 to 10 NTU: ±10% of the standard
	11 to 40 NTU: ±8% of the standard
	41 to 100 NTU: ±6.5% of the standard

Notes:

- mg/L = milligrams per liter
- mv = millivolts
- NTU = nephelometric turbidity units

pH Meters

- For the most accurate of pH measurements, pH meters should receive a three-point calibration. However, if a two-point calibration will bracket the groundwater pH of the site, a two-point calibration is acceptable. Three-point calibrations typically include calibrating to solutions of pH 7.00, 4.00, and 10.00. If groundwater pH is outside the calibration range of the solution standards, special buffers must be ordered to bracket the pH. Some meters will report the slope of the calibration and this may be used in checking the meter calibration (refer to the meter’s manual). When performing an ICV, the result must be within +/- 0.2 pH units of the stated buffer value.
- pH meters should be calibrated across the range of values to be measured. The maximum and minimum calibration solutions shall be outside the range of anticipated values. For example, if the expected range is between 7.50 and 9.00, the 7.00 and the 10.00 standard should be used for calibration. Perform the IC using at least two buffers, and always use the pH 7.00 buffer first. A reading that is above the maximum (or below the minimum) calibration standard is an estimate only and is not valid. This condition requires obtaining a new standard that is above (or below) the reported value, depending on the measurement.

- A percent slope of less than 90 percent indicates a bad electrode that must be changed or repaired. If percent slope cannot be determined, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

Specific Conductivity Meters

- For IC, when the sample measurements are expected to be 100 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) or greater, use two standard potassium chloride (KCl) solutions that bracket the range of expected sample conductivities. Calibrate the instrument with the first standard. Verify the calibration of the instrument with the second standard, bracketing the range of expected sample values.
- If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values.
- When the sample measurements are expected to be less than 100 $\mu\text{S}/\text{cm}$, a lower bracket is not required, but one standard (KCl) solution that is within the range of expected measurements must be used for the IC and the ICV.
- Accept the calibration if the meter reads within +/- 5 percent of the value of any calibration standard used to verify the calibration.
- Most field instruments read conductivity directly. Record all readings and calculations in the calibration records.
- For CCV, check the meter with at least one KCl standard with a specific conductance in the range of conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5 percent of the standard value.
- If new environmental samples are encountered outside the range of the IC, verify the instrument calibration with two standards bracketing the range of sample values. If these calibration verifications fail, recalibrate the instrument.

Dissolved Oxygen Meters

- Before calibrating, check the probe membrane for bubbles, tears, or wrinkles. These conditions require replacement of the membrane in accordance with the manufacturer's directions.
- If the meter provides readings that are off-scale, will not calibrate, or drift, check the leads, contacts, etc., for corrosion and/or short circuits. These conditions require replacement maintenance in accordance with the manufacturer's directions.
- Most DO meters must be calibrated based on an environment of 100 percent humidity and a known elevation and barometric pressure (BP).
- For 100 percent humidity, place the probe in the calibration container with a moist towel and allow the probe to remain, undisturbed, for 10 to 20 minutes.
- The IC is an air calibration at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar verification at the end of the day or sampling event. Follow the manufacturer's instructions for your specific instrument. Allow an appropriate warm up period before IC. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100 percent humidity). Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table (see Attachment 2) what DO should measure. The acceptance criterion for DO ICV is +/- 0.3 mg/L.
- Use the same procedure as above for CCV.

ORP Meters

- Verify electrode response before use in the field.
- Equilibrate the standard solution to the temperature of the sample. The standard solution is based on a 25°C temperature; however, the calibration solution standard's value will require adjustment based on the temperature.

- Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on, placing the function switch in the millivolt (mv) mode.
- Let the electrode equilibrate and record the reading to the nearest millivolt. The reading must be within ± 10 mv from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.
- Record the mv reading and temperature in the field notebook or in form. Rinse the electrode with distilled water and proceed with the sample measurement, unless using a flow cell. If a flow cell is used, rinse between sample locations.

Turbidity Meters

- Perform an initial calibration using at least two primary standards.
- If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard.
- Perform an ICV by reading at least one primary standard as a sample. The acceptance criterion for the ICV depends on the range of turbidity of the standard value:
 1. Standard Value = 0.1 to 10 NTU: the response must be within 10 percent of the standard;
 2. Standard Value = 11 to 40 NTU: the response must be within 8 percent of the standard;
 3. Standard Value = 41 to 100 NTU: the response must be within 6.5 percent of the standard; and
 4. Standard Value greater than 100 NTU: the response must be within 5 percent of the standard.
- Determining the Values of Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards may be used for CCVs.

To initially determine the value of a secondary standard, assign the value that is determined immediately after an ICV or verification with primary standards. This is done by reading the secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10 percent of the assigned standard value. If the +/- 10 percent criterion is not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

- CCV: Perform a CCV using at least one primary or secondary standard. The calibration acceptance criteria are the same as those for an ICV.

5.6 Direct Measurements

Direct measurements with meters are the most common methods and can be accomplished by placing a sample in a container with the probe or by allowing the water to flow past the probe in a flow cell. The use of a flow-through cell improves measurement quality by allowing the constant flow of water over the probes and reduces interaction of the sample with the atmosphere. Sample cups should be avoided. The quantity of samples, timing, and methodology should be described in the project SAP.

Following calibration of required probes, connect the bottom flow-cell port to the discharge line of the pump. Connect the top port to a discharge line directed to a bucket to collect the purge water. Allow the flow cell to completely fill. As the water flows over the probe, record the measurements. Continue to record the measurements at regular intervals, as specified in the SAP.

When the ambient air temperatures are much higher or lower than the temperature of the water sample, it is best to keep the length of tubing between the wellhead and the flow cell as short as possible to prevent heating or cooling of the water. Tubing and flow-through cell should not be exposed to direct sunlight, particularly in the summer, if at all possible, to avoid heating of water samples.

5.7 Data Acquisitions, Calculations, and Data Reduction

5.7.1 Specific Conductivity Correction Factors

If the meter does not automatically correct for temperature (i.e., read Specific Conductivity) record Conductivity and adjust for temperature upon returning to the office. The following equation can be used to convert Conductivity to Specific Conductivity.

$$K = \frac{(Km)(C)}{1 + 0.0191(T - 25)}$$

Where:

- K = Conductivity in $\mu\text{mhos/cm}$ at 25°C
- Km = Measured conductivity in $\mu\text{mhos/cm}$ at T degrees Celsius
- C = Cell constant
- T = Measured temperature of the sample in degrees Celsius;

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(Km)}{1 + 0.0191(T - 25)}$$

5.7.2 Percentage Difference Calculation

For evaluating slope of readings from either a flow cell or a sample cup.

$$\%Difference = \frac{(Highest\ Value - Lowest\ Value)}{(Highest\ Value)} \times 100$$

5.7.3 Convert mm mercury (mmHG) to inches mercury (inHG)

$$mmHG = inHG \times 25.4$$

5.7.4 True Barometric Pressure

For converting BP obtained from a public domain source that is expressed in BP at sea level to BP at the subject site.

$$TrueBP = (BP) - \frac{(2.5 \times [Local\ Altitude])}{100}$$

Where: BP is in mmHG and Local Altitude is in feet

Example: BP at site A is 30.49 inHg and elevation is 544 feet, calculate TrueBP

Convert inHG to mmHG:

$$\text{mmHg} = 30.49 \text{ inHg} \times 25.4 = 774.4 \text{ mmHg}$$

Calculate True BP:

$$\text{TrueBP} = (774.4 \text{ mmHg}) - [2.5 * (544 / 100)] = 774.4 - 13.6 = 760.8 \text{ mmHg}$$

6.0 RECORDS

Data will be recorded promptly, legibly, and in indelible ink on the appropriate logbooks and forms. At the completion of a field effort, all logbooks, field data forms, and calibration logs shall be scanned and made electronically available to the project team. The original field forms, calibrations logs, and log book will be maintained in the project file.

7.0 HEALTH AND SAFETY

Detailed Health and Safety requirements can be found in the site specific Health and Safety Plan. Ensure that a Safe Work Assessment and Permit form is filled out daily prior to any work in the field and reviewed with all project personnel in a daily safety brief.

Safety glasses with side shields or goggles and disposable gloves shall be worn during calibration activities.

8.0 REFERENCES

None

9.0 ATTACHMENTS

Attachment 1: Example Field Instrument Calibration Form

Attachment 2: Solubility of Oxygen at Given Temperatures

Attachment 3: Example Field Data Form

Attachment 1
Example Field Instrument Calibration Form

Field Instrument Calibration Form

Calibrated by: _____
Date: _____

Equipment (Make/Model/Serial#): _____
Equipment (Make/Model/Serial#): _____

pH (su) Standard: ± 0.2 standard units				DO (mg/L) Standard: ± 0.3 mg/L of theoretical*			
Initial Calibration		Initial Calibration Verification		IC (Temp:)		ICV (Temp:)	
Hach SL	Reading	Pine SL	Reading	Saturation (%)	Reading (%)	Theoretical (mg/L)	Reading (mg/L)
pH7	<input type="text"/>	<input type="text"/>	<input type="text"/>	100	<input type="text"/>	<input type="text"/>	<input type="text"/>
pH4	<input type="text"/>	<input type="text"/>	<input type="text"/>				
Continuing Calibration Verification				CCV (Temp:)			
Hach SL	Reading	Deviation	Acceptable Variance (Y/N)	Saturation (%)	Reading (%)	Deviation	Acceptable Variance (Y/N)
pH7	<input type="text"/>	<input type="text"/>	<input type="text"/>	100	<input type="text"/>	<input type="text"/>	<input type="text"/>
pH4	<input type="text"/>	<input type="text"/>	<input type="text"/>	Theoretical (mg/L)	Reading (mg/L)	Deviation	Acceptable Variance (Y/N)
	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
ORP (mV) Standard: NA				Turbidity (ntu) Standard: ±10% of Standard			
IC (Zobell SL:)		ICV (Pine SL:)		Initial Calibration			
TCS (Std/Temp)	Reading	TCS (Std/Temp)	Reading	Standard	Reading		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		
CCV (Zobell SL:)				Continuing Calibration Verification			
TCS (Std/Temp)	Reading	Deviation	Acceptable Variance (Y/N)	Standard	Reading	Deviation	Acceptable Variance (Y/N)
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Conductivity (ms ^c /cm) Standard: ± 5% of standard value				Comments:			
IC (YSI SL:)		ICV (Pine SL:)					
Standard	Reading	Standard	Reading				
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>				
CCV (YSI SL:)							
Standard	Reading	Deviation	Acceptable Variance (Y/N)				
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>				

Notes:

SL	solution lot	su	standard units	ntu	Nephelometric Turbidity Units
TCS	temperature corrected standard	mV	millivolts	°C	degrees Celsius
Std	standard	%	percent	ms ^c /cm	millisiemens per centimeter (temperature corrected)
Temp	temperature	mg/L	milligrams per liter	*	Theoretical value

Attachment 2
Solubility of Oxygen at Given Temperatures

Field Measurement of Dissolved Oxygen

Solubility of Oxygen in Water at Atmospheric Pressure			
Temperature	Oxygen Solubility	Temperature	Oxygen Solubility
°C	mg/L	°C	mg/L
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

Notes:

The table provides three decimals to aid interpolation

Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water saturated

°C = degrees Celsius

mg/L = milligrams per liter

Attachment 3
Example Field Data Form

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM		
DATE:	JOB NUMBER:	EQUIPMENT (Make/Model #/Serial #):
PROJECT:	EVENT:	/ /
WELL ID:	LOCATION:	/ /
WEATHER CONDITIONS:	AMBIENT TEMP:	/ /
REVIEWED BY:	PERSONNEL:	/ /

WELL DIA:	WELL DEVELOPMENT	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	GROUNDWATER SAMPLING	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

WELL DEVELOPMENT PARAMETERS	GW SAMPLING PARAMETERS
Temperature: ± 1.0° C	Temperature: ± 0.2° C
pH: ± 0.5 standard units	pH: ± 0.2 standard units
Specific Conductance: ± 10% of the past measurement	Specific Conductance: ± 5% of the past measurement
Turbidity: relatively stable	DO: ≤ 20% saturation
	ORP: ± 10 millivolts
	Turbidity: ≤ 10 NTU

IN-SITU TESTING

Circle one:	DEVELOPMENT	SAMPLING	<input type="checkbox"/> Bailer	<input type="checkbox"/> Pump	Description:
Time (hh:mm):					
pH (units):					
Conductivity (mS/cm):					
Turbidity (NTU):					
DO (mg/L): YSI 556					
DO (mg/L): YSI 550					
Temperature (C°):					
ORP (mV):					
Volume Purged (gal):					
Depth to Water (ft):					
					Well Goes Dry While Purging <input type="checkbox"/>

SAMPLE DATA

Sample ID	Date (m/d/y)	Time (hh:mm)	<input type="checkbox"/> Bailer	<input type="checkbox"/> Pump	Description:

Purging/Sampling Device Decon Process:

COMMENTS:

Appendix C

Laboratory Accreditation Certificates



**LABORATORY
ACCREDITATION
BUREAU**



Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2226

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville TN 37228

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: November 30, 2015



**R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 30th of January 2013**

*See the laboratory's Scope of Accreditation for details of accredited parameters

**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Scope of Accreditation For Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: November 30, 2015

Testing - Environmental

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B; EPA 624	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B; EPA 624	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B; EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B; EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B; EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 8260B; EPA 624	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B; EPA 624	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B; EPA 624	1,1-Dichloropropene
GC/MS	EPA 8260B; EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 8260B; EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B; EPA 624	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B; EPA 624	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B; EPA 624	1,2-Dichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B; EPA 624	1,2-Dichloropropane
GC/MS	EPA 8260B; EPA 624	1,3,5-Trimethylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B; EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,3-Dichloropropane
GC/MS	EPA 8260B; EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,4-Dioxane
GC/MS	EPA 8260B; EPA 624	1-Chlorohexane
GC/MS	EPA 8260B; EPA 624	2,2-Dichloropropane
GC/MS	EPA 8260B; EPA 624	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B; EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B; EPA 624	2-Chlorotoluene
GC/MS	EPA 8260B; EPA 624	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B; EPA 624	4-Chlorotoluene
GC/MS	EPA 8260B; EPA 624	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B; EPA 624	Acetone
GC/MS	EPA 8260B; EPA 624	Acetonitrile
GC/MS	EPA 8260B; EPA 624	Acrolein
GC/MS	EPA 8260B; EPA 624	Acrylonitrile
GC/MS	EPA 8260B; EPA 624	Allyl chloride
GC/MS	EPA 8260B; EPA 624	Benzene
GC/MS	EPA 8260B; EPA 624	Bromobenzene
GC/MS	EPA 8260B; EPA 624	Bromochloromethane
GC/MS	EPA 8260B; EPA 624	Bromodichloromethane
GC/MS	EPA 8260B; EPA 624	Bromoform
GC/MS	EPA 8260B; EPA 624	Bromomethane
GC/MS	EPA 8260B; EPA 624	Carbon Disulfide
GC/MS	EPA 8260B; EPA 624	Carbon Tetrachloride
GC/MS	EPA 8260B; EPA 624	Chlorobenzene
GC/MS	EPA 8260B; EPA 624	Chloroethane
GC/MS	EPA 8260B; EPA 624	Chloroform
GC/MS	EPA 8260B; EPA 624	Chloromethane
GC/MS	EPA 8260B; EPA 624	Chloroprene
GC/MS	EPA 8260B; EPA 624	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B; EPA 624	cis-1,3-Dichloropropene
GC/MS	EPA 8260B; EPA 624	cis-1,4-Dichloro-2-butene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B; EPA 624	Cyclohexane
GC/MS	EPA 8260B; EPA 624	Dibromochloromethane
GC/MS	EPA 8260B; EPA 624	Dibromomethane
GC/MS	EPA 8260B; EPA 624	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B; EPA 624	Di-isopropyl ether
GC/MS	EPA 8260B; EPA 624	ETBE
GC/MS	EPA 8260B; EPA 624	Ethyl methacrylate
GC/MS	EPA 8260B; EPA 624	Ethylbenzene
GC/MS	EPA 8260B; EPA 624	Hexachlorobutadiene
GC/MS	EPA 8260B; EPA 624	Hexane
GC/MS	EPA 8260B; EPA 624	Iodomethane
GC/MS	EPA 8260B; EPA 624	Isobutyl alcohol
GC/MS	EPA 8260B; EPA 624	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B; EPA 624	Methacrylonitrile
GC/MS	EPA 8260B; EPA 624	Methyl Acetate
GC/MS	EPA 8260B; EPA 624	Methyl methacrylate
GC/MS	EPA 8260B; EPA 624	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B; EPA 624	Methylcyclohexane
GC/MS	EPA 8260B; EPA 624	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B; EPA 624	Naphthalene
GC/MS	EPA 8260B; EPA 624	n-Butylbenzene
GC/MS	EPA 8260B; EPA 624	n-Propylbenzene
GC/MS	EPA 8260B; EPA 624	p-Isopropyltoluene
GC/MS	EPA 8260B; EPA 624	Propionitrile
GC/MS	EPA 8260B; EPA 624	sec-Butylbenzene
GC/MS	EPA 8260B; EPA 624	Styrene
GC/MS	EPA 8260B; EPA 624	t-Butyl alcohol
GC/MS	EPA 8260B; EPA 624	tert-Amyl methyl ether
GC/MS	EPA 8260B; EPA 624	tert-Butylbenzene
GC/MS	EPA 8260B; EPA 624	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B; EPA 624	Tetrahydrofuran
GC/MS	EPA 8260B; EPA 624	Toluene
GC/MS	EPA 8260B; EPA 624	trans-1,2-Dichloroethene (trans-1,2-DCE)

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B; EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 8260B; EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B; EPA 624	Trichloroethene (TCE)
GC/MS	EPA 8260B; EPA 624	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B; EPA 624	Vinyl acetate
GC/MS	EPA 8260B; EPA 624	Vinyl Chloride (VC)
GC/MS	EPA 8260B; EPA 624	m,p-Xylenes
GC/MS	EPA 8260B; EPA 624	o-Xylene
GC/MS	EPA 8260B; EPA 624	Xylenes (Total)
GC/MS	EPA 8270C/D; EPA 625	1,1'-Biphenyl
GC/MS	EPA 8270C/D; EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D; EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,4-Dioxane
GC/MS	EPA 8270C/D; EPA 625	1-Methylnaphthalene
GC/MS	EPA 8270C/D; EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D; EPA 625	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D; EPA 625	2,4-Dimethylphenol
GC/MS	EPA 8270C/D; EPA 625	2,4-Dinitrophenol
GC/MS	EPA 8270C/D; EPA 625	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D; EPA 625	2,6-Dichlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D; EPA 625	2-Chloronaphthalene
GC/MS	EPA 8270C/D; EPA 625	2-Chlorophenol
GC/MS	EPA 8270C/D; EPA 625	2-Methylnaphthalene
GC/MS	EPA 8270C/D; EPA 625	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D; EPA 625	2-Nitroaniline
GC/MS	EPA 8270C/D; EPA 625	2-Nitrophenol (ONP)

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D; EPA 625	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D; EPA 625	3-Methylphenol/4-Methylphenol
GC/MS	EPA 8270C/D; EPA 625	3-Nitroaniline
GC/MS	EPA 8270C/D; EPA 625	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D; EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D; EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D; EPA 625	4-Chloroaniline
GC/MS	EPA 8270C/D; EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D; EPA 625	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D; EPA 625	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D; EPA 625	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D; EPA 625	Acenaphthene
GC/MS	EPA 8270C/D; EPA 625	Acenaphthylene
GC/MS	EPA 8270C/D; EPA 625	Acetophenone
GC/MS	EPA 8270C/D; EPA 625	Aniline
GC/MS	EPA 8270C/D; EPA 625	Anthracene
GC/MS	EPA 8270C/D; EPA 625	Atrazine
GC/MS	EPA 8270C/D; EPA 625	Benzaldehyde
GC/MS	EPA 8270C/D; EPA 625	Benzidine
GC/MS	EPA 8270C/D; EPA 625	Benzo(a)anthracene
GC/MS	EPA 8270C/D; EPA 625	Benzo(a)pyrene
GC/MS	EPA 8270C/D; EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D; EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Benzoic Acid
GC/MS	EPA 8270C/D; EPA 625	Benzyl alcohol
GC/MS	EPA 8270C/D; EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D; EPA 625	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D; EPA 625	bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D; EPA 625	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D; EPA 625	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D; EPA 625	Caprolactam
GC/MS	EPA 8270C/D; EPA 625	Carbazole

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D; EPA 625	Chrysene
GC/MS	EPA 8270C/D; EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D; EPA 625	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D; EPA 625	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D; EPA 625	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D; EPA 625	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D; EPA 625	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D; EPA 625	Fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Fluorene
GC/MS	EPA 8270C/D; EPA 625	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D; EPA 625	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D; EPA 625	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D; EPA 625	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D; EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D; EPA 625	Isophorone
GC/MS	EPA 8270C/D; EPA 625	Naphthalene
GC/MS	EPA 8270C/D; EPA 625	Nitrobenzene
GC/MS	EPA 8270C/D; EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D; EPA 625	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D; EPA 625	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D; EPA 625	Pentachlorophenol
GC/MS	EPA 8270C/D; EPA 625	Phenanthrene
GC/MS	EPA 8270C/D; EPA 625	Phenol
GC/MS	EPA 8270C/D; EPA 625	Pyrene
GC/MS	EPA 8270C/D; EPA 625	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Chlordane (n.o.s.)
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)

Non-Potable Water		
Technology	Method	Analyte
HPLC/UV	EPA 8330A/B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A/B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A/B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A/B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Nitroguanidine
HPLC/UV	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B/C	TPH DRO
GC/FID	EPA 8015B/C	TPH ORO
GC/FID	EPA 8015B/C	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C; EPA 200.7	Aluminum
ICP	EPA 6010B/C; EPA 200.7	Antimony
ICP	EPA 6010B/C; EPA 200.7	Arsenic
ICP	EPA 6010B/C; EPA 200.7	Barium

Non-Potable Water		
Technology	Method	Analyte
ICP	EPA 6010B/C; EPA 200.7	Beryllium
ICP	EPA 6010B/C; EPA 200.7	Boron
ICP	EPA 6010B/C; EPA 200.7	Cadmium
ICP	EPA 6010B/C; EPA 200.7	Calcium
ICP	EPA 6010B/C; EPA 200.7	Chromium, total
ICP	EPA 6010B/C; EPA 200.7	Cobalt
ICP	EPA 6010B/C; EPA 200.7	Copper
ICP	EPA 6010B/C; EPA 200.7	Iron
ICP	EPA 6010B/C; EPA 200.7	Lead
ICP	EPA 6010B/C; EPA 200.7	Magnesium
ICP	EPA 6010B/C; EPA 200.7	Manganese
CVAA	EPA 7470A; EPA 245.1	Mercury
ICP	EPA 6010B/C; EPA 200.7	Molybdenum
ICP	EPA 6010B/C; EPA 200.7	Nickel
ICP	EPA 6010B/C; EPA 200.7	Potassium
ICP	EPA 6010B/C; EPA 200.7	Selenium
ICP	EPA 6010B/C; EPA 200.7	Silver
ICP	EPA 6010B/C; EPA 200.7	Sodium
ICP	EPA 6010B/C; EPA 200.7	Strontium
ICP	EPA 6010B/C; EPA 200.7	Thallium
ICP	EPA 6010B/C; EPA 200.7	Tin
ICP	EPA 6010B/C; EPA 200.7	Titanium
ICP	EPA 6010B/C; EPA 200.7	Vanadium
ICP	EPA 6010B/C; EPA 200.7	Zinc
IC	EPA 300.0	Bromide
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Sulfate
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride

Non-Potable Water		
Technology	Method	Analyte
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
Colorimetric	SM 4500-NO2 B-2011	Nitrite as N
Titration	SM 2320 B-2011	Alkalinity
Colorimetric	SM 4500-NH3 G-2011	Ammonia
Probe	SM 5210 B-2011	BOD
Probe	SM 5210 B-2011	CBOD
Colorimetric	EPA 410.4	COD
UV/Vis	EPA 7196A SM 3500-Cr B-2011	Hexavalent Chromium
Colorimetric	EPA 353.2 MOD	Nitrocellulose
Colorimetric	EPA 353.2	Nitrate/Nitrite
Gravimetric	EPA 1664A	Oil and Grease
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500-S2 F-2011	Sulfide
UV/Vis	SM 4500-P B5-2011	Total Phosphorus (as P)
UV/Vis	SM 4500-P E-2011	Ortho-Phosphate (as P)
TOC	EPA 9060A; SM 5310 C-2011	Total Organic Carbon
Gravimetric	SM 2540 C-2011	TDS
Gravimetric	SM 2540 D-2011	TSS
Colorimetric	EPA 9012A/B SM 4500-CN G-2011	Cyanide
Physical	EPA 1010A	Ignitability / Flashpoint
Physical	EPA 9095B	Paint Filter
Probe	EPA 9040B/C SM 4500-H+ B-2011	pH(Corrosivity)
Preparation	Method	Type
Preparation	EPA 1311	TCLP
Preparation	EPA 3005A	Metals digestion
Preparation	EPA 3010A	Metals digestion
Preparation	EPA 3510C	Organics Liquid Extraction
Preparation	EPA 5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Di-isopropyl ether
GC/MS	EPA 8260B	ETBE
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B	m,p-Xylenes
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	tert-Amyl methyl ether
GC/MS	EPA 8260B	tert-Butyl alcohol
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol/4-Methylphenol
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetophenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Chlordane (n.o.s.)
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroguanidine
HPLC/UV	EPA 8330A	PETN

Solid and Chemical Materials		
Technology	Method	Analyte
HPLC/UV	EPA 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330B	Nitrobenzene
HPLC/UV	EPA 8330B	Nitroguanidine
HPLC/UV	EPA 8330B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B/C	TPH DRO
GC/FID	EPA 8015B/C	TPH ORO
GC/FID	EPA 8015B/C	TPH GRO
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total



Solid and Chemical Materials		
Technology	Method	Analyte
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7471A/B	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
UV/Vis	EPA 7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	EPA 353.2 MOD	Nitrocellulose

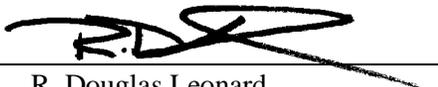


Solid and Chemical Materials		
Technology	Method	Analyte
Colorimetric	EPA 9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Physical	EPA 1010A	Ignitability/Flashpoint
Titration	EPA 9034	Sulfide
Probe	EPA 9045C/D	pH (Corrosivity)
Preparation	Method	Type
Preparation	EPA 1311	TCLP
Preparation	EPA 1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	EPA 3050B	Metals Digestion
Preparation	EPA 3546	Organics Microwave Extraction
Preparation	EPA 3550B/C	Organics Sonication
Preparation	SM 2540 B-1997	Percent Solids (Percent Moisture)
Preparation	EPA 5035 /A	Purge and Trap Solid

Notes:

- 1) This laboratory offers commercial testing service.

Approved By: _____


R. Douglas Leonard
Chief Technical Officer

Date: January 30, 2013

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