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FINAL TIER II SAMPLING AND ANALYSIS PLAN SITE 4 ASSESSMENT ADDENDUM NAS WHITING FIELD FL

5/1/2014

TIER II SAMPLING AND ANALYSIS (SAP) PLAN

SITE 4 – SITE ASSESSMENT ADDENDUM
NAVAL AIR STATION WHITING FIELD (NASWF)
MILTON, FLORIDA
EPA ID NO. FL2170023244

FINAL

Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southeast
Building 135 N, P.O. Box 30
Jacksonville, FL 32212-0030

Contract Number N62470-11-D-8013

CTO JM57

Prepared by:

Resolution Consultants
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May 2014

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SAP WORKSHEET #1: TITLE AND APPROVAL PAGE

TIER II SAMPLING AND ANALYSIS PLAN

Site 4 – Site Assessment Addendum
NASWF, Milton, Florida

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Review Signature:	Task Order Manager, Alex Eddington	20-Jan-2014 Date
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Other Approval Signature: (as required)	FDEP Federal Facilities PM, John Winters	5/30/14 Date

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EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) was prepared to the document the proposed remedial alternative evaluation and optimization to be performed at Department of Navy Environmental Restoration Program Site 4, AVGAS Tank Sludge Disposal Area, located at Naval Air Station Whiting Field (NASWF) in Milton, Florida. This SAP was also prepared in accordance with the requirements of the Intergovernmental Data Quality Task Force (IDQTF) *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Manual* (IDQTF, March 2005a), Environmental Protection Agency (EPA) publication number *EPA-505-B-04-900A* or United States Department of Defense (DoD) publication number *DTIC ADA 427486,* associated workbooks, *Part 2A: Workbook for UFP-QAPPs* (IDQTF, March 2005b), EPA publication number *EPA-505-B-04-900C* or DoD publication numbers *DTIC ADA 427486,* and companion document *UFP-QAPP, Part 2B: Quality Assurance/Quality Control (QA/QC) Compendium: Minimum QA/QC Activities* (IDQTF, March 2005c), EPA publication number *EPA-505-B-04-900B* or DoD publication number *DTIC ADA 426957* and the DoD *Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2* (DoD, October 2010).

Following the *Naval Facilities Engineering Command (NAVFAC) Tiered Approach for Developing Sampling and Analysis Plans* letter from the Department of the Navy dated 3 June 2011, this SAP was prepared to follow NAVFAC's Tier II UFP-QAPP template, developed to allow for an effective and efficient process for smaller and less complex sites such as Site 4. The Tier II template contains a smaller subset of the full 37-worksheet UFP-QAPP format. At the beginning of each section within this SAP, and in the section heading itself, the corresponding worksheet number from the UFP-QAPP Manual is shown for cross-reference.

Site 4 is in the industrial area within NASWF. Prior to 1992, Site 4 was known as Site 1467, referencing the former underground storage tank (UST) system. The UST site was renamed as "Site 4" when it moved from the UST Program to the CERCLA Program, as a result of chlorinated compound detection. Site 4 is identified as the AVGAS Tank Sludge Disposal Area, based upon UST cleaning practices reportedly used during the 1943 to 1968 operational period. Potential sources of petroleum hydrocarbons which are within or adjacent to Site 4 boundaries include former USTs, aboveground storage tanks (ASTs), abandoned AVGAS underground fuel pipelines, abandoned Jet Petroleum #5 (JP-5) pipelines, and abandoned underground AVGAS aircraft fuel hydrant systems.

Assessment activities proposed in this SAP will occur within three areas of Site 4, the North Field fuel distribution system; the northwest portion of the site; and the pipeline junction area. The activities proposed in this SAP are being conducted with the following objectives for each area to be further investigated:

North Field Fuel Distribution System

1. Improve the Navy's understanding of the presence or absence of residual fuel along the pipeline and hydrants within the vadose zone.
2. Complete a Site Assessment Report (SAR) Addendum for the northwest portion and north field fuel distribution system, including determination of presence or absence of impacted soil along the pipeline and hydrants.

Northwest Portion of Site 4

1. Define the nature and extent of Site 4 contamination in the northwestern portion of the site.
2. Address the uncertainties of the potential source area(s).
3. Establish a present day baseline of Site 4 vadose zone, perched and surficial groundwater conditions for remedial action optimization.
4. Complete a Site Assessment Report Addendum for the northwest portion and north field fuel distribution system, including the current site conditions and updates to the Conceptual Site Model (CSM) and the human health and ecological risk assessments, if necessary.

Pipeline Junction Area

1. Define the nature and extent of Site 4 contamination in the area of the pipeline junction.
2. Address the uncertainties of the source area(s).
3. Establish a present day baseline of pipeline junction vadose zone, lower perched and surficial groundwater conditions for remedial action optimization. Upper perched groundwater is not expected in this area because the clay aquitard identified in the vicinity of the ASTs does not extend laterally to the pipeline junction area as determined from soil borings for site monitoring wells.
4. Complete a Remedial Action Plan (RAP) Addendum for the pipeline junction area, including the current site conditions and updates to the CSM; the human health and ecological risk assessments, if necessary; and the results of a Remedial Alternatives Analysis (RAA).

Following the completion of the proposed activities in this SAP, an RAA may be performed to address a single primary question:

> If site-related contaminants are determined to pose an unacceptable threat to human health or the environment, what response action(s) should be implemented to reduce or eliminate the threat, while complying with applicable or relevant and appropriate requirements (ARARs) and satisfying the other criteria established in Chapter 62-780 Florida Administrative Code (FAC)?

With these questions answered, the remedial alternative can be evaluated and optimized in support of the exit strategy for this site.

A site-specific CSM that summarizes the presently known site conditions for Site 4 is presented in Section 4.0 (**Worksheet #10**). This CSM includes sections on the site history, physical setting characteristics, and summary of previous investigations. The CSM for the site will be validated and further refined based on data and information collected during this proposed effort.

This SAP was completed under the NAVFAC SE Contract No. N62470-11-D-8013, Contract Task Order (CTO) No. JM57.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
ARARs	applicable or relevant and appropriate requirements
ASTs	aboveground storage tanks
bls	below land surface
BNAs	Base Neutral Acid Compounds
BTEX	benzene, toluene, ethylbenzene, and total xylene
CAR	Contamination Assessment Report
CCV	Continuing Calibration Verification
CH2M HILL	CH2M HILL Constructors, Inc.
COCs	chemicals of concern
COPCs	chemicals of potential concern
CSM	Conceptual Site Model
CTO	Contract Task Order
DBCP	1,2-dibromo-3-chloropropane
DDT	Dichlorodiphenyltrichloroethane
DoD	Department of Defense
DPT	Direct Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
ECD	Electron Capture Detector
EDB	1,2-dibromoethane
EICP	Extracted Ion Current Profile
ELAP	Environmental Laboratory Accreditation Program
ENCO	Environmental Conservation Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
EPM	Exposure Pathway Model
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FEAD	Facility Engineering and Acquisition Division
FID	Flame Ionization Detector
FL-PRO	Florida Petroleum Residual Organic
FTM	Field Task Manager
GC	Gas Chromatograph
GCTLs	Groundwater Cleanup Target Levels
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HURCON	Hurricane Condition
ICAL	Initial Calibration

ICP-AES	inductively coupled plasma atomic emission spectroscopy
ICV	Initial Calibration Verification
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
JP-5	Jet Propulsion-5
KAG	Kerosene Analytical Group
LANT	Atlantic
LCS	Laboratory Control Sample
LNAPL	light non-aqueous phase liquid
LOD	Limit of Detection
LOQ	Laboratory Quantitation Limit
MB	method blank
MCLs	Maximum Contaminant Levels
mg/kg	milligrams per kilogram
MIP	Membrane Interphase Probe
MPC	Measurement Performance Criteria
MSA	method of standard additions
ms/msd	Matrix Spike/Matrix Spike Duplicate
MS	mass spectrometer
msl	mean sea level
MTBE	Methyl tertiary-butyl ether
NA	Not Applicable
NAD	North American Datum
NADC	Natural Attenuation Default Concentration
NAS	Naval Air Station
NASWF	Naval Air Station Whiting Field
NAVFAC	Naval Facilities Engineering Command
NAVFEC SE	Naval Facilities Engineering Command Southeast
NFA	No Further Action
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute for Occupational Safety and Health
NIRIS	Naval Installation Restoration Information Solution
OSHA	Occupational Safety and Health Administration
PAHs	Polynuclear Aromatic Hydrocarbons
PALs	Project Action Levels
PELs	Permissible Exposure Limits
PID	Photoionization Detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride

QA	Quality Assurance
QAM	Quality Assurance Manager
QC	Quality Control
QSM	Quality Systems Manual
RAA	Remedial Alternatives Analysis
RAP	Remedial Action Plan
RELs	Recommended Exposure Limits
RI	Remedial Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
RPM	Remedial Program Manager
RSLs	Regional Screening Levels
RT	Retention Time
SAP	Sampling and Analysis Plan
SAR	Site Assessment Report
SCTLs	Soil Cleanup Target Levels
SIM	Selective Ion Monitoring
SOPs	Standard Operating Procedures
SOW	Statement of Work
SSO	Site Safety Officer
SVE	soil vapor extraction
SVOCs	Semi-Volatile Organic Compounds
TBD	To Be Determined
TOM	Task Order Manager
TPH	Total Petroleum Hydrocarbon
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TRPH	Total Recoverable Petroleum Hydrocarbons
TtNUS	Tetra Tech Nuclear Utility Service, Inc.
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
µg/L	micrograms per liter
USGS	United States Geologic Survey
UST	underground storage tank
VOC	Volatile Organic Compound
WRS	WRS Infrastructure & Environment, Inc.

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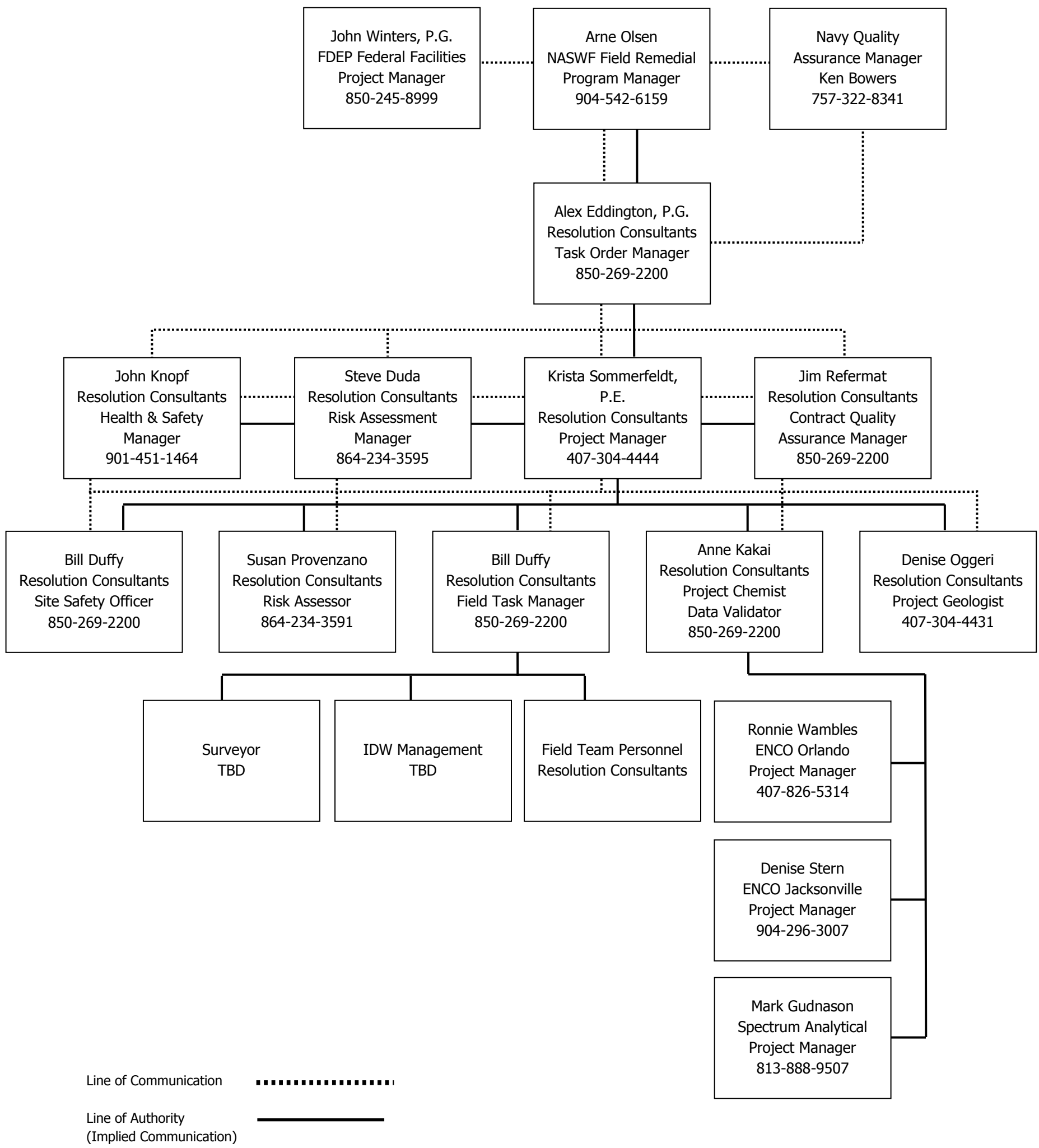
1.0 SAP Worksheet #5: Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1 – Worksheet #5)



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2.0 SAP Worksheet #6: Communication Pathways

(UFP-QAPP Manual Section 2.4.2 – Worksheet #6)

This worksheet describes the pathways and modes of communication that will be used during the project. Included are points of contact for resolving sampling and analysis problems; distributing preliminary, screening, and definitive level data to managers, users, and the public; and procedures for soliciting concurrence for project modifications. Procedures for soliciting and/or obtaining approval between project personnel, between different contractors, and between samplers and laboratory staff are described. Timing is the maximum amount of time allowed for the communication event to take place. Pathways describe the type of communication such as email, phone, etc.

Table 2-1: Communication Pathways Table

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Point of contact for regulatory agency	Navy Remedial Program Manager (RPM)	Arne Olsen	904-542-6159	The Navy RPM informs regulatory agency of work progress on a periodic basis.
Modification to this SAP, changes in Navy management	Florida Department of Environmental Protection (FDEP) Federal Facilities Project Manager (PM)	John Winters	850-245-8999	The FDEP Federal Facilities PM will be notified by the Navy RPM of pending modifications to the SAP or Navy management changes through written correspondence for documentation purposes. The FDEP Federal Facilities PM will respond with comments or approval of the modifications to the Navy RPM within the timeframe agreed upon during the initial notification of pending modifications.
Project Management	Task Order Manager (TOM)	Alex Eddington	850-269-2200	The TOM will approve all communication to Naval Air Station Whiting Field's (NASWF) RPM, including notification of SAP modifications or field deviations by close-of-business of the following day. The TOM will provide monthly status reports to the RPM and NAVFAC SE.
Site Management	PM	Krista Sommerfeldt	407-304-4444	The PM will assist the TOM with daily project management and activities and communicate routinely with both the TOM and project team.
Quality Assurance/Quality Control (QA/QC)	Quality Assurance Manager (QAM)	Jim Refermat	850-269-2200	The QAM will communicate with project quality personnel to perform specified QA and QC activities and report to project and program management. Issues and non-conformances and corrective actions will be reported to the PM within one day of nonconformance issuance.
Progress Reports	Resolution Consultants Field Task Manager (FTM) Resolution Consultants TOM Navy RPM	Bill Duffy Alex Eddington Arne Olsen	850-269-2200 850-269-2200 904-542-6159	FTM verbally informs the TOM on a daily basis about field updates. TOM provides a weekly update to the RPM, either by phone message and/or email, each Friday afternoon field activities are taking place.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Gaining Site Access	Resolution Consultants FTM Naval Air Station (NAS) Whiting Installation Restoration Program (IRP) PM	Bill Duffy Mike Pattison	850-269-2200 850-623-7017	The Resolution Consultants FTM will contact the NAS Whiting point of contact verbally or via email at least three 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 FTM NAS Jacksonville IRP PM	Bill Duffy Mike Pattison	850-269-2200 850-623-7017	The Resolution Consultants FTM will coordinate verbally or via email with NAS Whiting point of contact 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 FTM/Site Safety Officer (SSO) Resolution Consultants TOM Resolution Consultants HSM Navy RPM NAS Jacksonville IRP PM	Bill Duffy Alex Eddington John Knopf Arne Olsen Mike Pattison	850-269-2200 850-269-2200 901-937-4255 904-542-6159 850-623-7017	The responsible party verbally informs the FTM, TOM, and subcontractors within one hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an email to the Project Team within 24 hours. If a subcontractor is the responsible party, the subcontractor PM must verbally inform the Resolution Consultants SSO within 15 minutes, and the Resolution Consultants SSO will then follow the procedure listed above.
SAP Changes in the Field	Resolution Consultants FTM Resolution Consultants TOM Navy RPM	Bill Duffy Alex Eddington Arne Olsen	850-269-2200 850-269-2200 904-542-6159	FTM informs TOM verbally within same day; TOM informs Navy RPM via email within 24 hours; TOM sends a concurrence letter to RPM, if warranted, within seven calendar days and RPM signs the letter within five business days of receipt. Scope change is to be implemented before work is executed. Document the change on a field task modification request form (within two business days) or SAP amendment (within timeframe agreed to by Project Team).
Field Corrective Actions	Resolution Consultants FTM Resolution Consultants TOM Navy RPM	Bill Duffy Alex Eddington Arne Olsen	850-269-2200 850-269-2200 904-542-6159	FTM informs TOM verbally within same day; TOM informs Navy RPM via email within 24 hours that corrective actions have been implemented. Corrective actions will be documented in weekly progress reports.
Recommendations to stop work and initiate work upon corrective action	Resolution Consultants FTM Resolution Consultants TOM Resolution Consultants QAM Navy RPM	Bill Duffy Alex Eddington Jim Refermat Arne Olsen	850-269-2200 850-269-2200 850-269-2200 904-542-6159	FTM informs TOM verbally within same day; TOM informs Navy RPM via email within 24 hours that corrective actions have been implemented. Corrective actions will be documented in weekly progress reports.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Coordination and communication of fieldwork activities related to data collection	Resolution Consultants FTM	Bill Duffy	850-269-2200	Communicate relevant field information to the PM and Project Chemist daily during field activities by phone or email.
Deviations away from planned field activities	Resolution Consultants FTM	Bill Duffy	850-269-2200	Within one day of discovering site conditions dictate a deviation to the proposed field activities, the FTM will notify the PM verbally or by email, so the impact of the deviation on the project quality objectives can be determined.
Change in Site conditions	Field Task Manager/Site Safety Officer (FTM/SSO)	Bill Duffy	850-269-2200	Within one business day, communicate with PM and Health and Safety Manager any change in site conditions that affect or could affect safe completion of assigned tasks.
Coordination with laboratory for field activities	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	The Project Chemist will contact the laboratory by email to order the necessary sample containers and appropriate shipping for delivery on site before field sampling begins and throughout the project. The Project Chemist will also notify the laboratory of the expected turn-around-time for sampling analysis before field sampling begins.
Daily Chain-of-Custody reports and shipping documentation	Field Team Personnel	To Be Determined (TBD)	850-269-2200	Chains-of-Custody and shipping records will be submitted via fax or email to the PM and FTM at the end of each day that samples are collected for evaluation.
Sample shipment coordination with laboratory	Resolution Consultants FTM	Bill Duffy	850-269-2200	Coordinate with the laboratory on days of sample shipment to inform them of anticipated shipment arrival dates, including number of coolers shipped. Provide laboratory with Chains-of-Custody, shipment tracking numbers, and any other pertinent information, including verification of expected turn-around-time for sampling analysis.
Laboratory results	Environmental Conservation Laboratories, Inc. (ENCO) Orlando PM ENCO Jacksonville PM Spectrum Analytical Inc. PM Resolution Consultants Project Chemist	Ronnie Wambles Denise Stern Mark Gudnason Anne Kakai	407-826-5314 904-296-3007 813-888-9507 850-269-2200	Laboratory results will be reported to the Project Chemist in accordance with the laboratory Statement of Work (SOW).
Reporting laboratory data quality issues	ENCO Orlando PM ENCO Jacksonville PM Spectrum Analytical Inc. PM Resolution Consultants Project Chemist	Ronnie Wambles Denise Stern Mark Gudnason Anne Kakai	407-826-5314 904-296-3007 813-888-9507 850-269-2200	QA/QC issues that potentially affect data usability will be reported by the Laboratory PM to the Project Chemist by email within one business day.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Reporting serious laboratory issues	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	Within one business day of identification of a serious laboratory issue, the Project Chemist will notify the TOM and Navy RPM. The Navy RPM will engage the NAVFAC Atlantic (LANT) chemist to ensure the issues with this project can be evaluated to determine impact to other Department of Defense (DoD) projects.
Field and analytical corrective actions	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	The Project Chemist will immediately (no later than one business day) notify the QAM by email of field or analytical procedures that were not performed in accordance with the planning documents. The Project Chemist, in coordination with the QAM, will complete documentation of the nonconformance and corrective actions (including schedule) to be taken. The Project Chemist will verify that the corrective actions have been implemented according to schedule stated in the corrective action.
Release of analytical data	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	The Project Chemist will review faxed/emailed data (within five business days of receipt) to verify that data quality objectives (DQOs) are met as described in the planning documents before the data are released. Analytical data will be released to the PM (or designee) within one business day after the Project Chemist has verified that the data are in accordance with the project requirements.
Data validation issues	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	The Project Chemist will coordinate with the analytical laboratory to ensure data packages provided by the laboratory are complete and allow for full validation. All data validation issues will be reported to the QAM by the Project Chemist by telephone or email within one business day. The Project Chemist will generate memos to the laboratory with regard to incomplete deliverables or discrepancies within five business days of review while keeping the QAM informed of any significant data quality issues. The issue(s) will also be reported to the PM within one business day by telephone or email through the Project Chemist.
Project Assessments	Resolution Consultants TOM	Alex Eddington	850.269.2200	The TOM will provide the findings resulting from various Project Assessments to the Navy RPM within one week of receipt. If any findings show ineffective corrective actions or significant quality issues, the TOM will contact the Navy RPM within 1 business day of notification. The Navy RPM and TOM will provide notification of any significant assessment findings to the organizational partners/stakeholders (NASWF, NAVFAC LANT QA Manager, and FDEP) within 1 business day.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Approval and notification of SAP procedure deviation during field activities	Resolution Consultants TOM	Alex Eddington	850-269-2200	Within one business day of identification of a SAP deviation, the PM will notify the TOM and Navy RPM of the pending deviation and whether it is considered minor or significant. A minor deviation would require the approval of the PM, TOM, and QAM within one business day of notification. A significant deviation would require the approval of the organizational partners/stakeholders (NASWF, NAVFAC SE, U.S. Environmental Protection Agency (EPA), and FDEP) within the timeframe agreed upon during the initial notification of pending deviation. The PM would notify the FTM within one business day of receiving approval. The PM would ensure the deviation and approval is documented and incorporated into the project files via a field activity report within five business days (e.g., remedial investigation, remediation verification report, etc).
SAP modifications	Resolution Consultants PM	Krista Sommerfeldt	407-304-4444	Any modifications to the Final SAP will require the PM to prepare amended worksheets and distribute the revised SAP (or revision pages) for review and comment (within the timeframe agreed upon during the initial notification of pending modifications) before the activities begin.
Address comments on Work Plan revision (or revision pages), prepare final revision (or revision pages), and submit final revision (or revision pages) of the SAP	Resolution Consultants PM	Krista Sommerfeldt	407-304-4444	The PM will provide responses to comments received on revised SAP (or revision pages) within two weeks of receipt, incorporate comments into the document, and submit the final revision (or revision pages) of the SAP within one month of receiving comments.
Data usability	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	The Project Chemist will notify the PM and QAM of any data usability issues that are identified during data validation immediately. The FTM will notify the PM and QAM of any field conditions, sample collection techniques, or sample shipping issues that impact data usability at the end of the day of occurrence or earlier as deemed appropriate.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of non-usable data	ENCO Laboratory PM	Ronnie Wambles	407-826-5314	If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via email) the Resolution Consultants project chemist within one business day of when the issue is discovered.
	Resolution Consultants Project Chemist	Anne Kakai	850-269-2200	The Resolution Consultants project chemist will notify (verbally or via email) the Resolution Consultants TOM within one business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the effected samples. If a Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process, the TOM will be notified verbally or via email within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data.
	Resolution Consultants TOM Navy RPM	Alex Eddington Arne Olsen	850-269-2200 904-542-6159	The Resolution Consultants TOM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met. The Resolution Consultants TOM will notify (verbally or via email) 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 may, at their discretion, contact the Navy project chemist for assistance in problem resolution. Such notification will be made within one business day of when the issue is discovered. The Navy RPM will notify the EPA and FDEP when any significant corrective action is taken.

The TOM and PM will incorporate any document modifications into the Final SAP for inclusion into the administrative record. The document amendment history for this SAP is provided in **Appendix A**.

3.0 SAP Worksheet #9: Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1 – Worksheet #9)

The information presented below reflects the first scoping session for the development of this SAP.

Table 3-1: Scoping Session 1, 28 August 2013

Project Name: Site 4
Projected Date(s) of Sampling: Winter 2013
CTO Manager: Alex Eddington (Resolution Consultants)

Site Name: Site 4 AVGAS Tank Sludge Disposal Area
Site Location: NASWF, Milton, Florida

Date of Session: 28 August 2013
Scoping Session Purpose: Partnering Team Meeting

Name	Title	Affiliation	Phone #	Email Address	Project Role
Arne Olsen	Env. Engineer	NAVFAC SE	904.542.6159	arne.olsen@navy.mil	RPM
Mike Pattison	Env. Engineer	NASWF	850.623.7017	michael.pattison@navy.mil	NASWF Coordinator
John Winters	Professional Geologist 1	FDEP Federal Programs Section	850.245.8999	john.winters@dep.state.fl.us	RPM
Craig Benedikt	Florida Remedial Section	EPA, Region 4	404.562.8555	benedikt.craig@epa.gov	Partnering Team Member
Alex Eddington	Sr. Geologist	Resolution Consultants	850.269.2200	alex.eddington@aecom.com	TOM
Mike Jaynes	TOM	Tetra Tech NUS		mike.jaynes@tetratech.com	Technical Support
Amy Twitty	Engineer	CH2M HILL			Partnering Team Member
Kim Walker	Tier II Link				Tier II Link
Nancy Rouse	Facilitator	The Management Edge			Partnering Team Facilitator
Libby Claggett	Partnering Meeting Scribe	Tetra Tech NUS			Partnering Team Scribe

Comments/Decisions: The NASWF Partnering Team met on 28 August 2013. The Preliminary Draft Tier II SAP Worksheets Nos. 10, 11, 15, and 17 were distributed to the team for review prior to the meeting. Proposed areas of assessment in the Site 4 SAP were discussed and include the North Field Fuel Distribution System, the northwestern portion of Site 4, and the pipeline junction area. The Draft Meeting Minutes are provided in **Appendix B**.

Action Items: No action items were generated.

Consensus Decisions:

Decisions discussed in this section were derived through consensus among participating team members during the 28 August 2013 Scoping Session.

1. John Winters requested that Site 4 activities be discussed during Manager's Meetings to keep up with work being performed. Arne commented that a schedule will be developed and informational meetings will be held with the Partnering Team to discuss information collected at Site 4.

4.0 SAP Worksheet #10: Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)

The Conceptual Site Model (CSM) for Site 4 will be validated and further refined based on data and information collected during this proposed effort. Because assessment activities presented in this SAP will occur within three areas of Site 4, separate reports will be prepared based on the phase of each area. The updated CSM for Site 4 will be presented in both the Site Assessment Report (SAR) Addendum Report for Site 4 (which includes the North Field fuel distribution system and the northwest portion of the site) and the Remedial Action Plan (RAP) Addendum (which includes the pipeline junction area). This evolving CSM is intended to be a comprehensive and holistic description of Site 4 presented at a level of detail necessary to meet the data quality objectives (DQOs) of the three areas presented in this SAP.

4.1 GENERAL DESCRIPTION

4.1.1 Location

NASWF is located in Florida's northwest coastal area approximately seven miles north of Milton and 20 miles northeast of Pensacola (**Figure 4-1**). NASWF occupies 3,490 acres in north-central Santa Rosa County with easement rights to an additional 457 acres. The station is divided into a North Field used for fixed wing training, and a South Field used for helicopter training.

Site 4 AVGAS Tank Sludge Disposal Area (the site) is located south and east of North Field (**Figure 4-2**) and includes stretches of USS Saratoga Street and USS Hornet Street within the designated site boundaries. USS Enterprise Street is located just southwest of the site. The site area is approximately 14.4 acres of land and is covered in roads, buildings, base support infrastructure, and grass/wooded areas. The approximate geographic coordinates of the site are 30° 43' 00" latitude and 87° 01' 13" longitude. The site lies within the northeastern part of Section 2 in Township 2 North, and Range 28 West, as shown on the Milton North, Florida, United States Geologic Survey (USGS) Quadrangle Map (USGS, 1987; **Figure 4-3**).

4.1.2 Site Layout

Figure 4-4 shows the revised Site 4 boundaries relative to potential sources of petroleum hydrocarbons which are within or adjacent to Site 4 boundaries; including former underground storage tanks (USTs), aboveground storage tanks (ASTs), abandoned AVGAS underground fuel pipelines, abandoned Jet Petroleum #5 (JP-5) pipeline, and abandoned underground AVGAS aircraft fuel hydrant systems. The site boundaries were adjusted during the October 2011 NAS Whiting Field Partnering Team meeting to cover a broader area than previously depicted. The abandoned underground AVGAS pipeline zigzags through Site 4 in a northwest to southeast direction. Abandoned underground AVGAS aircraft fuel hydrant delivery systems are located to the

north and west of Site 4. The northern fuel hydrant system is currently covered by a flight line parking apron. The western boundary separates Site 4 from adjacent IRP Site 32 - the North Field Hangar, which included four USTs that were removed in 2000, and from the western fuel hydrant area. The southern border was drawn to include the abandoned AVGAS and abandoned JP-5 pipeline junction. The JP-5 pipeline runs parallel to USS Hornet Street.

A 3-dimensional rendering of the CSM is shown on **Figure 4-5**. This figure depicts the site surface features and the following site characteristics which are discussed in this CSM, to include potential releases based on site history, geology and hydrogeology, and potential receptor and exposure pathways.

4.2 RECORDS REVIEW

This CSM was prepared after a search and review of Naval Installation Restoration Information Solution (NIRIS), the Florida DEP OCULUS Electronic Document Management System, and the NASWF Administrative Record File (1983 through 2000) for all records pertaining to Site 4 investigation and remedial activities. All document references are listed in Section 13.0.

4.3 SITE HISTORY

4.3.1 North Field Fuel Distribution System and the Northwest Portion of the Site

Prior to 1992, Site 4 was known as Site 1467, referencing the former UST system. The UST site was renamed as "Site 4" when it moved from the UST Program to the CERCLA Program, as a result of chlorinated compound detection. Site 4 is identified as the AVGAS Tank Sludge Disposal Area, based upon UST cleaning practices reportedly used during the 1943 to 1968 operational period. Approximately every four years during the operational period, the bottom sludge was removed from the tanks and buried at shallow depths adjacent to the tanks. Records of any spills or leaks at Site 4 are not known. Petroleum contamination (staining and odors present) was observed during the removal of the USTs in 1992 (Tetra Tech Nuclear Utility Service, Inc. [TtNUS], 1999).

The former UST facility (designated as UST Site 1467) contained eight 25,000-gallon steel USTs (Tank IDs: 1467, 1467-A, -B, -C, -D, -E, -F, and -G) and one 15,000-gallon steel UST (Tank ID: 1467-H). AVGAS was piped from the storage system (Site 4 USTs) to the dispensing or delivery location (flight line hydrant area). According to historical documents, these nine USTs were installed in 1943. The USTs were labeled from east to west: 1467, 1467-A, -B, -C, -H, -D, -E, -F, and -G. The eight 25,000-gallon steel tanks initially held AVGAS and the 15,000-gallon tank (1467-H) initially held 80 octane motor gasoline (MOGAS). Sometime between 1968 and 1973, the contents of two 25,000-gallon USTs (1467 and 1467-A) were switched from AVGAS to unleaded gasoline and diesel, respectively.

Between 1973 and 1984, six of the 25,000-gallon USTs (1467, 1467-A, -B, -C, -D, and -E) were filled with water, leaving the remaining two 25,000-gallon USTs (1467-F and -G) and the single 15,000-gallon UST (1467-H) in use for storage of diesel, unleaded gasoline, and contaminated AVGAS, respectively. In 1992, as documented in the UST closure report (Sub-Tech, Inc., 1992), six of the 25,000-gallon USTs (1467, 1467-A, -B, -C, -D, and -E) and the 15,000-gallon UST (1467-H) were excavated and removed, and a Discharge Reporting Form was submitted to Florida Department of Environmental Protection (FDEP) for each of the USTs removed. USTs 1467-F and 1467-G were reportedly not removed and remained in use for storage of diesel and unleaded gasoline. The bulleted list below is a chronology of Site 4 USTs.

UST Chronology

1943 - Nine USTs installed (eight 25,000-gallon steel USTs and one 15,000-gallon steel UST).

1943-1968 – The nine USTs were cleaned every four years and tank bottom sludge was buried immediately adjacent to the tanks. The quantity of sludge disposed in this manner was grossly estimated at 1,000 to 2,000 gallons (Geraghty & Miller, Inc. 1986).

1955 - Schematic drawing depicts eight 25,000-gallon AVGAS USTs and one 15,000-gallon 80 octane motor gasoline (MOGAS) UST (**Appendix B**, Figure 2-1 presented in the Site Assessment Report [SAR], CH2M HILL Constructors, Inc. [CH2M HILL], June 2013).

1962 - Layout of AVGAS Fuel System at North and South Whiting Field (**Appendix B**, Figure 2-2 presented in the SAR [CH2M HILL, June 2013]).

1973 - As-built drawing depicting unleaded gasoline and diesel stored in two 25,000-gallon USTs (1467 and 1467-A, respectively) (**Appendix B**, Figure 2-3 presented in the SAR [CH2M HILL, June 2013]).

1984 - Six 25,000-gallon USTs are reported as being filled with water, leaving two 25,000-gallon USTs (1467-F and -G) and one 15,000-gallon UST (1467-H) in use for storage of gasoline, diesel and contaminated jet fuel respectively (Geraghty & Miller, Inc., 1986).

November 1989 - installation of compliance monitoring wells (25-foot total depth) around USTs 1467-F, -G and -H.

1992 - Six of the 25,000-gallon USTs (1467, 1467-A, -B, -C, -D, and –E) and the 15,000-gallon UST (1467-H) were removed and discharge reporting forms were submitted to FDEP (Sub-Tech, Inc., 1992). USTs 1467-F and 1467-G were reportedly not removed and remained in use for storage of diesel and unleaded gasoline. The 1992 *UST Closure Report* contradicted the 1986 *Verification*

Study Assessment of Potential Ground-Water Pollution (Geraghty & Miller, Inc.) and identified the 15,000-gallon UST 1467-H as containing contaminated AVGAS.

2000 - AVGAS pipeline closure in place.

4.3.2 North Field Hydrant Areas

Both North Field hydrant areas illustrated on **Figure 4-4** are located outside of the footprint of Site 4. The northern hydrant area is located hydrologically upgradient of the sand-and-gravel aquifer underlying Site 4.

The AVGAS Pipeline was installed for the distribution of AVGAS in approximately 1943 and continued operation until the late 1970s. The pipeline consists of one 6 inch diameter steel pipe which runs from the former South Field AVGAS Storage Tank Farm (USTs 1466A through 1466G) to the former pump house (Building 1470), located near the intersection of Langley Street and the aircraft tow road. From this point the pipeline divides and two 6 inch diameter steel pipes run from the former pump house (Building 1470) to the former North Field AVGAS Storage Tank Farm (USTs 1467 and 1467A through 1467G). The overall length of the AVGAS pipeline is approximately 7,050 feet.

An in-place, pipeline closure of the AVGAS pipeline was conducted by Florida Spill Response Corporation (FSRC), a certified pollutant storage systems contractor, in late August and early September 2000. Attempts to clean the pipeline with soft foam pigs were not successful since the pipeline could not be pressurized to advance the pigs. To close the AVGAS pipeline, water that was present in the pipeline was removed for proper off-site disposal and exposed ends of the pipeline were capped with grout plugs.

In 2001, a *Pipeline Closure Assessment Report* (TtNUS, April 2001) was submitted to document closure assessment activities for the Aviation Gasoline (AVGAS) Pipeline south of the North Field AVGAS Storage Tank Farm (Site 4) USTs (TtNUS, 2001). Closure activities and reporting have not been previously completed for the pipeline north of the North Field AVGAS Storage Tank Farm (Site 4) USTs. A total of 78 soil borings were advanced during the closure assessment field investigation. Soil borings were installed at pipeline junctions and elbows, and at approximately 100-foot intervals along straight sections of the pipeline. Soil samples were collected continuously from the ground surface to a depth of 20 feet below land surface (bls). The CA Report recommended the performance of a site assessment to be conducted at the pipeline section in vicinity of Building 2832 to evaluate petroleum impact to soil and groundwater due to AVGAS pipeline operations. This area is shown as Section E in **Appendix B**, Figure 3-1, presented in the *Pipeline Closure Assessment Report* (TtNUS, April 2001). Building 2832 was investigated and a

remedial action was completed in 2008 that entailed the excavation of 10,000 tons of impacted soils to a maximum depth of 20 feet bls (**Appendix B**, Figure 5 presented in the *Draft Project Completion Report* (WRS, May 2009).

4.3.3 Pipeline Junction Area

The abandoned JP-5 underground product line lies at a depth of approximately 3 feet bls, except for an aboveground junction with the abandoned AVGAS pipeline and an exposed portion near the pump station facility (locations shown on **Figure 4-4**). The 10-inch metal product pipeline was affiliated with two 230,000-gallon ASTs (ASTs 2891 and 2892) containing JP-5 located at the Bulk Fuel Storage Facility. The pipeline was taken out of service through in-place closure in 1996 (Jim Stidham & Associates Inc., 1996). Soil samples were collected, from borings ranging in depth from 28 to 95 feet bls, and screened for headspace concentrations along the JP-5 pipeline. The bulleted list below is a chronology of activities at the pipeline junction.

Pipeline Junction Chronology

1996 - Between February 26, 1996 and February 29, 1996, JP-5 product line was taken out of service through in-place closure. Soil samples were collected from borings ranging in depth from 28 to 95 feet bls, for headspace analysis at 100-foot intervals along the JP-5 pipeline. A product line closure assessment report was prepared and a discharge reporting form was submitted to FDEP.

1997 - Work Plan submitted for hydrocarbon evaluation. Brown & Root Environmental October 1997 Site Assessment Plan for Oil/Water Separator and Product Line Investigation, Naval Air Station Whiting Field, Milton, Florida submitted.

1997 - Soil samples collected from SB-1 through SB-11 at the pipeline junction near the intersection of USS Saratoga and USS Hornet Streets.

January 1998 - Soil samples collected from SB-12 through SB-20 and two monitoring wells were installed at the pipeline junction (WHF-PLJ-MW-01P and -02P).

February 10, 1998 - PLJ monitoring wells sampled.

July 1998 - Brown & Root Environmental, July 1998, Site Assessment Report Oil/Water Separator and Product Line Investigation Naval Air Station Whiting Field, Milton, Florida submitted.

September 29, 1998 - FDEP requested further assessment of the JP-5 pipeline.

August 2000 - Soil samples collected from 26 soil borings advanced by TtNUS.

August 2001 - Report recommended RAP preparation. TtNUS, August 2001, Site Assessment Report Addendum for Oil/Water Separator and Product Line Investigation, Naval Air Station Whiting Field, Milton, Florida submitted.

4.4 ADJACENT AND NEARBY SITES/AREAS

The vicinity surrounding Site 4 encompasses the majority of the administration and maintenance facilities buildings; an air traffic control tower; three aircraft maintenance hangars; vehicle and base general maintenance; a former power generation station; warehouses; a shopping center; housing; medical facilities; security facilities; a fire station; and additional facilities typically found in a small city. Other features include recreational areas (baseball and soccer/football fields and a running track), parking lots, and grassy areas.

Three public water supply wells (W-N4 [North], W-S2 [South], and W-W3 [West]) are located in this area. The locations of these public supply wells are shown on Figures 3-6 and 3-7 presented in the SAR for Site 4 – North AVGAS Tank Sludge Disposal Area (CH2M HILL, June 2013), provided in **Appendix B**. The potable drinking water wells are all screened in the sand-and-gravel aquifer from approximately 140 to 216 feet bls with approximately 50-foot-long screens. According to the NAS Whiting Field Public Works Department, water from each of the potable supply wells is filtered through granulated activated carbon filters, prior to use, because of the potential for volatile organic compound (VOC) contaminants from adjacent IRP sites to be captured by the potable drinking water wells (CH2M HILL, June 2013).

The western boundary separates Site 4 from adjacent IRP Site 32 - the North Field Hangar, which includes Building 1424, the adjacent wash rack area, and the location of the abandoned waste oil tanks east of Building 1424.

4.5 PHYSIOGRAPHY

NASWF is located within the Western Highlands subdivision of the Coastal Plain Physiographic province. This zone is characterized by southward slopping hills and plateaus, which have been cut by numerous streams, and elevations generally ranging from 50 to 200 feet above mean sea level (msl). At NASWF, site elevations range from approximately 150 to 190 feet msl. Surface water runoff at NASWF is conveyed to Clear Creek (west and south) and Big Coldwater Creek (east) by a system of ditches and storm drains. The drainage system was installed with the base and constructed in the early 1940s.

Site 4 is approximately 14.4 acres of land and is covered in grass, with the exception of building footprints and asphalt pavement on streets and parking areas. The North Field hydrant areas north and west of Site 4 boundaries are covered by the concrete flight apron. The elevation of Site 4 is

approximately 170 feet above the North American Datum of 1983 (NAD83). This elevation is maintained east and west of Site 4 across the plateau. At the edges of the plateau, surface elevation decreases rapidly to the southeast and northwest of Site 4. On the plateau, elevations gradually increase to 190 feet above NAD83 to the northeast of Site 4, and 185 feet above NAD83 to the southwest of Site 4 (**Figure 4-3**).

4.6 SURFACE WATERS

There are no naturally occurring surface water bodies on or in the immediate vicinity of Site 4. The closest surface water body to the site is a retention pond approximately 0.4 miles northeast of the site. Drainage ditches for site surface water runoff are located north and east of the site and connect to other drainages which eventually drain to Big Coldwater Creek approximately 2.5 miles northeast of the site.

4.7 GEOLOGY AND HYDROGEOLOGY

4.7.1 Geology

The soils at Site 4 consist of layers of very fine to coarse-grained quartz sand, clayey sand, and sandy clay. A 25 to 30 foot thick, semi-continuous yellowish brown sandy clay, with low to medium plasticity, and containing approximately 50% to 25% sand was identified extending from ground surface to approximately 30 feet bls. Below the sandy clay is predominantly poorly graded sand with interbedded, discontinuous, clay lenses to approximately 100 feet bls. A 5-foot thick, discontinuous yellowish brown medium stiff clay, with low plasticity, and containing approximately 25% sand grading to 10% sand with depth was identified at approximately 75 to 80 feet bls in the area north of the ASTs. This clay layer creates an aquitard which provides for the occurrence of localized upper perched water conditions at the site. A cross section location map and cross section are shown on Figures 5-1 and 5-2 in the SAR (CH2M HILL, June 2013), provided in **Appendix B**.

Another clay layer, which is more locally extensive, is approximately 5 to 10 feet thick and is encountered from approximately 90 feet to 105 feet bls and provide conditions for a lower perched water-bearing zone at the site. This layer also functions as a confining to semi-confining unit, separating the lower perched water-bearing zone from the occurrence of the surficial aquifer. The upper and lower perched groundwater is included as a component of the Site 4 investigation.

Aquifer tests in the Milton area indicated the clayey sand confining unit separating the upper and lower water-bearing zones is very leaky. In the NASWF area, clay lenses occur in the uppermost 30 feet and in the depth interval of approximately 100 to 170 feet bls (elevation 10 to 70 feet above msl). Although the clays appear to be continuous, they may contain permeable zones or

windows (*Contamination Assessment Report* [CAR], ABB Environmental Services, Inc. [ABB-ES], 1993).

4.7.2 Hydrogeology

There are three major aquifers in the NASWF area. The uppermost aquifer, the sand-and-gravel aquifer, exists under both artesian and non-artesian conditions, depending on the presence or absence of semi-confining clay lenses. The sand-and-gravel aquifer is estimated to be approximately 200 to 350 feet thick in the vicinity of NASWF (Musgrove et al, 1965). The two other aquifers, the Upper Floridan and the Lower Floridan, are deep artesian aquifers of the Floridan aquifer system.

At Site 4, there are three distinct water-bearing zones which are separated by clay layer aquitards. Groundwater in the upper perched aquifer is encountered at depths ranging from 72.58 to 78.14 feet bls, and in the lower perched aquifer groundwater is encountered from 89.26 to 94.04 feet bls. Underlying the lower perch clay layer, the sand-and-gravel aquifer groundwater table is encountered at 95.00 to 98.65 bls and has a potentiometric surface elevation ranging from 70.02 to 66.18 feet above National Geodetic Vertical Datum (NGVD). The sand-and-gravel aquifer underlying Site 4 is part of Site 40, the basewide groundwater unit.

The upper perch groundwater elevations illustrate the disparity between water elevations in the upper perch monitoring wells (91.3 to 92.18 feet above NAVD88) and surrounding lower perch monitoring wells (71.26 to 77.25 feet above NAVD88). A relative delineation of the clay lens confining this upper perched groundwater zone is indicated by the disparity and is shown on Figure 5-4 in the SAR (CH2M HILL, June 2013), provided in **Appendix B**. The groundwater elevations within the upper perch appear as an inverted bowl with groundwater water flow from the northeast and northwest towards the lowest groundwater elevation of 91.3 feet above NAVD88, as measured in 04-MC-12, the southernmost monitoring well completed above the upper confining clay. The edge of this clay lens is not delineated south of this well location.

The groundwater flow direction of the more regionally extensive lower perched water at the site is toward the northeast conforming to the north-northeast dip of the clay confining layer. This lower perched water was interpreted in the SAR as perched groundwater located above the true water table (CH2M HILL, June 2013). Support for this, as noted in the SAR, was that flow to the northwest is ninety degrees from the southwesterly groundwater flow interpreted from on-site monitoring wells screened within the surficial aquifer.

Aquifer characteristics at Site 4 are provided in the following table.

Table 4-1 Aquifer Characteristics

Perched Aquifer System Characteristics*	Value
Type:	Unconfined: perched water-bearing zone; referred to as upper perched groundwater
Groundwater elevation (feet above NGVD):	91.37 to 92.18 feet
Flow direction:	Southeast and Southwest
Effective porosity:	Not Available
Average pore water velocity:	Not Available
Average horizontal hydraulic gradient (i):	Not Available
Vertical hydraulic gradient (i):	Not Available
Average hydraulic conductivity (K):	Not Available
Type:	Unconfined: perched water-bearing zone; referred to as lower perched groundwater
Groundwater elevation (feet above NGVD):	70.22 to 81.09 feet
Flow direction:	Northwest
Effective porosity:	Estimated at 23%
Average pore water velocity:	0.07 feet/day
Average horizontal hydraulic gradient (i):	0.0016 feet/feet
Vertical hydraulic gradient (i):	Not calculated
Average hydraulic conductivity (K):	9.55 feet/day
Surficial Aquifer System Characteristics*	
Type:	Referred to as sand-and-gravel
Potentiometric surface elevation (feet above NGVD):	66.18 to 70.22 feet
Thickness:	250-300 feet
Flow direction:	southwest

*Information obtained from the SAR (CH2M HILL, June 2013).

4.8 SUMMARY OF PREVIOUS INVESTIGATIONS

4.8.1 Previous Investigation Documentation

Previous investigations at Site 4 are documented in the list of reports provided in **Table 4-2**. These reports were reviewed for the development of the CSM.

Table 4-2 Listing of Historical Site 4 Reports

Report Title	Date	Summary of Investigation Findings
Verification Study Assessment of Potential Ground-Water Pollution at NASWF, Florida, (Geraghty and Miller)	December 1986	Verification Study Assessment of Potential Groundwater Pollution. • A single monitoring well (Well 4) installed to 152 feet bls, approximately 60 feet south of the 1467 USTs and analyzed for BTX, naphthalene, 1,2-dibromoethane (EDB), and lead. Groundwater analysis revealed 17 micrograms per liter (µg/L) benzene, 10 µg/L toluene, and 5 µg/L lead. • Shallow soils (0 to 2 feet bls) collected adjacent to the tanks were composited and analyzed for total lead and toxicity. Total lead of 15 and 27 milligrams per kilogram (mg/kg), toxicity non-detect.
Jurisdiction Assessment Report Underground Storage Tank Program Sites 1466 and 1467 Installation Restoration Program Sites 7 and 4 (ABB-ES, 1994)	February 1994	Groundwater sampling and analysis from 19 monitoring wells at Site 1467 under the site jurisdiction field investigation. Total benzene, toluene, ethylbenzene, and xylene (BTEX) results from groundwater collected from the upper perched area ranged from 28,200 µg/L (WHF-1467-MW-6D) to 32,700J (estimated concentration) µg/L (WHF-1467-MW-26). The total BTEX concentration from groundwater collected from a well south of the UST area (WHF-1467-MW-24P) was 4,630 µg/L.
Remedial Investigation Report for Surface and Subsurface Soil at Sites 3, 4, 6, 30, 32, and 33, NASWF, Milton, Florida (TtNUS)	September 1999	• A Remedial Investigation (RI) at Site 4 was conducted in phases from 1986 through 1999. The RI included a range of environmental studies to collect data needed to determine the presence, nature, and extent of contamination; fieldwork included installing 11 soil borings, collecting surface (04-SB-01 through 04-SB-11) and subsurface (04SB-01 through 04-SB11) soil samples (analyzed for VOCs, semi-volatile organic compunds (SVOCs), pesticides/PCBs, Total Petroleum Hydrocarbon (TPH), and metals), and performing a Human Health and Ecological Risk Assessment. Groundwater in the surficial aquifer underlying Site 4 was not evaluated in the RI. • Dieldrin and arsenic exceeded Residential Soil Cleanup Target Levels (SCTLs) in surface soil. Both arsenic and dieldrin have been used in the past during normal pesticide application across the base and neither is fuel related. Arsenic also occurs naturally in soil. Benzo(a)pyrene and arsenic exceeded Residential SCTLs in subsurface soil. Neither surface or subsurface soil results exceeded the Industrial SCTLs.
Pipeline Closure Assessment Report for AVGAS Pipeline, NASWF, FL (TtNUS)	April 2001	• AVGAS/JP-5 pipeline junction is in the area of Section C. • Section C includes soil boring B08. Soil sample from ground surface to 2 feet bls screened using an OVA was 19.7 parts per million (ppm). Other screening samples collected from B08 had corrected OVA responses of less than 10 ppm. • One confirmatory soil sample was collected at the B08 location and analyzed for volatile organic aromatics, Polynuclear Aromatic Hydrocarbons (PAHs), and Total Recoverable Petroleum Hydrocarbons (TRPH). Results were non-detect. • Assessment Report recommended no further investigation for pipeline Section C.
Site Assessment Report Addendum for Oil/Water Separator and Product Line Investigation, NASWF, FL (TtNUS)	August 2001	• Twenty-six soil borings were advanced around the AVGAS/JP-5 pipeline junction between 1997 and 2000. • OVA headspace screening indicated that no volatiles were present in soil samples collected from 1 or 2 feet bls. • Corrected OVA measurements ranged from 0 to greater than 5,000 ppm (maximum instrument range) in soil samples collected from below 2 feet bls. • Subsurface soil samples from six locations were submitted for laboratory analysis for VOCs, PAHs, and TPH. Three of the samples were also analyzed for methyl tert-butyl ether (MTBE); exceedances of residential SCTL criteria for ethylbenzene, xylenes, and TPH. • Concluded impacted soil is approximately 7,069 square feet with vertical extent ranges from 5 to 25 feet bls to the water table at approximately 85 feet bls.

Report Title	Date	Summary of Investigation Findings
Technical Memorandum Results of Additional Soil Sampling at Site 4 NASWF, Milton, (CH2M HILL)	December 2004	Completed 22 soil borings to depths of 80 to 100 feet bls to further assess the extent of soil contamination at Site 4. A combination of headspace screening and select soil sampling for laboratory analysis of VOCs, SVOCs, and TRPH was used in the investigation.
Remedial Design Data Gap Analysis Report Site 4 - North AVGAS Tank Sludge Disposal Area (CH2M HILL)	December 2008	The field event objectives were to confirm/deny the presence of free product (light non-aqueous phase liquid [LNAPL]) north of the former AVGAS tanks in the vicinity of well WHF-1467-MW-26P, and to evaluate the radius of influence (ROI) of a conventional soil vapor extraction (SVE) system in the location of the previous Bechtel Technology & Consulting Solar Remediation System (SRS) pilot study. Tasks performed to accomplish this objective included installation of a replacement monitoring well, modification of an existing SRS recovery well to three SVE wells, soil and groundwater sampling, and free product evaluation in wells and borings. LNAPL was also detected in 3 upper perched wells. No LNAPL was detected in the lower perched nor the sand and gravel aquifer. Groundwater sampling results did not provide for delineation of impacted groundwater at Site 4
Technical Memorandum LNAPL Mobility Assessment Report (CH2M HILL)	12 October 2011	• Chromatograms indicated that one common source for the LNAPL samples collected from 04-MC-05, 04-MC-06, and 04-MC-12 was likely. Sample 04-MC-05 may be closest to the source with sample 04-MC-06 being at a distance and 04-MC-12 the furthest away. • Comparison of LNAPL samples to a reference library of chromatograms for the ASTM D5739 method indicated that the samples appear to consist of a mixture of regular gasoline (MOGAS) and AVGAS. • The soil cores were at or below residual saturation (with the exception of a few isolated sections of core on the order of 1 to 2 inches thick) indicating that a very limited amount of the total LNAPL present at the site would be expected to be recoverable through operation of an engineered LNAPL extraction system. However, the sections of soil cores above residual saturation suggest that some LNAPL at the site may be recoverable through an extraction system. • The Technical Memorandum identifies the source of the LNAPL impacting the upper perched zone as a mixture of MOGAS and AVGAS.
Site Assessment Report, Site 4 – North AVGAS Tank Sludge Disposal Area (CH2M HILL)	June 2013	• Determination that perched groundwater containing dissolved hydrocarbon contaminants that appear to spill over the low edge of the upper perched zone and migrate downward to the lower perched zone. The lower confining clay pinches out beneath the upper confining clay, allowing impacted groundwater to migrate into the sand-and-gravel aquifer. • The SAR does not identify the source of the LNAPL impacting the upper perched zone.

4.8.2 Existing Wells

The existing monitoring well network at Site 4 consists of 41 site monitoring wells; 15 monitoring wells in the upper perched water bearing zone, 13 in the lower perched water bearing zone, and 13 monitoring wells in the surficial aquifer. Two monitoring wells were installed at the product line junction site in January 1998. The screen intervals of these two wells indicate they were installed into the lower perch water bearing zone. Construction details of site wells are provided in **Table 4-3**. Refer to **Figure 4-4** for an illustration of well locations.

Table 4-3 Well Construction Details

Upper Perch Groundwater Monitoring Wells	Screen interval (feet bls)	Top of Casing Elevation (feet NGVD)
04-MC-01	56-76	164.42
04-MC-02	57-77	165.93
04-MC-03	56-76	165.22
04-MC-04	60-80	164.85
04-MC-05	62-82	167.83
04-MC-06	61-81	166.84
04-MC-08	60-80	167.28
04-MC-09	58-78	168.61
04-MC-10	64-84	167.88
04-MC-11	65-85	171.41
04-MC-12	64-84	170.1
WHF-1467-MW-7P	70-85	157.48
WHF-1467-MW-26P-R	73-83	166.48
WHF-1467-MW-33P	78-83	169.86
WHF-1467-MW-37P	65.3-85.3	164.7
Lower Perch Groundwater Monitoring Wells	**Screen interval (feet bls)**	**Top of Casing Elevation (feet NGVD)**
WHF-1467-MW-2R	86-101	169.96
WHF-1467-MW-5S	88-98	173.27
WHF-1467-MW-6D	97-102	165.99
WHF-1467-MW-9S	85-100	162.99
WHF-1467-MW-24P	85-95	169.77
WHF-1467-MW-29P	80-95	168.96
WHF-1467-MW-30P	87-102	174.23
WHF-1467-MW-45P	70-90	169.59
WHF-1467-MW-47P	80-100	163.8
WHF-1467-MW-48P	91-101	168.61
WHF-1467-MW-49P	80-100	171.73
WHF-1467-MW-50P	80-100	170.62
WHF-1467-MW-53P	81-101	164.79

Sand-and-Gravel Surficial Aquifer Groundwater Monitoring Wells	Screen interval (feet bls)	Top of Casing Elevation (feet NGVD)
WHF-04-MW-1I	143-153	172.45
WHF-1467-MW-5D	130-140	171.27
WHF-1467-MW-19S	90-105	169.33
WHF-1467-MW-20S	95-110	171.76
WHF-1467-MW-22P	88-98	172.38
WHF-1467-MW-28S	90-105	173.03
WHF-1467-MW-37S	95-105	164.06
WHF-1467-MW-39S	112-122	159.08
WHF-1467-MW-46P	84.1-104.1	165.22
WHF-1467-MW-51P	84-104	171.51
WHF-1467-MW-52P	95-105	171.86
WHF-1467-MW-52S	105-120	171.92
WHF-1467-MW-53S	136-150	164.83
Pipeline Junction Upper Perch Monitoring Wells	**Screen interval (feet bls)**	**Top of Casing Elevation (feet NGVD)**
WHF-PLJ-MW-01P	90-105	Unknown
WHF-PLJ-MW-02P	85-100	Unknown

4.9 EXTENT AND DISTRIBUTION OF CONTAMINANTS

The current extent and distribution of contaminants at Site 4 is discussed in the following sections.

4.9.1 List of Contaminants of Concern

The chemicals of concern (COCs) identified in the SAR (CH2M HILL, June 2013) are the Kerosene Analytical Group (KAG) constituents from 62-780 Florida Administrative Code (FAC), Table C, and include: volatile organic aromatics, polynuclear aromatic hydrocarbons (PAHs), total recoverable petroleum hydrocarbons (TRPHs), 1,2-dibromoethane (EDB), and dissolved lead.

Subsurface soil results from investigations conducted in 2004, 2008, and 2011 and groundwater results from investigations of the upper and lower perched water-bearing zones conducted in 2011 (SAR, CH2M HILL, June 2013) and from site investigations in 2004 and 2008 are summarized in the table below.

Table 4-4 Summary of Previously Identified COCs[A]

Subsurface Soil from 2004 to 2011[A]	Maximum Concentration (mg/kg)[B]	Residential SCTL (mg/kg)	Residential SCTL Exceedance	Industrial SCTL (mg/kg)	Industrial Exceedance Frequency[C]	Leachability SCTL (mg/kg)	Leachability SCTL Exceedance Frequency[C]
Benzene	24.6 J[D], April 2008	1.2	9/267	1.7	7/267	0.007	54/267
Toluene	445, 2008	7,500	0/267	60,000	0/267	0.5	53/267
Ethylbenzene	937, 2008	1,500	0/267	9,200	0/267	0.6	48/267
Total Xylenes	74.7, 2011	130	3/267	700	1/267	0.2	58/267
Chloroethane	6.6 J[D] 2008	3.9	1/267	5.4	1/267	0.06	1/267
Bromomethane	1.2 J[D], 2008	3.1	0/267	16	0/267	0.05	1/50
EDB	0.0019 J, 2004	0.1	0/267	0.2	0/267	0.0001	1/267
Isopropylbenzene	0.06, 2004	220	0/267	1,200	0/267	0.2	3/267
4-Methylphenol	0.081, 2004	300	0/267	3,400	0/267	0.03	1/267
1-Methylnapthalene	6.4, 2008	200	0/267	1,800	0/267	3.1	1/267
2-Methylnapthalene	8.7, 2008	210	0/267	2,100	0/267	8.5	1/267
Napthalene	3.0, 2008	55	0/267	300	0/267	1.2	1/267
Benzo(a)pyrene	0.23 J[D], 2011	0.1	1/267	0.7	0/267	8	0/267
TRPH	5,780, 2008	460	2/267	2,700	1/267	340	1/267

Upper Perched Aquifer Groundwater[A]	Maximum Concentration (micrograms per liter [µg/L])[B]	Groundwater Cleanup Target Level (GCTL) (µg/L)	Frequency GCTL Exceedances[C]	NADC (µg/L)	NADC Exceedance Frequency[C]
Benzene	3,600	1	6/6	100	5/6
Ethylbenzene	3,460	30	5/6	300	3/6
Toluene	71,700	40	4/6	400	4/6
Xylenes, total	11,900	20	5/6	200	3/6
Isopropylbenzene	12.7	0.8	2/3	8	2/3
Trichloroethene	41.8	3	3/3	300	0/3
Lead	92.4 J[D]	15	3/3	150	0/3

Lower Perched Aquifer Groundwater[A]	Maximum Concentration (µg/L)[B]	GCTL (µg/L)	Frequency GCTL Exceedances[C]	NADC (µg/L)	NADC Exceedance Frequency[C]
Benzene	6,610	1	7/7	100	4/7
Ethylbenzene	2,170	30	6/7	300	4/7
Toluene	25,400	40	6/7	400	5/7
Xylenes, total	5,340	20	6/7	200	5/7
Lead	270	15	6/7	150	1/7
Benzo(a)fluoranthene	0.84	0.05	2/7	5	0/7
Napthalene	16.8	14	1/7	140	0/7

[A] The COCs included were identified in previous investigations and will be subject to revision based on the results of the supplemental sampling activities.

[B] 2004 data from the Technical Memorandum Results of Additional Soil Sampling at Site 4 NAS Whiting Field, Milton (CH2M HILL, December 2004); 2008 data from the Remedial Design Data Gap Analysis Report Site 4 - North AVGAS Tank Sludge Disposal Area (CH2M HILL, December 2008); 2011 data from the SAR, Site 4 – North AVGAS Tank Sludge Disposal Area (CH2M HILL, June 2013).

[C] Frequency of exceedances (number of screening criteria exceedances/number of samples).

[D] J = Estimated Concentration

4.9.2 Potential Sources of Contaminants

Potential sources of petroleum hydrocarbons are located within or adjacent to Site 4 boundaries and include the former USTs, abandoned fuel pipelines, and abandoned aircraft fuel hydrant systems. It is unlikely the ASTs are a source of petroleum impacts to the site as they were installed in 1993 following the identification of soil and groundwater impacts at the site. However, due to the distribution of petroleum impacts in soil, past actions have resulted in a probable fuel release in the vicinity of the upper perched area in the past. These actions are currently unknown.

Free product has been identified floating on the surface of upper perched groundwater during measurement of liquid levels, and in soil samples during soil boring advancement during previous investigations. In April 1998 during groundwater sampling activities, TtNUS discovered 1.6 feet of free-phase petroleum hydrocarbon product floating on top of the water table in monitoring well WHF-1467-MW-26P. The well is located approximately 150 feet north of the former AVGAS tanks at Site 4 (**Figure 4-4**). Approximately 1.6 gallons of light non-aqueous phase liquid (LNAPL) were removed by bailing the well. A sample of the product was collected for fingerprinting which indicated that the collected LNAPL was 90 percent AVGAS. Hydrocarbon fingerprinting conducted during the 2011 LNAPL mobility assessment indicated a mixture of regular gasoline (MOGAS) and AVGAS. A uniformly blue cast to the LNAPL usually indicates AVGAS; however, photographs of the LNAPL in the 2011 LNAPL mobility assessment show the LNAPL as light blue to green. The 2011 chromatograms were interpreted to conclude that one common source for the LNAPL samples collected from 04-MC-05, 04-MC-06, and 04-MC-12 was likely. As reported in the LNAPL mobility assessment, sample 04-MC-05 appears closest to the source with sample 04-MC-06 being at a distance and 04-MC-12 the furthest away.

Residual LNAPL was identified at shallow elevations (vadose zone) in the 04-MC-05 soil profile and in the WHF-1467-MW-51 profile suggesting hydrocarbon releases occurred in both the area of the ASTs and former USTs. The close proximity of the residual LNAPL to the ground surface in both locations is not likely attributed to hydrocarbon migration from one source to the other. Although horizontal migration along the surface of clays is likely, the discontinuous nature of the clays have facilitated the downward vertical migration of LNAPL in both locations to the underlying sands. The sandy clays in the upper 30 feet bls are discontinuous and likely could not transport LNAPL laterally from the former UST area to the upper perched area, or vice versa, at shallow depths. However, it is unknown whether increased sand content in limited areas may provide for localized transport laterally and vertically.

Hydrocarbons in the former UST area can be attributed to releases from the USTs and associated piping. Based on the chronological uses of the AST, it is likely that the LNAPL source in the vicinity of the upper perched area is related to the underground AVGAS pipeline system in the area north

of the former USTs. The ASTs have contained gasoline since installation in 1993, and the free product observed in the wells associated with the upper perched area is blue to green. Monitoring well WHF-1467-MW-26 was installed on April 25, 1992, and headspace concentrations measured during well installation were greater than 1,000 parts per million (ppm) according to the soil boring log (CH2M HILL, June 2013). Additionally, a total BTEX concentration of 32,700 µg/L was detected in a groundwater sample collected from WHF-1467-MW-26 in August 1993 (ABB-ES, February 1994), when the ASTs were new.

4.9.3 Current Extent and Distribution of Contaminants

The current extent and distribution of petroleum contamination in soil and groundwater at Site 4 is complex. However, assumptions can be made on the current conditions based on the following conclusions from previous investigations:

4.9.3.1 Surface Soil

In 1998, eleven surface soil samples (04-SB-01 through 04-SB-11) were collected at Site 4 and analyzed for VOCs, SVOCs, pesticides/PCBs, Total Petroleum Hydrocarbon (TPH), and metals. The only surface soil parameters that exceed current Residential Soil Cleanup Target Levels (SCTLs) were dieldrin and arsenic. Industrial SCTLs were not exceeded. Both arsenic and dieldrin have been used in the past during normal pesticide application across the base and neither is fuel related. Arsenic also occurs naturally in soil.

Twenty-six soil borings were advanced around the AVGAS/JP-5 pipeline junction between 1997 and 2000 (TtNUS, 2001). Although no surface soil samples were submitted for laboratory analysis, they were screened in the field with an organic vapor analyzer (OVA). Headspace screening indicated that no volatiles were present in soil samples collected from 1 or 2 feet bls.

Surface soil samples collected in 2008 and 2011, from 29 locations, were also screened in the field with an OVA. Of the 29 locations, headspace measurements exceeded 1 ppm in only two samples. The two exceptions were 20 ppm in WHF-1467-MW-46P and 5 ppm in SB-WHF-1467-MW49P. The screening results indicate an absence of hydrocarbon contaminated surface soils at Site 4.

4.9.3.2 Subsurface Soil

In 1998, twenty-four subsurface soil samples were collected from 11 locations (04SB-01 through 04-SB11) at Site 4 and analyzed for VOCs, SVOCs, pesticides, PCBs, TPH, and metals. The only subsurface soil parameters that exceeded the Residential SCTLs (FDEP Chapter 62-777 FAC, April 2005) were benzo(a)pyrene and arsenic. Industrial SCTLs were not exceeded.

Twenty-six soil borings were advanced around the AVGAS/JP-5 pipeline junction between 1997 and 2000 (TtNUS, 2001). Subsurface soil samples from six locations were submitted for laboratory

analysis for VOCs, methyl tert-butyl ether (MTBE), PAHs, and TPH. Soil samples were also screened in the field with an OVA. Corrected OVA measurements ranged from 0 to greater than 5,000 ppm (maximum instrument range) in soil samples collected from below 2 feet bls. Subsurface soil analytical samples collected in the vicinity of the pipeline junction from the TtNUS 2001 Report indicate exceedances of residential SCTL criteria for ethylbenzene, xylenes and TPH.

During the 2004 investigation at Site 4, soil samples were collected at 20-foot intervals to the depth of the water table from 24 locations and field screened for VOCs. Corrected Flame Ionization Detector (FID) measurements ranged from 0 to 783,800 ppm. A total of 101 subsurface soil samples were analyzed for parameters including VOCs, SVOCs and/or TRPH. No TRPH exceedances were reported in 2004; however, VOC exceedances of Chapter 62-777 FAC criteria were reported in samples collected from 15 of the 24 soil borings locations. These exceedances were primarily BTEX constituents, although isopropylbenzene (cumene), EDB, and SVOC (4-Methylphenol) were also detected above leachability SCTLs.

In 2008, thirteen soil borings were advanced in the upper perched area of Site 4 to delineate the extent of free product. Monitoring wells were installed in 12 of the boring locations (WHF-1467-MW-26P and 04-MC-01 though -11). During the 2008 investigation, subsurface soil samples were collected continuously on 2-foot centers from 13 soil boring locations, and field screened for VOCs. Corrected OVA measurements ranged from 0 to greater than 185,000 ppm. With a few exceptions, soil samples were collected for laboratory analysis from depths of approximately 50, 60, and 70 feet bls, and analyzed for VOCs using EPA SW-846 Method 8260B, TRPH using the Florida Petroleum Residual Organic (FL-PRO) Method, PAHs using EPA SW-846 Method 8310, and lead using EPA SW-846 Method 6010B. Hydrocarbon constituents were detected in all 13 soil boring locations; BTEX constituents were the primary exceedances. TPH, isopropylbenzene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected in soil at concentrations exceeding leachability SCTLs collected from 04-MC-05, at a depth of 8 to 10 feet bls.

During the 2011 investigation at Site 4, at a minimum, soil samples were collected for laboratory analysis from depths of 50, 60, and 70 feet bls, as well as from the top of the upper perched water zone, in 16 locations. Subsurface soil samples were analyzed for VOCs using EPA SW-846 Method 8260B, TRPH using the FL-PRO Method, PAHs using EPA SW-846 Method 8310, lead using EPA SW-846 Method 6010B (or equivalent), and hydrocarbon fractions using the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) analytical method. Six soil samples collected from 16 locations in 2011 had parameters exceeding Chapter 62-777 FAC residential criteria (SCTLs). These exceedances were primarily BTEX constituents, although benzo(a)pyrene and TPH were also

detected above criteria, in a soil sample collected from WHF-1467-MW-51P at a depth of 16 to 18 feet bls.

4.9.3.3 Groundwater

Most of the wells completed in the upper perched groundwater zone currently or historically contain free product; therefore, not all wells from this zone were sampled. Total BTEX concentrations in the remaining three wells (WHF-1467-MW-33P, WHF-1467-MW-37P, and WHF-1467-MW-45P) sampled in 2011 during site assessment activities ranged from 101 µg/L to 1,304 µg/L. These three wells are upgradient of the free product area. BTEX contamination in the upper perched zone extends throughout the lateral extent of the confining clay. In addition, lead and trichloroethene exceeded Groundwater Cleanup Target Level (GCTL) criteria in all three wells and isopropylbenzene in two wells.

Figure 6-11 in the 2013 SAR, provided in **Appendix B**, illustrates total BTEX concentrations in lower perched groundwater zone from samples collected in April and May 2011. Seven monitoring wells were sampled from the lower perched zone. BTEX concentrations ranged from 11 µg/L in WHF-1467-MW-53P, the southeasternmost well, to 36,400 µg/L in groundwater collected from WHF-1467-MW-49P, located between the former AST and UST areas and immediately south of the extent of the upper perched water table. BTEX concentrations are highest within and downgradient (north) of the former UST area. The lower perched confining clay appears to pinch out beneath the upper confining clay. The northern extent of hydrocarbon impact in the lower perched zone is therefore defined in the north by the terminus of the confining clay.

Groundwater samples were collected from two wells (WHF-PLJ-MW-01P and WHF-PLJ-MW-02P) located at the pipeline junction on January 10, 1998. The screened intervals of these two wells indicate they were installed into the lower perched water bearing zone (**Table 4-3**). Groundwater samples from the two wells were analyzed for VOCs, SVOCs, TPH, and lead. Analytical results from the groundwater sample from WHF-PLJ-MW-01P indicate that BTEX, the PAHs naphthalene and 2-methylnaphthalene, and EDB and dichloromethane were present at concentrations exceeding GCTLs. Analytical results from the groundwater sample from WHF-PLJ-MW-02P indicate that BTEX, naphthalene, and total lead were present at concentrations exceeding GCTLs.

The surficial aquifer is being investigated under the Basewide Groundwater RI. However, one well installed during the 2011 site assessment activities, WHF-1467-MW-46P, was installed as a perched well, but was determined to be completed in the sand-and-gravel aquifer. Total BTEX concentration of 9,046 µg/L was observed from WHF-1467-MW-46P in May 2011. This well is the northernmost well in the Site 4 footprint. TtNUS conducted groundwater sampling from surficial well WHF-1467-MW-37S on March 1, 2011. Well WHF-1467-MW-37S is located approximately

120 feet south of WHF-1467-MW-46P (**Appendix B**, Figure 6-12 presented in the SAR [CH2M HILL, June 2013]). The BTEX concentration in a groundwater sample collected on March 1, 2011, from WHF-1467-MW-37S was 8,864 µg/L (TtNUS, 2012).

4.9.3.4 Mass Estimate

As reported in the SAR (CH2M HILL, June 2013), the approximate mass of contamination present in the subsurface is approximately 110,000 pounds, which includes soil contamination, free phase product, and dissolved phase contamination.

4.9.4 Site-Specific Fate and Transport

Jet fuels and diesels are middle distillate petroleum hydrocarbon products of intermediate volatility and mobility (Cole, 1994). As intermediate products, jet fuels have a combination of (mostly) lighter, less persistent and more mobile compounds as well as (some) heavier, more persistent and less mobile compounds. These two different groups are associated with two distinctly different patterns of fate and transport concerns: The relatively lighter, more volatile, mobile, and water soluble compounds in JP-5 will tend to evaporate into the atmosphere or migrate to groundwater. When exposed to oxygen and sunlight, most of these compounds will tend to break down. However, in groundwater, many of these compounds tend to be more persistent than in surface water, and readily partition on an equilibria basis back and forth between water and solids (soil and sediment) media. The compounds in jet fuel which will tend to be somewhat more persistent and more bound to solid particles include the PAHs, alkyl PAHs, alkyl benzenes, and higher molecular weight branched and straight chain alkanes and alkenes. Higher concentrations of heavier PAHs will tend to be in adjacent contaminated soils rather than in groundwater.

4.10 RECEPTOR AND EXPOSURE PATHWAYS

Receptors and exposure pathways relevant to soil and groundwater contaminants at Site 4 are summarized in the following sections. A preliminary Exposure Pathway Model (EPM) diagram has been developed to illustrate the potential exposure pathways for the site (**Figure 4-6**). The EPM will be validated and further refined based on data and information collected during this proposed effort. The updated EPM will be included in the CSM presented in the Addendum reports.

4.10.1 Receptors

The identification of potential receptors and exposure scenarios to Site 4 contaminants is dependent on land use. Land use conditions for current and future land uses at Site 4 are outlined in the following table.

Table 4-5 Land Use Conditions

Current Land Use:		Surrounding Land Use:		Future Land Use:	
	Residential		Residential	X	Residential
X	Industrial	X	Industrial	X	Industrial
	Commercial	X	Commercial		Commercial
	Agricultural		Agricultural		Agricultural
	Recreational	X	Recreational		Recreational
	Other	X	Other (Air Field Ops)	X	Other (Air Field Ops)

Access to NASWF is controlled through guarded gates and fencing.

Under the current land use, potential receptors to Site 4 contaminants are construction/utility workers because the depth to soil contamination at Site 4 in at least one location is 8 to 10 feet bls, which is within the typical construction depths of 10 feet bls. Hydrocarbon contamination has not been detected in surface soil at Site 4 (0 to 1 foot bls) by field screening or by laboratory analysis of soil samples. The absence of petroleum hydrocarbons in surface soil is anticipated because volatile compounds tend to evaporate into the atmosphere rather than persist in surface soils, the contaminant releases were primarily in the subsurface in the form of releases from buried pipelines or USTs, or possibly because of the buried sludges.

Site 4 provides minimal potential habitat for ecological receptors. The site is covered by roads, buildings, parking areas and other base support infrastructure with areas of grass maintained by periodic mowing. Receptors that may occur on the site, while foraging occasionally in the grassed areas, include birds such as the eastern meadowlark, northern mockingbird, and common grackle, and small mammals such as the oldfield mouse.

4.10.2 Site-Specific Exposure Pathway Model

Potential human exposure pathways will be identified in the context of the current and potential future land uses. A complete pathway includes: a chemical source and release mechanism, a transport or retention medium, an exposure point where human contact with the contaminated medium occurs, and a route of intake for the contaminant into the body at the exposure point. If any of these elements is missing, the pathway is incomplete and is not considered further. In the EPM diagram (**Figure 4-6**), the potentially complete pathways to be quantitatively evaluated are indicated by an "X" in a box. A box without an "X" indicates an incomplete pathway (which occurs when at least one of the pathway elements is missing), and a box with "**" indicates a pathway that potentially is complete but for which exposure would be insignificant and would not warrant evaluation.

4.10.2.1 Human Health Exposures

Under current land use, the construction/utility worker potentially could be exposed to site subsurface soil contaminants through incidental ingestion, dermal absorption, and inhalation of airborne particulates. Only one soil sample was collected from the potential soil direct exposure depth, at 8 to 10 feet bls, during the 2004 through 2011 soil sampling events. The sample collected from boring 04-SB-46/04-MC-05 in 2008 exceeded the Direct Exposure Residential and Industrial SCTLs for TRPH and the Leachability SCTL for TRPH and some VOCs and SVOCs. LNAPL was also present in the soil sample from 8 to 10 feet bls at this location as well as in boring 04-SB-25 near the pipeline junction. Other SCTLs were exceeded from 10 to 100 feet bls. Based on the exceedances of the SCTLs, exposure pathways are complete for site soils because of the presence of chemicals of potential concern (COPCs)/site-related contamination above health-protective levels for industrial workers in at least two locations.

Exposure to surface water and sediment through incidental ingestion and dermal contact are not potentially complete pathways because there are no surface water bodies on or in the immediate vicinity of the site. Any potable water used at the site is obtained from two public potable water wells within a ½-mile radius, outside the site boundary. Potential groundwater exposure pathways are incomplete under current conditions because neither receptor comes in contact with site groundwater while working on the site.

There is not sufficient data to perform a full vapor intrusion (VI) pathway exposure assessment using the existing industrial/commercial buildings and assuming a hypothetical future land use scenario in which residences could be constructed at the site. The groundwater data have not been evaluated against screening criteria for protection of indoor air VI at this time. However, all VOCs detected can be assumed to contribute to the VI exposure, and therefore are selected as COCs for remedial action.

The potential for exposure of construction workers to groundwater at the site can be discounted because of the depth of the water table at the site (approximately 75 feet bls).

For future on-site residents, potential subsurface soil exposure routes include ingestion, dermal absorption, and inhalation of airborne particulates through soil disruption. Inhalation of vapors from the migration of volatiles in subsurface soil into indoor air is also a potentially complete exposure pathway for the resident. For adult and child residents, it is assumed that exposures to site groundwater could occur through the use of an on-site well as a potable water source. Potential groundwater exposure routes for the resident include ingestion, dermal absorption, and inhalation of vapors from showering and other household uses of groundwater. Additionally,

inhalation of vapors migrating from subsurface soil or groundwater into indoor air may be a potentially complete exposure pathway.

4.10.2.2 Ecological Exposures

As shown on the EPM diagram (Figure 4-5), the potential for exposure of ecological receptors through potentially complete pathways at Site 4 would be negligible and would not be sufficient to warrant evaluation. The entire site is covered by roads, buildings, parking areas and other base support infrastructure, providing minimal habitat. Although some receptors (e.g., birds or rodents) may be exposed to surface soil while foraging occasionally in the grassed areas of the site, surface soil is unlikely to be contaminated given the volatility and leachability of the fuel-related COCs and the long period of time since contamination occurred. Thus, the potential for significant exposures and adverse effects on terrestrial wildlife populations is negligible. Also, there are no surface water bodies on or near the site that could provide ecological exposure pathways as a result of groundwater discharge.

5.0 SAP Worksheet #11: Data Quality Objectives/Systematic Planning Process Statements

(UFP-QAPP Manual Section 2.6.1 – Worksheet #11)

The DQOs, as defined through the seven-step process (EPA, February 2006), are as follows:

Table 5-1: Data Quality Objectives for the North Field Fuel Distribution System

DQO Step	Description
1. State the Problem	Uncertainties exist whether there are leaks along the abandoned underground AVGAS pipeline (from the former UST area north and west) and hydrants (currently covered by a flight line parking apron) associated with the North Field fuel distribution system which are contributing to known Site 4 contamination.
2. Identify the Goals of the Study (Alternative Actions presented in Step 5)	1. Improve the Navy's understanding of the presence or absence of residual fuel along the pipeline and hydrants within the vadose zone.
	2. Complete a SAR Addendum (which includes the North Field fuel distribution system and the northwest portion of the site), including determination of presence or absence of impacted soil along the pipeline and hydrants.
3. Identify Information Inputs	1. Preliminary CSM provided in Section 4.0 (**Worksheet #10**).
	2. Data to be collected during the following activities (A list of proposed samples is provided on **Tables 8-1** and locations illustrated on **Figure 7-1**. Initial points of interest have been identified and then real-time field screening and definitive data will be evaluated to determine subsequent sample locations. See Section 7.0 [**Worksheet #17**] for a discussion of sampling design and rationale.): • Ground Penetrating Radar (GPR) survey with line induction of the pipeline and hydrants; • Direct Push Technology (DPT) soil profiling along approximately 5,000 lineal feet of abandoned AVGAS pipeline, between the former Site 4 USTs and fuel hydrants, associated with the north field fuel distribution system to a depth of 10 feet at each location; and • Survey of all completed DPT boring locations. Types of data to be collected as follows: Screening Data: • Field screening of soil from DPT borings using an OVA. Chemical Data (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 [**Worksheet #15,** Table 9-1]. A list of sampling locations is provided on **Table 8-1**.): • Definitive off-site laboratory analyses of soil from DPT borings for the following analytical parameters: COCs listed on Table C of Chapter 62-780, effective date 12 June 2013 (select VOCs, PAHs, TRPH, and speciation of TRPH, if necessary). Analysis of other listed priority pollutant volatile organic halocarbons, which are not required for soil under Table C of Chapter 62-780; isopropylbenzene and 1,4-dioxane will be included based on the possibility of presence in the study area. SPLP analyses may be performed on select samples for site-specific leachability determination. Physical Data: Subsurface stratigraphy observed in the continuous soil core produced during drilling activities will be logged in accordance with the USCS. Types of utility locate and survey equipment: GPR, Global Positioning System (GPS) Types of soil sampling equipment: DPT, OVA
	3. Historical boring logs and soil data from Site 4 SAR, CH2M HILL, June 2013.

DQO Step	Description	
	4. Project Action Levels (PALs) provided in Section 9.0 (**Worksheet #15**) for soil are the most conservative of the EPA Region 4 Regional Screening Levels (RSLs) and FAC Chapter 62-777 SCTLs . PALs provided in Section 9.0 (**Worksheet #15**) for perched groundwater are the FAC Chapter 62-777 GCTLs.	
4. Define the Boundaries of the Study	**Lateral Boundary:** The study area is approximately three feet on both sides of the former abandoned underground AVGAS pipeline (from the former UST area north and west) and hydrants (currently covered by a flight line parking apron). The approximate locations of the former pipeline and hydrants are illustrated on **Figure 4-4**.	
	Vertical Boundary: Investigation depth is from ground surface to 10 feet bls.	
	Temporal Boundary: Estimated duration of investigation activities is approximately two weeks. Other Site 4 field activities proposed in this SAP will be scheduled alongside the north field fuel distribution assessment for optimization and efficiency.	
5. Develop the Analytic Approach	1. *If* "net" or corrected OVA field screening results of soil are observed greater than 10 ppm at any sample location within a boring, then the soil sample with the highest corrected OVA result from that boring will be submitted for definitive laboratory analyses. Conversely, *if* "net" or corrected OVA field screening results of soil are observed less than or equal to 10 ppm at any sample location within a boring, *then* one soil sample will be chosen from that boring (based on real-time data including, but not limited to, neighboring field screening and/or definitive analytical results, visual observations, and/or odor) to be submitted as a hold sample for definitive laboratory analyses. Approximately two hold samples are anticipated to be analyzed.	
	2. The soil analytical results will be screened against the PALs provided in Section 9.0 (**Worksheet #15**, Table 9-1). *If* soil concentrations exceed the PALs, *then* a remedial investigation of the north field fuel distribution system will be recommended in the SAR Addendum. Conversely, *if* soil concentrations are below PALs, *then* no further investigation of soil in the north field fuel distribution system will be recommended in the SAR Addendum.	
	3. *If* saturated soil is observed in the boring, concluding the presence of perched groundwater, *then* the boring at that location will be concluded. No saturated soil samples will be collected for field screening or definitive laboratory analysis.	
	4. *If* field screening and/or definitive laboratory data suggests a potential release area along the northern leg of the north field fuel distribution system, *then* the area will be further assessed as an initial point of interest in the northwest portion of Site 4 assessment (refer to **Table 5-2**).	
6. Specify Performance or Acceptance Criteria	For sampling and analytical tasks, erroneous decisions can be attributed to sampling error and measurement error. Sampling error occurs when the design and implementation of the field sampling plan does not provide representative data for the site. Measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The EPA identifies the combination of all these errors as a "total study error" (EPA 2006).	
	1. Errors generated from sampling and analysis tasks will be minimized to the extent practical through the use of Standard Operating Procedures (SOPs) presented in Section 8.0 in order to maximize confidence in the selected decision. Most of these procedures are adapted from FDEP and EPA guidance.	
	2. The acceptable limits for detection thresholds and precision, accuracy, representativeness, completeness, and comparability criteria for data collection and analysis procedures are presented in Section 6.0 (**Worksheet #12**).	
	3. Analytical data from all phases of the sampling conducted under this SAP will be generated by a fixed-base laboratory from discrete media samples and validated in accordance with the data validation procedures discussed in Section 12.0 (**Worksheets #34**, **#35**, and **#36**). The quality of the data collected during this SAP must be adequate to determine the risks to current and future human receptors and the environment, and to support the development and detailed analysis of remedial alternatives for the RAP.	
7. Develop the Plan for Obtaining Data	• Collect soil samples.	The sampling design for the site was developed to optimize resources and generate data to satisfy the DQOs. The sampling design and rationale for field sampling activities are presented in Section 7.0 (**Worksheet #17**).

Table 5-2: Data Quality Objectives for the Northwest Portion of Site 4

DQO Step	Description
1. State the Problem	In the northwest portion of Site 4, between the pipelines and known sources, there remains considerable uncertainty with respect to the sources of free phase hydrocarbons identified at Site 4 and how the previously identified free phase hydrocarbons are migrating through the vadose zone into the upper perched aquifer, and the interaction with the surficial aquifer with the lower perch aquifer in the north central of the site.
2. Identify the Goals of the Study (Alternative Actions presented in Step 5)	1. Define the nature and extent of Site 4 contamination in the northwestern portion of the site.
	2. Address the uncertainties of the potential source area(s).
	3. Establish a present day baseline of Site 4 vadose zone, perched and surficial groundwater conditions for remedial action optimization.
	4. Complete a Site Assessment Report Addendum (which includes the North Field fuel distribution system and the northwest portion of the site), including the current site conditions and updates to the CSM and the human health and ecological risk assessments, if necessary.
3. Identify Information Inputs	1. Preliminary CSM provided in Section 4.0 (**Worksheet #10**).
	2. Real-time field screening and definitive data collected as part of the northwest portion assessment activities used to identify any potential release areas along the northern leg of the pipeline.
	3. Data to be collected during the following activities (A list of proposed samples is provided on **Tables 8-2** through **8-4** and locations illustrated on **Figure 7-2**. Initial points of interest have been identified and then real-time field screening and definitive data will be evaluated to determine subsequent sample locations. See Section 7.0 (**Worksheet #17**) for a discussion of sampling design and rationale.): • GPR survey of former UST locations; • DPT soil profiling to an anticipated depth of 110 feet bls (the presumed depth of the surficial aquifer); • Monitoring well installation and sampling; and • Survey of all Site 4 existing monitoring wells, newly installed wells, and completed DPT boring locations. Types of data to be collected as follows: Screening Data: • Field screening of soil from DPT borings using an OVA; • On-site laboratory analysis of soil gas from DPT borings for VOCs using modified EPA Method TO-15 (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 [**Worksheet #15,** Table 9-4].); and • On-site laboratory analysis of soil from DPT borings for VOCs using EPA Method SW8260 (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 [**Worksheet #15,** Table 9-2]. A list of sampling locations is provided on **Tables 8-2** through **8-4**.). Chemical Data (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 [**Worksheet #15,** Tables 9-1, 9-3, 9-5 through 9-7].): • Definitive off-site laboratory analyses of soil gas from DPT borings for analysis of VOCs using EPA Method TO-15. • Definitive off-site laboratory analyses of soil from DPT borings for the following analytical parameters: COCs listed on Table C of Chapter 62-780, effective date 12 June 2013 (select VOCs, PAHs, TRPH, and speciation of TRPH, if necessary). Analysis of other listed priority pollutant volatile organic halocarbons, which are not required for soil under Table C of Chapter 62-780; isopropylbenzene; and 1,4-dioxane will be included based on the possibility of presence in the study area. SPLP analyses may be performed on select samples for site-specific leachability determination. • Definitive off-site laboratory analyses of groundwater from newly installed and existing perched and/or surficial aquifer monitoring wells for the following analytical parameters: COCs listed on Table C of Chapter 62-780, effective date 12 June 2013 (select VOCs, EDB, PAHs, TRPH, and lead). Isopropylbenzene and 1,4-dioxane will be included based on the possibility of presence in the study area. Physical Data: Subsurface stratigraphy observed in the continuous soil core produced during drilling activities will be logged in accordance with the USCS. Prior to each groundwater sampling event, a full round of water level data (i.e., a synoptic sampling event) will be collected from the Site 4 monitoring well network to support site-

DQO Step	Description
	specific groundwater flow determinations. Groundwater stabilization field parameters (pH, temperature, specific conductance, dissolved oxygen, oxidation reduction potential, and turbidity) will be collected during purging to ensure collection of representative samples. Types of utility locate and survey equipment: GPR, GPS Types of soil sampling equipment: DPT, OVA. Types of well installation equipment: Rotosonic drill rig Types of groundwater sampling equipment: submersible variable speed pumps and disposable Teflon® tubing.
	4. Historical boring logs, well construction details, soil, and perched and surficial groundwater data from Site 4 SAR, CH2M HILL, June 2013.
	5. PALs provided in Section 9.0 (**Worksheet #15,** Tables 9-1 through 9-7) are as follows: • Soil gas: most conservative of the EPA RSLs Resident Air, National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs), or Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) (whichever is more stringent) • Soil: most conservative of the EPA RSLs or Chapter 62-777 SCTLs • Upper perched groundwater: Chapter 62-777 GCTLs • Lower perched and surficial groundwater: most conservative of the EPA RSLs or Chapter 62-777 GCTLs (whichever is more stringent) for surficial groundwater. PALs for surficial groundwater will include EPA RSLs because the area lies within the Site 40 Operable Unit (OU), which is regulated under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As to whether the surficial groundwater results meet the No Further Action (NFA) requirements of Chapter 62-780, effective date 12 June 2013, this will be reported in the SAR Addendum.
4. Define the Boundaries of the Study	**Lateral Boundary:** The investigation area is depicted on **Figure 7-2** and begins approximately 100 feet south and 100 feet east of the former USTs and extends to the northwest.
	Vertical Boundary: Anticipated investigation depth will range between 75-feet and 120-feet bls (the occurrence of the surficial aquifer), depending on data collected during field activities.
	Temporal Boundary: Estimated duration of investigation activities is approximately four weeks. Other Site 4 field activities proposed in this SAP will be scheduled alongside the northwest portion of Site 4 assessment for optimization and efficiency.
5. Develop the Analytic Approach	1. ***If*** COC concentrations in soil gas and/or soil on-site laboratory screening samples suggest the potential for soil impacts, ***then*** real time decisions can be made regarding the next soil boring location to delineate the impacted media to the PALs both vertical or laterally. Conversely, ***if*** COC concentrations in soil gas and soil samples do not suggest the potential for soil impacts, ***then*** then the need to submit the delineating soil sample for definitive laboratory analysis will be evaluated. Data results from the on-site laboratory are intended to only be used as an evaluation tool during remedial strategy optimization. This data is not intended for final decisions.
	2. ***If*** COC concentrations in soil gas and/or soil definitive laboratory samples suggest the potential for soil impacts, ***then*** real time decisions can be made regarding the Navy's understanding of the source areas contributing to the contaminated media and evaluate whether nature and extent has been defined and whether additional DPT boring locations are necessary. Conversely, ***if*** COC concentrations in soil gas and soil samples do not suggest the potential for soil impacts, ***then*** real time decisions can be made regarding the Navy's understanding of the source areas contributing to the contaminated media and evaluate whether nature and extent has been defined.
	3. The upper perched groundwater analytical results will be screened against the PALs provided in Section 9.0 (**Worksheet #15,** Table 9-5). ***If*** upper perched groundwater concentrations exceed the PALs, ***then*** remedial alternative optimization for Site 4 will need to be proposed in the SAR Addendum. Conversely, if upper perched groundwater concentrations are below PALs, ***then*** NFA for soils in accordance with Chapter 62-780 FAC will be evaluated.

DQO Step	Description	
	4. The lower perched or surficial groundwater analytical results will be screened against the PALs provided in Section 9.0 (**Worksheet #15,** Table 9-6). ***If*** lower perched or surficial groundwater concentrations exceed the PALs, ***then*** continued sampling under the Site 40 groundwater investigation project or remedial alternative optimization for Site 4 will need to be proposed in the SAR Addendum. Conversely, ***if*** lower perched or surficial groundwater concentrations are below PALs, ***then*** additional quarters of lower perched or surficial groundwater sampling will be evaluated in the Addendum report.	
6. Specify Performance or Acceptance Criteria	For sampling and analytical tasks, erroneous decisions can be attributed to sampling error and measurement error. Sampling error occurs when the design and implementation of the field sampling plan does not provide representative data for the site. Measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The EPA identifies the combination of all these errors as a "total study error" (EPA 2006).	
	1. Errors generated from sampling and analysis tasks will be minimized to the extent practical through the use of SOPs presented in Section 8.0 in order to maximize confidence in the selected decision. Most of these procedures are adapted from FDEP and EPA guidance.	
	2. The acceptable limits for detection thresholds and precision, accuracy, representativeness, completeness, and comparability criteria for data collection and analysis procedures are presented in Section 6.0 (**Worksheet #12**).	
	3. Analytical data from all phases of the sampling conducted under this SAP will be generated by a fixed-base laboratory from discrete media samples and validated in accordance with the data validation procedures discussed in Section 12.0 (**Worksheets #34**, **#35**, and **#36**). The quality of the data collected during this SAP must be adequate to determine the risks to current and future human receptors and the environment, and to support the development and detailed analysis of remedial alternatives for the RAP.	
7. Develop the Plan for Obtaining Data	• Collect soil gas samples. • Collect soil samples. • Collect upper and lower perched and surficial groundwater samples.	The sampling design for the site was developed to optimize resources and generate data to satisfy the DQOs. The sampling design and rationale for field sampling activities are presented in Section 7.0 (**Worksheet #17**).

Table 5-3: Data Quality Objectives for the Pipeline Junction Area

DQO Step	Description
1. State the Problem	Due to the age of the existing assessment data (over 12 years) from the area of the abandoned underground pipeline junction, uncertainties of the nature and extent exist.
2. Identify the Goals of the Study (Alternative Actions presented in Step 5)	1. Define the nature and extent of Site 4 contamination in the area of the pipeline junction.
	2. Address the uncertainties of the source area(s).
	3. Establish a present day baseline of pipeline junction vadose zone, lower perched and surficial groundwater conditions for remedial action optimization. Upper perched groundwater is not expected in this area because the clay aquitard identified in the vicinity of the ASTs does not extend latterly to the pipeline junction area as determined from soil borings for site monitoring wells.
	4. Complete a RAP Addendum (which includes the pipeline junction area), including the current site conditions and updates to the CSM; the human health and ecological risk assessments, if necessary; and the results of a Remedial Alternatives Analysis (RAA).
3. Identify Information Inputs	1. Preliminary CSM provided in Section 4.0 (**Worksheet #10**).
	2. Data to be collected during the following activities (A list of proposed samples is provided on **Tables 8-5** through **8-7** and locations illustrated on **Figure 7-3**. Initial points of interest have been identified and then real-time field screening and definitive data will be evaluated to determine subsequent sample locations. See Section 7.0 [**Worksheet #17**] for a discussion of sampling design and rationale.): GPR survey of the pipeline; • DPT soil profiling to an anticipated depth of 110 feet bls (the presumed depth of the surficial aquifer); • Monitoring well installation and sampling; • Soil gas monitoring implant installation and sampling; • Survey of newly installed wells and completed DPT boring locations. Types of data to be collected as follows: Screening Data: • Field screening of soil from DPT borings using an OVA; • On-site laboratory analysis of soil gas from DPT soil borings for VOCs using EPA Method TO-15 (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, Table 9-4); and • On-site laboratory analysis of soil from DPT soil borings for VOCs using EPA Method SW8260 (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, Table 9-2). Chemical Data (A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 [**Worksheet #15**, **Tables 9-1, 9-3, 9-5** through **9-7**]. Lists of sampling locations are provided on **Tables 8-5** through **8-7**.): • Definitive off-site laboratory analyses of soil gas from DPT borings and soil gas monitoring implants for analysis of VOCs using EPA Method TO-15. • Definitive off-site laboratory analyses of soil from DPT borings for the following analytical parameters: COCs listed on Table C of Chapter 62-780, effective date 12 June 2013 (select VOCs, PAHs, TRPH, and speciation of TRPH, if necessary). Analysis of other listed priority pollutant volatile organic halocarbons, which are not required for soil under Table C of Chapter 62-780; isopropylbenzene; and 1,4-dioxane will be included based on the possibility of presence in the study area. SPLP analyses may be performed on select samples for site-specific leachability determination. • Definitive off-site laboratory analyses of groundwater from newly installed and existing perched and/or surficial aquifer monitoring wells for the following analytical parameters: COCs listed on Table C of Chapter 62-780, effective date 12 June 2013 (select VOCs, EDB, PAHs, TRPH, and lead). Isopropylbenzene and 1,4-dioxane will be included based on the possibility of presence in the study area. Physical Data: Subsurface stratigraphy observed in the continuous soil core produced during drilling activities will be logged in accordance with the USCS. Prior to each groundwater sampling event, a full round of water level data (i.e., a synoptic sampling event) will be collected from the Site 4 monitoring well network to support site-

DQO Step	Description
	specific groundwater flow determinations. Groundwater stabilization field parameters (pH, temperature, specific conductance, dissolved oxygen, oxidation reduction potential, and turbidity) will be collected during purging to ensure collection of representative samples. Types of utility locate and survey equipment: GPR, GPS Types of soil sampling equipment: DPT, vapor sampling pump, effluent collection device, and OVA. Types of well installation equipment: Rotosonic drill rig Types of groundwater sampling equipment: submersible variable speed pumps and disposable Teflon® tubing. See **Figure 7-3** for proposed sample locations and Section 7.0 (**Worksheet #17**) for a discussion of sampling design and rationale.
	3. Historical boring logs, well construction details, soil, and perched and surficial groundwater data from the Site 4 SAR, CH2M HILL, June 2013.
	4. PALs provided in Section 9.0 (**Worksheet #15, Tables 9-1** through **9-7**) are as follows: • Soil gas: most conservative of the EPA RSLs Resident Air, National Institute for Occupational Safety and Health (NIOSH) RELs, or OSHA PELs (whichever is more stringent) • Soil: most conservative of the EPA RSLs or Chapter 62-777 SCTLs • Lower perched and surficial groundwater: most conservative of the EPA RSLs or Chapter 62-777 GCTLs (whichever is more stringent) for surficial groundwater. PALs for surficial groundwater will include EPA RSLs because the area lies within the Site 40 Operable Unit (OU), which is regulated under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As to whether the surficial groundwater results meet the NFA requirements of Chapter 62-780, effective date 12 June 2013, this will be reported in the SAR Addendum.
4. Define the Boundaries of the Study	**Lateral Boundary:** Investigation boundary will extend 100 feet south of the former USTs to the southern extent of Site 4 to encompass the pipeline junction area.
	Vertical Boundary: Anticipated investigation depth will range between 75-feet and 120-feet bls (the occurrence of the surficial aquifer), depending on data collected during field activities.
	Temporal Boundary: Estimated duration of investigation activities is approximately three weeks. Other Site 4 field activities proposed in this SAP will be scheduled alongside the pipeline junction portion of Site 4 for optimization and efficiency. The soil gas survey will also be scheduled in succession with the active soil gas survey being conducted under CLEAN Contract Number N62470-11-D-8013, CTO JM44.
5. Develop the Analytic Approach	1. ***If*** COC concentrations in soil gas and/or soil on-site laboratory screening samples suggest the potential for soil impacts, ***then*** real time decisions can be made regarding the next soil boring location to delineate the impacted media to the PALs both vertical or laterally. Conversely, ***if*** COC concentrations in soil gas and soil samples do not suggest the potential for soil impacts, ***then*** then the need to submit the delineating soil sample for definitive laboratory analysis will be evaluated. Data results from the on-site laboratory are intended to only be used as an evaluation tool during remedial strategy optimization. This data is not intended for final decisions.
	2. ***If*** COC concentrations in soil gas and/or soil definitive laboratory samples suggest the potential for soil impacts, ***then*** real time decisions can be made regarding the Navy's understanding of the source areas contributing to the contaminated media and evaluate whether nature and extent has been defined and whether additional DPT boring locations are necessary. Conversely, ***if*** COC concentrations in soil gas and soil samples do not suggest the potential for soil impacts, ***then*** real time decisions can be made regarding the Navy's understanding of the source areas contributing to the contaminated media and evaluate whether nature and extent has been defined.
	3. The lower perched and surficial groundwater analytical results will be screened against the PALs provided in Section 9.0 (**Worksheet #15, Table 9-6**). ***If*** lower perched or surficial groundwater concentrations exceed the PALs, ***then*** continued sampling under the Site 40 groundwater investigation project or remedial alternative optimization for Site 4 will need to be evaluated in the RAP Addendum. Conversely, ***if*** lower perched or surficial groundwater concentrations are below PALs, ***then*** additional quarters of surficial groundwater sampling will be evaluated in the Addendum report.

DQO Step	Description	
6. Specify Performance or Acceptance Criteria	For sampling and analytical tasks, erroneous decisions can be attributed to sampling error and measurement error. Sampling error occurs when the design and implementation of the field sampling plan does not provide representative data for the site. Measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The EPA identifies the combination of all these errors as a "total study error" (EPA 2006).	
	1. Errors generated from sampling and analysis tasks will be minimized to the extent practical through the use of SOPs presented in Section 8.0 in order to maximize confidence in the selected decision. Most of these procedures are adapted from FDEP and EPA guidance.	
	2. The acceptable limits for detection thresholds and precision, accuracy, representativeness, completeness, and comparability criteria for data collection and analysis procedures are presented in Section 6.0 (**Worksheet #12**).	
	3. Analytical data from all phases of the sampling conducted under this SAP will be generated by a fixed-base laboratory from discrete media samples and validated in accordance with the data validation procedures discussed in Section 12.0 (**Worksheets #34**, **#35**, and **#36**). The quality of the data collected during this SAP must be adequate to determine the risks to current and future human receptors and the environment, and to support the development and detailed analysis of remedial alternatives for the RAP.	
7. Develop the Plan for Obtaining Data	• Collect soil gas samples. • Collect soil samples. • Collect perched and surficial groundwater samples. • Remedial alternative optimization, if necessary.	The sampling design for the site was developed to optimize resources and generate data to satisfy the DQOs. The sampling design and rationale for field sampling activities are presented in Section 7.0 (**Worksheet #17**).

6.0 SAP Worksheet #12: Field Quality Control Samples

(UFP-QAPP Manual Section 2.6.2 – Worksheet #12)

This worksheet identifies the measurement performance criteria (MPC) for QC samples collected during all media sampling at Site 4. The type of QC samples, associated analytical groups, frequency, data quality indicators (DQIs), MPC, and targeted assessment error assignment, were selected in accordance with *DoD quality Systems Manual (QSM) V4.2* (DoD, October 2010).

Table 6-1: Programmatic Measurement Performance Criteria Table – Field QC Samples

QC Sample [a]	Analytical Group	Frequency [b]	DQI [b]	Measurement Performance Criteria [b]
Trip Blank [c]	VOCs	One per cooler with VOC samples [b]	Accuracy/Bias	No analytes ≥ ½ Limit of Quantitation (LOQ), except common lab contaminants, which must be < LOQ.
Equipment Rinsate Blank	All	5% of primary samples collected with reusable sampling equipment per matrix per analytical method	Accuracy/Bias	No analytes ≥ ½ LOQ, except common lab contaminants, which must be < LOQ.
Temperature Blank	All	One per sample cooler requiring preservation	Accuracy/Bias	Temperature to remain >0°C and ≤6°C
Field Duplicate (Inorganic Constituents) [d]	All	10% of total samples planned for collection for each sampling technique utilized.	Precision	Values > 5X LOQ: Relative Percent Difference (RPD) must be ≤40% (soil), RPD must be ≤ 30% (waters) Values ≤ 5X LOQ: absolute difference ≤ 2x the LOQ
Field Duplicate (Organic Constituents) [d]	All	10% of total samples planned for collection for each sampling technique utilized.	Precision	Values > 5X LOQ: RPD must be ≤45% (soil), RPD must be ≤35% (waters), RPD must be ≤30% (Vapor) Values ≤ 5X LOQ: absolute difference ≤ 2x the LOQ
Split Samples (soil/Water)	All	10% of total samples planned for collection for each sampling technique utilized.	Precision/Accuracy	Values > 5X LOQ: RPD must be ≤40%
Split Samples (vapor)	All	10% of total samples planned for collection for each sampling technique utilized.	Precision/Accuracy	Values > 5X LOQ: RPD must be ≤30%

QC Sample [a]	Analytical Group	Frequency [b]	DQI [b]	Measurement Performance Criteria [b]
Matrix Spike/Matrix Spike Duplicate (ms/msd) (Inorganic Constituents)	All	5% of total samples planned for collection for each sampling technique utilized	Used to evaluate the precision of analytical measurements and potential interferences	RPDs ≤35% (waters) RPDs ≤45% (soils)
ms/msd (Organic Constituents)	All	5% of total samples planned for collection for each sampling technique utilized	Used to evaluate the precision of analytical measurements and potential interferences	RPDs ≤35% (vapors) RPDs ≤40% (waters) RPDs ≤50% (soils)

Notes:

Per FDEP 2008, DEP-SOP-001/01, FQ1000: refer to **Worksheet #20** for a summary of QC samples by project location, matrix, and analytical group.

[a] QC samples and associated MPC as provided in Section 6.0 (**Worksheet #12**) are applicable for all laboratory analyses intended for definitive data use and apply to both fixed and mobile laboratories without exception.

[b] Minimum frequency, DQI and MPC apply to concentrated levels (low, mid and high).

[c] One trip blank consists of two 40-milliliter volatile organic analytes vials containing organic-free water prepared by the laboratory.

[d] Duplicate samples and associated MPC as provided in Section 6.0 (**Worksheet #12**) are applicable for on-site field analyses intended for screening level data, excluding field measurements (e.g., water quality parameters) in support of definitive sample data collection.

7.0 SAP Worksheet #17: Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1 - Worksheet #17)

Based on the CSM (**Worksheet #10**), a judgmental data acquisition approach was selected for this field investigation. This sampling approach was selected primarily because the occurrence, nature, and extent of site-related contaminants have been historically characterized and the unacceptable threat ("risk") to human health or the environment associated with those site-related contaminants have been evaluated. The data collected during this investigation is intended for use in refining the current CSM and identify and characterize potential contaminant sources associated with the former North Field fuel distribution system and define the extent of known Site 4 related contamination located within the northwestern portion of the site and within the vadose zone and perched groundwater systems. In addition, acquire sufficient site-specific data necessary to prepare a RAP Addendum for the pipeline junction area of Site 4.

Field activities include soil screening and active soil gas surveys with confirmation soil sampling and the installation and sampling of monitoring wells within the upper and lower perched aquifers. Unless otherwise specified, project tasks will be conducted in conformance with FDEP-compliant sampling and assessment methods and Standard Operating Procedures (SOPs). Where available, the most recentversions of FDEP SOPs shall be used unless task-specific FDEP SOPs are unavailable or it is determined that SOPs from other organizations are more appropriate to meet project-specific conditions and objectives. SOPs intended for use during the implementation of this SAP including FDEP SOPs, EPA Region 4 Science and Ecosystem Support Division (SESD) SOPs, and Resolution Consultants SOPs are listed in Section 8.0, **Table 8-3**, and are provided in **Appendix C**. Intrusive field sampling activities as proposed in this section will be implemented in a dynamic fashion. The information collected from initial soil borings where field activities are proposed will be used to make decisions as to placement of additional subsequent soil borings and\or monitoring wells that will be necessary to fully characterize potential contaminant sources.

Details of the field project implementation tasks, including base procedures, field and laboratory SOPs, and a sample detail summary table to be implemented during the execution of the sampling summarized below, is provided in Section 8.0. Sampling locations are depicted in **Figures 7-1** through **7-3**. The target analytes for all proposed analysis are provided in Section 9.0 (**Worksheet #15**, **Tables 9-1** through **9-7**).

7.1 Field Sampling (Soil Screening/Active Soil Gas Surveys)

Soil screening will be conducted in accordance with FDEP SOP-001/01 FS 1000 and FS 3000 (FDEP, December 2008) and active soil gas surveys will be conducted in accordance with EPA Region 4, SOP SESDPRO0C-307-R2 within the three areas; North Field fuel distribution system, northwest

portion of Site 4, and the pipeline junction area. The active soil gas survey sampling design for soil will be implemented in a series of phases, each building upon the knowledge gained from the previous phase.

7.1.1 North Field Fuel Distribution System Soil Assessment

Direct push technology (DPT) drilling with soil profiling tooling will be used to characterize the presence or absence of potential contaminant releases within the vadose zone along approximately 5,000 lineal feet of abandoned AVGAS pipeline, between the former Site 4 USTs and fuel hydrants, associated with the North Field fuel distribution system as depicted on **Figure 7-1**.

The soil borings will be advanced at an approximately 50-foot spacing along the 5,000 lineal feet of AVGAS pipeline for a total of 125 boring locations (including straight sections, pipeline junctions and elbows, and hydrants). Due to the majority of the locations being covered by concrete, the coring and removal of up to 18–inches of concrete is anticipated. Soil cores will be collected continuously from just below the concrete sub-base (or the ground surface in grass areas) to a depth of 10 feet at each location. Soil cores will be divided into 2-foot intervals and field screened for petroleum impacts using an OVA. The filtered OVA result (using the charcoal filter adaptor) will be measured when the unfiltered reading is greater than 10 ppm.

The filtered OVA result is the methane concentration value which will be subtracted from the unfiltered results to obtain the "net" or corrected results. If corrected OVA field screening results of soil are observed greater than 10 ppm at any sample location, the soil sample with the highest corrected OVA result from that sample location will be collected in accordance with FDEP SOP FS 3000, and submitted to a DoD Environmental Laboratory Accreditation Program (ELAP)-accredited laboratory for definitive laboratory analyses of 62-780 FAC, Table C analytes (select VOCs by EPA Method SW8260B [soil list will be modified to match groundwater list for a comparable evaluation of COCs in the two media], PAHs by EPA Method SW8270D Selective Ion Monitoring (SIM), and TRPH by Method FL-PRO [TRPH speciation as needed by Method TPHCWG]) for definitive analyses. In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) and 1,4-dioxane by EPA Method SW8260B have been added to the proposed list of analytes per FDEP request (NASWF, Draft August 2013 Partnering Meeting Minutes). Assuming that the 10-ppm corrected OVA screening criteria will be exceeded at 10% of the 125 proposed boring locations, an estimated total 13 soil samples (plus QA/QC samples) will be submitted for definitive laboratory analyses. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-1**).

The abandonment of soil borings will be performed in accordance with FDEP guidance and NAS Whiting Field concrete repair requirements. Soil borings will be abandoned by replacing soil within

the boring, in the reverse order removed to within 2 feet of the surface, placing and compacted 6 to 8 inches of gravel sub-base, and sealing the upper 18-inches with 3,000 psi concrete plug/patch.

7.1.2 Northwest Portion of Site 4 Soil and Soil Gas Nature and Extent Assessment

Soil gas sampling will be completed utilizing DPT drilling with a combination of Dual Tube (DT) Soil Profiling and Post-Run Tubing (PRT) Soil Gas Sampling tooling systems in accordance with EPA Region 4, SOP SESDPRO0C-307-R2 and the jointly produced California Advisory – Active Soil Gas Investigations (**Appendix C**) to characterize potential contaminant sources within the vadose zone and soil gas. The ability to collect both soil and soil gas data will more efficiently aid in the characterization of potential contaminant sources within the vadose zone and the identification of low permeability stratigraphic units that may be redirecting the vertical migration of free phase hydrocarbons laterally in the area of Site 4. Initial soil gas boring locations are depicted on **Figure 7-2.**

At each selected boring location, a DPT soil boring will be advanced to an anticipated depth of approximately 110 feet bls, (the presumed depth of the surficial aquifer). Subsurface stratigraphy observed in the continuous DT soil profiling system soil core produced during drilling activities will be logged in accordance with the Unified Soil Classification System (USCS). Filtered and unfiltered OVA measurements from continuous soil core samples will also be collected during soil logging and documented with soil classification descriptions.

Soil gas samples will be collected in accordance with EPA Region 4, SOP SESDPRO0C-307-R2 and the jointly produced California Advisory – Active Soil Gas Investigations (**Appendix C**) from each of the 10 soil borings at 10-foot interval collection depths. An estimated 110 soil gas samples (11 samples from each soil boring plus QA/QC) will be collected for on-site laboratory analyses of select VOCs by EPA Method TO-15. Following on-site laboratory analyses, 10% of the estimated 110 soil gas samples (11 soil gas samples [plus QA/QC samples]) will be submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of select VOCs by EPA Method TO-15 for confirmation analyses based on on-site laboratory results. On-site laboratory soil gas analytical results are anticipated to be available for use within 24 to 48 hours from sample collection. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-3** and **9-4**).

Soil samples will be collected from each of the 10 soil borings at 10-foot depth intervals to correspond with proposed soil gas sample collection depths. An estimated 110 soil samples (11 samples from each soil boring plus QA/QC) will be collected for on-site laboratory analyses of select VOCs by EPA Method SW8260B. Following on-site laboratory analyses, 10% of the estimated 110 soil samples (11 soil samples, plus QA/QC samples) will be submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of 62-780 FAC, Table C analytes (select

VOCs by EPA Method SW8260B [soil list modified to match groundwater list for a comparable evaluation of COCs in the two media], PAHs by EPA Method SW8270D, and TRPH by Method FL-PRO [TRPH speciation as needed by Method TPHCWG]). In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) and 1,4-dioxane by EPA Method SW8260B have been added to the proposed list of analytes per FDEP request (NASWF, Draft August 2013 Partnering Meeting Minutes). Specific samples identified for definitive analysis will be determined based on on-site laboratory analyses. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-1** and **9-2**).

Collected soil and soil gas samples will be hand delivered to an on-site laboratory set up to provide high quality screening data. The samples will be analyzed the same day as they are collected with results made available the next day. Once the custody of the soil or soil gas samples have been transferred to the on-site laboratory, analysis of the samples will be initiated. The samples will be analyzed using an HP 5890 gas chromatograph (GC) coupled with an O.I. Corporation model 4430 photoionization detector and Hewlett-Packard 19231 E flame ionization detector (PID/FID) and/or an HP 5890 GC with a 5971 mass spectrometer (MS) or equivalent. The PID/FID GC will be the primary instrument and the GC/MS will be used more for conformation and dilution analysis. Tabulated results will be provided to the Resolution Consultants Task Order Manager (TOM) and NAVFAC SE Remedial Project Manager (RPM) so near real time decisions can be made regarding the next soil boring location.

7.1.3 Pipeline Junction Area Reassessment

Similar to the sampling design for the North Field fuel distribution system assessment and northwest portion of Site 4 soil and soil gas nature and extent assessment, seven DPT soil borings with soil and soil gas sampling at multiple depth intervals will be completed to assess and characterize contaminants within the vadose zone within the pipeline junction area. Initial soil gas boring locations are depicted on **Figure 7-3.**

Soil gas samples will be collected from each of the seven proposed soil borings at 10-foot interval collection depths. An estimated 77 soil gas samples (11 samples from each soil boring plus QA/QC) will be collected for on-site laboratory analyses of select VOCs by EPA Method TO-15. Following on-site laboratory analyses, 10% of the estimated 77 soil gas samples (7 soil gas samples, plus QA/QC samples) will be submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of select VOCs by EPA Method TO-15 for confirmation analyses. On-site laboratory soil gas analytical results are anticipated to be available for use within 24 to 48 hours from sample collection. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-3** and **9-4**).

Soil samples will be collected from each of the seven soil borings at 10-foot depth intervals to correspond with proposed soil gas sample collection depths. An estimated 77 soil samples (11 samples from each soil boring plus QA/QC) will be collected for on-site laboratory analyses of select VOCs by EPA Method SW8260B. Following on-site laboratory analyses, 10% of the estimated 77 soil samples (7 soil samples, plus QA/QC samples) will be submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of 62-780 FAC, Table C analytes (select VOCs by EPA Method SW8260B [soil list modified to match groundwater list for a comparable evaluation of COCs in the two media], PAHs by EPA Method SW8270D, and TRPH by Method FL-PRO [TRPH speciation as needed by Method TPHCWG]). In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) and 1,4-dioxane by EPA Method SW8260B have been added to the proposed list of analytes per FDEP request (NASWF, Draft August 2013 Partnering Meeting Minutes). Specific samples identified for definitive analysis will be determined based on on-site laboratory analyses. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-1** and **9-2**).

Collected soil and soil gas samples will be hand delivered to an on-site laboratory setup to provide high quality screening data. The samples will be analyzed the same day as they are collected with results made available the next day. Once the custody of the soil or soil gas samples have been transferred to the on-site laboratory, analysis of the samples will be initiated. The samples will be analyzed using a HP 5890 gas chromatograph coupled with an O.I Corporation model 4430 PID and HP 19231 E FID and/or a HP 5890 GC with a 5971 MS or equivalent. The PID/FID GC will be the primary instrument and the GC/MS will be used more for conformation and dilution analysis. Tabulated results will be provided to the Resolution Consultants TOM and NAVFAC SE RPM so near real time decisions can be made regarding the next soil boring location.

7.2 Northwest Portion of Site 4 Monitoring Well Installation and Soil Sampling

Due to considerable uncertainty as to how the upper and lower perched aquifers and surficial aquifer are interacting with one another and how free phase hydrocarbons are migrating beneath Site 4, additional monitoring wells are required to address these data gaps. However, the selection of monitoring well locations cannot effectively be determined until the field activities, outlined in Sections 7.1.1 and 7.1.2, are completed and other potential source areas are defined. It is anticipated that 10 new groundwater monitoring wells will be required to improve the Navy's understanding of the Site 4 hydrostratigraphy and the nature and extent of site related groundwater contamination.

Rotosonic drilling techniques will be used to advance 10 soil borings for monitoring well installation. Proposed monitoring wells will be installed across the potentiometric surface of either the upper perched aquifer, lower perched aquifer, or surficial aquifer in accordance with the *Monitoring Well*

Design and Construction Guidance Manual and Rules of the Northwest Florida Water Managment District, Chapter 40A-3, FAC, *Regulation of Wells, Regulatory Guidelines #2000-2* (FDEP, 2008 and FDEP, March 1, 2000, respectively; **Appendix C**). The anticipated well construction depths will range between 85 to 120 feet bls. Soil lithology from each continuous Rotosonic soil core will be logged and soil types classified in accordance with the USCS. Filtered and unfiltered OVA measurements from continuous soil core samples will also be collected during soil logging and documented with soil classification descriptions.

Soil matrix samples from each Rotosonic soil core will be collected, as needed to define the nature and extent of soil contamination. An estimated 50 soil samples (five samples from each soil boring plus QA/QC samples) will be collected in accordance with FDEP SOP FS 3000, and submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of 62-780 FAC, Table C analytes (select VOCs by EPA Method SW8260B [soil list modified to match groundwater list for a comparable evaluation of COCs in the two media], PAHs by EPA Method SW8270D, and TRPH by Method FL-PRO [TRPH speciation as needed by Method TPHCWG]). In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) and 1,4-dioxane by EPA Method SW8260B have been added to the proposed list of analytes per FDEP request (NASWF, Draft August 2013 Partnering Meeting Minutes). Specific samples identified for definitive analysis will be determined based on corrected OVA readings. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Table 9-1**).

Upon reaching the terminal depth of each soil boring, groundwater monitoring wells will be constructed using 2-inch, schedule 40 polyvinyl chloride (PVC) well materials in accordance with FDEP guidance and SOPs. Monitoring wells will be constructed with 15 feet of 0.010-inch, mill-slotted well screens and installed at depth intervals that straddle the observed potentiometric surface. Groundwater monitoring well construction as-built details will be prepared to document well installation.

Newly installed monitoring wells will be developed, in general accordance with the *Monitoring Well Design and Construction Guidance Manual* (FDEP, 2008) and Rules of the Northwest Florida Water Managment District, Chapter 40A-3, FAC, *Regulation of Wells, Regulatory Guidelines #2000-2* (FDEP, March 1, 2000). Monitoring wells will not be sampled until at least 24 hours after development.

7.3 Pipeline Junction Area Monitoring Well/Implant Installation and Soil Sampling

There is insufficient site-specific data to fully characterize the nature, extent, and transport of groundwater contamination and the dynamic hydrogeologic interaction between the lower perched and surficial aquifer systems proximal to the pipeline junction area as needed to develop a RAP

Addendum. The selection of monitoring well locations cannot effectively be determined until the field activities, outlined in Section 7.1.3, are completed and the nature and extent of soil contamination is defined.

Resolution Consultants proposed that Rotosonic drilling techniques be used to advance two soil borings for monitoring well installation. Proposed monitoring wells will be installed across the potentiometric surface of either the lower perched aquifer or sand and gravel aquifer in accordance with *Monitoring Well Design and Construction Guidance Manual* (FDEP, 2008) and Rules of the Northwest Florida Water Managment District, Chapter 40A-3, FAC, *Regulation of Wells, Regulatory Guidelines #2000-2* (FDEP, March 1, 2000). The anticipated well construction depths will range between 100 to 120 feet bls. Soil lithology from each continuous Rotosonic soil core will be logged and soil types classified in accordance with the USCS. Filtered and unfiltered OVA measurements from continuous soil core samples will also be collected during soil logging and documented with soil classification descriptions.

Soil matrix samples from each Rotosonic soil core will be collected as needed to define the nature and extent of soil contamination. An estimated 22 soil samples (11 samples from each soil boring plus QA/QC samples) will be collected in accordance with FDEP SOP FS 3000, for on-site laboratory analyses of select VOCs by EPA Method SW8260B. Following on-site laboratory analyses, 10% of the estimated 22 soil samples (2 soil samples, plus QA/QC samples) will be submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of 62-780 FAC, Table C analytes (select VOCs by EPA Method SW8260B [soil list modified to match groundwater list for a comparable evaluation of COCs in the two media], PAHs by EPA Method SW8270D, and TRPH by Method FL-PRO [TRPH speciation as needed by Method TPHCWG]). In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) and 1,4-dioxane by EPA Method SW8260B have been added to the proposed list of analytes per FDEP request (NASWF, *Draft August 2013 Partnering Meeting Minutes*). Specific samples identified for definitive analysis will be determined based on on-site laboratory analyses. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, Table 9-2).

Upon reaching the terminal depth of each soil boring, groundwater monitoring wells will be constructed using 2-inch, schedule 40 PVC well materials in accordance with FDEP guidance and SOPs. Monitoring wells will be constructed with 15 feet of 0.010-inch, mill-slotted well screens and installed at depth intervals that straddle the observed and targeted lower perched or surficial aquifer potentiometric surface. Groundwater monitoring well construction as-built details will be prepared to document well installation.

Newly installed wells will be developed, in general accordance with *Monitoring Well Design and Construction Guidance Manual* (FDEP, 2008; **Appendix C**) and Rules of the Northwest Florida Water Managment District, Chapter 40A-3, FAC, *Regulation of Wells, Regulatory Guidelines #2000-2* (FDEP, March 1, 2000; **Appendix C**). Monitoring wells will not be sampled until at least 24 hours after development.

Three additional Rotosonic soil borings completed with nested soil gas implants will be necessary to monitor soil gas contaminants within the vadose zone proximal to the pipeline junction area of Site 4. At each sample location, Rotosonic drilling will be used to advance a soil boring to an anticipated depth of approximately 110 feet (the presumed depth of the sand and gravel aquifer). Subsurface stratigraphy observed in the continuous soil core produced during drilling activities will be logged in accordance with the USCS. Filtered and unfiltered OVA measurements from continuous soil core samples will also be collected during soil logging and documented with soil classification descriptions.

Soil samples from each of the three soil borings at 10-foot depth interval will be collected to correspond with the installation of proposed soil gas implants at the same depth intervals. An estimated 33 soil samples (11 samples from each soil boring, plus QA/QC) will be collected in accordance with FDEP SOP FS 3000, for on-site laboratory analyses of VOCs by using EPA Method SW8260. Following on-site laboratory analyses, 10% of the estimated 33 soil samples (3 soil samples, plus QA/QC samples) will be submitted to a Florida NELAC and DoD ELAP-accredited laboratory for definitive laboratory analysis of 62-780 FAC, Table C analytes (select VOCs by EPA Method SW8260B [soil list modified to match groundwater list for a comparable evaluation of COCs in the two media], PAHs by EPA Method SW8270D, and TRPH by Method FL-PRO [TRPH speciation as needed by Method TPHCWG]). In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) and 1,4-dioxane by EPA Method SW8260B have been added to the proposed list of analytes per FDEP request (NASWF, *Draft August 2013 Partnering Meeting Minutes*). Specific samples identified for definitive analysis will be determined based on on-site laboratory analyses. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, Table 9-2).

Following completion of each soil boring, grease free stainless steel soil gas sample implants will be installed at intervals depicting a lithological change, at intervals having elevated corrected OVA levels, or at a minimum vertical spacing of 10 feet. Soil gas implants will be set within clean coarse quartz sand extending one foot above and below the implant intake. The soil gas implants in the boring will be isolated from each other with dry chipped and hydrated bentonite seal. The soil gas implants will be completed with 0.25-inch inner diameter (ID) Nylaflow® or Teflon tubing extending to ground surface. Dependent upon on-site laboratory screening results, soil gas

implants may be completed at ground surface in a permanent 12-inch diameter steel heavy traffic (H-20 load rating) rain tight vault set in a 2-foot by 2-foot concrete pad for future soil gas monitoring.

Upon installation of the soil gas implants, a timed series of percent oxygen (O_2) and percent carbon dioxide (CO_2) measurements will be collected after installation to demonstrate that soil gas equilibrium has returned. A portable gas analyzer (Landtec GEM™ 2000 or equivalent) will be used to analyze the soil gas samples. Assuming similar stratigraphy at all soil implant locations, the time required for soil gas in the first boring to return to equilibrium will serve as the waiting time surrogate for all other borings.

Once soil gas equilibration has returned, the soil gas implants will be sampled using a low flow pump. Pump flow rates will be maintained between 100 to 200 milliliters per minute (mL/min) with a vacuum less than 100 inches of water to minimize stripping (partitioning of vapors from pore water to soil gas) and to prevent ambient air from diluting the soil gas samples. Prior to purging, a shut-in test will be conducted to check for leaks in the above-ground sampling system. Following the purging of the air volume of each implants tubing, soil gas sample will be collected in accordance with EPA Region 4, SOP SESDPRO0C-307-R2 and the jointly produced California Advisory – Active Soil Gas Investigations (**Appendix C**) using a vacuum "lung" box and a one liter Tedlar™ bag. A leak test will also be conducted during the soil gas sampling to evaluate the integrity of tubing connections.

Collected soil gas samples will be hand delivered to an on-site laboratory setup to provide high quality screening data. Once the custody of the one liter Tedlar™ bags has been transferred to the on-site laboratory, analysis of the soil gas samples will be initiated. The samples will be analyzed for select VOCs using a HP 5890 gas chromatograph coupled with PID/FID and/or a HP5890 GC with a 5971 MS or equivalent. The PID/FID GC will be the primary instrument and the GC/MS will be used more for conformation and dilution analysis. On-site laboratory soil gas analytical results are anticipated to be available for use within 24 to 48 hours from sample collection. Tabulated results will then be provided to the Field TOM and NAVFAC SE RPM so near real time decisions can be made regarding the next soil boring location. An estimated 33 soil gas samples (11 samples from each soil boring plus QA/QC) will be collected and submitted to a Florida NELAC and DoD ELAP-accredited laboratory for analysis of select VOCs by EPA Method TO-15. A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-3** and **9-4**).

7.4 Groundwater Sampling

Upon completion of the new monitoring wells discussed in Section 7.2 and 7.3, a complete round of depth-to-groundwater and depth-to-product measurements will be collected from all Site 4 monitoring wells, including the newly installed monitoring wells and select Site 32 and Site 40 surficial aquifer monitoring wells surrounding Site 4. Additionally, depth-to-groundwater measurements from seven monitoring wells (including the two newly installed monitoring wells) related to the pipeline junction area of Site 4 will be conducted.

One full round of low-flow groundwater samples, including QA/QC, will be collected from all newly installed monitoring wells and three existing monitoring wells listed on **Table 8-6** and shown on **Figure 4-4** (only existing well locations shown). Groundwater samples will be submitted for definitive laboratory analyses of 62-780 FAC, Table C analytes (select VOCs by EPA Method SW8260B, EDB by EPA Method SW8011, PAHs by EPA Method SW8270D SIM, TRPH by Method FL-PRO, and lead by EPA Method SW6020A). In addition to the 62-780 FAC, Table C analytes, isopropylbenzene (cumene) by EPA Method SW8260B and 1,4-dioxane by EPA Method SW8260C SIM have been added to the proposed list of analytes per FDEP request (NASWF, Draft May 2013 Partnering Meeting Minutes). A detailed list of the analytes to be analyzed and their methods are provided in Section 9.0 (**Worksheet #15**, **Tables 9-5** through **9-7**). The monitoring wells will be sampled using low-flow, quiescent sampling methods to minimize turbidity in accordance with FDEP SOP FS 2200, Groundwater Sampling. Field parameters will also be measured including temperature, specific conductivity, oxygen reduction potential, pH, dissolved oxygen, and turbidity.

7.5 QA/QC Sampling

Field duplicate, matrix spike (ms)/matrix spike duplicate (msd), field blank, and equipment blank samples will be collected for QC purposes. The QA/QC sample collection frequencies are provided in Section 6.0 (**Worksheet #12**).

8.0 Field Project Implementation (Field Project Instructions)

(UFP-QAPP Manual Section 2.8.1 – Worksheet #14)

This section provides a summary of tasks that will be implemented during the execution of this SAP. In addition to project-specific investigative tasks summarized in this section, tasks associated with general NASWF operating procedures will be conducted and are summarized below.

8.1 General NASWF Field Tasks

Before commencing field work, the TOM will notify the NASWF RPM of the anticipated schedule for Site 4 planned field work and coordinate NASWF support. The following items require NASWF support:

- Obtaining site access, including temporary badges;
- Notifying NASWF personnel (site contacts, security, emergency response, etc.);
- Obtaining permits for digging (intrusive work) and camera use and Work Clearance Requests;
- Locating water hook-ups and off-site decontamination areas, investigation-derived waste (IDW) management areas, and equipment staging areas;
- Registering Hazardous Materials;
- Acquiring Land Mobile Radios (if necessary); and
- Obtaining information on hurricane threat levels and procedures.
- Each of these items is discussed in the following sections.

8.1.1 Site Access

The NASWF RPM, as identified in Section 1.0 of this SAP, is the sponsor point of contact for contractor access to NASWF. Access to NASWF will require RAPIDGate, or Common Access Card credentials by Eid Passport. Credentials may be requested for 90 days or as long as one year. Limitations placed upon the length of the credential validity are based upon the renewal date of the Company's registration (renewed annually) or the contract period of performance end date. Daily access passes are available and can be coordinated through the TOM and NASWF point of contact, for work durations less than 3 days.

Credentials and daily pass holders will have their NASWF access pass on them at all times, unless properly escorted by NASWF personnel. No escort privileges are included with RAPIDGate or Common Access Card credentials.

While driving on NASWF, drivers and passengers must use a fixed seat belt (including back seat passengers). The speed limit is 25 miles per hour unless otherwise posted. No cell phone use or texting is allowed while driving. No persons may ride in the bed of a truck. Drivers are asked to slow down and give room to runners on roads.

No known locked gates are in the area of the site where access is anticipated to be needed. If a locked gate is identified, the NASWF point of contact will contact and coordinate with security forces to obtain a "swipe card" for gate access. Field team members shall be in possession of this SAP stating the purpose and authorization for conducting field activities at all times.

8.1.2 Notification of Field Work

The TOM will confirm with the NASWF RPM that all pertinent Base personnel (Security, Emergency Response, Base Commanding Officer, tenant organizations, etc.) are notified in advance prior to conducting field activities. Important NASWF point of contact and associated contact information is provided below.

Table 8-1: Important NASWF Numbers

Functional Base Entity	Phone Number
Security Forces (Emergency)	850.623.7333
Emergency Management Office	850.623.7324
Security Forces (Non-Emergency)	850.623.7387, fax 850.623.7123
Command Safety Office, located in Building 1429	850.623.7180 or 850.626.0131
Public Works	850.623.7268
Fire Department	850.623.7193
Base Commanding Officer	850.623.7121
Natural Resources Office	850.623.7602
Hazardous Materials Management Office	850.623.7592
Pass/Tag Office	850.623.7205
Dig Permits	850.686.6415
Spill Reporting	850.623.7333
NASWF Environmental Office	850.623.7017
Public Affairs Office	850.623.7341
Airfield Manager	850.623.6133
Facility Engineering and Acquisition Division (FEAD)	850.623.7181
General Base Information During a Crisis	1.888.623.WHTG (9484)

8.1.3 Permits

Subsurface intrusive activities are proposed at Site 4; therefore, a Dig Permit from NASWF Public Works Department will be required.

A visual survey of the site will be conducted at the start of field activities to identify obstructions (fences, roads, power lines, rough terrain, etc.), access points, travel routes, decontamination and staging areas, water hookups, and emergency response center locations (security, fire department, hospitals, etc.). Vehicle access routes to sampling locations shall be determined prior to any field activity.

If required, a camera permit will also be obtained for at least one field team member at each site. Photographic documentation of sampling locations may be performed during field activities. For secure areas, an escort will be required while photographs are taken, or the film (or electronic file for digital photographs) will be given to the NSAWF RPM for development and screening.

8.1.4 Locating Water Hook-Ups and IDW Management Area

The TOM will consult with the NASWF RPM to arrange access to a potable water supply for field activities. The NASWF RPM will designate an IDW Management Area to temporarily store IDW before disposal. Waste management activities are discussed further in Section 8.2.3 of this worksheet.

8.1.5 HURCON Warning Emergency Action Plan

Hurricane Condition (HURCON) threat levels come through Security Forces and are posted on the signs as you enter the NAS. Information on HURCON threat levels and procedures will be provided by the NASWF RPM.

8.2 Site 4 Field Tasks

Site 4 field tasks include soil screening and active soil gas surveys with confirmation soil sampling and the installation and sampling of monitoring wells within the upper and lower perched aquifers.

8.2.1 Groundwater Sampling

Water levels will initially be measured in the existing monitoring wells. Groundwater samples will be collected using low flow quiescent sampling methods to minimize turbidity, and field parameters.

8.2.2 Waste Management

All waste management and disposal will be conducted by Resolution Consultants. Waste sampling will be conducted in accordance with DEP-SOP-001/01 FS 5000 Waste Sampling, included in **Appendix C**. Waste may be classified as either non-investigative waste or IDW as defined below.

Non-investigative waste, such as litter and household/office garbage, shall be collected on an as-needed basis to maintain the site in a clean and orderly manner. This waste shall be containerized and transported to the designated collection bin or sanitary landfill. Acceptable containers shall be sealed boxes or plastic garbage bags.

Investigative activities at Site 4 may produce the following types of IDW:

- Soil cuttings (from monitoring well installation);
- Purge water (monitoring wells);
- Decontamination fluids;
- Personal protective equipment (PPE) and disposable sampling equipment; and
- Packing and shipping materials.

Proper management and disposal of IDW and PPE will be the responsibility of Resolution Consultants, unless otherwise directed by the NASWF RPM. Waste profiles, manifests, bills of lading, and/or certifications of disposal/treatment/recycling will be provided to the appropriate NASWF point of contact as directed by the NASWF RPM. All Hazardous Waste Manifests will be signed by appropriate NASWF personnel. Documentation of proper management and disposal will be provided to the appropriate NASWF personnel.

IDW will be properly containerized and temporarily stored at the site prior to transportation, unless otherwise directed by NASWF and an IDW plan detailing off-site IDW management is amended and approved in this SAP. Depending on the constituents of concern, fencing or other special marking may be required for the IDW management area. The number of containers shall be estimated on an as-needed basis. Acceptable containers shall be sealed in United States Department of Transportation-approved, steel, 55-gallon drums; tanks made of polyethylene or steel; overpacks; or small dumping bins with lids (roll-off bins).

All drums temporarily stored on site prior to transportation shall be placed on wood pallets, not directly on the ground surface. The containers shall be transported in such a manner to prevent spillage or particulate loss to the atmosphere. To facilitate handling, the containers should be no more than half full when moved.

Solid (soil cuttings) and liquid IDW (purged groundwater) is anticipated for site activities. Each container shall be properly labeled with the date, site identification, sampling point, matrix, constituents of concern, and other pertinent information for handling. Labels shall also identify the NASWF point of contact and Resolution Consultants point of contact, and include contact information with telephone number(s) as a minimum requirement. Labeling shall be of a

permanent nature such that it is unaffected by exposure to outdoor elements over an extended period of time.

Used PPE, disposable sampling equipment, and other trash will be consolidated in trash bags at the end of each day and sealed. It is the responsibility of Resolution Consultants to properly dispose of all debris, PPE, and other trash off site. The appropriate method of disposal will be selected based upon the available data from the site and direct analytical data from representative samples of the IDW. If IDW analytical testing results show no exceedances of applicable criteria/standards, then certain IDW, such as groundwater and/or decontamination water, may be may be placed on the ground of the project site (i.e., returned to the source area from which it originated) if doing so does not endanger human health or the environment or violate federal or state regulations.

The following table summarizes approved management and disposal practices for various types of IDW.

Table 8-2: Approved Management and Disposal Practices

TYPE	HAZARDOUS	NON-HAZARDOUS
PPE-Disposable	Containerize in plastic 5-gallon bucket or similar container with tight-fitting lid. Identify and properly dispose of.	Place waste in trash bag, then into dumpster.
PPE-Reusable	Decontaminate in accordance with the procedures outlined in SOPs (**Appendix C**). If the equipment cannot be decontaminated, containerize in plastic 5-gallon bucket or similar container with tight-fitting lid. Identify and properly dispose of.	Decontaminate in accordance with the procedures outlined in SOPs (**Appendix C**).
Soil Cuttings	Containerize in Department of Transportation-approved container with tight-fitting lid. Identify and arrange for testing and proper disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on site for proper disposal, based on analytical results.*
Groundwater	Containerize in Department of Transportation-approved container with tight-fitting lid. Identify and arrange for testing and proper disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on site for proper disposal, based on analytical results.*
Decontamination Water	Containerize in Department of Transportation-approved container with tight-fitting lid. Identify and arrange for testing and proper disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on site for proper disposal, based on analytical results.*
Disposable Equipment	Containerize in Department of Transportation-approved container or 5-gallon plastic bucket with tight-fitting lid. Identify and arrange for testing and proper disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on site for proper disposal, based on analytical results.
Trash	Not applicable (NA	Place waste in trash bag, then into dumpster.

* These materials may be placed on the ground of the project site (i.e., returned to the source area from which it originated) if doing so does not endanger human health or the environment or violate federal or state regulations.

8.2.3 Site Restoration

Efforts will be made to minimize impacts to the site and sampling locations. Following the completion of work at the site, all drums, trash, and other waste will be removed. Decontamination and/or purge water and PPE will be transported to the designated IDW Management staging area and disposed of properly.

8.3 SAP Worksheet #21: Field SOP References Table

(UFP-QAPP Manual Section 3.1.2 – Worksheet #21)

The SOPs that will be followed during the field projects tasks are listed in the table below.

Table 8-3: Field SOP References Table

SOP Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
FC1000	FDEP SOP FC1000, Field Decontamination, Effective 3 Dec 2008	FDEP	None	N	None
FD1000	FDEP SOP FD1000, Documentation, Effective 3 Dec 2008	FDEP	None	N	None
FQ1000	FDEP SOP FQ1000, Quality Control, Effective 3 Dec 2008	FDEP	None	N	None
FS1000	FDEP SOP FS1000, General Sampling, Effective 3 Dec 2008	FDEP	None	N	None
FS2200	FDEP SOP FS2200, Groundwater Sampling, Effective 3 Dec 2008	FDEP	Variable Speed Submersible Pump, Multi-meter	N	None
FS3000	FDEP SOP FS3000, Soil, Effective 3 Dec 2008	FDEP	Hand Auger, DPT Rig	N	None
FS5000	FDEP SOP FS5000, Waste Sampling, Effective 3 Dec 2008	FDEP	None	N	None
FT1000	FDEP SOP FT1000, Field Testing General, Effective 3 Dec 2008	FDEP	None	N	None
FT1100	FDEP SOP FT1100, Field pH, Effective 3 Dec 2008	FDEP	Multi-meter	N	None
FT1200	FDEP SOP FT1200, Field Specific Conductance, Effective 3 Dec 2008	FDEP	Multi-meter	N	None
FT1400	FDEP SOP FT1400, Field Temperature, Effective 3 Dec 2008	FDEP	Multi-meter	N	None
FT1500	FDEP SOP FT1500, Field Dissolved Oxygen, Effective 3 Dec 2008	FDEP	Multi-meter	N	None
FT1600	FDEP SOP FT1600, Field Turbidity, Effective 3 Dec 2008	FDEP	Turbidity-meter or Multi-meter	N	None

SOP Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
N/A	Rules of the Northwest Florida Water Managment District, Chapter 40A-3, FAC, *Regulation of Wells, Regulatory Guidelines #2000-2*	Florida Administrative Code	Rotosonic drilling rig	N	None
N/A	*Monitoring Well Design and Construction Guidance Manual*	FDEP Bureau of Water Facilties	Rotosonic drilling rig	N	None
3-01	Utility Clearance, Rev 0, May 2012	Resolution Consultants	Hand auger, Schonstedt utilities locator	N	None
3-03	Recordkeeping, Sample Labeling, and Chain-of-Custody, Rev 0, May 2012	Resolution Consultants	NA	N	None
3-17	Direct Push Sampling Techniques, Rev 0, May 2012	Resolution Consultants	DPT Rig	N	None
3-19	Headspace Screening for Total VOCs, Rev 0, May 2012	Resolution Consultants	OVA, FID	N	None
SESDPROC-110-R3	EPA Region 4, SOP SESDPROC-110-R2, GPS, Effective 20 Apr 2011	EPA	GPS	N	None
SESDPROC-303-R4	EPA Region 4, SOP SESDPROC-303-R4, Ambient Air Sampling, Effective 5 Jan 2011	EPA	Summa Canister	N	None
SESDPROC-307-R2	EPA Region 4, SOP SESDPRO0C-307-R2, Soil Gas Sampling, Effective 9/8/10	EPA	DPT and soil gas sampling equipment	N	None

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8.4 SAP Worksheets #18, 19, 20, and 30: Sample Details Table

(UFP-QAPP Manual Sections 3.1.1 and 3.5.2.3 – Worksheets #18, 19, 20 and 30)

Details for each of the sampling locations are provided in **Table 8-4** for soil, **Table 8-5** for air, and **Table 8-6** for groundwater.

Table 8-4: Sample Details Table for Soil

CTO JM57 Site 4 Sampling Dates TBD	Analysis Group	VOCs (Field-Based Laboratory)	VOCs	PAHs	TRPH	TRPH Speciation
	Preparation and Analytical Method	NA	EPA Method SW8260B/SW5035	EPA Method SW8270D SIM/SW3550B	Method FL-PRO/SW3550B	Method TPHCWG/SW3550B
	Analytical Laboratory / Preparation and Analytical SOP Reference	GCMS001/ GCFID001	ENCO Orlando/ SOP VGCMS-05	ENCO Orlando/ SOP EXSV-16 and SOP SVGCMS-03	ENCO Orlando/ SOP SVGC-14	Spectrum Analytical Inc./ SOP SOP00197-S4
	Data Package Turnaround Time	24 to 48 hours from sample collection	21 Calendar days	21 Calendar days	21 Calendar days	21 Calendar days
Environmental Conservation Laboratories, Inc. (ENCO Orlando) **10775 Central Port Drive Orlando, FL 32824** **Point of Contact: Ronnie Wambles** **Phone: 407-826-5314** **Spectrum Analytical Inc.** **8405 Benjamin Road, Suite A, Tampa, FL 33634** **Point of Contact: Mark Gudnason** **Phone: 813-888-9507**	Container Type / Volume required (if different than container volume)	Terracore sampling kits, 3 x 40 mL vials with stir bar, 1 x 2 oz G, Teflon-lined septum sealed cap	Terracore sampling kits, 3 x 40 mL vials with stir bar, 1 x 2 oz G, Teflon-lined septum sealed cap	1 x 4 oz G, Teflon-lined septum sealed cap	Teflon-lined cap 1 x 4 oz G	1 x 4 oz G, Teflon-lined septum sealed cap
	Preservative	Terracore – 1 vial with methanol, 2 vial with water, ice to 4°	Terracore – 1 vial with methanol, 2 vial with water, ice to 4°	Ice to 4°C	Ice to 4°C	Ice to 4°C
	Holding Time (Preparation / Analysis)	48 hours/14 days	48 hours/14 days	14 days/40 days	14 days/40 days	14 days/40 days

Site	Matrix	Station ID	Sample ID	Coordinates (NAD83, Feet) X	Coordinates (NAD83, Feet) Y	Depth / Sampling Interval					
4	Solids	WHF-4 (North Field Fuel Distribution System)	WHF-4-NF-SO01 through WHF-4-NF-SOXXX	TBD	TBD	Varies, 0 – 10 feet bls, 2 foot intervals		**13**	**13**	**13**	**as needed**
4	Solids	WHF-4 (Northwest Portion of Site 4)	WHF-4-NW-SO01-fbl through WHF-NW-4-SOXX-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals	**110**				
4	Solids	WHF-4 (Northwest Portion of Site 4)	WHF-4-NW-SO01 through WHF-NW-4-SOXX	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals		**11**	**11**	**11**	**as needed**
4	Solids	WHF-4 (Northwest Portion of Site 4)	WHF-1467-MW-54 through WHF-1467-MW-MW64	TBD	TBD	Varies, 0 – 120 feet bls		**50**	**50**	**50**	**as needed**
4	Solids	WHF-4 (Pipeline Junction Area)	WHF-4-PLJ-SO01-fbl through WHF-4-PLJ-SOXX-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals	**77**				

CTO JM57 Site 4 Sampling Dates TBD						Analysis Group	VOCs (Field-Based Laboratory)	VOCs	PAHs	TRPH	TRPH Speciation
						Preparation and Analytical Method	NA	EPA Method SW8260B/SW5035	EPA Method SW8270D SIM/SW3550B	Method FL-PRO/SW3550B	Method TPHCWG/SW3550B
						Analytical Laboratory/ Preparation and Analytical SOP Reference	GCMS001/ GCFID001	ENCO Orlando/ SOP VGCMS-05	ENCO Orlando/ SOP EXSV-16 and SOP SVGCMS-03	ENCO Orlando/ SOP SVGC-14	Spectrum Analytical Inc./ SOP SOP00197-S4
Environmental Conservation Laboratories, Inc. (ENCO Orlando) 10775 Central Port Drive Orlando, FL 32824 Point of Contact: Ronnie Wambles Phone: 407-826-5314 Spectrum Analytical Inc. 8405 Benjamin Road, Suite A, Tampa, FL 33634 Point of Contact: Mark Gudnason Phone: 813-888-9507						Data Package Turnaround Time	24 to 48 hours from sample collection	21 Calendar days	21 Calendar days	21 Calendar days	21 Calendar days
						Container Type/ Volume required (if different than container volume)	Terracore sampling kits, 3 x 40 mL vials with stir bar, 1 x 2 oz G, Teflon-lined septum sealed cap	Terracore sampling kits, 3 x 40 mL vials with stir bar, 1 x 2 oz G, Teflon-lined septum sealed cap	1 x 4 oz G, Teflon-lined septum sealed cap	Teflon-lined cap 1 x 4 oz G	1 x 4 oz G, Teflon-lined septum sealed cap
						Preservative	Terracore – 1 vial with methanol, 2 vial with water, ice to 4°	Terracore – 1 vial with methanol, 2 vial with water, ice to 4°	Ice to 4°C	Ice to 4°C	Ice to 4°C
						Holding Time (Preparation/ Analysis)	48 hours/14 days	48 hours/14 days	14 days/40 days	14 days/40 days	14 days/40 days
Site	**Matrix**	**Station ID**	**Sample ID**	**Coordinates (NAD83, Feet)**		**Depth/Sampling Interval**					
4	Solids	WHF-4 (Pipeline Junction Area)	WHF-4-PLJ-SO01 through WHF-4-PLJ-SOXX	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals		**7**	**7**	**7**	**as needed**
4	Solids	WHF-4 (Pipeline Junction Area)	WHF-PLJ-MW-03-fbl through W WHF-PLJ-MW-04-fbl	TBD	TBD	Varies, 0 – 120 feet bls	**22**				
4	Solids	WHF-4 (Pipeline Junction Area)	WHF-PLJ-MW-03 through W WHF-PLJ-MW-04	TBD	TBD	Varies, 0 – 120 feet bls		**2**	**2**	**2**	**as needed**
4	Solids	WHF-4 (Pipeline Junction Area)	WHF-PLJ-SGI-01-fbl through W WHF-PLJ-SGI-03-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals	**33**				
4	Solids	WHF-4 (Pipeline Junction Area)	WHF-PLJ-SGI-01-fbl through W WHF-PLJ-SGI-03-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals		**3**	**3**	**3**	**as needed**
Field QC Samples[1]						**Total Number of Investigative Samples**	**242**	**86**	**86**	**86**	**as needed**
4	Field Duplicate	WHF-4	WHF-XXXX			TBD	**24**	**9**	**9**	**9**	**as needed**
4	MS	WHF-4	WHF-XXXX			TBD	**12**	**4**	**4**	**4**	**as needed**
4	MSD	WHF-4	WHF-XXXX			TBD	**12**	**4**	**4**	**4**	**as needed**
4	Equipment Blank	WHF-4	WHF-XXXX			NA	**12**	**4**	**4**	**4**	**as needed**

CTO JM57 Site 4 Sampling Dates TBD						Analysis Group	VOCs (Field-Based Laboratory)	VOCs	PAHs	TRPH	TRPH Speciation
						Preparation and Analytical Method	NA	EPA Method SW8260B/SW5035	EPA Method SW8270D SIM/SW3550B	Method FL-PRO/SW3550B	Method TPHCWG/SW3550B
						Analytical Laboratory/ Preparation and Analytical SOP Reference	GCMS001/ GCFID001	ENCO Orlando/ SOP VGCMS-05	ENCO Orlando/ SOP EXSV-16 and SOP SVGCMS-03	ENCO Orlando/ SOP SVGC-14	Spectrum Analytical Inc./ SOP SOP00197-S4
Environmental Conservation Laboratories, Inc. (ENCO Orlando) 10775 Central Port Drive Orlando, FL 32824 Point of Contact: Ronnie Wambles Phone: 407-826-5314 Spectrum Analytical Inc. 8405 Benjamin Road, Suite A, Tampa, FL 33634 Point of Contact: Mark Gudnason Phone: 813-888-9507						Data Package Turnaround Time	24 to 48 hours from sample collection	21 Calendar days	21 Calendar days	21 Calendar days	21 Calendar days
						Container Type/ Volume required (if different than container volume)	Terracore sampling kits, 3 x 40 mL vials with stir bar, 1 x 2 oz G, Teflon-lined septum sealed cap	Terracore sampling kits, 3 x 40 mL vials with stir bar, 1 x 2 oz G, Teflon-lined septum sealed cap	1 x 4 oz G, Teflon-lined septum sealed cap	Teflon-lined cap 1 x 4 oz G	1 x 4 oz G, Teflon-lined septum sealed cap
						Preservative	Terracore – 1 vial with methanol, 2 vial with water, ice to 4°	Terracore – 1 vial with methanol, 2 vial with water, ice to 4°	Ice to 4°C	Ice to 4°C	Ice to 4°C
						Holding Time (Preparation/ Analysis)	48 hours/14 days	48 hours/14 days	14 days/40 days	14 days/40 days	14 days/40 days
Site	Matrix	Station ID	Sample ID	Coordinates (NAD83, Feet)		Depth/Sampling Interval					
4	Trip Blank	WHF-4	WHF-XXXX			NA	**One per cooler with VOC samples**	**One per cooler with VOC samples**	**NA**	**NA**	**NA**
						Total Number of Samples to the Laboratory	**302**	**107**	**107**	**107**	**as needed**

Notes:

1 Resolution Consultants has adopted ENCO analytical SOPs in their entirety with the permission of the laboratory. For the purpose of differentiating the Resolution Consultants on-site field-screening laboratory operations from definitive fixed-base operations, SOPs for on-site analysis have been renamed and referenced as screening-level data.

Table 8-5: Sample Details Table for Air

CTO JM57 Site 4 Sampling Dates TBD						**Analysis Group**	**VOCs (Field-Based Laboratory)**	**VOCs**
						Preparation and Analytical Method	NA	EPA Method TO-15
						Analytical Laboratory/ Preparation and Analytical SOP Reference	GCMS002/ GCFID002	ENCO Jacksonville/ SOP VGCMS-07
Environmental Conservation Laboratories, Inc. (ENCO Jacksonville) **4810 Executive Park Court, Suite 111, Jacksonville, Florida 32216** **Point of Contact: Denise Stern** **Phone: 904-296-3007**						**Data Package Turnaround Time**	24 to 48 hours from sample collection	21 calendar days
						Container Type/ Volume required (if different than container volume)	1L Tedlar bag	1L Tedlar bag
						Preservative	None	None
						Holding Time (Preparation/ Analysis)	NA / 3d	NA / 3d
Site	**Matrix**	**Station ID**	**Sample ID**	**Coordinates (NAD83, Feet)**		**Depth/Sampling Interval**		
				X	**Y**			
4	Air	WHF-4 (Northwest Portion of Site 4)	WHF-4-NW-SG01-fbl through WHF-4-NW-SGXX-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals	**110**	
4	Air	WHF-4 (Northwest Portion of Site 4)	WHF-4-NW-SG01 through WHF-4-NW-SGXX	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals		**11**
4	Air	WHF-4 (Pipeline Junction Area)	WHF-4-PLJ-SG01-fbl through WHF-4-PLJ-SGXX-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals	**77**	
4	Air	WHF-4 (Pipeline Junction Area)	WHF-4-PLJ-SG01 through WHF-4-PLJ-SGXX	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals		**7**
4	Air	WHF-4 (Pipeline Junction Area)	WHF-PLJ-SGI-01-fbl through W WHF-PLJ-SGI-03-fbl	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals	**33**	
4	Air	WHF-4 (Pipeline Junction Area)	WHF-PLJ-SGI-01 through W WHF-PLJ-SGI-03	TBD	TBD	Varies, 0 – 110 feet bls, 10-foot intervals		**33**
Field QC Samples[1]						**Total Number of Investigative Samples**	**220**	**51**
4	Field Duplicate	WHF-4	WHF-XXXX			TBD	**22**	**5**
4	MS	WHF-4	WHF-XXXX			TBD	**11**	**2**
4	MSD	WHF-4	WHF-XXXX			TBD	**11**	**2**
4	Ambient Field Blank	WHF-4	WHF-XXXX			NA	**11**	**2**

CTO JM57 Site 4 Sampling Dates TBD						**Analysis Group**	**VOCs (Field-Based Laboratory)**	**VOCs**
						Preparation and Analytical Method	NA	EPA Method TO-15
						Analytical Laboratory / Preparation and Analytical SOP Reference	GCMS002/ GCFID002	ENCO Jacksonville/ SOP VGCMS-07
Environmental Conservation Laboratories, Inc. (ENCO Jacksonville) 4810 Executive Park Court, Suite 111, Jacksonville, Florida 32216 Point of Contact: Denise Stern Phone: 904-296-3007						**Data Package Turnaround Time**	24 to 48 hours from sample collection	21 calendar days
						Container Type / Volume required (if different than container volume)	1L Tedlar bag	1L Tedlar bag
						Preservative	None	None
						Holding Time (Preparation / Analysis)	NA / 3d	NA / 3d
Site	**Matrix**	**Station ID**	**Sample ID**	**Coordinates (NAD83, Feet)**		**Depth / Sampling Interval**		
				X	**Y**			
						Total Number of Samples to the Laboratory	**275**	**62**

Notes:

2 Frequency of QA/QC sample collection is provided in Section 6.0 (**Worksheet #12**).

3 Resolution Consultants has adopted ENCO analytical SOPs in their entirety with the permission of the laboratory. For the purpose of differentiating the Resolution Consultants on-site field-screening laboratory operations from definitive fixed-base operations, SOPs for on-site analysis have been renamed and referenced as screening-level data.

Table 8-6: Sample Details Table for Groundwater

CTO JM57 Site 4 Sampling Dates TBD						**Analysis Group**	**VOC**	**EDB**	**PAH**	**TRPH**	**Lead**
						Preparation and Analytical Method	EPA Method SW8260B and SW8260C SIM/SW5030B	EPA Method SW8011	EPA Method SW8270D SIM/SW3510C	FL-PRO/ SW3510C	EPA Method SW6020A/SW3005A
						Analytical Laboratory/ Preparation and Analytical SOP Reference	ENCO Orlando/ SOP VGCMS-05	ENCO Orlando/ SOP SVGC-03	ENCO Orlando/ SOP EXSV-27 and SOP SVGCMS-03	ENCO Orlando/ SOP SVGC-14	ENCO Jacksonville/ SOP EXMT-12 and SOP MET-05
Environmental Conservation Laboratories, Inc. (ENCO Orlando) **10775 Central Port Drive Orlando, FL 32824** **Point of Contact: Ronnie Wambles** **Phone: 407-826-5314** **Environmental Conservation Laboratories, Inc. (ENCO Jacksonville)** **4810 Executive Park Court, Suite 111, Jacksonville, Florida 32216** **Point of Contact: Denise Stern** **Phone: 904-296-3007**						**Data Package Turnaround Time**	21 calendar days	21 calendar days	21 calendar days	21 calendar days	21 calendar days
						Container Type/ Volume required (if different than container volume)	3 x 40mL G, Septa vial Teflon-lined septum sealed cap	3 x 40mL G, Septa vial Teflon-lined septum sealed cap	2 x 1 L Amber G Teflon-lined cap	2 x 1 L Amber G Teflon-lined cap	1 x 1 500mL P
						Preservative	Ice to 4°C HCl pH <2	Ice to 4°C	Ice to 4°C	H_2SO_4 pH <2 Ice to 4°C	HNO_3 pH <2/ Ice to 4°C
						Holding Time (Preparation/ Analysis)	NA / 14d	NA / 14d	7d / 40d[2]	7d / 40d[2]	NA / 6mo
Site	**Matrix**	**Station ID**	**Sample ID**	**Coordinates (NAD83, Feet)**		**Depth/Sampling Interval**					
				X	**Y**						
4	Aqueous	WHF-4 (Northwest Portion of Site 4)	WHF-1467-MW-54 through WHF-1467-MW-MW64	TBD	TBD	TBD	**10**	**10**	**10**	**10**	**10**
4	Aqueous	WHF-4 (Pipeline Junction Area)	WHF-PLJ-MW-01 through WHF-PLJ-MW-04 and WHF-1467-MW-29P	TBD	TBD	TBD	**5**	**5**	**5**	**5**	**5**
Field QC Samples[1]						**Total Number of Investigative Samples**	**15**	**15**	**15**	**15**	**15**
	Field Duplicate	WHF-4	WHF-XXXX			TBD	**2**	**1**	**1**	**1**	**1**
	MS	WHF-4	WHF-XXXX			TBD	**1**	**1**	**1**	**1**	**1**
	MSD	WHF-4	WHF-XXXX			TBD	**1**	**1**	**1**	**1**	**1**
	Equipment Blank	WHF-4	WHF-XXXX			NA	**2**	**1**	**1**	**1**	**1**
	Trip Blank	WHF-4	WHF-XXXX			NA	**2**	**NA**	**NA**	**NA**	**NA**
						Total Number of Samples to the Laboratory	**23**	**22**	**22**	**22**	**22**

Notes:

[1] Frequency of QA/QC sample collection is provided in Section 6.0 (**Worksheet #12**).

8.5 CSM Validation and Refinement

After completion of the activities proposed in this SAP, the data collected over the course of the project shall be evaluated against the current CSM. As appropriate, the content of the CSM shall be validated and/or updated with refinement based on the new data. An updated CSM that documents the post-investigation level of understanding of site conditions will be prepared and incorporated into the RAP Amendment.

8.6 Reporting

A SAR Addendum Report for Site 4 (which includes the North Field fuel distribution system and the northwest portion of the site) and a RAP Addendum (which includes the pipeline junction area) will be prepared following activities proposed in this SAP. The CSM for Site 4 will be validated and further refined based on data and information collected during this proposed effort. In addition to the updated CSM, the investigation field activities and results, updates to the human health and ecological risk assessments, if necessary, and the results of the Remedial Alternatives Analysis (RAA) will be prepared and presented in the appropriate report.

8.7 Health and Safety Plan

The activities proposed in this SAP will be completed in accordance with the site-specific Safety and Health Plan (SSHP) presented in the Accident Prevention Plan (**Appendix D**).

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9.0 SAP Worksheet #15: Reference Limits and Evaluation Tables

(UFP-QAPP Manual Section 2.8.1 – Worksheet # 15)

This worksheet identifies the TAL, required Project Action Levels (PALs) and associated sources, achievable Limits of Detection (LODs), and laboratory quantitation limits (LOQs) for each analyte of concern at the site.

PALs do not necessarily represent applicable or relevant and appropriate requirements (ARARs). Individual PALs in this worksheet represent the most conservative (i.e., the lowest) of the project-specific data screening levels that follow:

- **Soil Screening Levels:**
  - Soil Human Health (Direct Exposure evaluation): More conservative (i.e., most protective) of the FDEP SCTLs for residential and industrial exposure from Chapter 62-777 of the Florida Administrative Code and EPA RSLs.
  - Soil Human Health (Leachability for protection of groundwater evaluation): FDEP Leachability SCTLs from Chapter 62-777, FAC, developed based on Florida soil types.
  - Soil Ecological: The potential for exposure of ecological receptors from potentially complete pathways at Site 4 would be negligible and would not be sufficient to warrant evaluation.
- **Soil Gas Screening Levels:**
  - Air Human Health: More conservative (i.e., most protective) of the EPA RSLs Resident Air, National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs), Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs), and Project QL Goal values.
  - Air Ecological: The potential for exposure of ecological receptors through potentially complete pathways at Site 4 would be negligible and would not be sufficient to warrant evaluation.
- **Upper Perched Groundwater Screening Levels:**
  - Upper Perched Groundwater Human Health: FDEP GCTLs from Chapter 62-777 FAC (values used are the risk-based values [minimum criteria-carcinogen, minimum criteria-systemic toxicant, minimum criteria-health advisory level]).
  - Upper Perched Groundwater Ecological: The potential for exposure of ecological receptors from potentially complete pathways at Site 4 would be negligible and would not be sufficient to warrant evaluation.

- **Lower Perched Groundwater Screening Levels:**
  - Lower Perched Groundwater Human Health: More conservative (i.e., most protective) of the Federal Maximum Contaminant Levels (MCLs), EPA tap water RSLs (based on a carcinogenic risk level of 10^{-6} or noncarcinogenic HQ of 0.1), Florida Primary and Secondary MCLs from Chapter 62-550 FAC (FDEP, 16 February 2012), and FDEP GCTLs from Chapter 62-777 FAC (FDEP, April 2005; values used are the risk-based values [minimum criteria-carcinogen, minimum criteria-systemic toxicant, minimum criteria-health advisory level]).
  - Lower Perched Groundwater Ecological: The potential for exposure of ecological receptors from potentially complete pathways at Site 4 would be negligible and would not be sufficient to warrant evaluation
- **Surficial Groundwater Screening Levels:**
  - Surficial Groundwater Human Health: More conservative (i.e., most protective) of the Federal MCLs, EPA tap water RSLs (based on a carcinogenic risk level of 10^{-6} or noncarcinogenic HQ of 0.1), Florida Primary and Secondary MCLs from Chapter 62-550 FAC, and FDEP GCTLs from Chapter 62-777 FAC (values used are the risk-based values [minimum criteria-carcinogen, minimum criteria-systemic toxicant, minimum criteria-health advisory level]).
  - Surficial Groundwater Ecological: The potential for exposure of ecological receptors through potentially complete pathways at Site 4 would be negligible and would not be sufficient to warrant evaluation.

Laboratory-specific LOQs and LODs for each analyte were generated by the analytical laboratory(ies) and provided to Resolution Consultants.

It should be noted, the PAL for every analyte may not be achieved using the best available technology. Every PAL presented does not necessarily represent specific delineation criteria for that matrix; rather the PAL is the most conservative screening value available from all relevant regulatory screening sources. Therefore, the inability to meet a PAL must be evaluated for the purpose the data is intended. For instance, if a chemical is present in environmental media at concentrations below the LOQ and below the screening criteria, then that chemical should be eliminated from consideration as a COC/COPC. However, it is also possible that a chemical is present below the LOQ and above the screening criteria. In the latter scenario, the result will be flagged and the potential implication will be assessed for this investigation on an analyte/media-specific basis for the intended use of the data, including review of FDEP's guidance document *Guidance for the Selection of Analytical Methods and for the Evaluation of Practical Quantitation Limits*, dated October 12, 2004.

Table 9-1: Soil Reference Limits and Evaluation Table for Fixed-Base Laboratory (Definitive-Level Data)
Matrix: Solids
Units: mg/kg

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Data Quality Objectives - Leachability				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: Volatile Organic Compounds by EPA Method SW8260B												
1,1,1-Trichloroethane	71-55-6	730	62-777 Res. SCTL	PAL Flag	0.0050	1.9	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
1,1,2,2-Tetrachloroethane	79-34-5	0.56	EPA RSL Res.	PAL Flag	0.0050	0.0010	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0003
1,1,2-Trichloroethane	79-00-5	1.1	EPA RSL Res.	PAL Flag	0.0050	0.030	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006
1,1-Dichloroethane	75-34-3	3.3	EPA RSL Res.	PAL Flag	0.0050	0.40	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006
1,1-Dichloroethene	75-35-4	95	62-777 Res. SCTL	PAL Flag	0.0050	0.060	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006
1,2,4 Trichlorobenzene	120-82-1	22	EPA RSL Res.	PAL Flag	0.0050	5.3	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0008
1,2-Dichlorobenzene	95-50-1	880	62-777 Res. SCTL	PAL Flag	0.0050	17	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
1,2-Dichloroethane	107-06-2	0.43	EPA RSL Res.	PAL Flag	0.0050	0.010	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0003
1,2-Dichloropropane	78-87-5	0.60	62-777 Res. SCTL	PAL Flag	0.0050	0.030	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006
1,3-Dichlorobenzene	541-73-1	380	62-777 Res. SCTL	PAL Flag	0.0050	7.0	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
1,4-Dichlorobenzene	106-46-7	2.4	EPA RSL Res.	PAL Flag	0.0050	2.2	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
1,4-Dioxane	123-91-1	4.9	EPA RSL Res.	PAL Flag	0.0050	0.010	62-777 Leachability SCTL	PAL Flag	0.0050	0.10	0.050	0.0055
Benzene	71-43-2	1.1	EPA RSL Res.	PAL Flag	0.0050	0.0070	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
Bromodichloromethane	75-27-4	0.27	EPA RSL Res.	PAL Flag	0.0050	0.0040	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
Bromoform	75-25-2	48	62-777 Res. SCTL	PAL Flag	0.0050	0.030	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0003
Bromomethane	74-83-9	3.1	62-777 Res. SCTL	PAL Flag	0.0050	0.050	62-777 Leachability SCTL	PAL Flag	0.0050	0.010	0.0050	0.0009
Carbon tetrachloride	56-23-5	0.50	62-777 Res. SCTL	PAL Flag	0.0050	0.040	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Data Quality Objectives - Leachability				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Chlorobenzene	108-90-7	120	62-777 Res. SCTL	PAL Flag	0.0050	1.3	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
Chloroethane	75-00-3	3.9	62-777 Res. SCTL	PAL Flag	0.0050	0.060	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
Chloroform	67-66-3	0.29	EPA RSL Res.	PAL Flag	0.0050	0.40	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
Chloromethane	74-87-3	4.0	62-777 Res. SCTL	PAL Flag	0.0050	0.010	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006
cis-1,2-Dichloroethene	156-59-2	33	62-777 Res. SCTL	PAL Flag	0.0050	0.40	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
trans-1,2-Dichloroethene	156-60-5	53	62-777 Res. SCTL	PAL Flag	0.0050	0.70	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0007
Dibromochloromethane	124-48-1	0.68	EPA RSL Res.	PAL Flag	0.0050	0.0030	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0003
Ethylbenzene	100-41-4	5.4	EPA RSL Res.	PAL Flag	0.0050	0.60	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0006
Isopropylbenzene	98-82-8	220	62-777 Res. SCTL	PAL Flag	0.0050	0.20	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
Methyl tert-butyl ether (MTBE)	1634-04-4	43	EPA RSL Res.	PAL Flag	0.0050	0.090	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0003
Methylene chloride	75-09-2	17	62-777 Res. SCTL	PAL Flag	0.0050	0.020	62-777 Leachability SCTL	PAL Flag	0.0050	0.010	0.0050	0.0007
Tetrachloroethene	127-18-4	8.8	62-777 Res. SCTL	PAL Flag	0.0050	0.030	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
Toluene	108-88-3	5000	EPA RSL Res.	PAL Flag	0.0050	0.50	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
Trichloroethene	79-01-6	0.91	EPA RSL Res.	PAL Flag	0.0050	0.030	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0005
Vinyl chloride	75-01-4	0.060	EPA RSL Res.	PAL Flag	0.0050	0.0070	62-777 Leachability SCTL	PAL Flag	0.0050	0.0020	0.0010	0.0004
Xylenes (total)	1330-20-7	130	62-777 Res. SCTL	PAL Flag	0.0050	0.20	62-777 Leachability SCTL	PAL Flag	0.0050	0.0040	0.0020	0.0010
Analytical Group: TCL Polynuclear Aromatic Hydrocarbons by EPA Method SW8270D SIM												
1-Methylnaphthalene	90-12-0	16	EPA RSL Res.	PAL Flag	0.030	3.1	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.019
2-Methylnaphthalene	91-57-6	210	62-777 Res. SCTL	PAL Flag	0.030	8.5	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.018
Acenaphthene	83-32-9	2400	62-777 Res. SCTL	PAL Flag	0.030	2.1	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.015
Acenaphthylene	208-96-8	1800	62-777 Res. SCTL	PAL Flag	0.030	27	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.018

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Data Quality Objectives - Leachability				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Anthracene	120-12-7	17000	EPA RSL Res.	PAL Flag	0.030	2500	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.014
Benzo[a]anthracene[3, #]	56-55-3	0.15	EPA RSL Res.	PAL Flag	0.030	0.80	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.014
Benzo[a]pyrene	50-32-8	0.015	EPA RSL Res.	PAL Flag	0.030	8.0	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.015
Benzo[b]fluoranthene[3, #]	205-99-2	0.15	EPA RSL Res.	PAL Flag	0.030	2.4	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.017
Benzo[k]fluoranthene[3, #]	207-08-9	1.5	EPA RSL Res.	PAL Flag	0.030	24	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.019
Benzo[g,h,i]perylene	191-24-2	2500	62-777 Res. SCTL	PAL Flag	0.030	32000	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.015
Chrysene[3, #]	218-01-9	15	EPA RSL Res.	PAL Flag	0.030	77	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.012
Dibenz[a,h]anthracene[3, #]	53-70-3	0.015	EPA RSL Res.	PAL Flag	0.030	0.70	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.016
Fluoranthene	206-44-0	2300	EPA RSL Res.	PAL Flag	0.030	1200	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.017
Fluorene	86-73-7	2300	EPA RSL Res.	PAL Flag	0.030	160	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.017
Indeno[1,2,3-cd]pyrene[3, #]	193-39-5	0.15	EPA RSL Res.	PAL Flag	0.030	6.6	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.015
Naphthalene	91-20-3	3.6	EPA RSL Res.	PAL Flag	0.030	1.2	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.018
Phenanthrene	85-01-8	2200	62-777 Res. SCTL	PAL Flag	0.030	250	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.015
Pyrene	129-00-0	1700	EPA RSL Res.	PAL Flag	0.030	880	62-777 Leachability SCTL	PAL Flag	0.030	0.035	0.025	0.016
Analytical Group: Total Hydrocarbons by Method FL-PRO												
TRPH (FL-PRO)	NOCAS	460	62-777 Res. SCTL	PAL Flag	5.0	340	62-777 Leachability SCTL	PAL Flag	5.0	5.7	3.1	1.2
Analytical Group: Total Hydrocarbon Fractions/Speciation by Method TPHCWG												
C10-C12 Petroleum Hydrocarbons, Aliphatic	NOCAS	1700	62-777 Res. SCTL		5.0	51000	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C10-C12 Petroleum Hydrocarbons, Aromatic	NOCAS	900	62-777 Res. SCTL		5.0	520	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C12-C16 Petroleum Hydrocarbons, Aliphatic	NOCAS	2900	62-777 Res. SCTL		5.0	*	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C12-C16 Petroleum Hydrocarbons, Aromatic	NOCAS	1500	62-777 Res. SCTL		5.0	1000	62-777 Leachability SCTL		5.0	5.0	5.0	2.5

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Data Quality Objectives - Leachability				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
C16-C21 Petroleum Hydrocarbons, Aliphatic	NOCAS	42000	62-777 Res. SCTL		5.0	*	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C16-C21 Petroleum Hydrocarbons, Aromatic	NOCAS	1300	62-777 Res. SCTL		5.0	3200	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C21-C35 Petroleum Hydrocarbons, Aromatic	NOCAS	2300	62-777 Res. SCTL		5.0	25000	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C6-C8 Petroleum Hydrocarbons, Aliphatic	NOCAS	8700	62-777 Res. SCTL		5.0	1300	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C7-C8 Petroleum Hydrocarbons, Aromatic	NOCAS	490	62-777 Res. SCTL		5.0	59	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C8-C10 Petroleum Hydrocarbons, Aliphatic	NOCAS	850	62-777 Res. SCTL		5.0	7000	62-777 Leachability SCTL		5.0	5.0	5.0	2.5
C8-C10 Petroleum Hydrocarbons, Aromatic	NOCAS	460	62-777 Res. SCTL		5.0	340	62-777 Leachability SCTL		5.0	5.0	5.0	2.5

Table 9-2: Soil Reference Limits and Evaluation Table for Field-Base Laboratory (Screening-Level Data)
Matrix: Solids
Units: mg/kg

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Data Quality Objectives - Leachability				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: Volatile Organic Compounds by EPA Method SW8260B												
1,1-Dichloroethane	75-34-3	3.3	EPA RSL Res.	PAL Flag	0.25	0.40	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
1,4-Dioxane	123-91-1	4.9	EPA RSL Res.	PAL Flag	0.25	0.010	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Benzene	71-43-2	1.1	EPA RSL Res.	PAL Flag	0.25	0.0070	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
cis-1,2-Dichloroethene	156-59-2	33	62-777 Res. SCTL	PAL Flag	0.25	0.40	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
trans-1,2-Dichloroethene	156-60-5	53	62-777 Res. SCTL	PAL Flag	0.25	0.70	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Ethylbenzene	100-41-4	5.4	EPA RSL Res.	PAL Flag	0.25	0.60	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Isopropylbenzene	98-82-8	220	62-777 Res. SCTL	PAL Flag	0.25	0.20	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Methyl tert-butyl ether (MTBE)	1634-04-4	43	EPA RSL Res.	PAL Flag	0.25	0.090	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Tetrachloroethene	127-18-4	8.8	62-777 Res. SCTL	PAL Flag	0.25	0.030	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Toluene	108-88-3	5000	EPA RSL Res.	PAL Flag	0.25	0.50	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Trichloroethene	79-01-6	0.91	EPA RSL Res.	PAL Flag	0.25	0.030	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Vinyl chloride	75-01-4	0.060	EPA RSL Res.	PAL Flag	0.25	0.0070	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD
Xylenes (total)	1330-20-7	130	62-777 Res. SCTL	PAL Flag	0.25	0.20	62-777 Leachability SCTL	PAL Flag	0.25	TBD	TBD	TBD

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Table 9-3: Soil Gas Reference Limits and Evaluation Table for Fixed-Base Laboratory (Definitive-Level Data)
Matrix: Air
Units: µg/m^3

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	LOQ Goal	LOQ	LOD	MDL
Analytical Group: Volatile Organic Compounds by EPA Method TO-15								
1,1-Dichloroethane	75-34-3	1.5	EPA RSL Res.	PAL Flag	2.5	10	10	0.8
1,4-Dioxane	123-91-1	0.32	EPA RSL Res.	PAL Flag	2.5	9	9	2.3
Benzene	71-43-2	0.31	EPA RSL Res.	PAL Flag	2.5	8	8	0.75
cis-1,2-Dichloroethene	156-59-2	NS	NS		2.5	10	10	0.92
Ethylbenzene	100-41-4	0.97	EPA RSL Res.	PAL Flag	2.5	11	11	1
Isopropylbenzene	98-82-8	420	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Methyl tert-butyl ether (MTBE)	1634-04-4	9.4	EPA RSL Res.		2.5	9.1	9.1	0.65
Tetrachloroethene	127-18-4	9.4	EPA RSL Res.	PAL Flag	2.5	17	17	1.3
Toluene	108-88-3	5200	EPA RSL Res.		2.5	9.5	9.5	0.76
trans-1,2-Dichloroethene	156-60-5	63	EPA RSL Res.		2.5	10	10	0.84
Trichloroethene	79-01-6	0.43	EPA RSL Res.	PAL Flag	2.5	14	14	1.3
Vinyl chloride	75-01-4	0.16	EPA RSL Res.	PAL Flag	2.5	6.5	6.5	0.78
Xylenes (total)	1330-20-7	100	EPA RSL Res.		2.5	11	11	2

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Table 9-4: Soil Gas Reference Limits and Evaluation Table for Field-Base Laboratory (Screening-Level Data)
Matrix: Air
Units: µg/m^3

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	LOQ Goal	LOQ	LOD	MDL
Analytical Group: Volatile Organic Compounds by EPA Method TO-15								
1,1-Dichloroethane	75-34-3	1.5	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
1,4-Dioxane	123-91-1	0.32	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Benzene	71-43-2	0.31	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
cis-1,2-Dichloroethene	156-59-2	NS	NS	PAL Flag	2.5	TBD	TBD	TBD
Ethylbenzene	100-41-4	0.97	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Isopropylbenzene	98-82-8	420	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Methyl tert-butyl ether (MTBE)	1634-04-4	9.4	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Tetrachloroethene	127-18-4	9.4	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Toluene	108-88-3	5200	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
trans-1,2-Dichloroethene	156-60-5	63	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Trichloroethene	79-01-6	0.43	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Vinyl chloride	75-01-4	0.16	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD
Xylenes (total)	1330-20-7	100	EPA RSL Res.	PAL Flag	2.5	TBD	TBD	TBD

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Table 9-5: Upper Perched Groundwater Reference Limits and Evaluation Table for Fixed-Base Laboratory (Definitive-Level Data)
Matrix: Aqueous
Units: µg/L

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: TCL Volatile Organic Compounds by EPA Method SW8260B								
1,1,1-Trichloroethane	71-55-6	200	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.80
1,1,2,2-Tetrachloroethane	79-34-5	0.20	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.54
1,1,2-Trichloroethane	79-00-5	5.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.76
1,1-Dichloroethane	75-34-3	70	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.62
1,1-Dichloroethene	75-35-4	7.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.94
1,2,4 Trichlorobenzene	120-82-1	70	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.70
1,2-Dichlorobenzene	95-50-1	600	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.73
1,2-Dichloroethane	107-06-2	3.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.63
1,2-Dichloropropane	78-87-5	5.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.80
1,3-Dichlorobenzene	541-73-1	210	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.77
1,4-Dichlorobenzene	106-46-7	75	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.76
Benzene	71-43-2	1.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.71
Bromodichloromethane	75-27-4	0.60	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.52
Bromoform	75-25-2	4.4	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.75
Bromomethane	74-83-9	10	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.95
Carbon tetrachloride	56-23-5	3.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.94

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Chlorobenzene	108-90-7	100	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.72
Chloroethane	75-00-3	12	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.98
Chloroform	67-66-3	70	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.80
Chloromethane	74-87-3	2.7	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.82
cis-1,2-Dichloroethene	156-59-2	70	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.53
trans-1,2-Dichloroethene	156-60-5	100	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.73
Dibromochloromethane	124-48-1	0.40	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.44
Ethylbenzene	100-41-4	30	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.69
Isopropylbenzene	98-82-8	0.80	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.67
Methyl tert-butyl ether (MTBE)	1634-04-4	20	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.60
Methylene chloride	75-09-2	5.0	62-777 GCTL	PAL Flag	1.0	10	5.0	0.71
Tetrachloroethene	127-18-4	3.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.76
Toluene	108-88-3	40	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.72
Trichloroethene	79-01-6	3.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.89
Vinyl chloride	75-01-4	1.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.71
Xylenes (total)	1330-20-7	20	62-777 GCTL	PAL Flag	1.0	4.0	2.0	1.3
Analytical Group: 1,4-Dioxane by EPA Method SW8260C SIM								
1,4-Dioxane	123-91-1	3.2	62-777 GCTL	PAL Flag	1.0	6.0	3.0	1.2
Analytical Group: 1,2-Dibromoethane by EPA Method SW8011								
1,2-Dibromoethane (EDB)	106-93-4	0.020	62-777 GCTL	PAL Flag	0.020	0.0020	0.0010	0.0003

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: TCL Polynuclear Aromatic Hydrocarbons by EPA Method SW8270D SIM								
1-Methylnaphthalene	90-12-0	28	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.044
2-Methylnaphthalene	91-57-6	28	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.042
Acenaphthene	83-32-9	20	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.045
Acenaphthylene	208-96-8	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.046
Anthracene	120-12-7	2100	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.059
Benzo[a]anthracene	56-55-3	0.050	62-777 GCTL	PAL Flag	0.05	0.10	0.080	0.062
Benzo[a]pyrene	50-32-8	0.20	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.077
Benzo[b]fluoranthene	205-99-2	0.050	62-777 GCTL	PAL Flag	0.05	0.10	0.080	0.072
Benzo[k]fluoranthene	207-08-9	0.50	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.078
Benzo[g,h,i]perylene	191-24-2	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.072
Chrysene	218-01-9	4.8	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.062
Dibenz[a,h]anthracene	53-70-3	0.0050	62-777 GCTL	PAL Flag	0.05	0.10	0.080	0.069
Fluoranthene	206-44-0	280	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.075
Fluorene	86-73-7	280	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.047
Indeno[1,2,3-cd]pyrene	193-39-5	0.050	62-777 GCTL	PAL Flag	0.05	0.10	0.080	0.070
Naphthalene	91-20-3	14	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.045
Phenanthrene	85-01-8	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.063
Pyrene	129-00-0	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.075
Analytical Group: Total Hydrocarbons by Method FL-PRO								
TRPH (FL-PRO)	NOCAS	5000	62-777 GCTL	PAL Flag	5.0	170	85	69

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: Lead by EPA Method SW6020A								
Lead	7439-92-1	15.0	62-777 GCTL	PAL Flag	10.0	1.0	0.600	0.160

Table 9-6: Lower Perched Groundwater Reference Limits and Evaluation Table for Fixed-Base Laboratory (Definitive-Level Data)
Matrix: Aqueous
Units: µg/L

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: TCL Volatile Organic Compounds by EPA Method SW8260B								
1,1,1-Trichloroethane	71-55-6	200	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.80
1,1,2,2-Tetrachloroethane	79-34-5	0.066	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.54
1,1,2-Trichloroethane	79-00-5	0.24	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.76
1,1-Dichloroethane	75-34-3	2.4	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.62
1,1-Dichloroethene	75-35-4	7.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.94
1,2,4 Trichlorobenzene	120-82-1	1.0	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.70
1,2-Dichlorobenzene	95-50-1	280	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.73
1,2-Dichloroethane	107-06-2	0.15	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.63
1,2-Dichloropropane	78-87-5	0.38	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.80
1,3-Dichlorobenzene	541-73-1	210	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.77
1,4-Dichlorobenzene	106-46-7	0.42	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.76
Benzene	71-43-2	0.39	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.71
Bromodichloromethane	75-27-4	0.12	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.52
Bromoform	75-25-2	4.4	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.75
Bromomethane	74-83-9	7.0	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.95
Carbon tetrachloride	56-23-5	0.39	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.94

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Chlorobenzene	108-90-7	72	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.72
Chloroethane	75-00-3	12	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.98
Chloroform	67-66-3	0.19	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.80
Chloromethane	74-87-3	2.7	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.82
cis-1,2-Dichloroethene	156-59-2	28	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.53
trans-1,2-Dichloroethene	156-60-5	86	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.73
Dibromochloromethane	124-48-1	0.15	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.44
Ethylbenzene	100-41-4	1.3	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.69
Isopropylbenzene	98-82-8	0.80	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.67
Methyl tert-butyl ether (MTBE)	1634-04-4	12	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.60
Methylene chloride	75-09-2	5.0	62-777 GCTL	PAL Flag	1.0	10	5.0	0.71
Tetrachloroethene	127-18-4	3.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.76
Toluene	108-88-3	40	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.72
Trichloroethene	79-01-6	0.44	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.89
Vinyl chloride	75-01-4	0.015	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.71
Xylenes (total)	1330-20-7	20	62-777 GCTL	PAL Flag	1.0	4.0	2.0	1.3
Analytical Group: 1,4-Dioxane by EPA Method SW8260C SIM								
1,4-Dioxane	123-91-1	0.67	EPA RSL - Tap Water	PAL Flag	0.50	6.0	3.0	1.2
Analytical Group: 1,2-Dibromoethane by EPA Method SW8011								
1,2-Dibromoethane (EDB)	106-93-4	0.0065	EPA RSL - Tap Water	PAL Flag	0.0065	0.0020	0.0010	0.0003

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: TCL Polynuclear Aromatic Hydrocarbons by EPA Method SW8270D SIM								
1-Methylnaphthalene	90-12-0	1.0	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.044
2-Methylnaphthalene	91-57-6	27	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.042
Acenaphthene	83-32-9	20	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.045
Acenaphthylene	208-96-8	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.046
Anthracene	120-12-7	1300	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.059
Benzo[a]anthracene	56-55-3	0.029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.062
Benzo[a]pyrene	50-32-8	0.0029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.077
Benzo[b]fluoranthene	205-99-2	0.029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.072
Benzo[k]fluoranthene	207-08-9	0.29	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.078
Benzo[g,h,i]perylene	191-24-2	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.072
Chrysene	218-01-9	2.9	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.062
Dibenz[a,h]anthracene	53-70-3	0.0029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.069
Fluoranthene	206-44-0	280	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.075
Fluorene	86-73-7	220	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.047
Indeno[1,2,3-cd]pyrene	193-39-5	0.029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.070
Naphthalene	91-20-3	0.14	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.045
Phenanthrene	85-01-8	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.063
Pyrene	129-00-0	87	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.075
Analytical Group: Total Hydrocarbons by Method FL-PRO								
TRPH (FL-PRO)	NOCAS	5000	62-777 GCTL	PAL Flag	5.0	170	85	69

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: Lead by EPA Method SW6020A								
Lead	7439-92-1	15.0	62-777 GCTL	PAL Flag	10.0	1.0	0.600	0.160

Table 9-7: Surficial Groundwater Reference Limits and Evaluation Table for Fixed-Base Laboratory (Definitive-Level Data)
Matrix: Aqueous
Units: µg/L

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Analytical Group: TCL Volatile Organic Compounds by EPA Method SW8260B								
1,1,1-Trichloroethane	71-55-6	200	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.80
1,1,2,2-Tetrachloroethane	79-34-5	0.066	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.54
1,1,2-Trichloroethane	79-00-5	0.24	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.76
1,1-Dichloroethane	75-34-3	2.4	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.62
1,1-Dichloroethene	75-35-4	7.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.94
1,2,4 Trichlorobenzene	120-82-1	1.0	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.70
1,2-Dichlorobenzene	95-50-1	280	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.73
1,2-Dichloroethane	107-06-2	0.15	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.63
1,2-Dichloropropane	78-87-5	0.38	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.80
1,3-Dichlorobenzene	541-73-1	210	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.77
1,4-Dichlorobenzene	106-46-7	0.42	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.76
Benzene	71-43-2	0.39	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.71
Bromodichloromethane	75-27-4	0.12	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.52
Bromoform	75-25-2	4.4	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.75
Bromomethane	74-83-9	7.0	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.95
Carbon tetrachloride	56-23-5	0.39	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.94
Chlorobenzene	108-90-7	72	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.72
Chloroethane	75-00-3	12	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.98

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Chloroform	67-66-3	0.19	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.80
Chloromethane	74-87-3	2.7	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.82
cis-1,2-Dichloroethene	156-59-2	28	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.53
trans-1,2-Dichloroethene	156-60-5	86	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.73
Dibromochloromethane	124-48-1	0.15	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.44
Ethylbenzene	100-41-4	1.3	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.69
Isopropylbenzene	98-82-8	0.80	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.67
Methyl tert-butyl ether (MTBE)	1634-04-4	12	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.60
Methylene chloride	75-09-2	5.0	62-777 GCTL	PAL Flag	1.0	10	5.0	0.71
Tetrachloroethene	127-18-4	3.0	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.76
Toluene	108-88-3	40	62-777 GCTL	PAL Flag	1.0	2.0	1.0	0.72
Trichloroethene	79-01-6	0.44	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.89
Vinyl chloride	75-01-4	0.015	EPA RSL - Tap Water	PAL Flag	1.0	2.0	1.0	0.71
Xylenes (total)	1330-20-7	20	62-777 GCTL	PAL Flag	1.0	4.0	2.0	1.3
Analytical Group: 1,4-Dioxane by EPA Method SW8260C SIM								
1,4-Dioxane	123-91-1	0.67	EPA RSL - Tap Water	PAL Flag	0.50	6.0	3.0	1.2
Analytical Group: 1,2-Dibromoethane by EPA Method SW8011								
1,2-Dibromoethane (EDB)	106-93-4	0.0065	EPA RSL - Tap Water	PAL Flag	0.0065	0.0020	0.0010	0.0003
Analytical Group: TCL Polynuclear Aromatic Hydrocarbons by EPA Method SW8270D SIM								
1-Methylnaphthalene	90-12-0	1.0	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.044
2-Methylnaphthalene	91-57-6	27	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.042
Acenaphthene	83-32-9	20	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.045

Analyte	CAS Number	Data Quality Objectives - Direct Exposure				Laboratory-Specific Limits		
		PAL[1]	PAL Reference	Comparing PAL and LOD*	Project QL Goal	LOQ	LOD	MDL
Acenaphthylene	208-96-8	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.046
Anthracene	120-12-7	1300	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.059
Benzo[a]anthracene	56-55-3	0.029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.062
Benzo[a]pyrene	50-32-8	0.0029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.077
Benzo[b]fluoranthene	205-99-2	0.029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.072
Benzo[k]fluoranthene	207-08-9	0.29	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.078
Benzo[g,h,i]perylene	191-24-2	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.072
Chrysene	218-01-9	2.9	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.062
Dibenz[a,h]anthracene	53-70-3	0.0029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.069
Fluoranthene	206-44-0	280	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.075
Fluorene	86-73-7	220	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.047
Indeno[1,2,3-cd]pyrene	193-39-5	0.029	EPA RSL - Tap Water	PAL Flag	0.050	0.10	0.080	0.070
Naphthalene	91-20-3	0.14	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.045
Phenanthrene	85-01-8	210	62-777 GCTL	PAL Flag	0.10	0.10	0.080	0.063
Pyrene	129-00-0	87	EPA RSL - Tap Water	PAL Flag	0.10	0.10	0.080	0.075
Analytical Group: Total Hydrocarbons by Method FL-PRO								
TRPH (FL-PRO)	NOCAS	5000	62-777 GCTL	PAL Flag	5.0	170	85	69
Analytical Group: Lead by EPA Method SW6020A								
Lead	7439-92-1	15.0	62-777 GCTL	PAL Flag	10.0	1.0	0.600	0.160

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10.0 Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1 – Worksheet #23)

Table 10-1: Analytical SOP References Table for ENCO Orlando

Environmental Conservation Laboratories, Inc. of Orlando

10775 Central Port Drive Orlando, FL 32824

Point of Contact: Ronnie Wambles

Phone: 407-826-5314

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
Preparation Method / SOP Reference						
EXSV-16	EXTRACTION OF SOIL/SOLID SAMPLES USING SONICATION (Revision 6, Effective 3/23/2010).	Definitive	Solids Base Neutral Acid Compounds (BNAs)	NA	N	N
EXSV-27	EXTRACTION OF AQUEOUS SAMPLES USING SEPARATORY FUNNEL TECHNIQUES (Revision 4, Effective 3/2/2010).	Definitive	Aqueous BNAs	NA	N	N
Analytical Method / SOP Reference						
SVGC-03	EDB/1,2-dibromo-3-chloropropane (DBCP) MICROEXTRACTION AND gas chromatograph / electron capture detector (GC/ECD) ANALYSIS (Revision 12, Effective 2/14/2010)	Definitive	Aqueous EDB	GC/ECD	N	N

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
SVGC-14	FLORIDA DEP METHOD FOR DETERMINATION OF PETROLEUM RANGE ORGANICS (FL-PRO) (Revision 5, Effective 3/4/2010)	Definitive	Solids and Aqueous TRPH	GC/FID	N	N
SVGCMS-03	SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (Revision 16, Effective 11/29/2010)	Definitive	Solids and Aqueous (SVOCs)	GC/MS	N	N
VGCMS-05	ANALYSIS OF VOCs BY GC/MS (Revision 16, Effective 11/29/2010)	Definitive	Solids and Aqueous VOCs	GC/MS	N	N

Note:

Under DoD ELAP Certification No. 3000.01 (valid through 31 March 2014), ENCO Orlando is certified to perform the analysis listed above. The ELAP Certification for ENCO Orlando is provided in **Appendix E**.

There are no variances to the *DoD QSM V4.2* and the SOPs were not modified for project work; therefore, the laboratory analytical SOPs are not provided as an appendix to this SAP.

Table 10-2: Analytical SOP References Table for ENCO Jacksonville

Environmental Conservation Laboratories, Inc. of Jacksonville

4810 Executive Park Court, Suite 111, Jacksonville, Florida 32216

Point of Contact: Denise Stern

Phone: 904-296-3007

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
Preparation Method / SOP Reference						
EXMT-12	ACID DIGESTION OF AQUEOUS SAMPLES FOR ANALYSIS BY ICP AND ICP/MS (Revision 4, Effective 12/30/2009).	Definitive	Aqueous Metals	NA	N	N
Analytical Method / SOP Reference						
MET-05	METALS ANALYSIS USING INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION ATOMIC SPECTROSCOPY (ICP-AES; Revision 7, Effective 10/30/2009)	Definitive	Aqueous Metals	ICP-AES	N	N
VGCMS-07	ANALYSIS OF VOCs IN AMBIENT AIR BY GC/MS (Revision 2, Effective 2/26/2009)	Definitive	Air/Vapor VOCs	GC/MS	N	N

Note:

Under DoD ELAP Certification No. 3000.02 (valid through 30 April 2014), ENCO Jacksonville is certified to perform the analysis listed above. The ELAP Certification for ENCO Jacksonville is provided in **Appendix E**.

There are no variances to the *DoD QSM V4.2* and the SOPs were not modified for project work; therefore, the laboratory analytical SOPs are not provided as an appendix to this SAP.

Table 10-3: Analytical SOP References Table for Spectrum Analytical Inc.

Spectrum Analytical Inc.

8405 Benjamin Road, Suite A, Tampa, FL 33634

Point of Contact: Mark Gudnason

Phone: 813-888-9507

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
Analytical Method / SOP Reference						
SOP00197-S4	Total Petroleum Hydrocarbons Criteria Working Groups: Characterization of C6-C35 Petroleum Hydrocarbons in Environmental Samples by TPHCWG Direct Method (Revision 4, Effective 06/26/2013)	Definitive	Soil TRPH Speciation	GC/FID	N	N

Note:

Under DoD ELAP Certification No. E84207-28 (valid through October 13, 2013), Spectrum Analytical, Inc. is certified to perform the analysis listed above. The ELAP Certification for Spectrum Analytical, Inc. is provided in **Appendix E**.

There are no variances to the *DoD QSM V4.2* and the SOPs were not modified for project work; therefore, the laboratory analytical SOPs are not provided as an appendix to this SAP.

Table 10-4: Analytical SOP References Table for Field-Based Laboratory

Resolution Consultants

Point of Contact: Jim Refermat

Phone: 850-269-2200

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
Analytical Method / SOP Reference						
GCMS001	ANALYSIS OF VOCs in SOIL BY GC/MS Revision 1, May 15, 2013	Screening	Soil VOCs	GC/MS	No	Y
GCFID001	ANALYSIS OF VOCs in SOIL BY GC/FID/PID Revision 1, May 15, 2013	Screening	Soil VOCs	GC/PID/FID	No	Y
GCMS002	ANALYSIS OF VOCs in AMBIENT AIR BY GC/MS Revision 1, May 15, 2013	Screening	Vapor VOCs	GC/MS	No	Y
GCFID002	ANALYSIS OF VOCs in AMBIENT AIR BY GC/FID/PID Revision 1, May 15, 2013	Screening	Vapor VOCs	GC/PID/FID	No	Y

Note:

Analytical SOPs listed above are for on-site field-based laboratory screening level analysis. For the purpose of comparability and completeness, Resolution Consultants has adopted ENCO analytical SOPs in their entirety with the permission of the laboratory. For the purpose of differentiating RC on-site field-screening laboratory operations from definitive fixed-base operations, SOPs for on-site analysis have been renamed and referenced as screening-level data.

11.0 Laboratory QC Samples Table

(UFP-QAPP Manual Section 3.4 – Worksheet #28)

Table 11-1: Laboratory QC Samples Table

Matrix	**Aqueous**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference	**EPA Method SW8260B and SW8260C SIM/SW5030B and lab SOP VGCMS-05**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Mass Tuning	Prior to initial calibration and at the beginning of each 12-hour period	Values for masses 69, 219, and 264 (if using Perfluorotributylamine) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable
Initial and Continuing Calibration Verification (ICV/CCV)	Daily, prior to sample analysis and every 12 hours of analysis time	1. Average RF for SPCCs VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. %Difference for all target compounds and surrogates: %Difference ≤ 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by DoD QSM V4.2 (DoD, October 2010) where applicable
Laboratory Control Sample (LCS)	Each group of 20 or less prior to analysis of samples	Per EPA Method SW8260B/SW5030B and lab SOP VGCMS-05	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.

Matrix	**Aqueous**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference	**EPA Method SW8260B and SW8260C SIM/SW5030B and lab SOP VGCMS-05**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Method Blank (MB)	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 the Reporting Limit (RL). For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (Tables 9-5 through 9-7)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per EPA Method SW8260B/SW5030B and lab SOP VGCMS-05	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per EPA Method SW8260B/SW5030B and lab SOP VGCMS-05	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2.*
Internal Standards	3 per sample. Recommended: Fluorobenzene Chlorobenzene-d5 1,4-Dichlorobenzene-d5	Retention time (RT) +/- 30 seconds from retention time of the Initial Calibration (ICAL) midpoint standard, and the Extracted Ion Current Profile (EICP) area within -50% to +100 % of ICAL midpoint standard.	Inspect MS and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	Retention time +/- 30 seconds from RT of the ICAL midpoint standard, and EICP area within -50% to +100 % of ICAL midpoint standard.

Matrix	**Aqueous**
Analytical Group	**EDB**
Analytical Method/ SOP Reference	**EPA Method SW8011 and lab SOP SVGC-03**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Laboratory Control Sample	Each group of 20 or less prior to analysis of samples	Per EPA Method SW8011 and lab SOP SVGC-03	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (**Tables 9-5** through **9-7**)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
Initial and Continuing Calibration Verification (ICV/CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the sequence	All project analytes within ± 20% of the expected value from the initial calibration.	Correct problem, then repeat. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by DoD QSM V4.2 (DoD, October 2010) where applicable.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per EPA Method SW8011 and lab SOP SVGC-03	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per EPA Method SW8011 and lab SOP SVGC-03	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2.*

Matrix	**Aqueous**
Analytical Group	**PAHs (SIM)**
Analytical Method/ SOP Reference	**EPA Method SW8270D SIM/SW3510C and lab SOP SVGCMS-03/EXSV-27**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Mass Tuning	Prior to initial calibration and at the beginning of each 12-hour period	Values for masses 69, 219, and 264 (if using Perfluorotributylamine) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable
Initial and Continuing Calibration Verification (ICV/CCV)	Daily, prior to sample analysis and every 12 hours of analysis time	1. Average RF for SPCCs : VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. %Difference for all target compounds and surrogates: %Difference ≤ 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by DoD QSM V4.2 (DoD, October 2010) where applicable
Laboratory Control Sample	Each group of 20 or less prior to analysis of samples	Per EPA Method SW8270D SIM/SW3510C and lab SOP SVGCMS-03/EXSV-27	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Breakdown check Dichlorodiphenyltrichloroethane (DDT)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown checks.	Analyst, Laboratory Supervisor	Accuracy / Bias	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.

Matrix	**Aqueous**
Analytical Group	**EDB**
Analytical Method/ SOP Reference	**EPA Method SW8011 and lab SOP SVGC-03**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (**Tables 9-5** through **9-7**)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per EPA Method SW8270D SIM/SW3510C and lab SOP SVGCMS-03/EXSV-27	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per EPA Method SW8270D SIM/SW3510C and lab SOP SVGCMS-03/EXSV-27	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Internal Standards	6 per sample. Recommended: 1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12	Retention time +/- 30 seconds from RT of the ICAL midpoint standard, and the EICP area within -50% to +100 % of ICAL midpoint standard.	Inspect MS and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Supervisor and Data Validator.	Accuracy / Bias	Retention time +/- 30 seconds from RT of the ICAL midpoint standard, and the EICP area within -50% to +100 % of ICAL midpoint standard.

Matrix	**Aqueous**
Analytical Group	**TRPH**
Analytical Method/ SOP Reference	**Method FL-PRO/SW3510C and lab SOP SVGC-14**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Laboratory Control Sample	Each group of 20 or less prior to analysis of samples	Per Method FL-PRO/ SW3510C and lab SOP SVGC-14	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (**Tables 9-5** through **9-7**)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
Initial and Continuing Calibration Verification (ICV/CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the sequence	All project analytes within ± 20% of the expected value from the initial calibration.	Correct problem, then repeat. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by the analytical method.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per Method FL-PRO/ SW3510C and lab SOP SVGC-14	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per Method FL-PRO/ SW3510C and lab SOP SVGC-14	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.

Matrix	**Aqueous**
Analytical Group	**Lead Only**
Analytical Method/ SOP Reference	**EPA Method SW6020A/3005A and lab SOP MET-05/EXMT-12**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Calibration Blank	After the Initial Calibration Verification (ICV) and after every Continuing Calibration Verification (CCV)	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Laboratory Supervisor and Data Validator	Bias / Contamination	No analytes detected > LOD.
Laboratory Control Sample	Each group of 20 or less prior to analysis of samples	Per EPA Method SW6020A/3005A and lab SOP MET-05/EXMT-12	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (**Tables 9-5** through **9-7**)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
Low-Level Calibration Check sample	Daily, after one-point ICAL.	Within ± 20% of true value.	Correct problem, then reanalyze.	Analyst, Laboratory Supervisor	Accuracy / Bias	Within ± 20% of true value.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per EPA Method SW6020A/SW3005A and lab SOP MET-05/EXMT-12	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).

Matrix	**Aqueous**
Analytical Group	**TRPH**
Analytical Method/ SOP Reference	**Method FL-PRO/SW3510C and lab SOP SVGC-14**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Inductively Coupled Plasma (ICP) Serial Dilution	One per digestion batch	If original sample result is at least 50x the instrument detection limit, 5-fold dilution must be ≤10% RPD.	Analyze Post Digestion Spike and narrate the analytes that fail criteria.	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias	If original sample result is at least 50x the LOQ, 5-fold dilution must agree within ± 10%.
Post-Digestion Spike	One per digestion batch of 20 or fewer samples	%R must be within 75-125% of expected value.	Run all associated samples in the preparatory batch by method of standard additions (MSA) or see flagging criteria.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias in matrix	DoD QSM limits of 75-125 %R.

Matrix	**Air/Vapor**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference	**EPA Method TO 15 and lab SOP VGCMS-07/GCMS002**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Mass Tuning	Prior to initial calibration and at the beginning of each 12-hour period	Values for masses 69, 219, and 264 (if using Perfluorotributylamine) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable
Initial and Continuing Calibration Verification (ICV/CCV)	Daily, prior to sample analysis and every 12 hours of analysis time	1. Average RF for SPCCs : VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. %Difference for all target compounds and surrogates: %Difference ≤ 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by DoD QSM V4.2 (DoD, October 2010) where applicable
Laboratory Control Sample	Each group of 20 or less prior or analysis of samples	Per EPA Method TO-15 and lab SOP VGCMS-07	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2.*
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (Table 9-3)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.

Matrix	**Air/Vapor**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference	**EPA Method TO 15 and lab SOP VGCMS-07/GCMS002**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
MS/SMD	One per MS pair per analytical method for each batch of at most 20 samples	Per EPA Method TO-15 and lab SOP VGCMS-07	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per EPA Method TO-15 and lab SOP VGCMS-07	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Duplicate Sample	One per batch of 20 or less.	RPD ≤ 30 where concentration >5x the LOQ; RPD ≤ 40 when concentrations are <5x the LOQ	Reanalyze once if RPDs exceed criteria. If still out, flag associated data (*) and report all analyses.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	%R limits specified in method TO-15.
Internal Standards	3 per sample: Bromochloromethane Chlorobenzene-d5 1,4-Dichlorobenzene-d5	Retention time +/- 20 seconds from RT of the ICAL midpoint standard, and the EICP area within +/- 40%of ICAL midpoint standard.	Inspect MS and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	Retention time +/- 20 seconds from RT of the ICAL midpoint standard, and the EICP area within +/-40%of ICAL midpoint standard.

Matrix	**Solids**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference	**EPA Method SW8260B /SW5035 and lab SOP VGCMS-05/GCMS001**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Mass Tuning	Prior to initial calibration and at the beginning of each 12-hour period	Values for masses 69, 219, and 264 (if using Perfluorotributylamine) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable
Initial and Continuing Calibration Verification (ICV/CCV)	Daily, prior to sample analysis and every 12 hours of analysis time	1. Average RF for SPCCs : VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. %Difference for all target compounds and surrogates: %Difference ≤ 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by DoD QSM V4.2 (DoD, October 2010) where applicable
LCS	Each group of 20 or less prior to analysis of samples	Per EPA Method SW8260B/SW5035 and lab SOP VGCMS-05	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
MB	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 the RL. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (Table 9-1)	Correct problem, then re-prep and reanalyze the MB and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.

Matrix	**Solids**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference	**EPA Method SW8260B /SW5035 and lab SOP VGCMS-05/GCMS001**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per EPA Method SW8260B/SW5035 and lab SOP VGCMS-05	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per EPA Method SW8260B/SW5035 and lab SOP VGCMS-05	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2.*
Internal Standards	3 per sample. Recommended: Fluorobenzene Chlorobenzene-d5 1,4-Dichlorobenzene-d5	RT +/- 30 seconds from retention time of the ICAL midpoint standard, and the EICP area within -50% to +100 % of ICAL midpoint standard.	Inspect MS and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	Retention time +/- 30 seconds from RT of the ICAL midpoint standard, and EICP area within -50% to +100 % of ICAL midpoint standard.

Matrix	**Solids**
Analytical Group	**PAHs (SIM)**
Analytical Method/ SOP Reference	**EPA Method SW8270D SIM/SW3550B and lab SOP SVGCMS-03/EXSV-16**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Mass Tuning	Prior to initial calibration and at the beginning of each 12-hour period	Values for masses 69, 219, and 264 (if using Perfluorotributylamine) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable
Initial and Continuing Calibration Verification (ICV/CCV)	Daily, prior to sample analysis and every 12 hours of analysis time	1. Average RF for SPCCs : VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. %Difference for all target compounds and surrogates: %Difference ≤ 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by DoD QSM V4.2 (DoD, October 2010) where applicable
LCS	Each group of 20 or less prior to analysis of samples	Per EPA Method SW8270D SIM/SW3550B and lab SOP SVGCMS-03/EXSV-16	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.

Matrix	**Solids**
Analytical Group	**PAHs (SIM)**
Analytical Method/ SOP Reference	**EPA Method SW8270D SIM/SW3550B and lab SOP SVGCMS-03/EXSV-16**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Breakdown check DDT	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown checks.	Analyst, Laboratory Supervisor	Accuracy / Bias	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (Table 9-1)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per EPA Method SW8270D SIM/SW3550B and lab SOP SVGCMS-03/EXSV-16	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per EPA Method SW8270D SIM/SW3550B and lab SOP SVGCMS-03/EXSV-16	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.

Matrix	**Solids**
Analytical Group	**PAHs (SIM)**
Analytical Method/ SOP Reference	**EPA Method SW8270D SIM/SW3550B and lab SOP SVGCMS-03/EXSV-16**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Internal Standards	6 per sample. Recommended: 1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12	Retention time +/- 30 seconds from RT of the ICAL midpoint standard, and the EICP area within -50% to +100 % of ICAL midpoint standard.	Inspect MS and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Supervisor and Data Validator.	Accuracy / Bias	Retention time +/- 30 seconds from RT of the ICAL midpoint standard, and the EICP area within -50% to +100 % of ICAL midpoint standard.

Matrix	**Solids**
Analytical Group	**TRPH**
Analytical Method/ SOP Reference	**Method FL-PRO/SW3550B and lab SOP SVGC-14**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
LCS	Each group of 20 or less prior to analysis of samples	Per Method FL-PRO/SW3550B and lab SOP SVGC-14	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Initial and Continuing Calibration Verification (ICV/CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the sequence	All project analytes within ± 20% of the expected value from the initial calibration.	Correct problem, then repeat. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by the analytical method.
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (Table 9-1)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
MS/MSD	One per matrix spike pair per analytical method for each batch of at most 20 samples	Per Method FL-PRO/SW3550B and lab SOP SVGC-14	Examine the project-specific DQOs. Notify lab QA Officer and Project Chemist as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	For matrix evaluation, use QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010).
Surrogate Spike	All field and QC samples	Per Method FL-PRO/SW3550B and lab SOP SVGC-14	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.

Matrix	**Solids**
Analytical Group	**TRPH Speciation**
Analytical Method/ SOP Reference	**Method TPHCWG/SW3550B and lab SOP SOP00197-S4**

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
LCS	Each group of 20 or less prior to analysis of samples	Per Method TPHCWG/SW3550B and lab SOP SOP00197-S4	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.
Initial and Continuing Calibration Verification (ICV/CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the sequence	All project analytes within ± 20% of the expected value from the initial calibration.	Correct problem, then repeat. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by the analytical method.
Method Blank	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected ≥ LOQ as shown in **Worksheet #15** (Table 9-1)	Correct problem, then re-prep and reanalyze the method blank and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity/ Bias	No analytes detected > 1/2 LOQ. For common laboratory contaminants, no analytes detected > LOQ.
Surrogate Spike	All field and QC samples	Per Method TPHCWG/SW3550B and lab SOP SOP00197-S4	Correct problem, then re-prep and reanalyze all failed samples for failed surrogates in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy/ Precision	QC acceptance criteria specified by *DoD QSM V4.2* (DoD, October 2010) where applicable; lab historical acceptance criteria will be used for analytes not specified in *DoD QSM V4.2*.

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12.0 Data Verification and Validation (Steps I and IIa/IIb) Process Table

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual – Worksheets #34, 35, 36)

Table 12-1: Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/External[1]
Review of Field SOPs	Determines whether field SOPs are performed in accordance with this SAP and prescribed SOPs. Frequency is once or more depending on size and complexity of project and experience of field personnel. Verification of field SOPs, field logs and sample colletion will be documented by dated signature on the last page or page immediately following the review material.	John Clauson, Resolution Consultants	External
Review of Field Notes	Determines whether field procedures are performed in accordance with this SAP and prescribed procedures. Notes allow reconstruction of activities and identification of sampling locations. The field logbook and any field notes will be reviewed internally on a weekly basis and placed in the project file. Copies of the field logbook and field notes will be provided to the TOM and included in the Field Audit Report. Verification of field logs and sample colletion will be documented by dated signature on the last page or page immediately following the review material.	John Clauson, Resolution Consultants	External
Review of field instrument calibration sheets	Determines whether field instruments are calibrated and used in accordance with manufacturers' requirements. Frequency is daily during instrument use. Verification of field instrument calibration will be documented by dated signature on the last page or page immediately following the review material.	John Clauson, Resolution Consultants Anne Kakai, Resolution Consultants	External
Review of Chain-of-Custody Forms	Chain-of-Custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. A determination will then be made to verify whether samples are labeled and handled in accordance with this SAP and prescribed procedures, and the correct analysis is selected. The final Chain-of-Custody verification step is to compare the reported analytical results against the Chain-of-Custody to ensure all requested analysis were performed and reported.	Ronnie Wambles, ENCO	Internal

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/External[1]
Review of Chain-of-Custody Forms	Chain-of-Custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. A determination will then be made to verify whether samples are labeled and handled in accordance with this SAP and prescribed procedures, and the correct analysis is selected. The final Chain-of-Custody verification step is to compare the reported analytical results against the Chain-of-Custody to ensure all requested analysis were performed and reported. Verification of chain-of-custody forms will be documented in the DVA workbook.	Anne Kakai, Resolution Consultants	External
Analytical Data Package	All analytical data packages will be verified internally by the laboratory performing the work for completeness prior to submittal of the data to Resolution Consultants. All analytical data will be verified according to the data validation procedures specified in the **Validation section** after the data are received from the analytical laboratory. Verification with method and SOP QA/QC proceedured will be documented in the DVA workbook.	Ronnie Wambles, ENCO Orlando	Internal
Review of fixed laboratory instrument calibration sheets and laboratory analysis procedures	Determine whether laboratory instruments are used in accordance with manufactures' requirements and determine whether the laboratory analysis is performed in accordance with the procedures described in the laboratory-specific SOPs. Frequency is once during the project. Verification the correct SOP and analytical method/s were used will be documented by the laboratory PM or designee by their dated signature on each laboratory submittal, and in the DVA workbook.	Anne Kakai, Resolution Consultants	External
Laboratory Data Assessment	Determines whether electronic and hard copy data upon receipt are comparable and contain the proper reporting format. The assessment will consist of reviewing both types of data to verify that data were delivered in the proper fields and that all required fields are populated correctly. Verification of data package completeness will be documented in the DVA workbook.	Jim Refermat, Resolution Consultants	External
NIRIS Review	Determines whether electronic data upon receipt is comparable and contains the proper reporting format. The assessment will consist of reviewing data to verify that data was delivered in the proper fields and that all required fields are populated correctly. Electronic data deliverable verification will be documented in the DVA workbook.	Jim Refermat, Resolution Consultants	External
SOP Deviation (if any)	Document and assess the impact on the data from any deviations of the analytical or field SOPs. Verification the correct SOP and analytical method/s were used will be documented by the laboratory PM or designee by their dated signature on each laboratory submittal, and in the DVA workbook.	Bill Duffy, John Clauson, Jim Refermat, Resolution Consultants	External

VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/External[1]
On-site data	All on-site data will be reviewed against SAP requirements for completeness; precision and accuracy based on the field calibration requirements and overall project DQOs. Verification of field calibration requirements meet project DQOs will be documented by dated signature on the last page or page immediately following the review material.	John Clauson, Resolution Consultants	External
Field Water Quality Parameters	Review of instrument calibration procedures and overall method sensitivity, precision, accuracy and completeness. Verification of field calibration requirements meet overall method sensitivity, precision, accuracy and completenes will be documented by dated signature on the last page or page immediately following the review material.	Anne Kakai, Resolution Consultants	External
Environmental Restoration Programs	Ensures that all sampling and analytical SOPs were followed. Verification of field SOPs, field logs and sample colletion will be documented by dated signature on the last page or page immediately following the review material.	Bill Duffy, Resolution Consultants	External
Chain-of-Custody and Field QC logbook	Examines traceability of data from sample collection to generation of project data. Verification of chain-of-custody forms will be documented in the DVA workbook.	Anne Kakai, Resolution Consultants	External
Project LOD and LOQs and data qualifiers	Review LOD and LOQs achieved as outlined in the SAP and verify that the laboratory successfully analyzed all samples submitted and the PAL was attained where achievable. Evaluate the impact data qualifiers have on the project objectives and required corrective action, if any. Verificatoin projectof DQOs and impacts of qualified data will be documented in the DVA workbook.	Jim Refermat, Resolution Consultants	External
SAP	Determine whether the number and type of samples specified in **Sample Details Table** were collected and analyzed.	John Clauson, Resolution Consultants Anne Kakai, Resolution Consultants	External
SAP and Laboratory SOW	Determines whether all analytes specified in **Worksheet #15** (Tables 9-1 through 9-7) were analyzed and reported by the laboratory. Verification the correct target list were analyzed by each analytical fraction will be documented in the DVA workbook.	Anne Kakai, Resolution Consultants	External
Laboratory Data and SAP requirements	Assess and document the performance of the analytical process. A summary of all QC samples and results will be verified for MPC and completeness. Full verification will be performed on 10% of the data and Standard Level verification will be performed on 90% of the data. A report shall be prepared within 21 days of receipt of the data package from the laboratory. Verification of validation proceedures will be documented in the DVA workbook.	Jim Refermat, Resolution Consultants	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/External[1]
Methods, Field QC logbook and SAP requirements	Determines impacts of any deviations from methods and corrective actions implemented during sampling and analysis. Verification the correct analytical methods, filed QC and analytical/field SOPs were used will be documented by dated signature on the last page or page immediately following the review material and in the DVA woorkbook.	Anne Kakai, Resolution Consultants	External

VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE

Step IIa/IIb [a]	Matrix/Analytical Group	Responsible (Name, Organization)	Validation Criterion
IIa/IIb Air/Vapor/VOCs	Full Validation Procedure for GC/MS Volatile Organics by EPA Method TO-15, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Aqueous/VOCs	Full Validation Procedure for GC/MS Volatile Organics by EPA Method SW8260B/SW8260C SIM andSW8011, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Aqueous/PAH(SIM)	Full Validation Procedure for GC/MS PAHs by EPA Method SW8270D SIM, using DoD *QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Aqueous/Lead Only	Full Validation Procedure for Metals by EPA Method SW6020A, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External

Step IIa/IIb [a]	Matrix/Analytical Group	Responsible (Name, Organization)	Validation Criterion
IIa/IIb Aqueous (TRPH)	Full Validation Procedure for Total Recoverable Petroleum Hydrocarbons by Method FL-PRO, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Solids/VOCs	Full Validation Procedure for GC/MS Volatile Organics by EPA Method SW8260B, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Solids/PAH(SIM)	Full Validation Procedure for GC/MS PAHs by EPA Method SW8270D SIM, using DoD *QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Solids/(TRPH)	Full Validation Procedure for Total Recoverable Petroleum Hydrocarbons by Method FL-PRO, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External
IIa/IIb Solids/(TRPH Speciation)	Full Validation Procedure for Total Hydrocarbon Fractions by Method TPHCWG, using *DoD QSM V4.2* (DoD, October 2010) and modeled after the EPA National Functional Guidelines for Data Review to the extent possible. Validation will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Anne Kakai, Resolution Consultants	External

[1] "Internal" is completed by the laboratory. "External" is not completed by the laboratory
[a] IIa Compliance with methods, procedures, and contracts (see Table 10, page 117, *UFP-QAPP Manual*, V.1, Intergovernmental Data Quality Task Force (IDQTF), March 2005a)
IIb Comparison with MPC in the SAP (see Table 11, page 118, *UFP-QAPP Manual*, V.1, IDQTF, March 2005a)
All analyses will be performed at low concentration levels.

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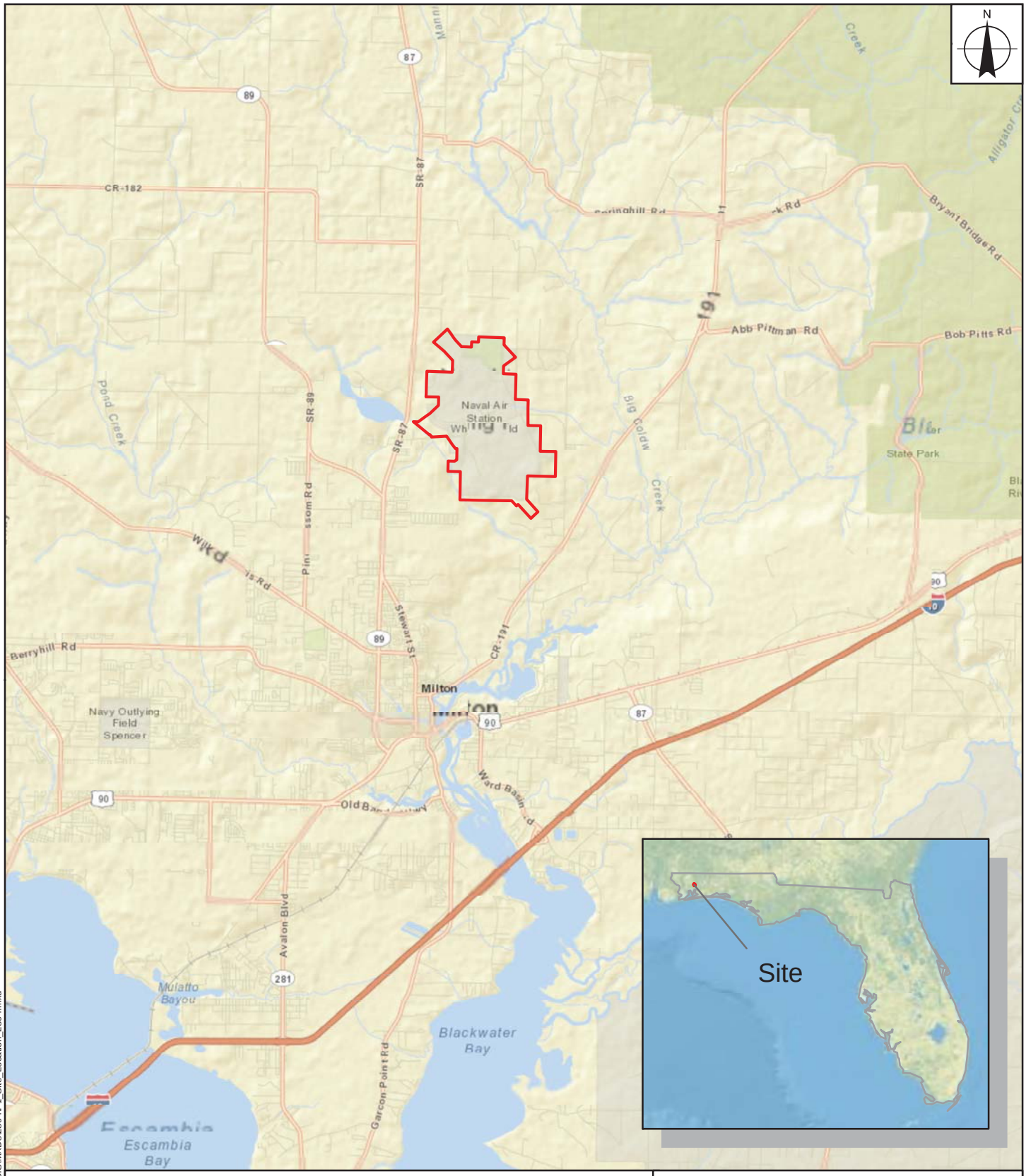
FIGURES



Legend

NAS WHITING FIELD SITE BOUNDARY

0 1 2 3 4 Miles

1 in = 3 miles

Basemap Source: Esri World Imagery 2010
http://services.arcgisonline.com/arcgis/services/World_Imagery
© 2011 Esri, i-cubed, USDA FSA, USGS, AEX, GeoEye, AeroGRID, Getmapping, IGP

FIGURE 4-1
SITE LOCATION MAP
NAS WHITING FIELD - SITE 4
MILTON, FLORIDA

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: A. EDDINGTON	DATE: 7/24/2012
DRAWN BY: M. MARTIN	TASK ORDER NUMBER: JM09

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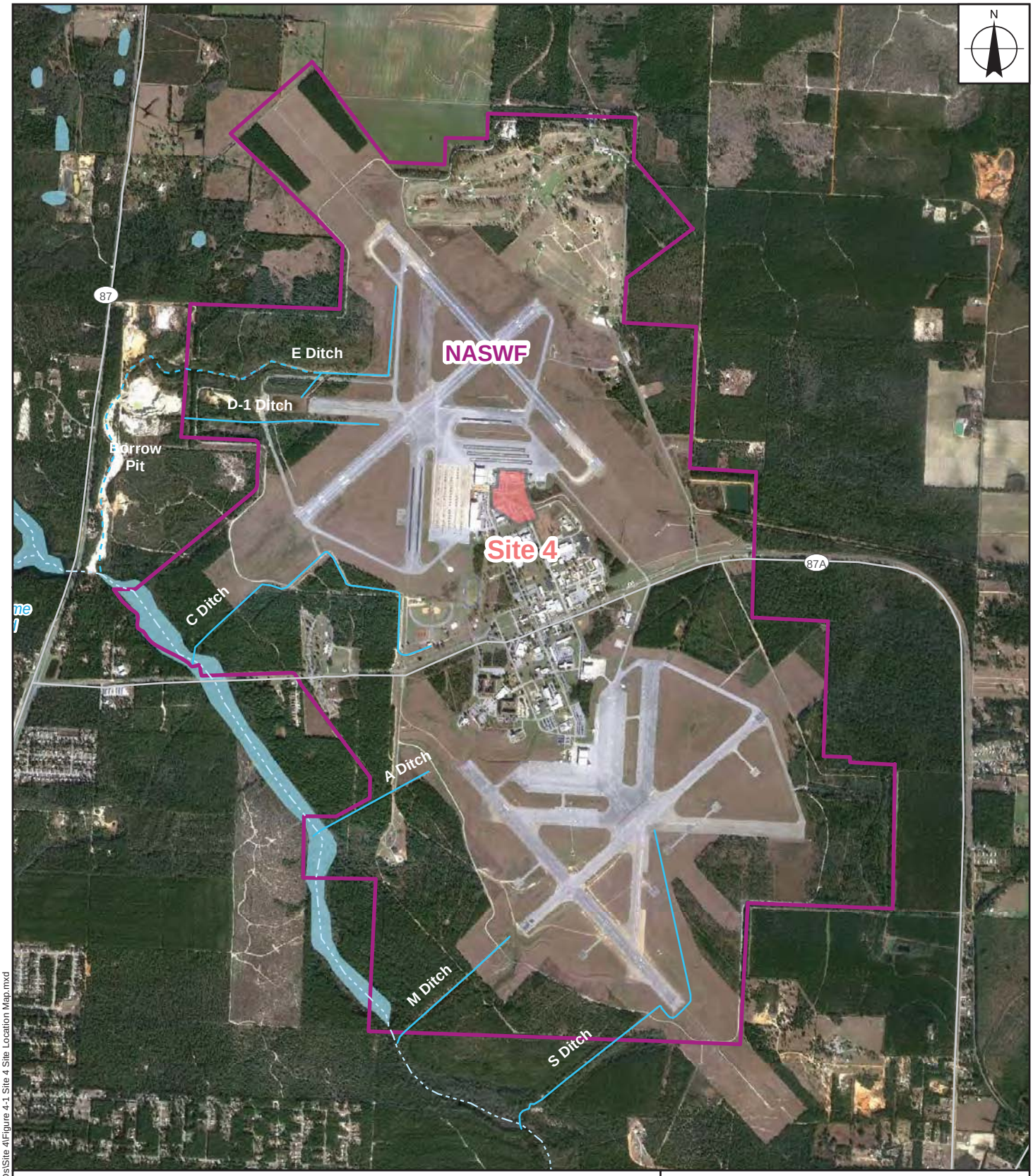


Legend

- Ditches (Dashed Where Inferred"
- Streams and Rivers
- Major Roads
- Surface Water Body or Floodplain

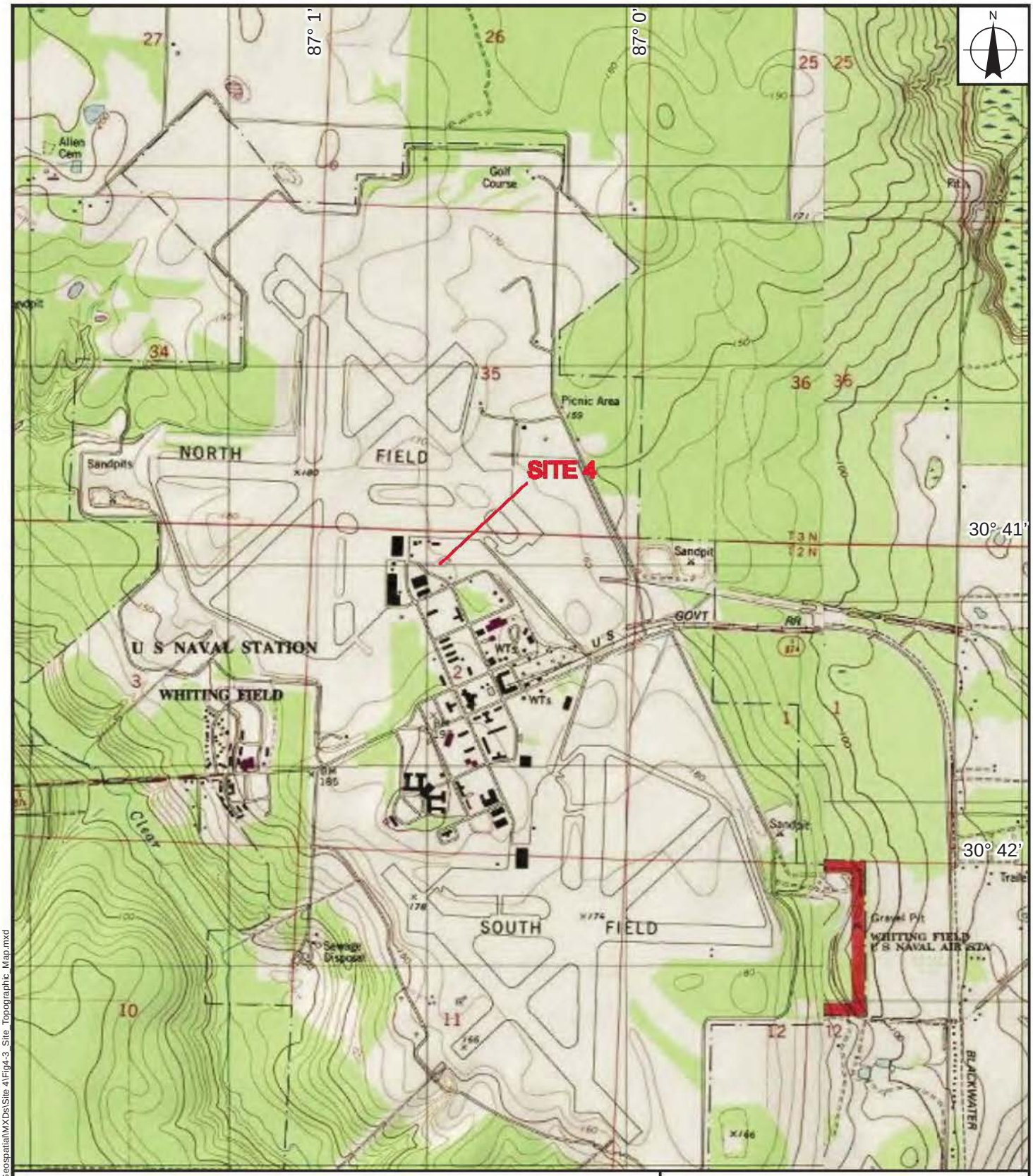
0 2,500 5,000 Feet

FIGURE 4-2
SITE LOCATION MAP
SITE 4
NASWF - Milton, Florida

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: Krista Sommerfeldt	DATE: 6/12/2013
DRAWN BY: Tammy Godfrey	TASK ORDER NUMBER:

L:\Group\IT_GIS\GIS Projects\NAVFAC\MXDs\Site 4\Figure 4-1 Site 4 Site Location Map.mxd



SOURCE:
USGS TOPOGRAPHIC QUADRANGLE
MILTON, FLORIDA 1997
TOWNSHIP: 2 NORTH
SECTION: 2
RANGE: 28 WEST

0 1,300 2,600 3,900 5,200 Feet

1 inch = 2,600 feet

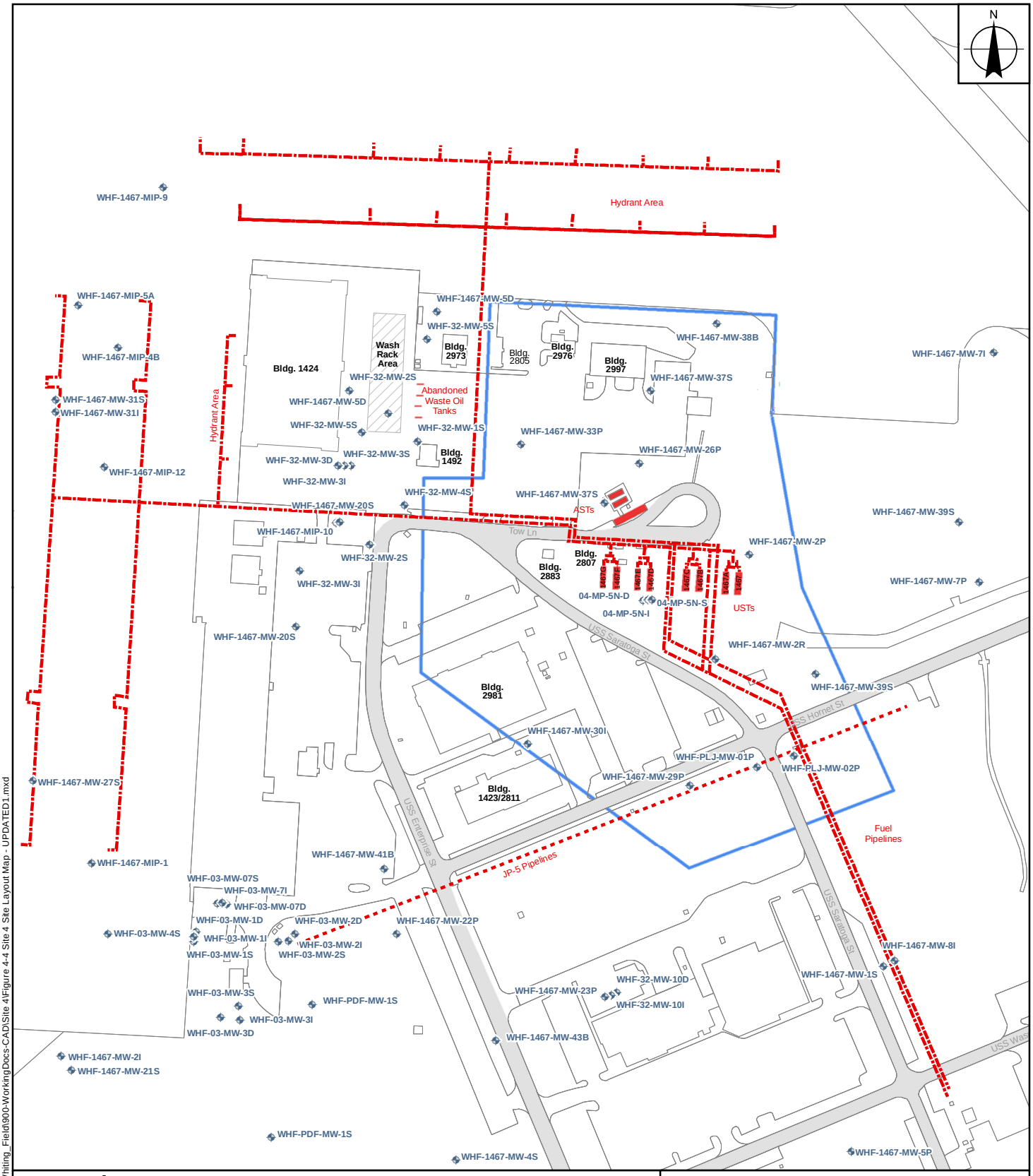
FIGURE 4-3
SITE TOPOGRAPHIC MAP
NAS WHITING FIELD - SITE 4
MILTON, FLORIDA

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: A. EDDINGTON	DATE: 7/26/2013
DRAWN BY: M. MARTIN	TASK ORDER NUMBER: JM09

L:\projects\Navy CLEAN\Whiting Field\9.0_Geospatial\MXDs\Site 4\Fig4-3_Site_Topographic_Map.mxd



Legend

- Monitoring Well Location
- Fuel Pipeline Location
- JP-5 Pipeline
- Site 4 Boundary

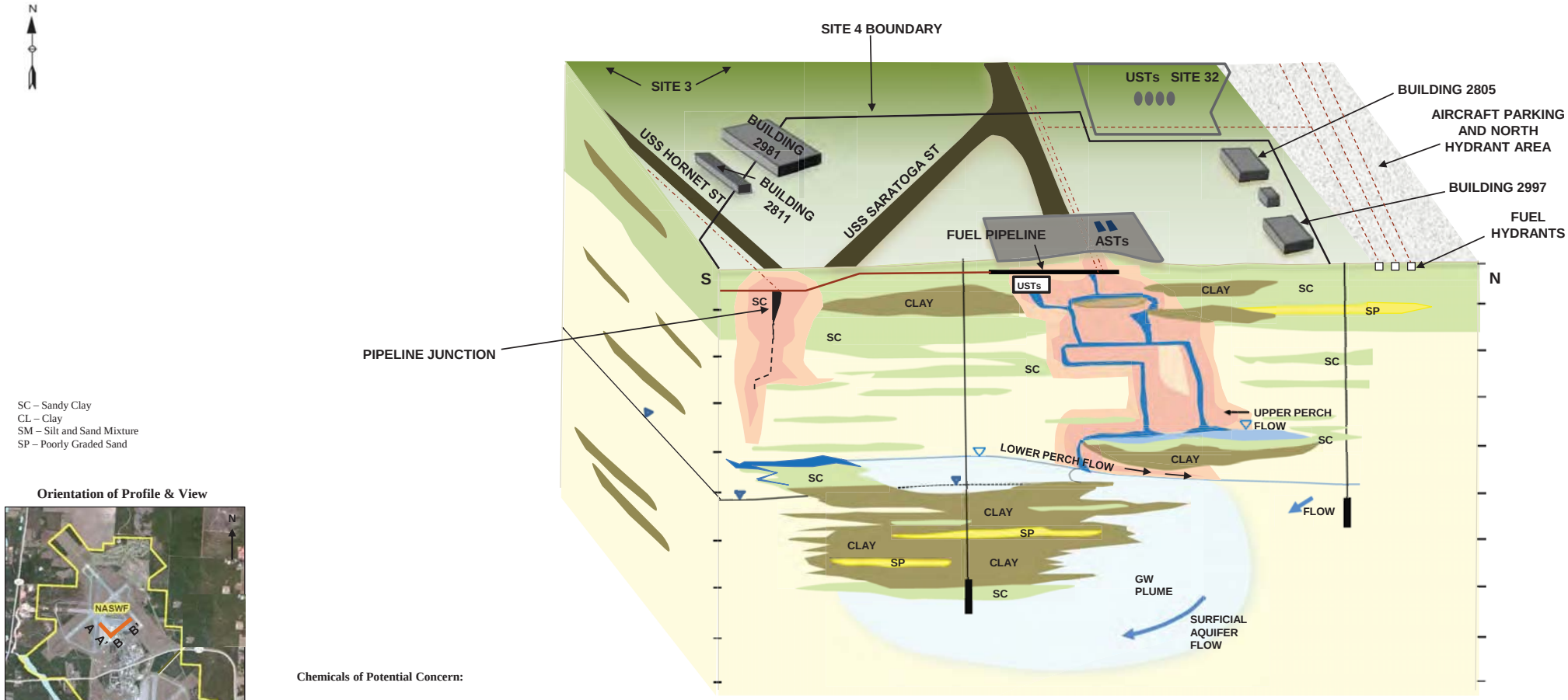
0 125 250 500 Feet

FIGURE 4-4
SITE LAYOUT MAP
SITE 4
NASWF - Milton, Florida

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: Krista Sommerfeldt	DATE: 11/6/2013
DRAWN BY: J CHASTAIN	TASK ORDER NUMBER:

L:\work\NAVY CLEAN\JM57_Site-4_NAS_Whiting_Field\900-WorkingDocs-CAD\Site 4\Figure 4-4 Site 4 Site Layout Map - UPDATED1.mxd



SC – Sandy Clay
CL – Clay
SM – Silt and Sand Mixture
SP – Poorly Graded Sand

Orientation of Profile & View

Chemicals of Potential Concern:

VOCs: 1,1 Dichloroethane, cis-1,2-DCE, carbon tetrachloride, chloroform, tetrachloroethene, trichloroethene, vinyl chloride, benzene, toluene, ethylbenzene, and total xylenes

Metals: aluminum, antimony, arsenic, cadmium, cobalt, iron, lead, manganese, mercury, and thallium

LEGEND

- Road
- Surface Water Flow Direction
- Surface Water Body
- Woods or Heavily Vegetated Area
- Grass or Open Area
- 50 Groundsurface Elevation Contour (ft amsl)
- Perched Water (UP-Upper Perched, LP-Lower Perched)
- Groundwater Table (Surficial Aquifer)
- Groundwater Flow Direction
- North Central Area Plume Extent
- BTEX and Chlorinated Ethene Plume
- 50 Groundwater Elevation Contour (amsl)
- Soil Gas (High Concentration)
- Soil Gas (Low Concertration)
- BTEX and TCE

RED Text – Potential source of contamination for Site 40

POTENTIAL EXPOSURE PATHWAYS AND RECEPTORS

Human Receptors: current and future residents (child and adult), industrial/occupational workers, and construction workers potentially exposed from incidental ingestion and dermal contact with contaminated soil and/or groundwater and inhalation of VOCs emanating from soil and/or groundwater. Groundwater is a source of potable drinking water at NAS Whiting Field and is treated using a granular activated carbon system.

FIGURE 4-5

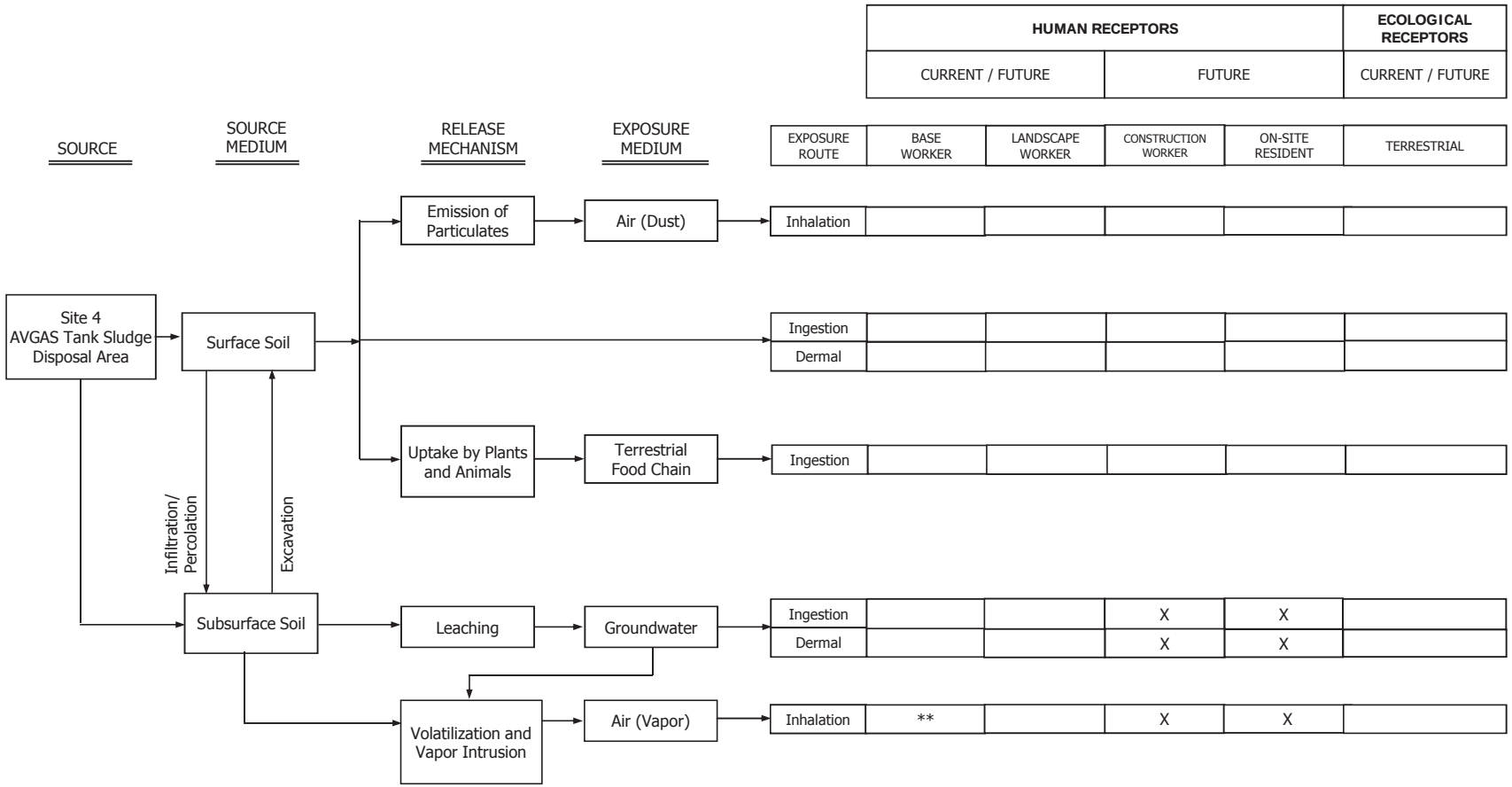
CONCEPTUAL SITE MODEL

SITE 4

SOURCE AREA DELINEATION

NAVAL AIR STATION WHITING FIELD

MILTON, FLORIDA



LEGEND
X = Potentially complete exposure pathway to be evaluated
** = Pathway potentially complete, but exposure would not be sufficient to warrant evaluation
Empty block = Incomplete exposure pathway

Figure 4-6
Preliminary
Exposure Pathway Model Diagram
Site 4
NAS Whiting Field, Milton, Florida

Legend

- Proposed Screening Location
- Monitoring Well
- Fuel Pipelines
- JP-5 Pipeline
- Wash Rack Area
- Site 4 Boundary

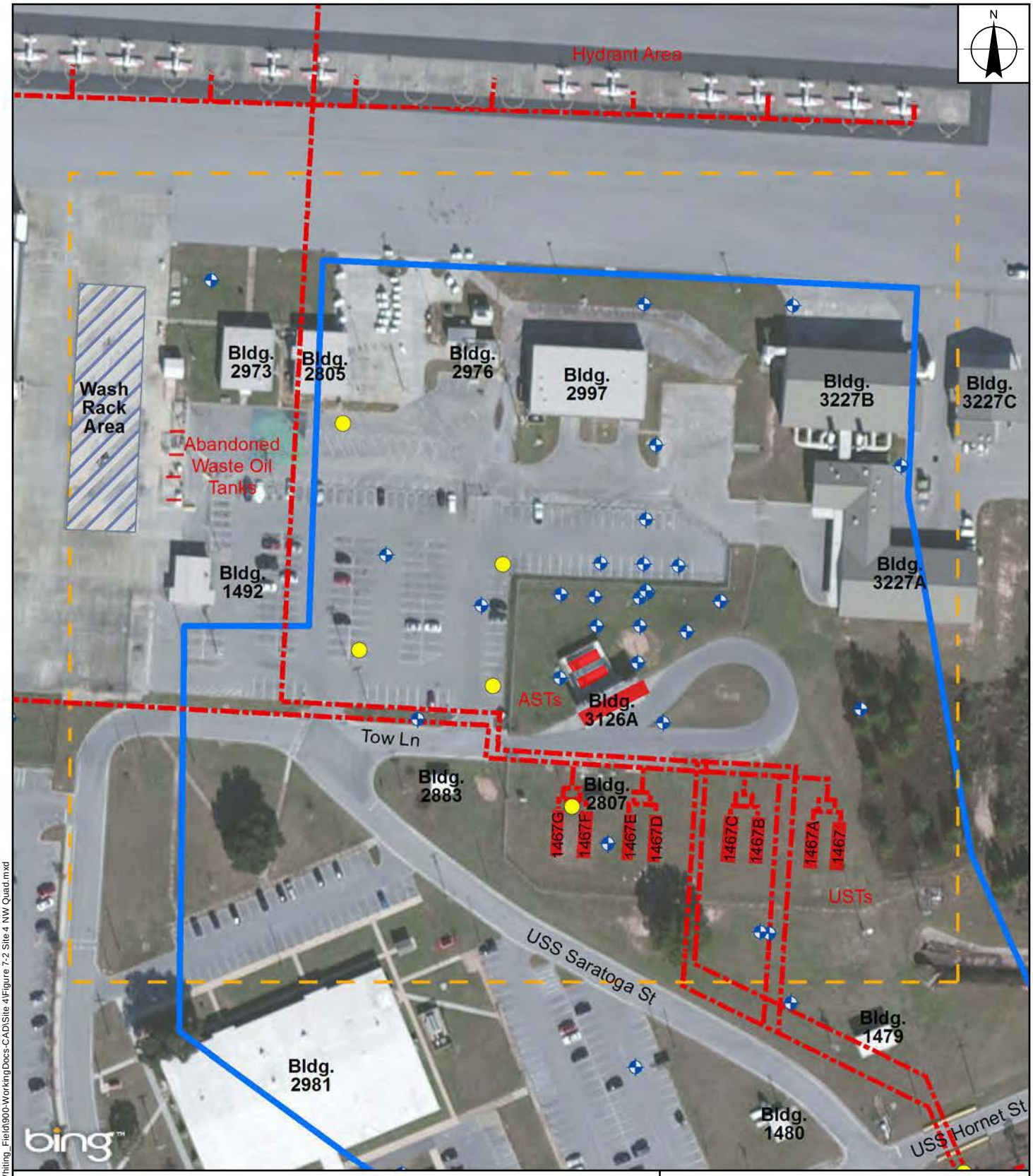
0 120 240 360 480 Feet

FIGURE 7-1
PIPELINE SCREENING LOCATIONS
SITE 4
NASWF - Milton, Florida

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: Krista Sommerfeldt	DATE: 11/6/2013
DRAWN BY: J CHASTAIN	TASK ORDER NUMBER:

L:\work\NAVY CLEAN\JM57_Site-4_NAS_Whiting_Field\900-WorkingDocs-CAD\Site 4\Figure 7-1 Site 4 Pipeline - UPDATED.mxd



Legend

- Proposed Soil Boring
- Monitoring Well
- Fuel Pipelines
- JP-5 Pipeline
- Northwest Quadrant
- Wash Rack Area
- Site 4 Boundary

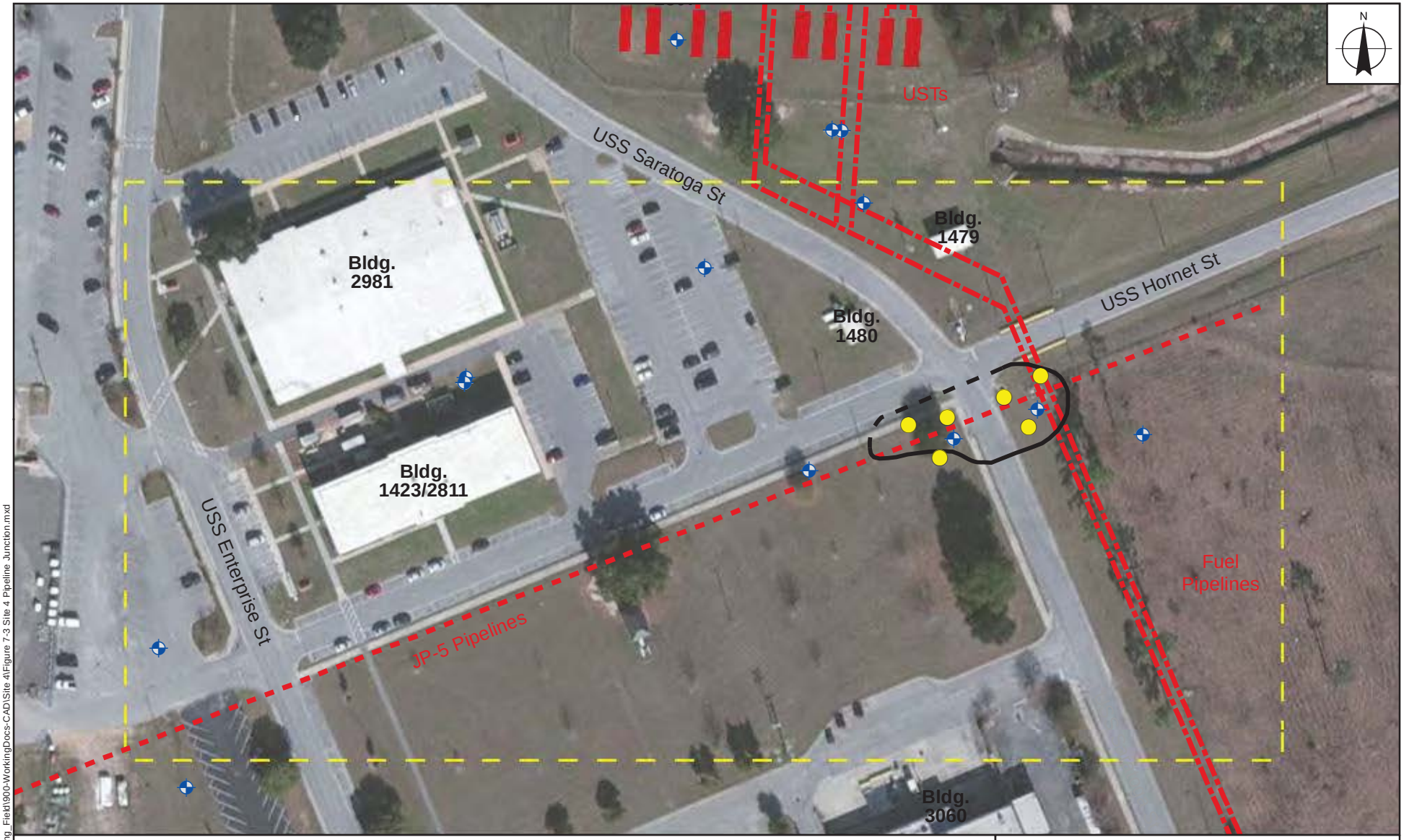
0 60 120 180 240 Feet

FIGURE 7-2
NORTHWEST QUADRANT
SITE 4
NASWF - Milton, Florida

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: A. EDDINGTON	DATE: 11/6/2013
DRAWN BY: J. CHASTAIN	TASK ORDER NUMBER:

L:\work\NAVY CLEAN\JM57_Site-4_NAS_Whiting_Field\900-WorkingDocs-CAD\Site 4\Figure 7-2 Site 4 NW Quad.mxd



Legend

- Proposed Soil Boring
- Monitoring Well
- Fuel Pipelines
- JP-5 Pipeline
- Pipeline Junction Area
- Impacted Soil (2001 Site Assessment Report Addendum, dashed where inferred)
- Site 4 Boundary

0 60 120 180 240 Feet

FIGURE 7-3
PIPELINE JUNCTION AREA
SITE 4
NASWF - Milton, Florida

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: Krista Sommerfeldt	DATE: 7/16/2013
DRAWN BY: Tammy Godfrey	TASK ORDER NUMBER:

L:\work\NAVY CLEAN\JM57_Site-4_NAS_Whiting_Field\900-WorkingDocs-CAD\Site 4\Figure 7-3 Site 4 Pipeline Junction.mxd

APPENDIX A

SAP AMENDMENT HISTORY

APPENDIX A
Amendment History Summary
Tier II SAP, Site 4
NASWF, Milton, Florida

Date	Worksheet/ Section	Page #	Description of Document Subject Affected	Modification Rationale
2/27/2014			FDEP technical review comments and concurrance of Draft Tier II Sampling and Analysis Plan, Site 4, North AVGAS Tank Sludge Disposal Area, Naval Air Station Whiting Field, USEPA ID #FL2 170 023 244, Milton, Florida.	
3/11/2014	Only incidental modifications were made by Resolution Consultants to the Draft Tier II Sampling and Analysis Plan, Site 4, North AVGAS Tank Sludge Disposal Area, Naval Air Station Whiting Field, USEPA ID #FL2 170 023 244, Milton, Florida, to transition the document from Draft to Final. No significant modifications were requested by FDEP, therefore, a Draft-Final version of the document was not prepared. Incidental modifications, such as changes to date and formatting were made throughout the document but have not been tracked independently.			

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
BOB MARTINEZ CENTER
2600 BLAIRSTONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

RICK SCOTT
GOVERNOR

CARLOS LOPEZ-CANTERA
LT. GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

February 27, 2014

Department of the Navy
Naval Facilities Engineering Command Southeast
Attn: Arne Olsen, OPUE3
135 Ajax Street North, Building 903
Naval Air Station Jacksonville
Jacksonville, Florida 32212-0030

RE: Draft Tier II Sampling and Analysis Plan, Site 4, North AVGAS Tank Sludge Disposal Area, Naval Air Station Whiting Field, USEPA ID #FL2 170 023 244, Milton, Florida (RC, February 5, 2014)

Dear Mr. Olsen:

I have reviewed the above document dated February 5, 2014. The Department received this document on February 14, 2014. It was completed under Contract Task Order JM57.

The Tier II Sampling and Analysis Plan (SAP) states *"This Sampling and Analysis Plan (SAP) was prepared to document the proposed remedial alternative evaluation and optimization to be performed at Department of Navy Environmental Restoration Program Site 4, AVGAS Tank Sludge Disposal Area, located at Naval Air Station Whiting Field (NASWF), in Milton, Florida."*

Based on my review of this document, the Department is in concurrence with the sampling and analysis plan (see particularly Worksheets #11, #15, and #17) as outlined in this SAP.

Thank you for the opportunity to review this document. If you require additional clarification, or other assistance, please feel free to contact me at 850/245-8999.

Sincerely,

John Winters, P.G.
Remedial Project Manager
Federal Programs Section

KAW

DOD_17_1860

APPENDIX B

EXCERPTS FROM HISTORICAL REPORTS: (PROVIDED ELECTRONICALLY ONLY)

Figure 3-1, *Pipeline Closure Assessment Report*, TtNUS, April 2001

Figure 5, *Draft Project Completion Report*, WRS, May 2009

Figure 2-1, Site Assessment Report (SAR), CH2M HILL, June 2013

Figure 2-2, SAR, CH2M HILL, June 2013

Figure 2-3, SAR, CH2M HILL, June 2013

Figure 3-6, SAR, CH2M HILL, June 2013

Figure 3-7, SAR, CH2M HILL, June 2013

Figure 5-1, SAR, CH2M HILL, June 2013

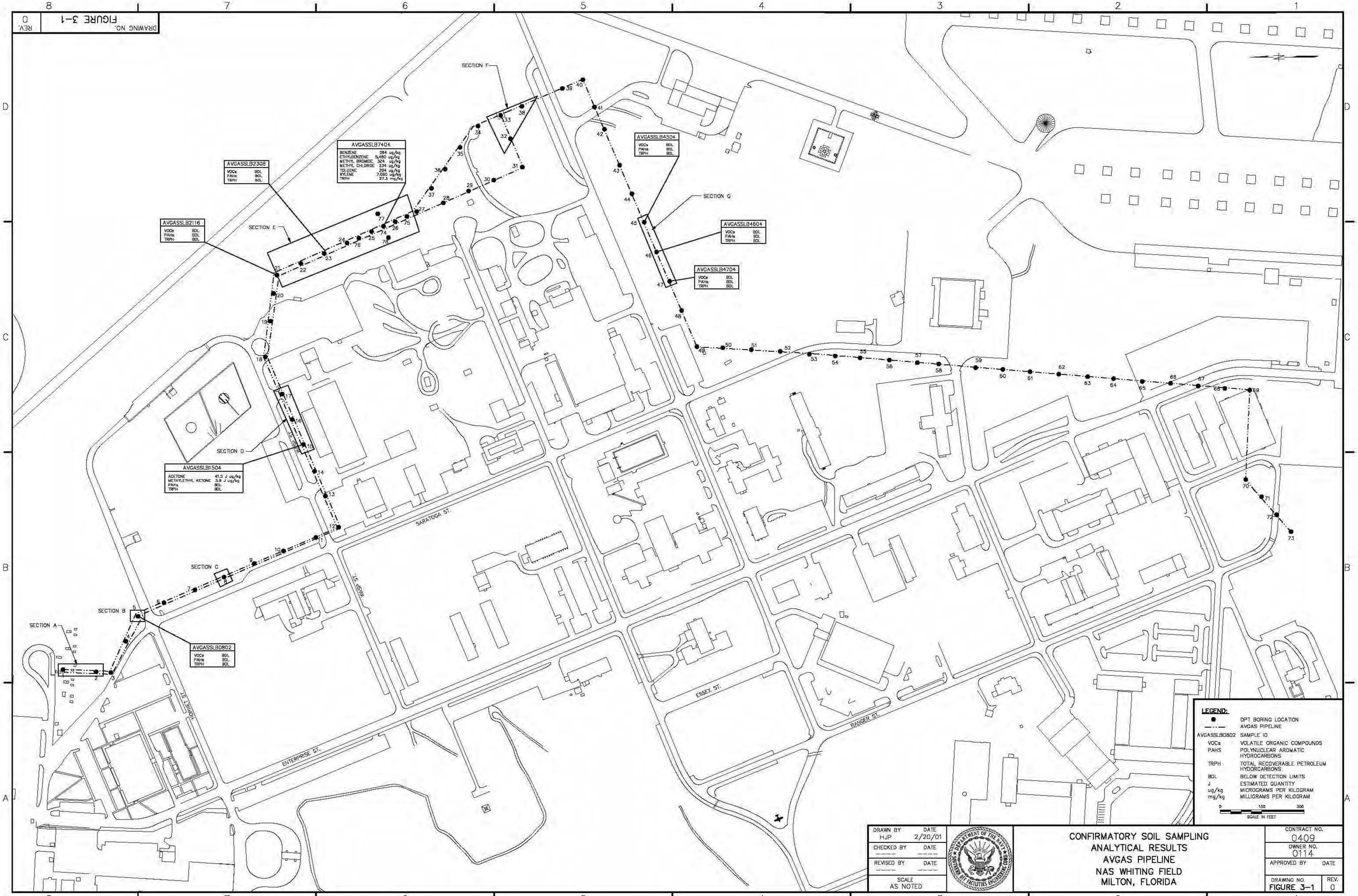
Figure 5-2, SAR, CH2M HILL, June 2013

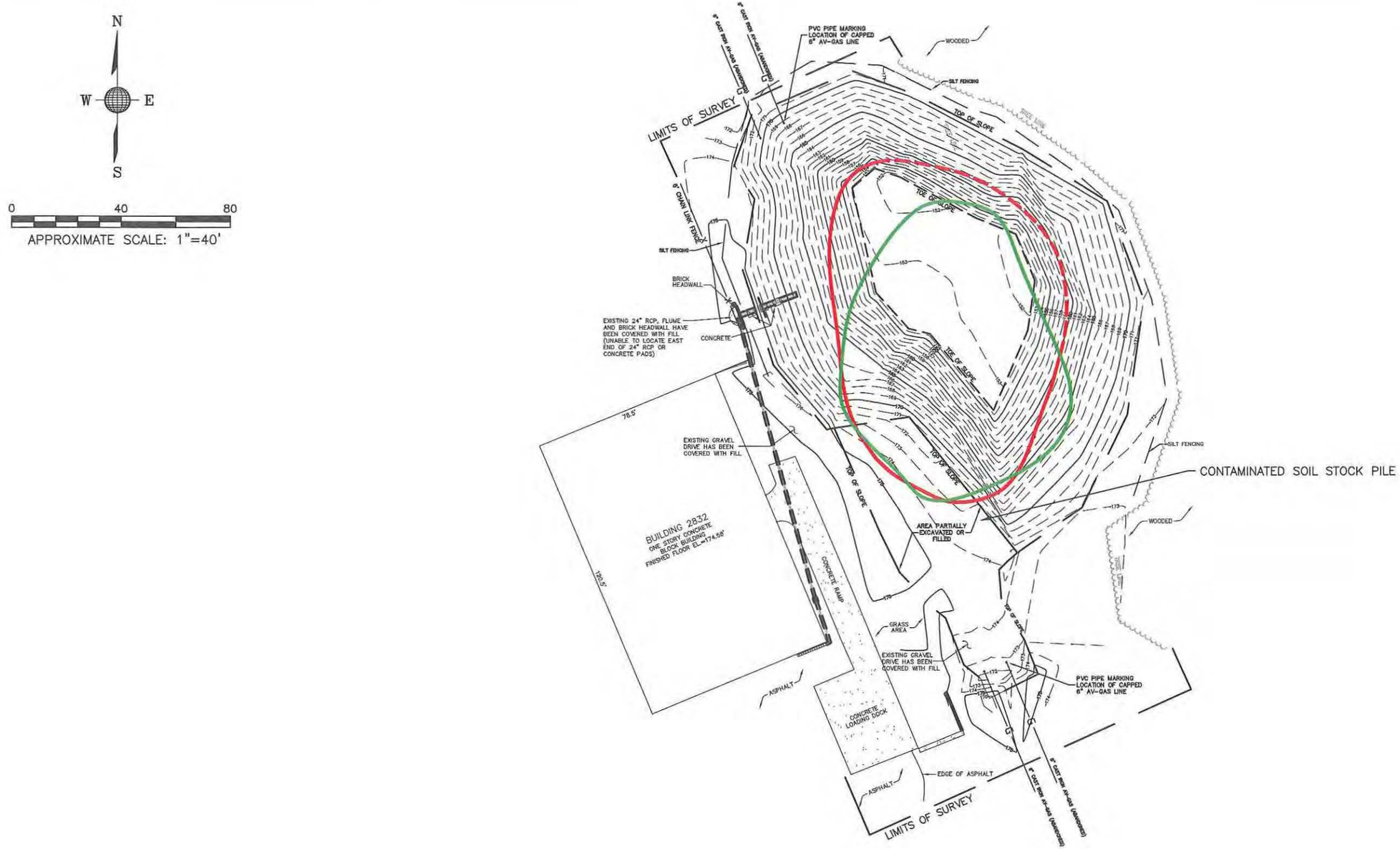
Figure 5-4, SAR, CH2M HILL, June 2013

Figure 6-11, SAR, CH2M HILL, June 2013

Figure 6-12, SAR, CH2M HILL, June 2013

NASWF 28 August 2013 Draft Partnering Meeting Minutes


SECTION A
SECTION B
SECTION C
SECTION D
SECTION E
SECTION F
SECTION G
AVGASSLB0802
VOCs BDL
PAHs BDL
TRPH BDL
AVGASSLB1504
ACETONE 41.5 J ug/kg
METHYLETHYL KETONE 3.9 J ug/kg
PAHs BDL
TRPH BDL
AVGASSLB2116
VOCs BDL
PAHs BDL
TRPH BDL
AVGASSLB2308
VOCs BDL
PAHs BDL
TRPH BDL
AVGASSLB7404
BENZENE 284 ug/kg
ETHYLBENZENE 5,480 ug/kg
METHYL BROMIDE 324 ug/kg
METHYL CHLORIDE 234 ug/kg
TOLUENE 294 ug/kg
XYLENE 7,080 ug/kg
TRPH 27.3 mg/kg
AVGASSLB4504
VOCs BDL
PAHs BDL
TRPH BDL
AVGASSLB4604
VOCs BDL
PAHs BDL
TRPH BDL
AVGASSLB4704
VOCs BDL
PAHs BDL
TRPH BDL
SARATOGA ST.
HUGHES ST.
ENTERPRISE ST.
ESSEX ST.
RANGER ST.
LEGEND:
DPT BORING LOCATION
AVGAS PIPELINE
AVGASSLB0802 SAMPLE ID
VOCs VOLATILE ORGANIC COMPOUNDS
PAHS POLYNUCLEAR AROMATIC HYDROCARBONS
TRPH TOTAL RECOVERABLE PETROLEUM HYDORCARBONS
BDL BELOW DETECTION LIMITS
J ESTIMATED QUANTITY
ug/kg MICROGRAMS PER KILOGRAM
mg/kg MILLIGRAMS PER KILOGRAM
0 150 300
SCALE IN FEET
DRAWN BY HJP
DATE 2/20/01
CHECKED BY
DATE
REVISED BY
DATE
SCALE AS NOTED
DEPARTMENT OF THE NAVY SOUTHERN DIVISION FACILITIES ENGINEERING COMMAND
CONFIRMATORY SOIL SAMPLING
ANALYTICAL RESULTS
AVGAS PIPELINE
NAS WHITING FIELD
MILTON, FLORIDA
CONTRACT NO. 0409
OWNER NO. 0114
APPROVED BY
DATE
DRAWING NO. FIGURE 3-1
REV. 0
ACAD: 0409TM02.dwg 02/22/01 HJP



LEGEND:

- PLANNED EXCAVATION EXTENT (0–10 FEET BLS)
- PLANNED EXCAVATION EXTENT (10–20 FEET BLS)

DRAWING STATUS	DRAFT	FINAL ☒
PROPOSAL NO. : 32-63-060001		
PROJECT MANAGER: MARK WHITE		
SCALE: 1"=40'		
REVISION NO.: 0	REV DATE:	
CADD ID: 0600011001	PLOT DATE:	05/14/09
DRN BY: A.R.W.	DRN DATE:	04/30/09
CHK BY: C.C.	CHK DATE:	04/30/09
APPVD BY: M.W.	APPVD DATE:	05/14/09

WRS Infrastructure & Environment, Inc.
221 HOBBS STREET, SUITE 108, TAMPA, FLORIDA 33619
PH: (813) 684-4400 FAX: (813) 684-9177

NAVFAC

FIGURE 5
FINAL EXCAVATION SITE MAP
DRAFT PROJECT COMPLETION REPORT–
AVGAS PIPELINE – SECTION E
ENVIRONMENTAL MULTIPLE AWARD CONTRACT (EMAC)
NAS WHITING FIELD
MILTON, SANTA ROSA COUNTY, FLORIDA

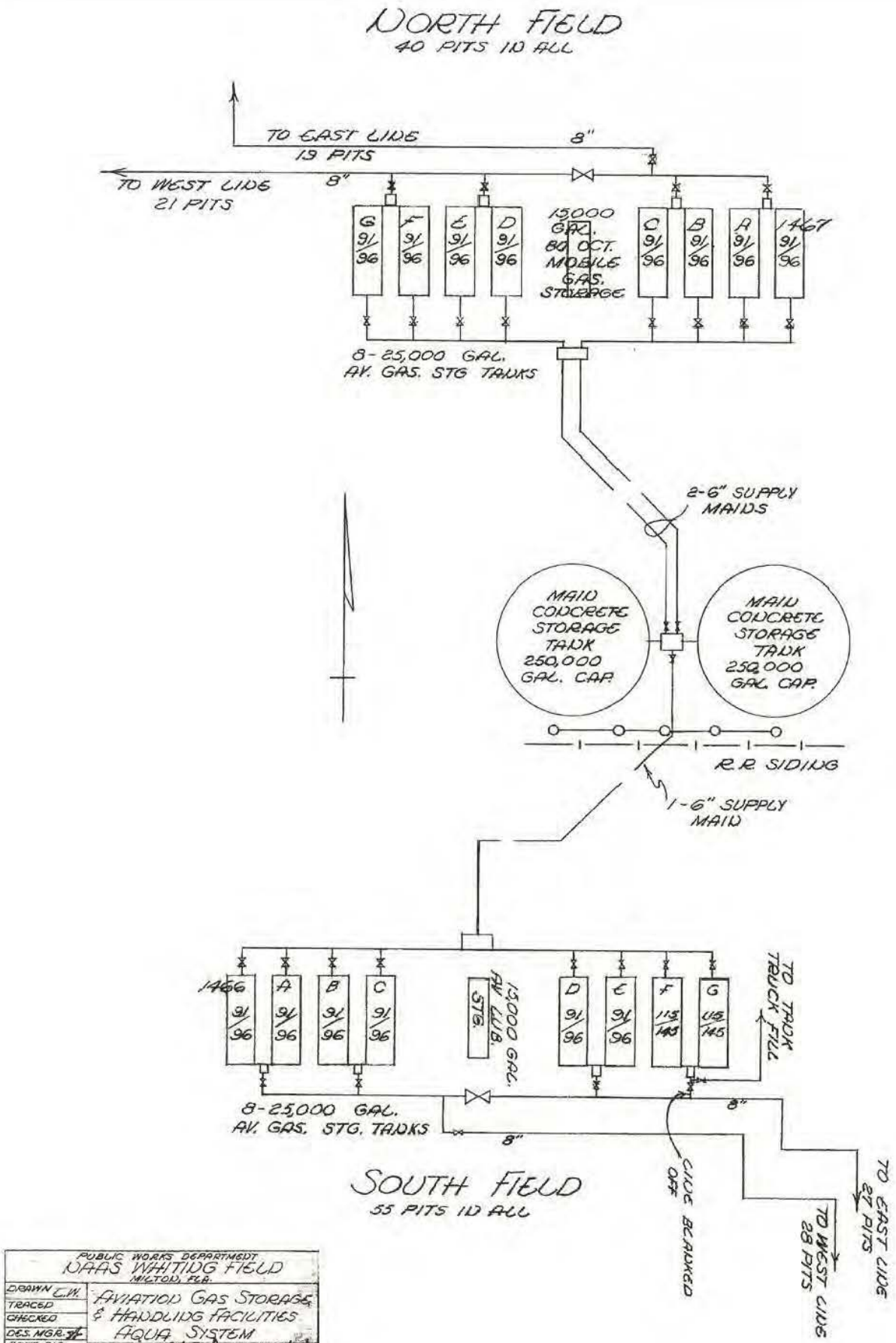


FIGURE 2-1
1955 Schematic of USTs
Site 4, NAS Whiting Field

CH2MHILL.

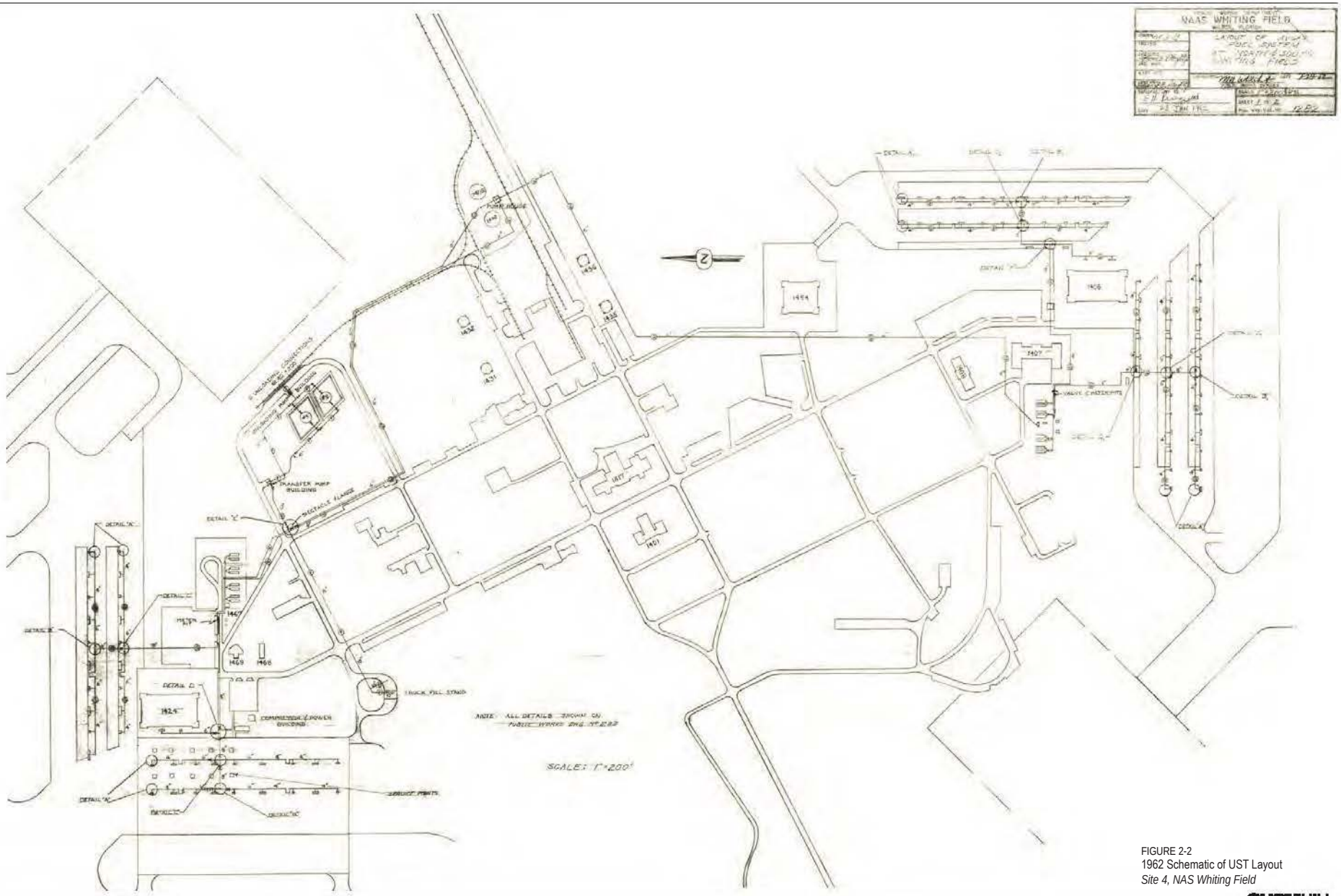


FIGURE 2-2
1962 Schematic of UST Layout
Site 4, NAS Whiting Field

CH2MHILL

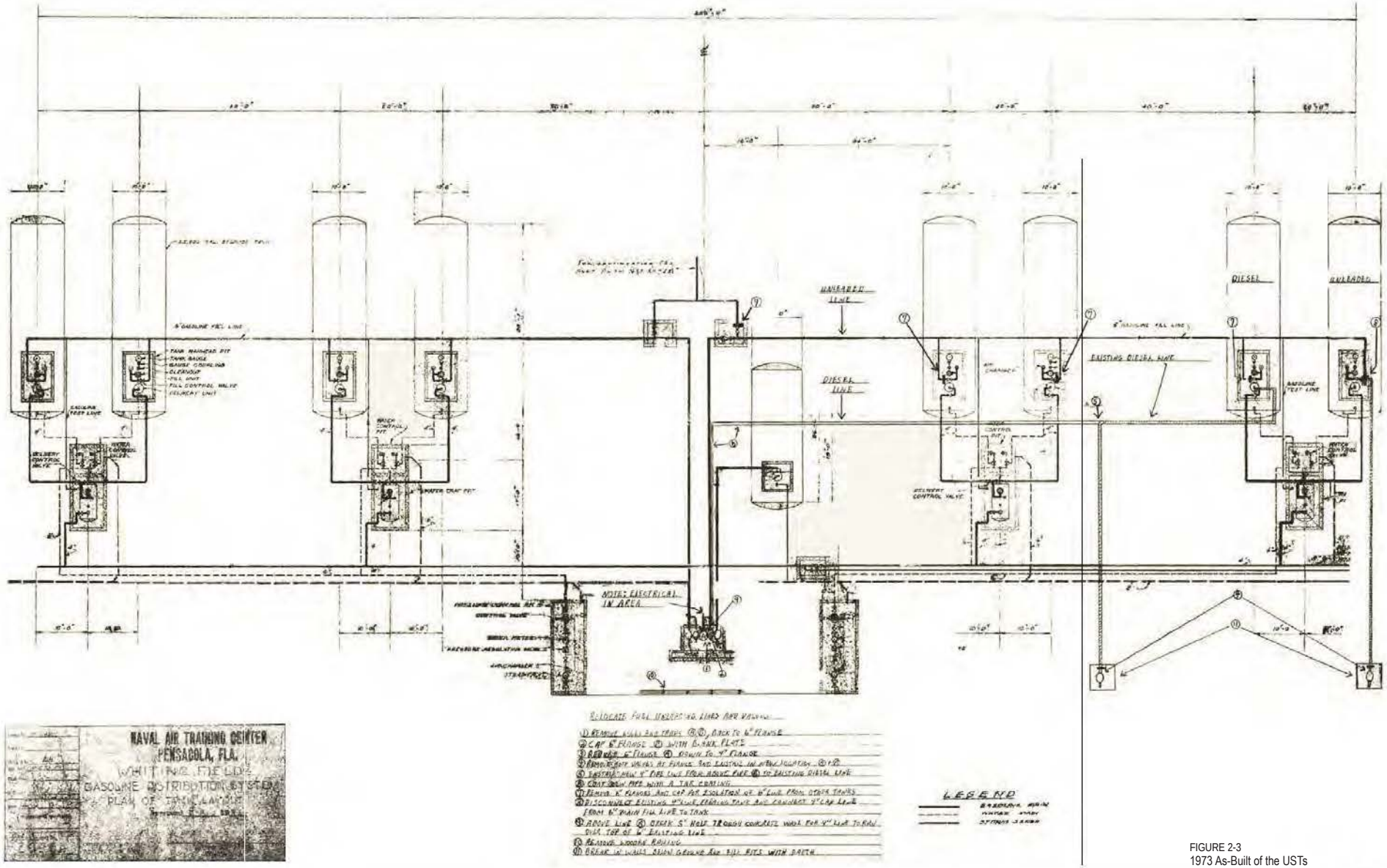
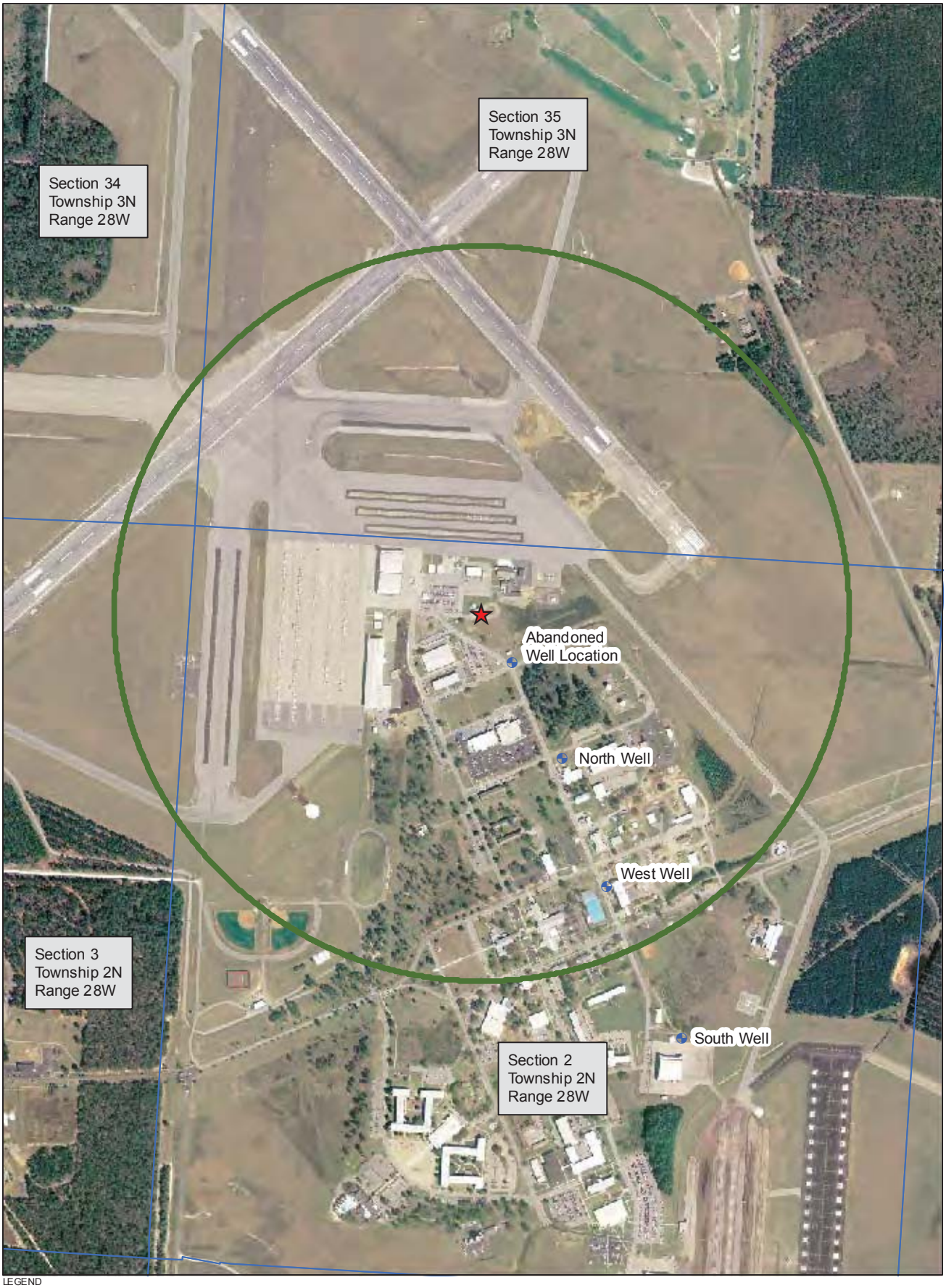


FIGURE 2-3
1973 As-Built of the USTs
Site 4, NAS Whiting Field

CH2MHILL.



LEGEND

- Public Supply Wells
- Whiting Site 4
- 1/2 Mile Site Buffer
- STR

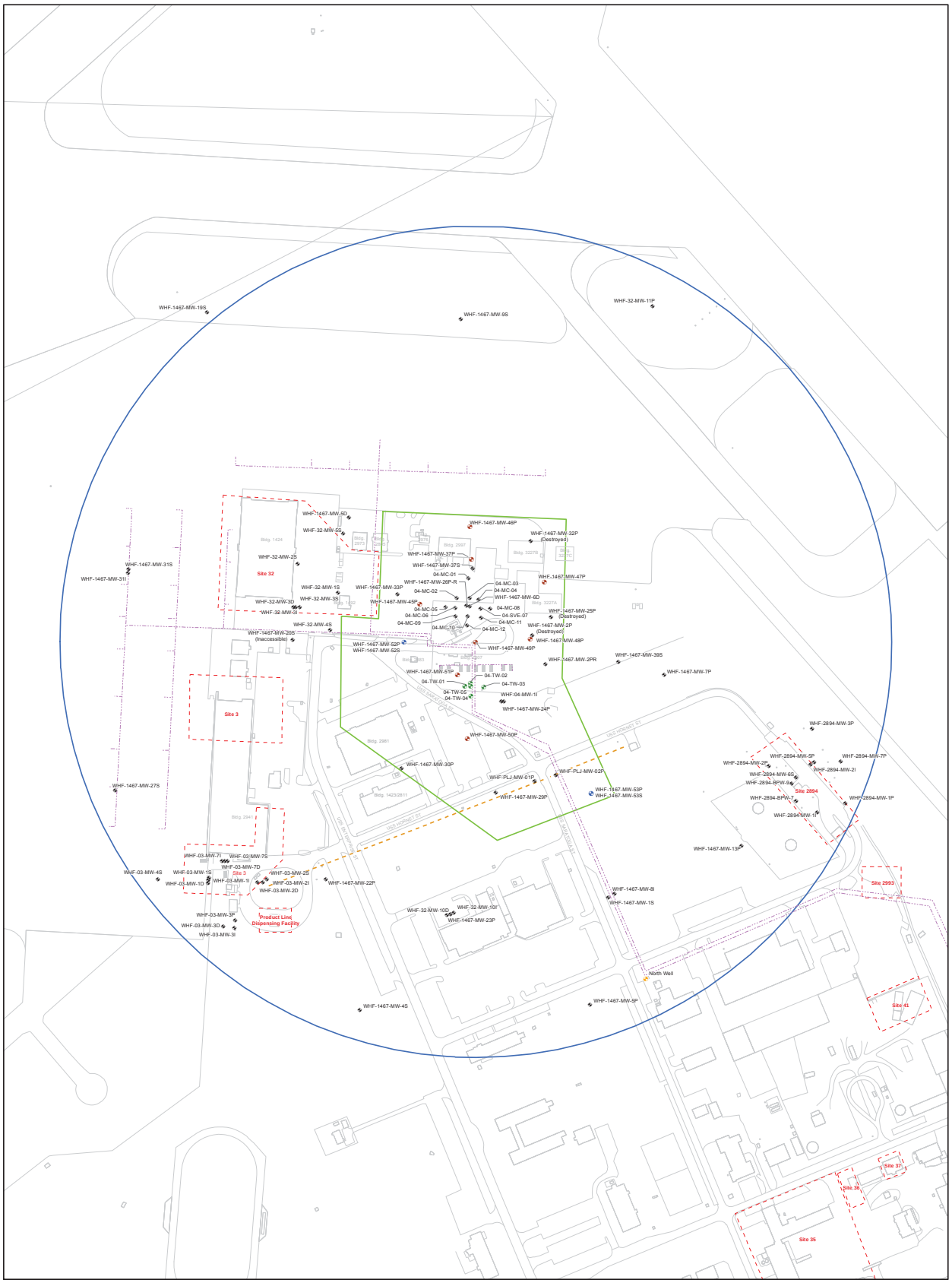
0 500 1,000
Feet

N

FIGURE 3-6
Public Supply Well Location Map
Site 4, NAS Whiting Field

CH2MHILL

GNV \\CYPRESS\PROJ\ENVIRONMENTAL\DRAWINGS\WHITING FIELD\FIGURE3-6 NAS WHITING FIELD SITE 4 BUFFER.MXD 02/8/2012



Legend

- 2011 Monitor Well
- Existing Monitor Well
- 2011 Multi Completion Well
- Treatment Well
- JP-5 Pipeline
- Fuel Pipeline Location
- Site 4 Boundary
- Quarter Mile Buffer
- IR Sites

0 300 600

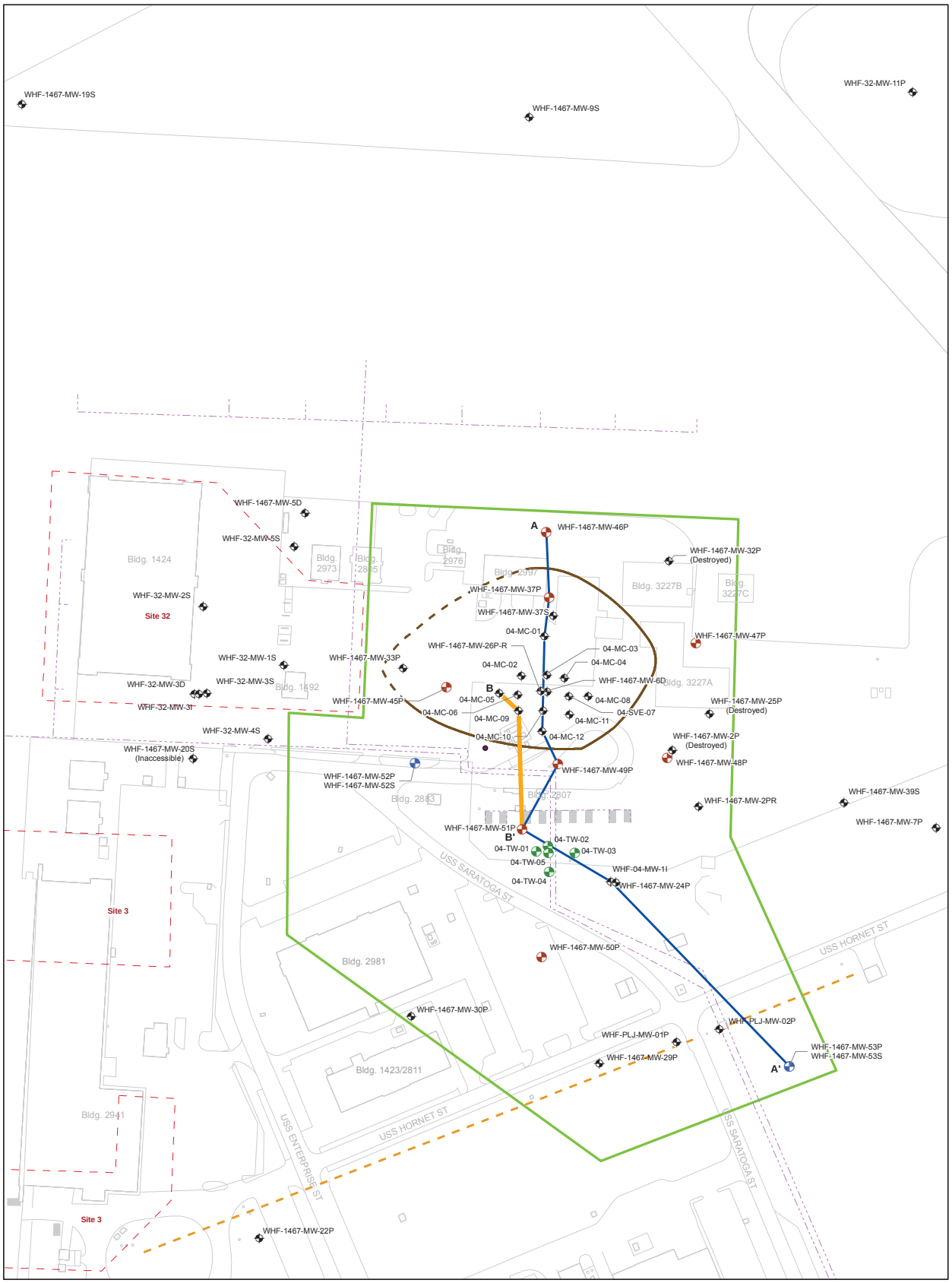
1" = 300'

N

FIGURE 3-7
Well Survey Map
Site 4, NAS Whiting Field

CH2MHILL

\\GAINESVILLE\PROJ\USNAVY\361476NASWHITINGFIEL\GIS\MAPFILES\20120127_FINAL\NASWF_FIGURE_3-7_WELLSURVEY_20120509_1_WCS.MXD WSWALES 5/9/2012 16:57:35



Legend

- 2011 Monitor Well
- Existing Monitor Well
- 2011 Multi Completion Well
- Treatment Well
- Lateral Extent Upper Clay
- JP-5 Pipeline
- Fuel Pipeline Location
- Site 4 Boundary
- IR Sites

N

0 150 300

1" = 150'

Note: Dashed Where Inferred

FIGURE 5-1
Cross Section Location Map
Site 4, NAS Whiting Field

CH2MHILL

\\GAINESVILLE\PROJ\USNAVY\361476NASWHITINGFIEL\GIS\MAPFILES\20120127_FINAL\NASWF_FIGURE_5-1_CROSSSECTIONLOCATION_20120127_1_WCS.MXD WSWALES 1/27/2012 13:05:50

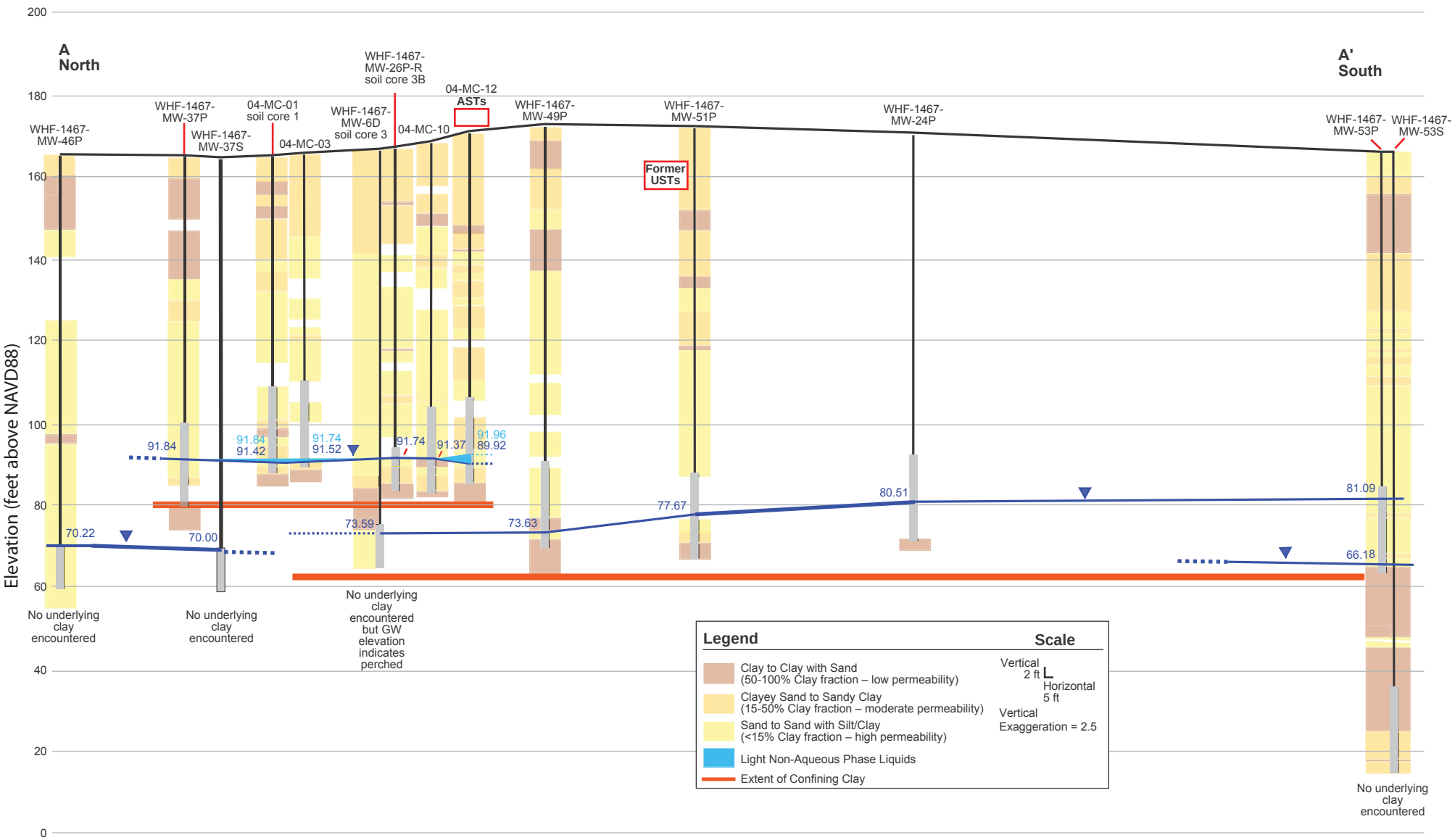
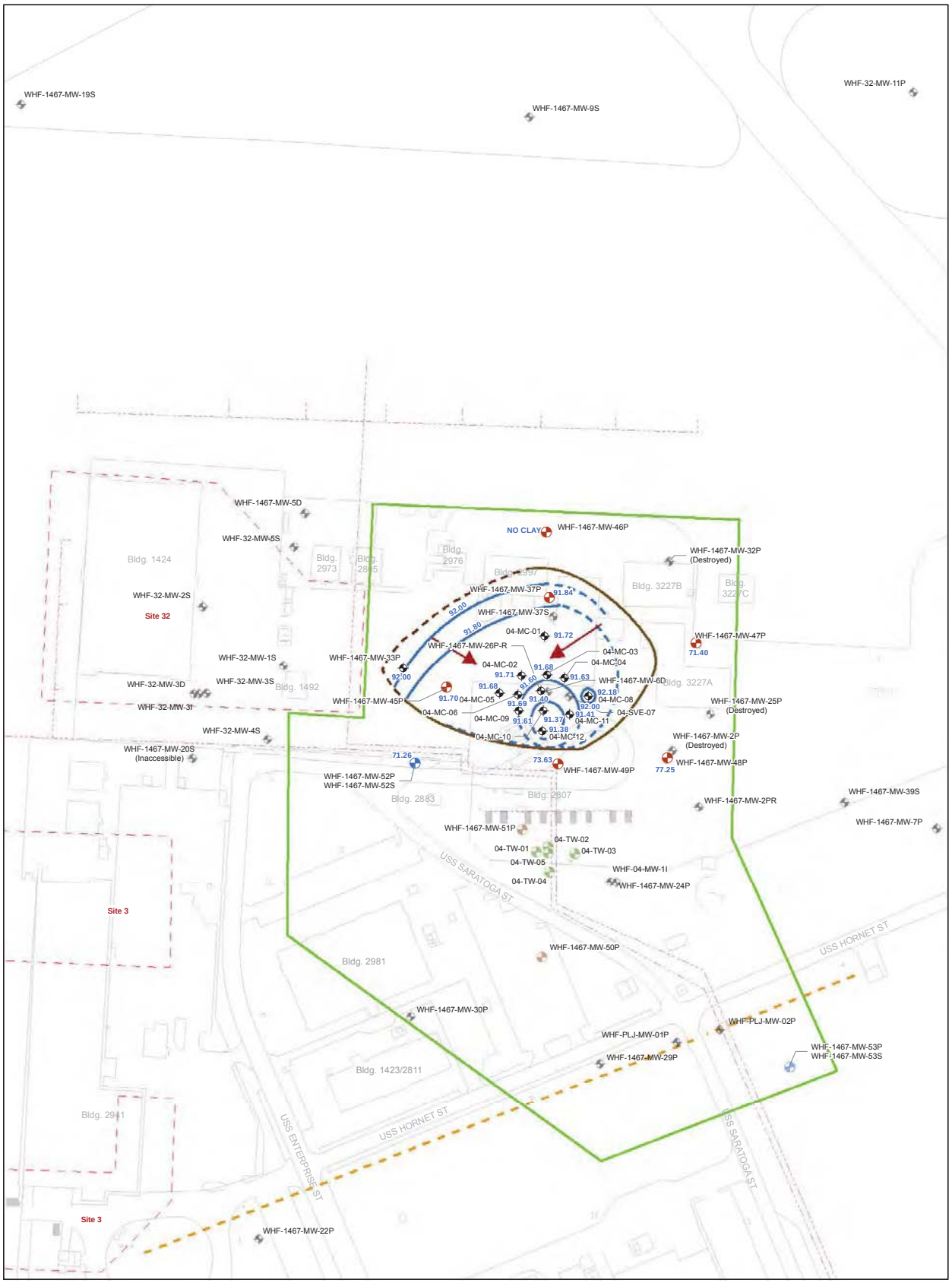


FIGURE 5-2
Section A-A' Groundwater Elevations
Site 4, NAS Whiting Field

CH2MHILL



Legend

- 2011 Monitor Well
- Existing Monitor Well
- 2011 Multi Completion Well
- Treatment Well
- Elevation Isocontour Line (68 Feet Above NAVD88)
- Lateral Extent Upper Clay
- Water Flow Direction
- 91 Elevation in Feet Above NAVD88

Note: Dashed where inferred

- JP-5 Pipeline
- Fuel Pipeline Location
- Site 4 Boundary
- IR Sites

0 150 300

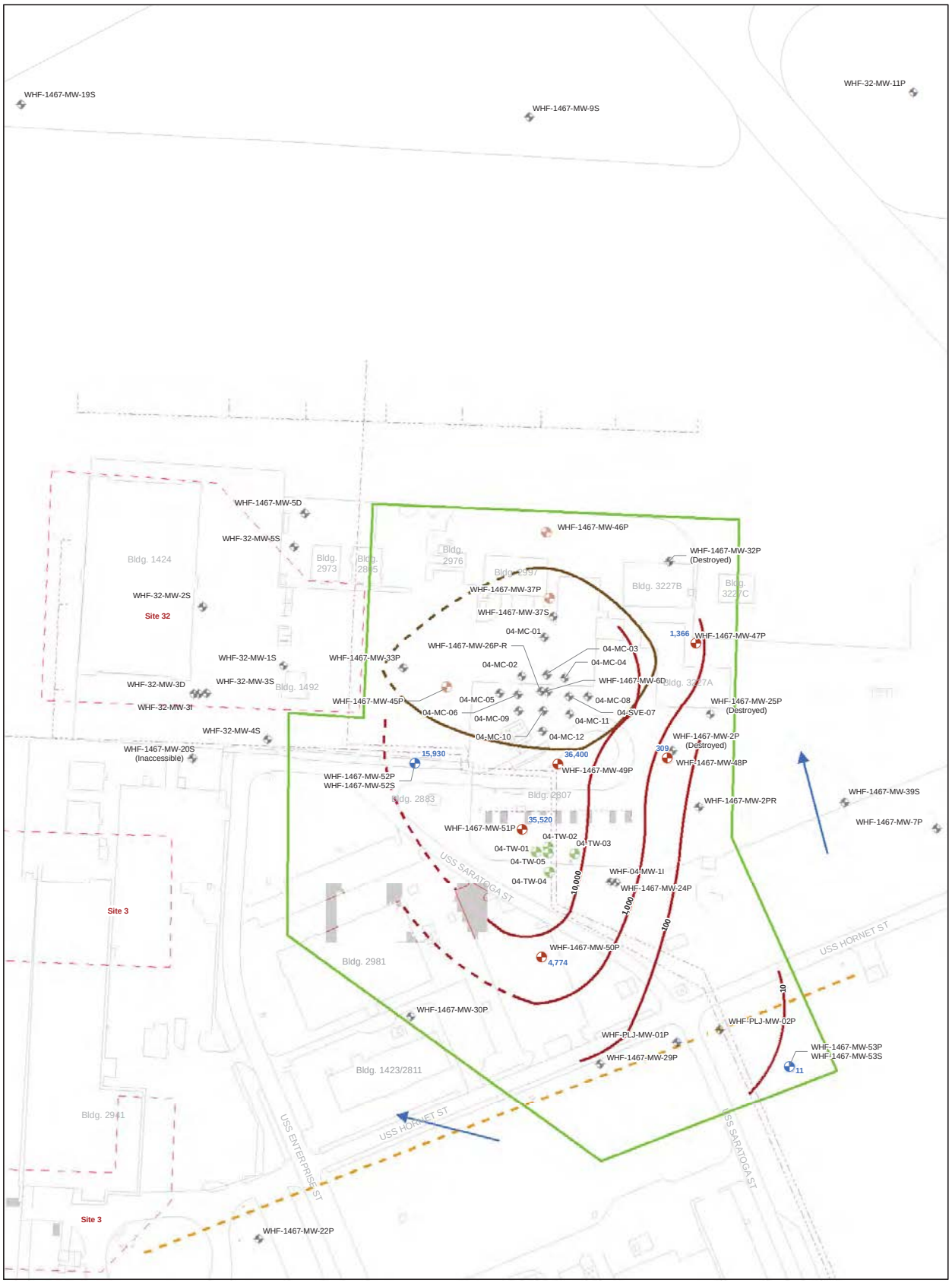
1" = 150'

N

FIGURE 5-4
Upper Perched Groundwater Contour Map
December 2, 2011
Site 4, NAS Whiting Field

CH2MHILL

\\GAINESVILLE\PROJ\USNAVY\361476NASWHITINGFIEL\GIS\MAPFILES\20120127_FINAL\NASWF_figure_5-4_UpperPerchedGroundwaterElevationMap_20120514_1_wcs WSWALES 2/16/2012 14:59:17



Legend

- 2011 Monitor Well
- Existing Monitor Well
- 2011 Multi Completion Well
- Treatment Well
- Isocontour Line
- Flow Direction
- 431 BTEX Concentration in µg/L
- Lateral Extent Upper Clay
- JP-5 Pipeline
- Fuel Pipeline Location
- IR Sites
- Site 4 Boundary

0 150 300

1" = 150'

N

Note: Dashed where inferred

FIGURE 6-11
BTEX Concentrations
in Lower Perched Groundwater
April / May 2011
Site 4, NAS Whiting Field

CH2MHILL

\\GAINESVILLE\PROJ\USNAVY\361476NASWHITINGFIEL\GIS\MAPFILES\20120127_FINAL\NASWF_FIGURE_6-11_BTEX_LOWER_20120508_1_WCS.MXD WSWALES 5/9/2012 16:02:00

Legend

- 2011 Monitor Well
- Existing Monitor Well
- 2011 Multi Completion Well
- Treatment Well
- Groundwater Flow Direction
- 431 BTEX Concentration in µg/L
- Lateral Extent Upper Clay
- JP-5 Pipeline
- Fuel Pipeline Location
- Site 4 Boundary
- Sites

N

0 150 300

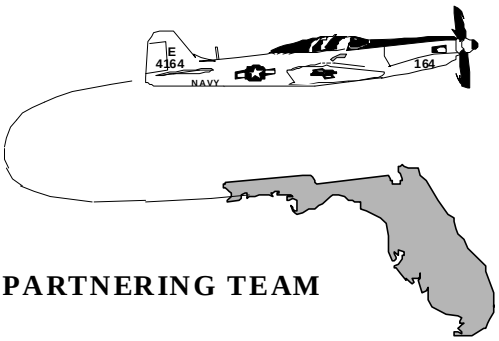
1" = 150'

FIGURE 6-12
BTEX Concentrations
in the Surficial Aquifer
April / May 2011
Site 4, NAS Whiting Field

CH2MHILL

\\GAINESVILLE\PROJ\USNAVY\361476NASWHITINGFIEL\GIS\MAPFILES\20120127_FINAL\NASWF_FIGURE_6-12_BTEX_SURFICIAL_20120508_1_WCS.MXD WSWALES 5/9/2012 16:03:24

NAS WHITING FIELD



PARTNERING TEAM

FINAL VIRTUAL MEETING MINUTES
AUGUST 28, 2013

Team Members Present:	Craig Benedikt (EPA) Alex Eddington (Resolution Consultants) Mike Jaynes (Tetra Tech) Arne Olsen (NAVFAC SE) Mike Pattison (NAS WF) – Timekeeper Amy Twitty (CH2M HILL) – Leader John Winters (FDEP) Kim Walker – Tier II Link Nancy Rouse (TME) – Facilitator Libby Claggett (Tetra Tech) – Scribe
Team Members Absent:	None
Guests:	None
Attachments:	1 – Tier II Response to Roles and Responsibilities for NAS Whiting Field

1. Check-In/Opening Remarks/Ground Rules Review

The meeting began at 8:00 a.m. Central Time (CT). The Team checked in and shared events since the last meeting.

The Team reviewed the ground rules and the May 2013 meeting plus/deltas.

Plus/Delta	
+ What went well?	Δ What could have been better?
SAP discussions (on board review)	Craig not at meeting
Worked out Craig's phone issues	Craig's phone went off line every 90 minutes
Craig did a good staying focused even though not physically at the meeting	

2. Minutes Approval

Team members reviewed the May 2013 meeting minutes.

Consensus Item: The May 2013 meeting minutes were approved as final.

3. Action Item/Parking Lot Review

The following action items were reviewed:

Action Items				
Action Item #	**Responsible Party**	**Status**	**Due Date**	**Action Item**
042611-05	Mike P.	Ongoing	Before the next meeting held at Whiting Field	Mike P. is to invite the new FEAD Director to the next Whiting Field Partnering Team meeting in Milton. **Update 02-2013:** The FEAD Director attended the last meeting. A new FEAD Director will be appointed in the near future; thus, this action item was left as ongoing. **Update 05-2013:** The FEAD Director will be transitioned in June. **Update 08-2013:** The new FEAD Director is on board and Mike P. will try to arrange a briefing at the next face-to-face meeting.
111312-03	Arne	Ongoing	11/21/2012	Arne is to create a responsibility matrix and distribute to Team members. **Update 05-2013:** Arne will review the Scopes of Works before creating the matrix. **Update 08-2013:** Arne plans to have this done by the next meeting.
022813-02	Helen	**Done**	03/19/2013	Helen is to report the comments received from the Whiting Field Team on the Roles and Responsibilities of Tier I Team members to Tier II. **Update 05-2013:** The next Tier II meeting is in June 2013. **Update 08-2013:** Tier II reviewed and discussed the Whiting Field comments.
051413-01	PMs	Ongoing	06/10/2013	Project Managers are to send Arne a copy of their Microsoft Project schedules for use in revising the Exit Strategy.
051413-02	Arne	Ongoing	05/15/2013	Arne is to send Mike J. the Aerostar document describing the details of the Thermox system at Site 7.
051413-03	Arne	**Done**	05/15/2013	Arne is to send the leachability model to John and Craig.
051413-04	Arne, Amy	**Done**	05/15/2013	Arne, Amy, and Hector are to discuss the path forward for the remedial system for Site 4. **Update 08-2013:** The development of the RAP is ongoing.
051413-05	Arne	**Done**	05/24/2013	Arne is to schedule scoping session to discuss the Site 40 source study and the off-site potable water well will be held between the Navy, Resolution Consultants, EPA, FDEP, and Tetra Tech on Tuesday, May 28, at 10:00 a.m. using GoToMeeting and send a sketch of the revised well location to Craig (by 05/16/2013).

4. Agenda Additions/Modifications

Team members reviewed the agenda and modifications were made accordingly.

5. Facility Update/Brief

There is a new public works officer, Lieutenant Alex Kuriatnyk. The new FEAD Director is Lieutenant Brad Pittman.

Staffing at the environmental office is down to three people. At the end of September, environmental support will not be in the BOSC contract; the BOSC contract is a 5-year contract and was awarded to EML.

The Paraloft building is complete, the Fuel Farm upgrade is underway, and the runway extension real estate contracts are almost completed and construction has started.

6. Tier II Update

Kim Walker, FDEP, is the new Tier II Link for NAS Whiting Field.

The last Tier II meeting was held June 19-20, 2013, in Jacksonville. Major topics of discussion included reorganization and funding updates, FDEP One Rule (Chapter 62-780), review Tier II goals, review Tier I Team reports (discussed Whiting Field Team Roles and Responsibilities comments), Key West Team presentation, Five-Year Review schedules, technical presentation on emerging contaminants, training, lessons learned from conference calls, Exit Strategy revision update, NIRIS/LUC Tracker training, and possible Tier I Team recognition. The next meeting is scheduled for September 18-19, 2013, in Jacksonville.

<u>Reorganization and Funding Updates</u>

<u>FDEP</u> – The district reorganization is done. Air and Waste have been combined into one group. Signature blocks will be changed, but is merely administrative in nature. Rule changes are being proposed. The one cleanup rule is done and is now all 62-780, which mostly stayed the same. Other rules changes will regard pre-approval costs and should not affect 62-780.

<u>EPA</u> – The Regional Administrator has left, and there is an acting Regional Administrator. Federal Facilities has a new Section Chief, Rachael McCullough. Debbie Vaughn-Wright is retiring at the end of July. Funding remains an issue within the branch and may impact the ability to review documents and provide permits. The regional oversight contract (ROC) expired, and the target date to issue a new ROC is November. Travel funding is confusing, and only funding for site travel is being used. Furloughs have begun. The EPA has officially backed out of oversight of the Redstone Arsenal (will not review documents, participate in meetings, etc.); the EPA will continue to work on the Five Year Reviews for Redstone.

<u>Navy</u> – Funding remains an issue. Limited travel is being approved, but needs to be planned far in advance. FY 13 project funding has been received for the Southeast area as originally planned. FY 14 levels are in good shape, but out years have not taken sequestration into account. The first furlough day is projected to be July 8; various people will be furloughed on various days, with a maximum of 11 furlough days. There are no new organization changes.

<u>BRAC</u> – Project funding was increased for execution. Furloughs have begun; BRAC will be limited to Mondays and Fridays for furlough days. Personnel are down approximately 50 percent with no plans to backfill the positions. The Southeast Director retired in January, thus, combining BRAC SE with the Northeast Division. BRAC SE will be moving offices to Joint Base Charleston.

Tier II Goals

The following Tier II goals for FY 2013 were reviewed at the June 2013 meeting:

Develop an appropriate submission (Lessons Learned) and review schedule for Five Year Reviews. **Ongoing**

Define the purpose and attributes of the Exit Strategy, revise the format, and distribute the information for Tier I implementation. **Ongoing**

Continue to develop contingencies for virtual meetings. **Ongoing**

Have the petroleum SMP Amendment submitted by August 1, 2013, and finalized by September 30, 2013. **Ongoing**

Consider response complete requirements in the revised Exit Strategy. **Ongoing**

Disseminate guidance on Tier I presentation formats. **Completed**

Complete guidance on raising Tier I issues to Tier II and disseminate to Tier I Teams. **Completed**

Five-Year Reviews

Resolution Consultants provided the following Five-Year Review table:

Florida Navy Installations
Last Updated: January 2, 2013

Installation	Team Exit Strategy – Next Five Year Review Due Date	EPA Database – Next Five Year Review Due Date
CECIL FIELD	4/12/2016	9/8/2016
CORRY STATION	NA	NA
NAS JACKSONVILLE	3/6/2015	9/29/2016
NAS KEY WEST	5/31/2014	NA
NS MAYPORT	NA	NA
NTC ORLANDO	12/1/2015	NA
NSA PANAMA CITY	NA	NA
NAS PENSACOLA	8/6/2013	9/28/2013
NAS SAUFLEY FIELD	NA	NA
NAS WHITING FIELD	9/29/2014	9/27/2016

Technical Presentation

Mike Singletary provided a presentation on emerging contaminants Perfluorinated Compounds (PFCs), Perfluorooctane Sulfonate (PFOS), and Perfluorooctanoic Acid (PFOA). Currently, there are no criteria for these contaminants.

Lessons Learned from Conference Calls

Positive
Can call in from almost anywhere (office, home, hotel)
Cost-effective

Negative

Telephone issues

- Speaker differences (one person loud, one person soft)
- Feedback (echoes on phones)
- Outside noises (not all phones on mute when someone else is speaking)

If a participant “drops” off the call, the rest of the Team may not know about it.

Using a cell phone as the main phone for the meeting room is not adequate. Need a dedicated land line in the conference room.

Cannot see others’ body language

Full day conference calls are too long.

Too easy to “zone out” and not pay attention if not with others

Outside distractions

- Other people in the office
- If at home, family, pets

Other Information

All Team members should have materials ahead of time.

- Maps, Charts
- Action Item List
- Presentations
- Document Schedule

Having the members that are located nearby meeting together in a conference room helps greatly.

Even when presentation materials are sent to Team member(s) not able to attend a face-to-face meeting, sometimes other figures/materials are presented during the meeting. This leaves the member(s) attending via telephone at a loss.

When giving a presentation via teleconference, need to state when changing pages (next slide). Even with participants having the presentation, if they do not know what page or slide the presenter is on, it can be challenging.

GoToMeeting seems to work for all parties (EPA, FDEP, Navy, Contractors).

Get better feedback on the minutes when the meeting is face-to-face versus teleconference because Team members are more engaged in the meeting and retaining information given at the meeting longer.

Team members discussed a web-cast versus a conference call. During a web-cast, participants can view documents, presentations, etc. during the meeting.

With Adobe Connect, multiple windows can be opened at the same time. It also has the functionality to use a web cam. The downfall to Adobe Connect is that it takes a lot of band width to run; there are two different band widths to choose from. According to the people who have used Adobe Connect, it is more interactive than GoToMeeting and keeps participants more engaged. All participants would need to be able to connect to the internet.

Live Meeting is very similar to GoToMeeting, but there have been issues with Navy and FDEP personnel not being able to log in and join the web-cast.

Web-casts are very beneficial to save money on travel for technical meetings with a mature team that functions well. They are also beneficial for collaborative-type meetings. Web-casts may not be good for teams that do not have trust or are new. Ground rules for web-casts should be created and followed. Team members also discussed optional equipment for web-casts (i.e., web cams, headsets).

NAS Whiting Field Comments to Team Members' Roles and Responsibilities

Tier II's response to the Whiting Field Team's comments on their Roles and Responsibilities is included as Attachment 1.

7. Navy RPM Update

The Navy is working on petroleum sites. The Site 7 Site Assessment Report (SAR) was sent to the FDEP. The soil vapor extraction (SVE) blower at Site 1438/1439 is broken. Resolution Consultants is working on several UFP-SAPs. The Navy is still working on a strategy to address UXO 1. Currently, the Navy's budget database (NORM) is not available to the RPMs; changes cannot be made at this time. During the transition from one FY to the next, the Navy is planning on conducting a geophysical investigation/removal action at UXO 2 to eliminate the site as soon as possible. The Whiting Boat Dock has been submitted to Navy Headquarters as a new site, but will not be able to be entered until NORM is back up and running. The OLF Barin Skeet Range has been submitted as a Munitions Response Program (MRP) site.

8. UXO 2 Sampling and Analysis Plan (SAP)

The dart Preliminary Assessment (PA) Report was submitted by Resolution Consultants to the EPA and FDEP for review on 23 July 2013. A scoping session will be conducted on 28 August 2013 for the Site Investigation (SI) UFP-SAP. Resolution Consultants anticipates submission of the draft SI UFP-SAP for regulatory review and comment by 21 October 2013, and anticipates initiation of SI field in February 2014.

The PA Report concluded there is a potential MEC (unspent flares or "duds") in the subsurface at the Flare Disposal Area. Based on the presence of flare casings at UXO 2, MC may be present in soil. The presence and extent of MC cannot be assessed until soil samples are collected and definitive laboratory data becomes available for evaluation. To facilitate SI soil sampling, MEC anomaly avoidance is required as a protective measure for the field team.

The project goals are to verify that anomalies and MEC-related hazards are not present at proposed, discrete soil sampling locations and to determine the presence of absence of MC-related contamination, if any, in soil to reduce uncertainty and prove the Navy's understanding of occurrence and spatial extent of MC contamination.

Craig suggested making the goal more general and to determine the presence or absence of any contamination. John asked why groundwater and surface water are not being sampled and stated that downgradient groundwater samples will be required. Alex stated that groundwater in this area is 100 to 110 feet bgs. Arne added that in the future, subsurface soil may be sampled to relate to leachability to groundwater. However, because of the Navy's SI protocols (explosive hazard), this participate study is limited to surface soil sampling. John requested to have Arne's statement added to the text of the document.

Craig asked if Resolution Consultants took into account erosion and deposition and is 6 inches enough to account for erosion and deposition over the years. Alex responded that proposed sampling locations were selected based on MEC avoidance. Arne agreed that future investigations will look into deposition and be sampled accordingly; however, to collect a sample at a greater depth, and Explosive Safety Submittal would be required; the investigation of deposition can be conducted during the removal action.

Sampling Design Approach: Based on the Conceptual Site Model (CSM), a combined sampling approach was selected including a primary systematic grid-based sampling approach with a judgmental component to bias select sampling locations towards areas where the highest probable contractions of MC are most likely.

Anomaly Avoidance: Upon determination that an area is free of anomalies, the UXO technician will communicate to the field team that it is safe to collect the soil sample. If potential MEC-related anomalies are identified, the proposed soil sampling location will be relocated to a nearby area free of anomalies that meets the intent of the sampling design.

Soil Information Input: Twenty-five surface soil samples will be collected from 0 to 0.5 foot bgs. Soil samples will be collected using disposable sampling equipment. Soil samples will be analyzed for hexachlorobenzene, perchlorate, nitrate, nitrite, sulfide, and strontium.

Per Arne, a non-time critical removal action will be conducted at UXO 2 as soon as possible.

9. Site 4 SAP

The areas of assessment in the Site 4 SAP include the North Field Fuel Distribution System, the northwestern portion of Site 4, and the pipeline junction area. The pipeline assessment will be for the fuel hydrants on the northern and western sides of Site 4 and all of the associates piping from the former UST distribution system leading out to the former hydrant areas. Findings will be presenting in the form of a Site Assessment Report (SAR) Addendum or a Remedial Action Plan (RAP) Addendum.

<u>North Field Fuel Distribution System</u>

Problem Statement: Uncertainties exist whether the abandoned, underground AVGAS pipeline and the former flight line fuel hydrants associated with the North Field Fuel Distribution System have contributed to Site 4 contamination.

Project Goal: Complete a SAR Addendum for the North Field Fuel Distribution System and the northwestern portion of Site 4.

Sampling Design Approach: Thirteen soil samples (plus QA/QC samples) will be submitted for definitive laboratory analysis, assuming corrected organic vapor analyzer (OVA) screening criteria will be exceeded at 10 percent of the 125 direct push technology (DPT) boring locations (advanced at 50-foot space to a depth of 10 feet along the Fuel Distribution Pipeline).

Alex noted that Site 40 work will be completed before the North Field Fuel Distribution System work begins.

<u>Northwestern Portion of Site 4</u>

Problem Statement: Uncertainty remains with respect to 1) the source of free phase hydrocarbons identified at Site 4, 2) how free phase hydrocarbons are migrating through the vadose zone into the upper perched aquifer, and 3) the interaction between the lower perch aquifer in the north-central area of Site 4 and the surficial aquifer.

Project Goal: Complete a SAR Addendum for the North Field Fuel Distribution System and the northwestern portion of Site 4.

Sampling Design Approach: DPT drilling with soil profiling tooling will be used to advance 10 soil borings for the purpose of characterizing soil and collecting soil and soil gas samples. Soil gas and soil samples will be collected from up to 11 depths (10-foot intervals) at each sampling location. An on-site laboratory will be used for soil gas screening for volatile organic compounds (VOCs) and total recoverable petroleum

hydrocarbons (TRPH). Ten percent of the soil gas and soil samples collected will be submitted to an ELAP-certified laboratory for confirmation analyses of VOCs using EPA method SW8260.

Ten new groundwater monitoring wells will be installed between 85 to 120 (is this correct?) feet bgs across the potentiometric surface of either the upper perched, lower perched, or surficial aquifers. Soil matrix samples will be collected, as needed, to define the nature and extent of soil contamination. An estimated 50 soil samples (plus QA/QC samples) will be collected for definitive laboratory analysis of Chapter 62-780, Florida Administrative Code (F.A.C.), Table C analytes plus isopropylbenzene and 1,4-dioxane analyses.

One complete round of depth-to-groundwater and depth-to-product measurements will be collected from Site 4 monitoring wells, including the newly-installed monitoring wells and selected Site 32 and Site 40 surficial aquifer monitoring wells surrounding Site 4. One full round of low-flow groundwater samples (including QA/QC) will be collected from the site monitoring wells for definitive laboratory analysis of Chapter 62-780, F.A.C., Table C analytes plus cis-1,2-dichloroethene and 1,4-dioxane analyses.

John asked if at a Manager's Meeting can Site 4 be discussed to keep up with work being performed (revise sentence please). Arne commented that a schedule will be developed and informational meetings will be held with the Partnering Team to discuss information collected at Site 4.

Pipeline Junction Area

Problem Statement: Uncertainties exist with respect to the current nature and extent of subsurface contamination associated with the abandoned pipeline junction due to the age of the existing assessment data (over 12 years old).

Project Goal: Complete a RAP Addendum for the Pipeline Junction Area.

Sampling Design Approach: DTP drilling with soil profiling tooling will be used to advance seven soil borings for the purpose of characterization of soil and collecting soil and soil gas samples. Soil gas and soil samples will be collected from up to 11 depths (10-foot intervals) at each sampling location for on-site laboratory soil gas screening for VOCs and TRPH. Ten percent of the soil gas and soil samples collected will be submitted to an ELAP-certified laboratory for confirmation analyses of VOCs using EPA Method SW8260.

Rotosonic drilling will be sued to advance 2 soil borings for monitoring well installation to remove uncertainties related to the interactions between the lower perched and surficial aquifers. Two new groundwater monitoring wells will be installed between 100 to 120 feet bgs with well screens placed to intersect the potentiometric surface of either the lower perched or surficial aquifers. An estimated 22 soil samples will be collected for on-site laboratory screening analysis of Chapter 62-780, F.A.C., Table C analytes plus isopropylbenzene and 1,4-diosane analyses.

Soil matrix samples will be collected, as needed to define the nature and extent of soil contamination. An estimated 33 soil samples will be collected for on-site laboratory screening with 10 percent of soil samples collected for definitive laboratory analysis per Chapter 62-780, F.A.C., Table C analytes plus isopropylbenzene and 1,4-dioxane analyses.

Upon soil gas monitoring implant completion, an estimated 33 soil gas samples (11 samples from each soil boring) will be collected and analyzed for select VOCs using EPA Method TO-15.

Action Item: Arne is to send the Battelle Tier II UFP-SAP to Team members.

10. MRP Sites Update

UXO 1 – Since the last meeting, CH2M HILL received analytical data, and more contamination was found. Upper Confidence Level (UCL) 95 was performed on the data collected to date, but the

excavation area was not significantly reduced; therefore, the areas will not be excavated to residential criteria. The removal tonnage was contracted at 1,400 tons. Removal to industrial would be 3,824 tons for the Gunnery Area and Skeet Range.

Currently, the Engineering Evaluation/Corrective Action (EE/CA) has the following four proposed alternatives:

Alternative 1: No Action
Alternative 2: Excavation to Residential Criteria, Offsite Disposal, and Backfill
Alternative 3: Excavation to Industrial Criteria, Offsite Disposal, Backfill, and Institutional Controls
Alternative 4: Excavation to Recreational Criteria, Offsite Disposal, Backfill, and Institutional Controls

Per Arne, other remedial alternatives will be investigated. Craig asked if the removal route is not intended, then why submit an EE/CA if a Remedial Investigation (RI)/Feasibility Study (FS) route will be required. Craig suggested putting efforts into conducting an RI and then reviewing the use scenarios and exposure assumption (when looking at the risk assessment). Information gathered for the EE/CA can be used in the FS. Arne agreed to the approach, but stated the Navy would need to re-program how the funds are allocated. Arne will discuss the Scope of Work for UXO 1 to perform an RI/FS instead of an EE/CA with Amy off-line.

11. Site 41 Update

Tetra Tech responded to comments on the CBI Work Plan for the excavation. The CBI Work Plan is in the process of being approved with field work currently scheduled to begin in November 2013. Other comments (from EPA) included adding more information to cover the gap between the ROD and the Work Plan. Craig stated he submitted his approval letter to the Navy; Arne will forward the letter to CBI. John stated he will get his approval letter to Arne by Friday. Per Arne, the Remedial Action Completion Report (RACR) should be out by April 2014, if not sooner.

12. Site 7 Update

Tetra Tech submitted the draft-final SAR for regulatory review last week (8/21/13). The SAR conclusions include a table of Proposed Alternative SCTLs for Soil at Site 7, which will also be proposed as the site remediation goals in the upcoming RAP, if there is agreement from FDEP. Currently waiting on Aerostar to fix the existing remedial system, including the addition of the catalytic oxidizer, and put it on line.

13. Site 39 Update

Resolution Consultants submitted the UFP-SAP for regulatory review and comment on 5 February 2013; conducted rep-sampling (rep-sampling?) reconnaissance to characterize the flood plain depositional environment along Clear Creek and select background study sample locations on 25 March 2013. FDEP comments to the UFP-SAP were received on 17 June 2013 (Craig stated he is working on his comment letter). It is anticipated implementation of field activities will begin in November 2013.

14. Site 40 Update

Per Kim, the FDEP comment letter on the draft-final Site 40 RI has been signed. In the last Manager's meeting, responding to EPA comments was discussed. In early September, the Managers will get together via conference call and discuss all comments for the Site 40 RI. The Navy is refining their assessment of the Mann-Kendall analysis.

Resolution Consults will issue the draft-final well installation UFP-SAP later this week. A response to comments letter will be included. Changes to the document will be highlighted for easier review.

Pending supplemental RI activities include monitoring well upgrades (3 new well nests at the NCA Plume and 3 new well nests at the SCA plume). Chemical and microbial groundwater data will be collected for

use in the Remedial Action Alternatives (RAA)/FS. Resolution Consultants anticipates initiating well installation and groundwater sampling on 14 October 2013 and submission of the draft RI Amendment Report on 21 April 2014.

The Contaminant Source Delineation Activities UFP-SAP is anticipated to be submitted on 30 August 2013 for Navy review. Resolution Consultants anticipates submitting the UFP-SAP for regulatory review in mid-October 2013, and initiation of field activities in January 2014.

15. UST Sites Update

Site 2894 – Resolution Consultants submitted the final Tier II UFP-SAP in July 2013. Field activities were initiated on 30 July 2013. Monitoring well redevelopment of sites wells (with no product observed in well MW-07) was conducted from 6 August to 8 August 2013. On 7 August 2013, the system startup was initiated, valve gaskets were replaced, and unfiltered and filtered FID readings were collected. Monitoring well sampling of site wells was conducted from 13 August to 16 August 2013, with no free product observed in well MW-07. The 1st weekly O&M was conducted 16 August 2013, and the 2nd weekly was conducted 21 August, 2013. Groundwater flow is consistent with what has been seen in the past.

By the next meeting, two rounds of gas samples will have been collected, and preliminary Remedial Process Optimization data will be ready to be presented.

John stated the FDEP acceptance letter for the final UFP-SAP is waiting for FDEP management signature. John asked for a quick turnaround on communication if the data show something significant and for a progress update on Site 2894. Alex anticipates having the data back by the next Partnering Team meeting.

Action Item: Arne is to coordinate Petroleum SMP update meetings with the Partnering Team.

Av Gas E (2832) – Resolution Consultants submitted the final SAP on 23 July 2013. The boring locations were relocated by the surveyor on 2 August 2013. Due to the large amount of rain received in July, the grass had overgrown the nubs. Fifteen CPT/MIP borings were completed from 6 August to 9 August 2013 and site monitoring wells were redeveloped on 9 August 2013. Site monitoring wells were sampled (including full round of depth-to-groundwater) from monitoring wells from 16 August to 19 August 2013.

Verification soil sampling is scheduled to be conducted from 3 September to 4 September 2013. Resolution Consultants anticipates completion of the remedial process optimization and RAA by February 2014 with submission of the draft RAP Amendment in May 2014.

Initial findings from the CPT/MIP indicate the minor adjustments need to be made to some of the borings (a second fiber optic line was installed). During groundwater monitoring and sampling, no indicates of grossly contaminated soils were observed. There was no indication of free phase hydrocarbons observed, and no discernible visual or olfactory observations indicating contamination were made.

Clean fill remains at Site 2832 that can be used at Site 1438/1439 to fill in ruts.

Site 1438/1439 – There is a belt that connects the electric motor to the blower on the SVE system. The belt breaks often. A system technician inspected the motor and compressor, and stated the motor did not sound good. The bearings are about to fail. As far as the compressor is concerned, there appears to be metal on metal contact. A new set of belts were installed, but the belts were damaged within a few minutes of operation. The system technician did not feel it was cost advantageous to fix the system and suggested purchasing a new system. A quote will be given to fix the system and then compared with replacing the system. Transition from an SVE system to a bioventing system will be considered.

16. Training

Nancy provided continued training on Crucial Conversations – Tools for Talking When Stakes are High (Part II). The training consisted of a presentation and discussion.

17. Facilitator Feedback/Meeting Accomplishments

Nancy emailed Team members a meeting evaluation form to be completed and returned to her. Nancy stated the format of the Whiting Field Virtual meetings is very effective. Alex's scoping presentations were very clear and easy to follow. The Site 4 discussion to include the entire Team was good. The UXO 1 discussion was great with points made about waiting about waiting until completion of the risk assessment and not performing the EE/CA. The sound quality was much better than on the last conference call. GoToMeeting worked well and Amy worked well as the meeting leader for a virtual meeting.

18. Meeting Closeout

Next Meeting: November 20 and 21, 2013
Leader: John Winters
Timekeeper: Amy Twitty
Scribe: Libby Claggett
Location: NAS Whiting Field

November 2013 Proposed Meeting Agenda			
Description	**Presenter**	**Time**	**Category/ Expectation**
Check-in, Opening Remarks, Resource Sharing, Announcements, Head Count, and Proxies	Leader	15 min	Sharing
Agenda Additions/Modifications	Leader	5 min	Decision
Ground Rules, Minutes Approval, Action Item Review, Parking Lot Review, and Review Plus/Deltas from Previous Meeting	Leader	15 min	Review
UST Sites Update Site 2894 Site 1438/1439 Av Gas E	Alex Arne	30 min	Information
MRP Sites Update UXO 1 UXO 2	Amy Alex	60 min	Information
Training (Communications Part III)	Nancy	30 min	Learning
Facility Update/Brief	Mike P.	5 min	Information
Tier II Update	Kim	10 min	Information
Navy RPM Update	Arne	15 min	Information
Site 4 Update	Amy	30 min	Information
Site 7 Update	Mike J.	15 min	Information
Site 39 Update	Alex	15 min	Information
Site 40 Update	Alex	15 min	Information
Site 41 Update	Mike J.	15 min	Information
Closeout: Review Action Items, Review Consensus Items Review Parking Lot, Set Future Meeting Date(s), and Plan Next Meeting Agenda Review Plus/Deltas	Team	30 min	Planning
Facilitator Feedback/Meeting Accomplishments	Nancy	10 min	Information

Future Meeting Dates

Dates	Location
NEED TO SET DATES AT THE NOVEMBER 2013 MEETING	

Plus/Delta	
+ What went well?	Δ What could have been better?
GoToMeeting worked very well	Some members confused about meeting start time (different time zones involved)
Completed agenda ahead of time	GoToMeeting start time was different
Improved sound quality on phones	Did not get to formally say goodbye to Rich or formally induct Kim onto the Team
Good direction on path forward for UXO 1	
Path and vision for Whiting Field becoming more clear to all parties – moving to a common understanding of the direction of all projects	

Action Items				
Action Item #	**Responsible Party**	**Status**	**Due Date**	**Action Item**
042611-05	Mike P.	Ongoing	Before the next meeting held at Whiting Field	Mike P. is to invite the new FEAD Director to the next Whiting Field Partnering Team meeting in Milton. **Update 02-2013:** The FEAD Director attended the last meeting. A new FEAD Director will be appointed in the near future; thus, this action item was left as ongoing. **Update 05-2013:** The FEAD Director will be transitioned in June. **Update 08-2013:** The new FEAD Director is on board and Mike P. will try to arrange a briefing at the next face-to-face meeting.
111312-03	Arne	Ongoing	11/21/2012	Arne is to create a responsibility matrix and distribute to Team members. **Update 05-2013:** Arne will review the Scopes of Works before creating the matrix. **Update 08-2013:** Arne plans to have this done by the next meeting.
022813-02	Helen	**Done**	03/19/2013	Helen is to report the comments received from the Whiting Field Team on the Roles and Responsibilities of Tier I Team members to Tier II. **Update 05-2013:** The next Tier II meeting is in June 2013. **Update 08-2013:** Tier II reviewed and discussed the Whiting Field comments.
051413-01	PMs	Ongoing	06/10/2013	Project Managers are to send Arne a copy of their Microsoft Project schedules for use in revising the Exit Strategy.
051413-02	Arne	Ongoing	05/15/2013	Arne is to send Mike J. the Aerostar document describing the details of the Thermox system at Site 7.
051413-03	Arne	**Done**	05/15/2013	Arne is to send the leachability model to John and Craig.

Action Items				
Action Item #	**Responsible Party**	**Status**	**Due Date**	**Action Item**
051413-04	Arne, Amy	**Done**	05/15/2013	Arne, Amy, and Hector are to discuss the path forward for the remedial system for Site 4. **Update 08-2013:** The development of the RAP is ongoing.
051413-05	Arne	**Done**	05/24/2013	Arne is to schedule scoping session to discuss the Site 40 source study and the off-site potable water well will be held between the Navy, Resolution Consultants, EPA, FDEP, and Tetra Tech on Tuesday, May 28, at 10:00 a.m. using Go-to-Meeting and send a sketch of the revised well location to Craig (by 05/16/2013).
082813-01	Arne		08/29/2013	Arne is to send the Battelle Tier II UFP-SAP to Team members.
082813-02	Arne		09/10/2013	Arne is to coordinate Petroleum SMP update meetings with the Partnering Team.

Consensus Items	
Consensus Number	**Consensus Item**
020111-01	The October 2010 meeting minutes were approved.
020111-02	The Team reached consensus to withhold approval of the October 2010 meeting minutes pending an FDEP review.
042611-01	The February 2011 meeting minutes were approved as final.
080211-01	The October 2010 meeting minutes with minor changes were approved as final.
080211-02	The April 2011 meeting minutes with minor changes were approved as final.
101811-01	The August 2011 meeting minutes were approved as final with minor changes.
101811-02	The Team reached consensus that the Site 4 soil boundary will be based on data collected in May 2011 and will be presented in the SAR with an explanation.
013112-01	The October 2011 meeting minutes were approved as final with minor changes.
013112-02	Team members reached consensus to the changes on the Team Charter.
013112-03	The Team reached consensus on the modified ground rules.
042512-01	The January 2012 meeting minutes were approved as final with minor changes.
042512-02	The Team reached consensus on the modified ground rules and meeting conduct.
111312-01	The April 2012 meeting minutes were approved as final.
022813-01	The November 2012 meeting minutes were approved as final.
051413-01	The February 2013 meeting minutes were approved as final.
051413-02	The Team reached consensus to request Tier II to use Go-to-Meeting as the formal protocol for virtual meetings.
082813-01	The May 2013 meeting minutes were approved as final.

Parking Lot		
Item Number	**Status**	**Parking Lot Issue**
14	**Done, but keep on parking lot until the RI is finished**	Information for consideration/incorporation during the Site 40 Investigation: Add site visit information to Site 40 RI: In response to EPA's request for a downgradient well at Site 12, a 31 May 00 site visit determined no additional wells were needed. Monitoring well 12-1 was incorrectly plotted on existing maps. In its actual location as observed in the field, this well is an adequate downgradient monitoring well. Tetra Tech will include this information in the Site 40 RI. As part of Site 40 documentation, Tetra Tech will also consider leachability concerns at Site 16 as well as Sites 4, 7, 30, 32, and 35. Check UST groundwater data for inclusion in the Site 40 RI. Tetra Tech will coordinate with FDEP on evaluating sites for "common inorganics" to determine if SPLP samples need to be taken. Groundwater at two UST sites, the pipeline junction site and the oil/water separator, should be included in the Site 40 RI.
013112-01	Until the Revised Exit Strategy is finished	Arne is to review and update the Exit Strategy before the Team meeting. **Update 08-2013:** Arne is planning to have the revised Exit Strategy finished by the end of next week. All project schedules need to be sent to Arne as soon as possible.

RESPONSIBILITIES OF ALL TIER I TEAM MEMBERS: (NAVFAC SE)

1. Identify remedies following the applicable Federal and State regulatory requirements
2. Orient new team members
3. Help identify stakeholders
4. Identify sites
5. Listen and attempt to understand other parties' goals, needs, priorities, issues, etc.
6. Represent the concerns, policies, and guidance of your organization
7. Provide a dedicated core project team member
8. Attend team meetings
9. Host meetings as assigned
10. Actively participate in team/partnering
11. Review work products
12. Provide approval and concurrence within the limits of your empowerment or provide justification of why you cannot.
13. Understand the boundaries and levels of empowerment of team members and organizations
14. Share all existing information to the extent practical, including resources
15. Establish Team priorities for operational, technical, and cleanup issues
16. Address stakeholder concerns
17. Be knowledgeable of innovative and green and sustainable remediation cleanup technologies and incorporate into plan
18. Find ways to keep work on schedule
19. Maintain regular contact with team members
20. Resolve conflict at the lowest level possible
21. Elevate unresolvable conflicts or impasses to Tier II with a problem statement developed by the Team
22. Be knowledgeable and maintain compliance with regulations
23. Implement cost-effective remedies that comply with regulatory requirements
24. Ensure remedies are protective of public health, welfare, and the environment
25. Incorporate risk management principles in decision making
26. Participate in preparing decision documents
27. Advise team of agency regulations, guidances, policies, and SOPs
28. Promote technology transfer
29. Transfer and document successes and lessons learned
30. Implement quality improvements such as the UFP-SAP process
31. Optimize sampling and analysis so that data collection meets requirements
32. Continuously strive to become a higher performing team

RESPONSIBILITIES OF THE TIER I STATE RPM/EPA RPM: (NAVFAC SE)

1. Coordinate and prepare comments on documents
2. Advise team members of upcoming regulatory changes to allow effective implementation of those changes
3. Review and identify ARARs
4. Review documents in a timely manner within defined schedules, or request additional time as required by FFAs, SMPs, Petroleum SMP Amendments, and CAMPs
5. Review regulatory compliance status and conduct enforcement
6. Assist in preparing decision documents
7. Approve/disapprove primary documents in a timely manner as required by FFAs
8. Draft permits and agreements
9. Provide technical oversight and support
10. Resolve issues or concerns within the department or agency and outside the agency where it might impact cleanup (e.g., EPA HQs, DOD HQs, Congressional, GAO, OIG, etc.)
11. Maintain documents
12. Assist Navy to comply with applicable Federal and State regulatory requirements
13. Determine applicability of regulations
14. Represents the team to coordinate with other regulatory programs and agencies (e.g., state, county)
15. Oversee technical assistance contractors
16. Support community relations
17. Review and oversight of petroleum cleanup (FDEP)
18. Meet DSMOA commitments (FDEP)
19. Provide information in to RCRIS and/or CERCLIS data management systems
20. Review and oversight of state authorized programs (FDEP)
21. ~~Provide program and technical training~~
212. Attend RAB meetings or appoint proxy when unable to attend
223. Provide leadership on policy issue resolution through informal and formal dispute processes following the FFAs or applicable process
243. Assist in resolution of permitting concerns and issues
245. Request extensions per approved FFA agreements or applicable process
256. Follow agency procedures to obtain agency concurrence where required
267. Understand your boundaries and level of empowerment, and seek appropriate agency approvals for decisions when outside level of empowerment

Comment [LC1]: RCRIS does not apply to Whiting Field.

Comment [LC2]: Tier II agreed to this change – 06/19/2013

Comment [LC3]: Not appropriate for Tier I level to provide training.

Comment [LC4]: Tier II suggested rewording to "Provide/coordinate program and technical updates"

RESPONSIBILITIES OF THE TIER I NAVY REPRESENTATIVES: (NAVFAC SE)

1. Maintain the administrative record
2. Provide contract administration
3. Manage ER,N/BRAC program (budgeting)
4. Manage and oversee contractor
5. Provide responsive technical support and coordinate legal support to the Installation
6. Coordinate with the Installation and bring operational concerns/requirements to the team
7. Assist the Installation in community relations
8. Coordinate involvement of team in NAVFAC budget process
9. Manage IDW
10. Solicit and respond to comments
11. Keep chain of command informed
12. Coordinate with other Navy RPMs
13. Keep the work on schedule
14. Have contractor prepare plans and documents and distribute for Navy review for accuracy and correctness prior to submittal to the regulators
15. Implement team's decision through Navy contracts or in-house efforts
16. Take the lead in facilitating team communication
17. Develop and maintain the SMP and submit to regulatory agencies in a timely manner
18. Determine ER,N/BRAC eligibility
19. Ensure compliance with applicable Federal and State regulatory requirements
20. Ensure decision documents are prepared
21. Communicate the execution plan to Team members on a regular basis
22. Respond to inquiries on hazardous waste sites
23. Ensure the Decision Document is implemented
24. Ensure and document site closeout
25. Upload information to and maintain the NIRIS and NORM databases
26. Implement Navy policy and guidance
27. Ensure field oversight of contractor efforts
28. Ensure compliance with applicable permits, Federal Facilities Agreements, and other applicable agreements
29. Request extensions per FFA or applicable process
30. Co-chair the RAB

Comment [LC5]: The Whiting Field RAB Charter has the FDEP and USEPA as co-chairs on the RAB. However, the Whiting Field RAB is inactive.

Comment [LC6]: Per Tier II, it is Navy policy that Navy RPM is one of the co-chairs of the RAB. The responsibility remains.

RESPONSIBILITIES OF THE TIER I CONTRACTOR: (NAVFAC SE)

1. Conduct fieldwork and prepare work products as directed by the Navy in a cost-effective, timely manner ensuring adequacy and completeness and meeting regulatory requirements
2. Suggest technical ways to meet customer and regulator's requirements
3. Advise of ways to do work cheaper, better, and faster while meeting regulator's requirements
4. Maintain cost and schedule control
5. Advise the Navy RPM of schedule changes
6. Provide recommendations to the Navy RPM to maintain schedule integrity
7. Notify the Navy RPM when assigned tasks will not meet goals
8. Coordinate with Navy RPM regarding field changes
9. Ensure qualified people are on the project at all times
10. Focus work to support decision-making
11. Be responsive to the Navy
12. Ensure QA/QC on all products meets applicable Federal and State regulatory requirements
13. Keep Installation informed of conditions that affect Installation operations
14. Maintain access to adequate technical expertise
15. Keep team members informed of status of contractor project work
16. Provide adequate quantity and quality of field equipment
17. Maximize use of all existing data and information
18. Be knowledgeable and willing to use latest techniques
19. Respond to changes rapidly with minimum disruption
20. Coordinate with their subcontractors and PMs
21. Assist in planning and execution of program
22. Implement team decisions as directed by the Navy
23. Develop and implement site safety plan ~~(accident prevention plan)~~, and report any safety issues immediately, to include subcontractors
24. Be knowledgeable of regulations and guidance of DOD, EPA, and FDEP
25. Cooperate with regulator's oversight during fieldwork
26. Fully coordinate fieldwork with Installation and NTR prior to entering the Installation
27. Monitor subcontractors
28. Advise team of economic and technical impact of Team recommendations

Comment [LC7]: The APP is part of the safety plan and does not need to be called out.

Comment [LC8]: Per Tier II, APP can be deleted.

EXPECTATIONS OF THE TIER I PROJECT TEAM: (NAVFAC SE)

1. Work as a team to overcome challenges
2. Seek opportunities to accelerate remedies while managing risks
3. Achieve objectives in Charter
4. Keep projects moving forward
5. Maintain open and honest communication
6. Identify and use best talents on the team to accomplish goals
7. Facilitate and assist other team members in accomplishing their goals
8. Accept and execute roles and responsibilities
9. Seek solutions that all team members can support
10. Be self-motivated
11. Share successes and failures
12. Be decisive and innovative
13. Be flexible
14. Be professional
15. Think short- and long-term
16. Ensure regulatory compliance
17. Work collaboratively
18. Make decisions by consensus
19. Use Partnering processes and tools
20. Aim to have award winning projects

Comment [LC9]: More clarification needs to be included – pie in the sky – ambiguous. Whose awards? Why do projects need to be award winning?

Comment [LC10]: Per Tier II, the comment was discussed; however the responsibility remains. It is CNO policy to work toward award-winning projects.

For informational purposes, Tier II has the following clarification for Item 20:

If a Team is functioning effectively, award-winning projects should be one of many elements the Team focuses on.

Regarding “whose” awards: any – Navy, State, Brownfields, any other third party.

APPENDIX C

STANDARD OPERATING PROCEDURES
(PROVIDED ELECTRONICALLY ONLY)

EPA

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Global Positioning System**

Effective Date: April 20, 2011	**Number:** SESDPROC-110-R3

Authors

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-110-R3, *Global Positioning System*, replaces SESDPROC-110-R2 **Cover Page:** The EIB Branch Chief was changed from Antonio Quinones to Archie Lee. The FQM was changed from Laura Ackerman to Liza Montalvo. **Revision History:** Changed Field Quality Manager to Document Control Coordinator. **Section 1.2:** Added the following statement: Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use. **Section 1.3:** Omitted the reference to the H: drive of the LAN. Changed Field Quality Manager to Document Control Coordinator.	April 20, 2011
SESDPROC-110-R2, *Global Positioning System*, replaces SESDPROC-110-R01 **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove‟s title from Acting Chief to Chief. **Section 1.4** Alphabetized and added a reference.	November 1, 2007
SESDPROC-110-R1, *Global Positioning System*, replaces SESDPROC-110-R0 This revision reflects the following changes: **General** Extensive rewrite with additional information added to most sections. Brian Striggow added as coauthor. **Section 2.1** Rewritten description of GPS system. Descriptions of "GPS Accuracy Factors" and "Differential GPS" isolated as separate subsections.	October 1, 2007

Section 2.2 This Section, titled "Requirements for Locational Information" inserted. Supplies guidance on accuracy requirements for various study types and potential means used to obtain requisite accuracy. Subsection on datums and data formats included. **Section 2.3** "Quality Control Procedures", previously numbered as Section 2.2. Most information in this section moved to Section 2.1 discussion of Accuracy Factors and Section 2.4 discussion of specific receivers. Explicit statement added that no specific GPS quality control procedures are required for most SESD studies. **Section 2.4** Information added to sections on Trimble and Garmin receivers. **Section 2.5** Issue of electronic data-logging addressed. Storage of electronic data records addressed.	
SESDPROC-110-R0, Global Positioning System, Original Issue	March 22, 2007

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Contents

1 General Information

1.1 Purpose

This document describes the Global Positioning System (GPS) and procedures, methods and considerations to be used and observed when using GPS to record location data in the field. Guidance is provided on accuracy requirements for various uses of location data and potential means to obtain the requisite accuracy. This document contains direction developed solely to provide internal guidance to SESD employees.

1.2 Scope/Application

The procedures contained in this document are to be used by SESD field investigators when using the Global Positioning System to obtain the geographical coordinates of sampling locations and/or measurements during field investigations. In SESD investigations, GPS is the preferred means of collecting horizontal location information. In most cases the accuracy of GPS is unsuitable for collection of elevation data.

On the occasion that SESD field personnel determine that any of the procedures described in this section cannot be used to obtain the required coordinate information and alternate procedures are employed, the alternate procedure will be documented in the field log book, along with a description of the circumstances requiring its use. GPS users must be currently qualified as proficient in the operation of the specific GPS equipment to be used. The manufacturer"s operation manuals should be used for detailed information on the use of specific GPS equipment. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

Rand Corporation, The Global Positioning System, Assessing National Policies, Appendix B, GPS History, Chronology, and Budgets, 1995.

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version.

Trimble® Navigation Limited, Mapping Systems General Reference, Revision B, 1996.

USEPA, Global Position Systems – Technical Implementation Guidance, Office of Environmental Information (EPA/250/R-03/001), 2003.

USEPA, GIS Technical Memorandum 3. Global Positioning Systems – Technology and It"s Application in Environmental Programs, Research and Development (PM-225). EPA/600/R-92/036, 1992.

USEPA, Locational Data Policy, Office of Information Resources Management, IRM Policy Manual 2100 Chapter 13, 1991.

2 Methodology

2.1 General

2.1.1 GPS Description

The Navigation Satellite Time and Ranging (NAVSTAR) Global Positioning System (GPS) is a worldwide radio-navigation system created by the U. S. Department of Defense (DOD) to provide navigation, location, and timing information for military operations. System testing using a limited number of satellites began in 1978 with the system being declared fully operational in 1995. The system was declared available for civilian uses in the 1980s and has seen burgeoning civilian application for navigation and mapping.

The GPS system consists of three basic elements: the space segment, control segment, and user segment. The space segment consists of the constellation of up to 24 active NAVSTAR satellites in six orbital tracks. The satellites are not in geo-synchronous orbit and are in constant motion relative to a ground user. The control segment consists of several ground stations that serve as uplinks to the satellites and that make adjustments to satellite orbits and clocks when necessary. The user segment consists of the GPS receiver which will typically consist of an antenna, multi-channel receiver, and processing unit.

For the purposes of this document, the user segment GPS receivers may be loosely grouped into Recreational and Navigational receivers (henceforth referred to as General Use receivers), Mapping Grade receivers, and Survey Grade receivers.

- Most General Use grade receivers are available on the retail market to consumers for a variety of applications including boating, hiking, and automotive navigation. They display an instantaneous reading of position and are generally not optimized for data collection. Waypoints containing instantaneous position fixes can often be stored and downloaded. The accuracy of these receivers is adequate for many environmental applications.

- Mapping Grade receivers are used for applications such as resource management and Geographical Information System (GIS) feature collection. The receivers are capable of averaging multiple position fixes for greater accuracy and then data-logging the results with sufficient information to post-correct the positions as described below. The potential accuracy that can be achieved may be better than one meter.

- Survey Grade receivers can provide accuracy at the centimeter level by using long occupation times and special techniques for receiver use and data processing. Survey Grade receivers are not used by SESD in field investigations.

GPS receivers derive positions by simultaneously measuring the distance (range) to several satellites in precisely known orbits, and using triangulation of the ranges to calculate a unique position for the receiver. The range to each satellite is determined by precisely measuring the transit time of radio signals broadcast from the satellites.

2.1.2 GPS Accuracy Factors

The accuracy of the basic GPS system is approximately 15m. GPS accuracy can be affected by a number of factors including the Selective Availability feature, atmospheric delays, satellite clock and orbit errors, multipath signals, signal strength, and satellite geometry relative to the user.

In the early GPS implementation, the DOD used a feature known as Selective Availability (SA) to degrade the quality and subsequent accuracy of the GPS signals to non-DOD users. With Selective Availability enabled, accuracy of position fixes could be as poor as 100m without the use of differential correction techniques described below. Currently there is no SA limitation in accuracy in place with a stated Executive Branch intention to not return to the use of the SA signal degradation.

As satellites move in their orbits and some signals are blocked by obstructions, the geometry of the available satellite signals relative to the user will constantly change. When the satellites with available signals are clustered closely together in the sky, small errors in range will result in large errors in reported position. Conversely, when the satellites are distributed more broadly across the sky, the resultant position errors will be at their minimum. The general measure of this phenomenon is Dilution of Precision (DOP), which may be represented as Position Dilution of Precision (PDOP), or more specifically for geographical coordinate collection, Horizontal Dilution of Precision (HDOP). Mapping and Survey Grade receivers generally can calculate and display DOP and allow the user to limit logging to times when the higher potential accuracy conditions of low DOP prevail. General Use receivers may display DOP and use DOP with other factors to estimate a general accuracy figure. DOP may range from approximately 2 to 50, with high quality work usually requiring a HDOP of less than 4-6.

Signal strength and multipath signals relate to the strength and quality of the signal reaching the receiver antenna. Signal attenuation by the atmosphere, buildings, and tree cover limit the accuracy of the ranges obtained. The measure of signal strength is Signal to Noise Ratio (SNR), generally measured in decibels(db). Most receivers of any grade will display the SNR of the satellite signals in a bar graph or table. Mapping Grade Receivers generally allow the user to specify a minimum signal strength for the use of a satellite signal (commonly 2-15db). Poor signal strength can be resolved by waiting for satellite locations to change or moving the receiver location. Multipath signals result

from portions of the satellite signal bouncing off terrain, structures, or atmospheric disturbances, resulting in a degraded total signal. Higher quality Mapping Grade receivers may be capable of rejecting the stray multipath signals, such as Trimble® receivers using Everest™ technology.

2.1.3 Differential GPS

Selective Availability, clock errors, and orbital errors affect all GPS users and atmospheric delays affect all users over a relatively wide region. A second GPS receiver in the same general area as the user will experience the same errors from these sources as the user‟s receiver. Consequently, correction factors from a remote station at a known location can be applied to the user‟s receiver in a process known as Differential GPS (DGPS). DGPS can be applied in real-time using additional radio signals, or after the collection event by a method called post-correction.

Real-time DGPS uses established networks of base stations at precisely surveyed locations. The US Coast Guard operates a system of 80 base stations which became fully operational in 1999. The range corrections are broadcast on marine radiobeacon frequencies, with redundant coverage of most of the US coastline and the Mississippi River. There is near complete single beacon coverage of most of the internal US, but there are known gaps in coverage in both EPA Region 4 and the US as a whole. The system is sometimes referred to using the more general term DGPS or in nomenclature referring to the beacon-based nature of the system. Beacon-based DGPS is implemented primarily in Navigational and Mapping Grade receivers.

Real-time DGPS can also be implemented with a Space Based Augmentation System (SBAS). The most common SBAS currently used in the United States is the Wide Area Augmentation System (WAAS), developed by the Federal Aviation Administration to meet the additional demands on GPS for aircraft navigation. The WAAS network of base stations collects information on satellite clock errors, orbital errors, and atmospheric conditions. The error information is transferred to satellites in geo-synchronous orbits and subsequently broadcast to suitably equipped GPS receivers on frequencies compatible with the GPS range signals. While beacon-based DGPS passes range corrections to the receivers, WAAS communicates a model for the errors which is capable of providing more accurate corrections. Current Mapping Grade receivers will likely use WAAS with or without the option of beacon-based DGPS. All but the least expensive General Use receivers are generally equipped with WAAS differential correction capability.

Post-Corrected DGPS is generally accomplished by downloading the receiver survey files to a desktop or laptop computer and then retrieving correction files for the same time period (generally via the internet) from an established base station in the area of the survey. Post-processed accuracy improves with proximity of the base station to the surveyed locations and base station data should be used from a station within 300km of the site surveyed. The survey positions are processed by application software and a new

set of positions is generated using the correction data. The capability for post-processed differential correction is generally limited to Mapping Grade and Survey Grade receivers.

Various factors limit GPS accuracy in the vertical plane to approximately half of that obtainable in the horizontal plane, i.e., if a location fix is accurate to 3 m in the horizontal plane, it may only be accurate to 6 m in the vertical plane. Since relatively high accuracy is usually required for the uses of elevation data, GPS is rarely used to obtain and report elevations.

2.2 Requirements for Locational Information

2.2.1 Data Uses

Locational information can serve many purposes in an environmental investigation, a few of which are listed below:

1. Providing an unambiguous means to identify facilities or sampling plats.
2. Providing locational information to key analytical data in a GIS based data archiving system to the original sampling locations.
3. Differentiating watersheds.
4. Providing information to calculate extents and volumes of contamination.
5. Providing a means to relocate the media represented by samples for removal or treatment.
6. Providing information to prepare presentation graphics of sampling locations.

Depending on the specific uses for the data and the type of work being performed, there will be different needs for the accuracy of the locational data. Studies where a sample represents a large area of relatively homogeneous material would not require the same accuracy as the location of a permanent monitoring well. Below are broad guidelines for the accuracy that might be required for different applications.

Desired Accuracy	**Application**
100 m	Open ocean work where sample is presumed to be representative of a large area
20 m	Open water work (lakes or estuaries) where sample is presumed to be representative of a large area
10 m	Stream and river work where samples are presumed to be broadly representative of a reach
5-3 m	Stream work where samples are representative of a specific narrowly defined section

10 m	Air Monitoring Stations
10 - 3 m	Microscale air monitoring
3 - 1 m	Permanent monitoring wells
1 m	Locations of 'Hot Spots' destined for removal of limited areal extent
3 - 1 m	Locations of Temporary groundwater wells in plumes requiring narrow delineation
3 m	Locations of Temporary groundwater wells in broad plumes
3 m	Locations of environmental samples with sample spacing >20 m
5 m	Locations of environmental samples with sample spacing >60 m
200 - 20 m	Coordinates describing a facility where mobile waste units are sampled
30 - 3 m	Locations of industrial process areas or NPDES permitted facilities where the sampling locations are described in field notes relative to the process or site features

Specific demands of a study may drive increased or decreased requirements for accuracy. The preferred means of locational data collection for most studies will be GPS, although alternate means are permissible if they meet accuracy requirements. The following table indicates the accuracy that may be expected from various means of establishing coordinates.

Accuracy	**Description**
200 - 50 m	Map Derived, coarse work
40 - 20 m	Map Derived, fine work or using GIS with digital imagery
15 m	General Use Grade GPS, w/o WAAS
5 m	General Use Grade GPS, w/ WAAS or beacon corrections
10 m	Mapping Grade GPS, no corrections, averaged readings,
3 m	Mapping Grade GPS w/ differential correction, averaged readings
1 m	Mapping Grade GPS w/ differential correction, controlled DOP and SNR, averaged readings
10 cm	Surveying Grade GPS or optical surveying (dependent on baseline length)

Accuracy is a term used to describe the degree of conformity of a measurement. In GPS, accuracy is usually specified as an estimate of the radius from the measured coordinates that is likely to include the actual coordinates. The estimate is based on several standard deviations probability of including the actual point in the measurement. As such, it is recognized that some measurements will fall outside of the specified accuracy. For the purposes of SESD GPS work, the nominal accuracy figures derived from manufacturer‟s literature for specific operating conditions, displayed by the receiver at the time of feature collection, or output from processing software will be taken at face value.

2.2.2 Datums and Data formats

In general, a datum is a reference from which other measurements are taken. In the development of surveying systems by civil entities, different datums were used as base references that will result in differing coordinates for the same location. A GPS receiver will generally display coordinates in a number of different user-selected datums. **Unless there are specific requirements on a project, all SESD work should be conducted using the WGS84 datum. A**lternatively, the nearly equivalent NAD83 datum may be used if WGS84 is unavailable as a receiver option. If an alternate coordinate system is used where coordinates are obtained and recorded in field logbooks, the use of the alternate coordinate system should also be noted in the logbook.

The SESD Data Archival and Retrieval System (DART) requires that coordinates for sample locations be entered in the WGS84 datum and dd.dddddd format. Unless specific project requirements dictate otherwise, all coordinates explicitly stated in reports will be in WGS84 format and in all cases the datum used will be specified.

There is no SESD policy on significant digits for GPS information, and accuracy should not be implied from the presence of significant digits in reported coordinates. However, good scientific practice should be followed in the presentation of locational information in order that useful information not be truncated or a higher degree of accuracy implied. The following table shows the incremental distance in latitude represented by the least significant digit for various coordinate formats:

dd.dddddd°	Approximately 4" or 10 cm
dd.ddddd°	Approximately 44" or 1.1 m
dd.dddd°	Approximately 36' or 11 m
dd°mm'ss"	Approximately 100' or 30 m
dd°mm'ss.x"	Approximately 10' or 3 m
dd°mm'ss.xx"	Approximately 1' or 30 cm
dd°mm.xxxx'	Approximately 7" or 18 cm
dd°mm.xxx'	Approximately 6' or 1.8 m
dd°mm.xx'	Approximately 60' or 18 m

2.3 Quality Control Procedures

By nature of its origin in the DOD and recent application to aircraft navigation, the GPS is designed for high reliability. GPS failures resulting in an incorrect reading beyond the bounds of known errors are so rare that the possibility can be ignored for most SESD studies. If a study requires the verification of receiver function, this can be accomplished by verifying that a receiver displays the correct position while occupying a known benchmark.

2.4 Special Considerations

The application will dictate the type of receiver used. There are several specific considerations for the use of the various receiver types.

2.4.1 Special considerations for the use of Trimble® Mapping Grade Receivers

The suggested settings for Trimble® receivers are:

1. Position mode: Overdetermined 3D (or manual 3D if only 4 satellites are visible)
2. Elevation mask: 15 degrees
3. PDOP: 6
4. Signal to noise ratio (SNR) mask: 6
5. Dynamics code: Land
6. Logging interval: 1 second for points, 5 seconds for lines and areas
7. Audible click: Yes
8. Log DOP data: Yes
9. Coordinate System: Geographic Datum WGS84

When using Trimble® Geoexplorer receivers, the option of using the accuracy „slider bar‟ display may be used to consolidate many of the above parameters. The slider bar position must be positioned at midscale or towards the „Precision‟ end of the scale to achieve 1m accuracy work. When conducting work requiring less accuracy, the slider should be initially positioned midscale and may be adjusted toward the Production‟ end of the scale if the higher level of accuracy can not be maintained.

The receivers may be configured to force real-time position correction. The use of real-time correction reduces the risk of being unable to obtain appropriate post-correction files, but may limit productivity when differential signals cannot be

received or are intermittent. The use of forced real-time vs. post-correction is an operator decision. If the positions are not to be downloaded and the accuracy of differential correction is required, it will be necessary to force real-time correction.

Trimble® receivers at SESD contain a data dictionary that can facilitate the management of GIS data. If the COC_GIS dictionary is selected at the time of file creation, SESD standard media codes can be assigned to features at the time of logging that will accompany the data through the download process. The use of the COC_GIS data dictionary can simplify the management of the data when processed in a GIS system or when entered into the DART system.

The logging interval of most Trimble® GPS receivers defaults to a 5 second interval. This may be changed to a 1 second interval to expedite feature collection. A point feature should have a minimum of 36 positions logged to obtain the additional accuracy afforded by averaging positions. After a minimum of 36 positions are logged and the feature is closed, the averaged position can be obtained by selecting the feature on the „Map" screen. The averaged position should always be the one entered into field notebooks.

Some Trimble® receivers may only display data in dd°mm"ss.sss" format. If the coordinates are downloaded and processed through Pathfinder Office software, they can be output in the dd.dddddd (or any other) format. If the coordinates were only recorded in field logbooks, they can be converted to decimal degrees as follows:

Converting to decimal degrees (dd.dddddd) from degrees°minutes"seconds" (dd°mm"ss.sss"):

dd.dddddd = dd + (mm/60) + (ss.sss/3600)

Example: Convert 33°28"45.241" to decimal degrees

33 + (28/60) + (45.241/3600) = 33.479236

The reverse conversion is accomplished as follows:

Converting to degrees°minutes"seconds" from decimal degrees

Starting with dd.dddddd

Multiply .dddddd by 60 to obtain mm.mmmm

Multiply .mmmm by 60 to obtain ss.sss

Then dd°mm"ss.sss" = dd & mm & ss.sss

Example: Convert 33.479236 to dd°mm‟ss.sss” format

Multiply .479236 by 60 to obtain 28.7540 (mm.mmmm)

Multiply .7540 by 60 to obtain 45.241 (ss.sss)

Dd°mm‟ss.sss” = 33° & 28‟ & 45.241” = 33°28‟45.241”

2.4.2 Special considerations for the use of Garmin® General Use Grade Receivers

The standard format for navigational purposes is decimal minutes (dd°mm.mmm‟). This format is utilized due to the fact that nautical navigation charts are set up in this format. However, location information must be converted to a decimal degree (dd.ddddd°) format in order for GIS software to properly interpret the information. The conversion is accomplished by dividing the minutes portion of the coordinates by 60.

<u>Converting to decimal degrees from decimal minutes:</u>

dd.ddddd° = dd + (mm.mmm/60)

Example: Convert 81°49.386 degrees to decimal degrees

81 + (49.386/60) = 81.8231 degrees

<u>The reverse conversion is accomplished as follows:</u>

dd°mm.mmm‟ = dd & (.ddddd*60)

Example: Convert 81.8231 degrees to decimal minutes (dd°mm.mmm‟)

Multiply .8231 by 60 to obtain 49.386 (mm.mmm)

81° & 49.386‟ = 81°49.386‟

GPS users need to familiarize themselves with the differences between the two formats, as they appear similar. Spreadsheets can automate the conversion process.

2.5 Records

The GPS coordinates and the SESD equipment identification number of the GPS receiver should be recorded in field logbooks at the time of GPS coordinate collection. The data logging capability of receivers may be used in lieu of the requirement to record the coordinates in logbooks when the following conditions can be met:

1. The location can easily be found later if it needs to be resurveyed prior to demobilization. A permanent monitoring well can easily be resurveyed, while most open-water work would not afford this opportunity.

2. The data is downloaded and ascertained to meet the accuracy requirements for the project prior to demobilization from the site.

3. The data is stored in at least two separate locations for transport, such as a laptop hard drive and a flash drive or compact disc.

In all cases where positions are electronically recorded, the provisions of the Electronic Records section of the SESD Operating Procedure for Control of Records (SESDPROC-002) should be followed.

Where locational data is collected and processed electronically, but not reported explicitly in the final report, a copy of the coordinates in text format should be output and entered into the project file in paper or electronic form. The output should include:

1. Latitude, generally in dd.dddddd format.

2. Longitude, generally in dd.dddddd format.

3. Date of collection.

4. DOP information where it supports the accuracy requirements.

5. Correction status of each point where it supports the accuracy requirements.

6. The datum used for the export.

Trimble® Pathfinder Office will create files with this information by exporting to a text file. The information will be contained in the .pos and .inf files.

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Logbooks**

Effective Date: May 30, 2013	**Number:** SESDPROC-010-R5

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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESCPROC-010-R5, *Logbooks*, replaces SESDPROC-010-R4 **General:** Corrected any typographical, grammatical and/or editorial errors. **Title Page:** Changed author from Liza Montalvo to Hunter Johnson. Changed Enforcement and Investigation Branch Chief from Archie Lee to Danny France. Changed Ecological Assessment Branch Chief from Bill Cosgrove to John Deatrick. Changed Field Quality Manager from Liza Montalvo to Bobby Lewis. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history **Section 1.2**: Added the following statement: "Requirements for SESD records, which include field logbooks, are outlined in the SESD Operating Procedure for Control of Records (SESDPROC-002)." **Section 1.4**: Updated references **Section 2.1**: Added "bound" to the first sentence. Replaced the last sentence of the first paragraph with the following language: "All pertinent field activity information will be recorded contemporaneously when observed or collected to prevent a loss of information." Added the second paragraph partially comprised of language from the omitted paragraph from Section 2.2. **Section2.2**: Omitted the first paragraph. Added the following language to the first line (formerly the second paragraph): "The following requirements apply to **all logbooks**:" Added Items 1 and 2 and omitted Item 4. Renumbered items as appropriate. Added "End of Notes" to the second sentence in item 6 (formerly item 5). Also added the last sentence which states: "Field investigators will draw a diagonal line through blank or unused portions of pages/forms	May 30, 2013

that are located prior to the "End of Notes" entry and initial them." Added "and SESD-generated forms" to Item 7 (formerly item 6).	
SESCPROC-010-R4, *Logbooks*, replaces SESDPROC-010-R3	October 8, 2010
SESCPROC-010-R3, *Logbooks*, replaces SESDPROC-010-R2	November 1, 2007
SESCPROC-010-R2, *Logbooks*, Replaces SESDPROC-010-R1	September 25, 2007
SESDPROC-010-R1, *Logbooks*, Replaces *Field Records (Logbooks)* SESDPROC-010-R0	August 10, 2007
SESDPROC-010-R0, Field Records (Logbooks), Original Issue	February 5, 2007

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1 General Information

1.1 Purpose

This procedure is to be used by field investigators when documenting pertinent and factual information in logbooks related to field investigations involving sampling and measurement procedures and/or other data collection events.

1.2 Scope/Application

This document describes the various types of information that should be included in the field logbooks used to document field investigations conducted by SESD. Requirements for SESD records, which include field logbooks, are outlined in the SESD Operating Procedure for Control of Records (SESDPROC-002). Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

The procedures found within this document were prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Field Branches Quality Management Plan, SESDPLAN-001, Most Recent Version

2 Field Records and Documentation Procedures

2.1 General

Dedicated bound logbooks will be used for field data collection including but not limited to sampling, measurements and observations. Logbook entries should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. All pertinent field activity information will be recorded contemporaneously when observed or collected to prevent a loss of information.

To facilitate accurate and complete documentation of field sampling and measurement activities, SESD-generated forms may be used. In order to be utilized, SESD-generated forms must be bound prior to use and adhere to all requirements outlined in this procedure. In cases where unbound pages/forms are necessary due to project requirements or practicality, approval must be obtained from both the Field Quality Manager and Management. In these cases, the Field Quality Manager and Management will dictate the steps that will be taken to ensure credibility, traceability and defensibility of information collected.

Any deviations from the quality assurance project plan that occur while in the field will be noted in the logbook(s). Logbook entries that may be considered privileged or confidential information will be handled in accordance with the relevant sections of SESD Operating Procedure for Control of Records (SESDPROC-002). The logbooks will be placed in the SESD project file upon transmittal of the final report to the project requestor.

2.2 Field Data Integrity and Accountability

The following requirements apply to **all logbooks**:

1. The project's unique identifier (unique identification number(s)) will be included on each page.
2. Field personnel will date and number each page. Numbering will be conducted by utilizing a format that incorporates both the current page number and the total number of pages (e.g. "page x of y" or "x/y", where "x" is the current page number and "y" is the total number of pages).
3. Observations, data and calculations will be recorded at the time they are made.
4. Unless prohibited by environmental conditions, pens with permanent ink will be used to record all data. When environmental conditions do not make it feasible to use permanent ink, entries should be made using a non-smear lead pencil (e.g., 2H or 3H). Upon returning from the field, the project leader will photocopy the penciled section of the logbook and certify, in writing, that the photocopied record is a true copy of the original logbook entry. The photocopy will be included in the project file.

5. Entries will be legible and contain pertinent, accurate and inclusive documentation of project activities.
6. Upon completion of the field investigation, the end of project entries in the logbook and/or bound forms will be clearly indicated. This may be accomplished by noting "End" or "End of Notes" on the last page of notes and dating and initialing the notation. Field investigators will draw a diagonal line through blank or unused portions of pages/forms that are located prior to the "End of Notes" entry and initial them.
7. In order to demonstrate continuity of the project and to preclude questioning of the integrity of the data collection process, pages and SESD-generated forms should not be removed from bound logbooks under any circumstances.
8. Data or other information that has been entered incorrectly will be corrected by drawing a line through the incorrect entry and **initialing and dating** the lined-through entry. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.
9. If pre-printed adhesive labels are used in logbooks or bound forms to facilitate organization of information entry, the field investigator who is responsible for taking notes will sign the label with the signature beginning on the label and ending on the page of the logbook such that the label cannot be removed without detection.

2.3 Logbook Entry Information

2.3.1 General Information Required in All Logbooks

The following information will be included either on the front cover or the first page of **all logbooks**:

1. Project name
2. Project location
3. Project identification number
4. Project leader (full name)
5. Sample team leader (full name) and initials
6. Sample team member(s) (full name) and initials

2.3.2 Information Required for Sample Collection

In addition to the information listed in Section 2.3.1, the following information will be included in all logbooks when **samples** are collected:

1. Applicable SESD Operating Procedures for field sampling
2. Date and time of collection
3. Station identification
4. Sample identification

5. Method of collection
6. Number and type of containers
7. Sample collection equipment
8. SESD equipment identification number, if applicable
9. Physical description of sample
10. Matrix sampled
11. Sample team member duties (calibration, collection, deployment, etc.)
12. Sample preservation (including ice), if applicable
13. Conditions that may adversely impact quality of samples, if applicable (rain, wind, smoke, dust, extreme temperature, etc.)
14. GPS coordinates (Non-logging GPS units), if applicable
15. Location of electronic data file backups, if applicable

16. Monitoring of condition of ice in coolers or sampler
17. Other pertinent information.

2.3.3 Information Required for Field Measurements

In addition to the information listed in Section 2.3.1, the following information will be included in all logbooks when **measurements** are conducted:

1. Applicable SESD Operating Procedures for field measurement
2. Date and time of measurement or deployment
3. Sample identification, if appropriate
4. Station identification
5. Sample measurement equipment
6. SESD sample measurement equipment identification number
7. Manufacturer name, lot number and expiration date of all buffers and standards*
8. Calibration information, including before and after calibration readings*
9. Meter end check information
10. Deployment depth and total depth, if applicable
11. Pinger identification number and frequency for deployed equipment, if applicable
12. Time of retrieval for deployed equipment, if applicable
13. Physical description of matrix
14. Sample team member duties (calibration, collection, deployment, etc.)
15. Measurement values for non-logging equipment
16. GPS coordinates (non-logging GPS units), if applicable
17. Location of electronic data file backups, if applicable
18. Ambient air temperature, where applicable
19. Conditions that may adversely impact quality of measurement (Ex. temperature extremes)
20. Maintenance performed, if applicable

21. Meter malfunctions, if applicable
22. Other pertinent information

* Entry of calibration information in logbooks is only required for calibrations conducted in the field. All calibrations conducted at the Field Equipment Center or SESD laboratory will be recorded in the appropriate equipment tracking logbook.

2.3.4 Additional Information for Inclusion

The following information may be included in logbooks as appropriate:

1. Maps/sketches
2. Photographic or videographic log
3. Process diagrams

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Management of Investigation Derived Waste**

Effective Date: October 15, 2010	**Number:** SESDPROC-202-R2

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Revision History

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History	Effective Date
SESDPROC-202-R2, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R1. **General:** Corrected typographical, grammatical and/or editorial errors. **Cover Page:** The Enforcement and Investigations Branch Chief was changed from Antonio Quinones to Archie Lee. The FQM was changed from Laura Ackerman to Liza Montalvo. **Revision History:** Changed Field Quality Manager to Document Control Coordinator. **Section 1.2:** Added the following statement: Mention of trade names or commercial products does not constitute endorsement or recommendation for use. **Section 1.3:** Omitted reference to the H: drive of the LAN. Changed Field Quality Manager to Document Control Coordinator. **Section 2, first bullet:** Replaced "personnel" protective equipment with "personal" protective equipment. **Table 1:** On the Hazardous/PPE-Reusable cell - Added the full reference to SESDPROC-205. On the Non-hazardous/Decontamination Water cell - Added a statement to reflect that decontamination water may also be disposed in a sanitary sewer system, with permission from the wastewater treatment plant representative, and if doing so does not endanger human health or the environment, or violate federal or state regulations. On the Non-hazardous/Disposable Equipment cell - Added a statement to reflect that, if unfeasible, this equipment could be returned to the FEC for disposal in the FEC's dumpster.	October 15, 2010
SESDPROC-202-R1, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch.	November 1, 2007

Changed Bill Cosgrove's title from Acting Chief to Chief. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	
SESDPROC-202-R0, Management of Investigation Derived Waste, Original Issue	February 05, 2007

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Table 1: Disposal of IDW **10**

Contents

1 General Information

1.1 Purpose

This document describes general and specific procedures and considerations to be used and observed when managing investigation derived waste (IDW) generated during the course of hazardous waste site investigations.

1.2 Scope/Application

The procedures and management options for the different categories of IDW described in this document are to be used by SESD field personnel to manage IDW generated during site investigations. On the occasion that SESD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to manage IDW generated at a particular site, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when managing IDW. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when managing IDW:

- Due to time limitations and restrictions posed by RCRA regulations on storage of hazardous waste, accumulation start dates should be identified on all drums, buckets or other containers used to hold IDW so that it can be managed in a timely manner.
- During generation of both non-hazardous and hazardous IDW, keep hazardous IDW segregated from non-hazardous IDW to minimize the volume of hazardous IDW that must be properly managed.

2 Types of Investigation Derived Waste

Materials which may become IDW include, but are not limited to:

- Personal protective equipment (PPE) - This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.
- Disposable equipment and items - This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.
- Soil cuttings from drilling or hand augering.
- Drilling mud or water used for mud or water rotary drilling.
- Groundwater obtained through well development or well purging.
- Cleaning fluids such as spent solvents and wash water.
- Packing and shipping materials.

Table 1, found at the end of this procedure, lists the types of IDW commonly generated during field investigations and the current disposal practices for these materials.

For the purpose of determining the ultimate disposition of IDW, it is typically distinguished as being either hazardous or non-hazardous. This determination is based on either clear regulatory guidance or by subsequent analysis. This determination and subsequent management is the responsibility of the program site manager.

3 Management of Non-Hazardous IDW

Disposal of non-hazardous IDW should be addressed in the study plan or QAPP for the investigation. To reduce the volume of any IDW transported back to the Field Equipment Center (FEC), it may be necessary to compact the waste into a reusable container, such as a 55-gallon drum.

If the waste is from an active facility, permission should be sought from the operator of the facility to place the non-hazardous PPE, disposable equipment, and/or paper/cardboard into the facility's dumpsters. If necessary, these materials may be placed into municipal dumpsters, with the permission of the owner. These materials may also be taken to a nearby permitted landfill. On larger studies, waste hauling services may be obtained and a dumpster located at the study site.

Disposal of non-hazardous IDW such as drill cuttings, drilling mud, purge or development water, decontamination wash water, etc., should be specified in the approved study plan or QAPP. It is recommended that these materials be placed into a unit with an environmental permit, such as a landfill or sanitary sewer. These materials must not be placed into dumpsters. If the facility at which the study is being conducted is active, permission should be sought to place these types of IDW into the facility's treatment system. It may be feasible to spread drill cuttings around the borehole, or, if the well is temporary, to place the cuttings back into the borehole. Non-hazardous monitoring well purge or development water may also be poured onto the ground down gradient of the monitoring well when site conditions permit. Purge water from private potable wells which are in service may be discharged directly onto the ground surface.

The minimum requirements for this subsection are:

- Non-hazardous liquid and soil/sediment IDW may be placed on the ground or returned to the source if doing so does not endanger human health or the environment or violate federal or state regulations. Under no circumstances, however, should monitoring well purge water be placed back into the well from which it came.
- Soap and water decontamination fluids and rinsates of such cannot be placed in any water bodies and must be collected and returned to the FEC for disposition.
- The collection, handling and proposed disposal method must be specified in the approved study plan or QAPP.

4 Management of Hazardous IDW

Disposal of hazardous or suspected hazardous IDW must be specified in the approved study plan or QAPP for the study or investigation. Hazardous IDW must be disposed as specified in USEPA regulations. If appropriate, these wastes may be placed back in an active facility waste treatment system. These wastes may also be disposed in the source area from which they originated if doing so does not endanger human health or the environment.

If on-site disposal is not feasible, and if the wastes are suspected to be hazardous, appropriate tests must be conducted to make that determination. If they are determined to be hazardous wastes, they must be properly contained and labeled. They may be stored on the site for a maximum of 90 days before they must be manifested and shipped to a permitted treatment or disposal facility. Generation of hazardous IDW must be anticipated, if possible, to allow arrangements for proper containerization, labeling, transportation and disposal/treatment in accordance with USEPA regulations.

The generation of hazardous IDW should be minimized to conserve Division resources. Most routine studies should not produce any hazardous IDW, with the possible exception of spent solvents and, possibly, purged groundwater. The use of solvents during field cleaning of equipment should be minimized by using solvent-free cleaning procedures for routine cleaning and decontamination (see SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205). If solvents are needed, the volume should be minimized by using only the amount necessary and by capturing the residual solvent separately from the aqueous decontamination fluids (detergent/wash water mixes and water rinses).

At a minimum, the requirements of the management of hazardous IDW are as follows:

- Spent solvents must be left on-site with the permission of site operator and proper disposal arranged.
- All hazardous IDW must be containerized. Proper handling and disposal should be arranged prior to commencement of field activities.

Table 1: Disposal of IDW

TYPE	HAZARDOUS	NON - HAZARDOUS
PPE-Disposable	Containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.
PPE-Reusable	Decontaminate as per SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, if possible. If the equipment cannot be decontaminated, containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Decontaminate as per SESDPROC-205, and return to FEC.
Spent Solvents	Containerize in original containers. Clearly identify contents. Leave on-site with permission of site operator and arrange for proper disposal.	N/A
Soil Cuttings	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in a 55-gallon steel drum with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Groundwater	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Decontamination Water	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. Decontamination water may also be disposed in a sanitary sewer system, with permission from the wastewater treatment plant representative, and if doing so does not endanger human health or the environment, or violate federal or state regulations.
Disposable Equipment	Containerize in DOT-approved container or 5-gallon plastic bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. If unfeasible, return to FEC for disposal in dumpster.
Trash	N/A	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.

**** These materials may be placed on the ground if doing so does not endanger human health or the environment or violate federal or state regulations.**

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Purchasing of Services and Supplies**

Effective Date: June 20, 2013	**Number:** SESDPROC-015-R4

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SESDPROC-015-R4, *Purchasing of Services and Supplies*, Replaces SESDPROC-015-R3 **General:** Corrected any typographical, grammatical, and/or editorial errors. Throughout the document certain terms were replaced with their appropriate acronyms. **Cover Page:** Changed the Author from Laura Ackerman to Bobby Lewis. Changed the Enforcement and Investigations Branch Chief from Archie Lee to Danny France. Changed the Ecological Assessment Branch Chief from Bill Cosgrove to John Deatrick. Changed the FQM from Laura Ackerman to Bobby Lewis. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history. **Section 1.1:** Changed "chemical standards" to "chemical buffer/standard" in the last sentence of the paragraph. **Section 1.2:** Added the following statement - Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use. **Section 2.2.1**: Added the second paragraph of the section, which indicates the procedure for ordering chemical preservatives that will be kept at the FEC. Added "by a BFEM" to the first sentence of the third paragraph. **Section 2.2.2**: In the first sentence of the second paragraph, omitted the following: "in an email to the appropriate Branch Quality Assurance Officer (QAO)." Omitted the second sentence of the second paragraph. In the last sentence of the second paragraph, omitted the word "corrective" and "and notify the Field Quality Manager if deemed necessary." **Section 2.2.4**: In the second paragraph, added the following sentence: "Commercially available chemical preservatives will be tested as described in the Field Sampling Quality Control Operating Procedure (SESDPROC-011)."	**June 20, 2013**
SESDPROC-015-R3, *Purchasing of Services and Supplies*, Replaces SESDPROC-015-R2	**July 10, 2009**
SESDPROC-015-R2, *Purchasing of Services and Supplies*, Replaces SESDPROC-015-R1	**November 1, 2007**
SESDPROC-015-R1, *Purchasing of Services and Supplies*, Replaces SESDPROC-015-R0	**October 1, 2007**

SESDPROC-015-R0, Purchasing of Equipment and Supplies, Original Issue	**March 22, 2007**

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1 General Information

1.1 Purpose

This procedure addresses the purchasing of services and supplies whose properties could affect the quality of sampling and measurement activities. Services can include but are not limited to equipment maintenance, repair, certification and proficiency test providers. Supplies can include but are not limited to chemical buffer/standard, chemical reagents, sample containers, disposable sampling equipment (i.e., COLIWASAs, bailers), laboratory supplies, tubing and latex gloves.

1.2 Scope and Application

This procedure applies to the purchase of services and consumable supplies that are used in support of sampling and measurement activities that may affect the quality of the results generated. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on LAN and for maintaining records of review conducted prior to its issuance.

1.4 Definitions

1.4.1 Branch Field Equipment Manager

Staff designated by management to be responsible for ensuring that the procedures for Equipment Inventory, and Equipment and Supply Management are followed. At least one Equipment Manager will be designated for the Enforcement and Investigations Branch (EIB) and the Ecological Assessment Branch (EAB).

1.4.2 Branch Quality Assurance Officer

Branch Quality Assurance Officers (QAOs) are designated by and report to the Section Chiefs in both field branches. The Branch QAOs assist the Field Quality Manager (FQM) in disseminating, reviewing and implementing the SESD field branches quality assurance system.

1.4.3 Buffer/Standard

A reference material whose properties have been established so that it can provide a level of performance verification. For field measurements, examples are pH buffers, specific conductivity standards, turbidity standards and oxidation-reduction potential standards.

1.4.4 Certification

A document issued by the manufacturer of a chemical reagent, standard or reference material that certifies its identity, concentration or purity.

1.4.5 Chemical Hygiene Officer

An individual assigned by SESD management to monitor procurement and use of chemicals within SESD through a Chemical Inventory Program; also advises on the special handling and disposal requirements for chemicals.

1.4.6 Reference Material

A material with known analyte concentration and matrix type used to demonstrate that a measurement system is functioning.

1.4.7 Reagent

Any water, solvent, gas or chemical that potentially affects the outcome of environmental measurements.

1.4.8 Supplies

Any materials such as calibration standards, sample containers or disposable sampling equipment that potentially affects the outcome of environmental measurements.

1.4.9 Verification

Visual inspection and/or testing of supplies to verify consistency with labeling and/or certification.

1.5 Precautions

Proper safety precautions will be observed when handling and storing chemical supplies. Material Safety Data Sheets (MSDS) should be used for chemical specific safety requirements. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Manual and any pertinent site-specific Health and Safety Plans

(HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional.

1.6 References

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

SESD Safety, Health and Environmental Management Program (SHEMP) Manual, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management, (SESDPROC-108, Most Recent Version).

SESD Operating Procedure for Field Sampling Quality Control, (SESDPROC-011, Most Recent Version).

Quarantined Item Release Form, (SESDFORM-015, Most Recent Version).

2 Methodology

2.1 Services

Purchases of services that affect the quality of field sampling and measurement activities can be originated by any employee. SESD purchases services through procurements, bank card orders or contracts. Regardless of the mechanism utilized to purchase a service, it is the responsibility of the originator to:

1. ensure funding is available for the purchase;
2. determine the specifications for the service;
3. establish acceptance criteria for use in evaluating the service; and
4. provide source recommendations to the purchasing official.

Whenever possible, services will be purchased from vendors with quality systems comparable to the SESD field branches' (i.e., ISO 17025 compliant).

Once the purchasing documents have been completed, management will authorize and sign them and then forward the documents to the purchasing official. The purchasing official will maintain a record of all services purchased. The purchase originator will provide a copy of the purchasing documents to the appropriate Branch Field Equipment Manager (BFEM).

Following completion of the service, the purchase originator will evaluate the service based on the specification of the purchase to determine if the service was acceptable. If the service is deemed unacceptable, the purchase originator will work in conjunction with the vendor and the purchasing official to correct the problem. The purchase originator will provide the appropriate BFEM with the evaluation of the vendor. The BFEMs will maintain a list of vendors used and a notation of the evaluations.

2.2 Field Supplies

2.2.1 Purchase of Field Supplies

Supply purchases, other than chemical standards, are made using procurement requests (PR) or purchase card orders and can be initiated by any employee.
The initiator of a purchase is responsible for preparing a PR or purchase card order that specifies the correct name of the item, the relevant quality criteria of the item, the item number, a quote or price, possible sources and any other associated information that helps identify the correct item to be purchased.

Once the PR or purchase card order has been prepared, the information is forwarded to the appropriate BFEM for origination of the purchase. Management will authorize and sign the order and forward it to the purchasing official. The purchasing official will ensure the order is processed according to the information on the PR or purchase card order.

For chemicals standards that are stored at the Field Equipment Center (FEC) and used to calibrate field meters, the purchase request should be prepared by a BFEM. These chemical standards will then be directly shipped to the FEC where they will be stored for use.

For chemicals standards that are stored at the SESD laboratory and used to calibrate field meters, the purchase request should be prepared separately from other supplies by a BFEM. After required approvals from management, purchase requests will be routed to the Chemical Hygiene Officer (CHO). The CHO is responsible for ordering, receiving and tracking all chemicals at SESD. Upon receipt, each chemical received will be inventoried by name, Chemical Abstract Service (CAS) number, quantity, expiration date, NFPA Hazard Rating and storage location. The CHO will then notify the BFEM of receipt and will coordinate transfer of the order to the BFEM. The CHO will track chemicals via the Chemical Inventory System throughout storage, use and disposal.

If the CHO is unavailable and there is an immediate need to place the order, the BFEM will get the required approval from management for the purchase and submit the order to the appropriate SESD purchasing representative. The SESD purchasing representative will place the order and subsequently transmit all information about the order to the CHO.

Whenever possible, the field branches will purchase supplies of chemical standards from ISO 9000 certified vendors.

2.2.2 Receipt of Field Supplies

Anyone can accept delivery of supply orders. For purchases received at the SESD laboratory, the BFEM will inspect the items to ensure they comply with the PR or purchase card order. If the items are acceptable, the BFEM will sign and date the invoice that accompanied the order and any other required documentation. For purchases received at the FEC, contract personnel or the BFEM will inspect the items to ensure they comply with the PR or purchase card order. If the items are acceptable, the contract personnel or BFEM will sign and date the invoice that accompanied the order and any other required documentation. The original paperwork will be forwarded to the purchasing official.

If any supplies prove to be unsuitable for use, the BFEMs will document the issue. The BFEM will compile all occurrences of unsuitable consumables, supplies or services and determine what further action may be necessary.

2.2.3 Storage of Field Supplies

Upon acceptance, supplies will be stored either at the SESD laboratory or the FEC. An inventory of consumable supplies, such as sample containers, buffers/standards, latex gloves and tubing will be maintained by the BFEM. The inventory will be examined periodically, to identify supplies to be ordered.

All buffers/standards will be labeled with the chemical/reagent name, the material's concentration, manufacturer or vendor, lot number and expiration date. Chemical hazard information is addressed in Material Safety Data Sheets (MSDSs). Buffers/standards will be managed to prevent contamination. Buffers/standards that have been found to be improperly stored or have exceeded the manufacturer's expiration date and are no longer suitable for use will be removed from service and disposed of by pouring them down the sink drain in one of the SESD laboratories or at the FEC as long as the pH is greater than 2 or less than 12.5. Otherwise, the SESD Hazardous Waste Control Officer should be consulted for disposal instructions.

2.2.4 Verification of Field Supplies

SESD will ensure that supplies are not used until they have been inspected or otherwise verified as complying with SESD Quality Assurance requirements. If supplies will be released for field use prior to being verified, the project leader will notify the FQM and appropriate BFEM. The project leader will fill out SESDFORM-015 (Quarantined Item Release Form) prior to taking supply items out of quarantine.

National Institute of Standards and Technology (NIST) traceable buffers/standards and reagents will be used whenever possible. Certificates of traceability will be obtained for all NIST traceable buffers/standards and reagents. All buffers/standards and reagents will be tested prior to use and the test results will be compared to those of similar materials from independent sources or lots for verification. Commercially available chemical preservatives will be tested as described in the Field Sampling Quality Control Operating Procedure (SESDPROC-011). A record of the tests and the results will be maintained at either the FEC or the SESD laboratory, depending on the storage location.

Verification of supplies such as sample containers, disposable sampling equipment (e.g., COLIWASAs, bailers), latex gloves and tubing is conducted as described in the SESD Procedure for Field Sampling Quality Control (SESDPROC-011). In general, rinse blanks are collected for each lot number in an order for sample containers, latex gloves and tubing. The blanks are analyzed for relevant contaminants and the data is evaluated by the EIB QAO prior to releasing the items for use during field investigations. The EIB QAO is responsible for maintaining records of the results of the verification of sample containers, latex gloves and tubing.

2.3 Laboratory Supplies

2.3.1 Purchase of Laboratory Supplies

For consumable laboratory supplies, the purchase request is prepared by the analyst and must be authorized by management. The purchase request is then forwarded to the purchasing official. The purchasing official will ensure the order is processed according to the information on the PR or purchase card order. Purchased supplies can be accepted by the PR initiator, the SESD ordering official, or the SESD mail room attendant. The initiator inspects the item to ensure consistency with the PR and packing slip. Inconsistencies will be brought to the attention of the ordering official for correction. Once the item is deemed consistent with the PR, the receiver dates and initials the packing slip and forwards the packing slip to the ordering official.

If any supplies prove to be unsuitable for use, the person making that determination shall document the issue in an email to the appropriate Branch Quality Assurance Officer (QAO). The documentation should include a description of the item, the deficiency, and the vendor. The Branch QAO will compile all occurrences of unsuitable supplies and determine what further corrective action may be necessary and notify the FQM if deemed necessary.

For chemicals, the purchase request should be prepared separately from other supplies. After required approvals from management, purchase requests will be routed to the Chemical Hygiene Officer (CHO). The CHO is responsible for ordering, receiving and tracking all chemicals at SESD. Upon receipt, each chemical received will be inventoried by name, Chemical Abstract Service (CAS) number, quantity, expiration date, NFPA Hazard Rating and storage location. The CHO will then notify the requestor of receipt and will coordinate transfer of the order to the analyst/initiator. The CHO will track chemicals via the Chemical Inventory System throughout storage, use and disposal. Reagents which are not deemed hazardous, critical to the success of the analysis or those that are used in negligible quantities do not have to be tracked. For example, acids and solvents used in rinsing glassware prior to use typically would not require reagent traceability.

If the CHO is unavailable and there is an immediate need to place the order, the requestor will get the required approval from management for the purchase and submit the order to the appropriate SESD purchasing representative. The SESD purchasing representative will place the order and subsequently transmit all information about the order to the CHO.

2.3.2 Storage of Laboratory Supplies

Requestors are responsible for insuring that all chemicals are maintained within the designated storage areas. Storage location choice will take into consideration any special storage requirements to maintain the physical integrity and safety of the material. The Hazardous Materials Building serves as temporary storage for bulk shipments of acids and solvents until the individual containers are needed by personnel. The CHO must be notified and all tracking documentation updated if the materials need to be moved and/or stored in a different room within the SESD. Notification of the CHO is not required when acids and solvents are transferred from the Hazardous Materials Building to a laboratory. For laboratories containing flammable solvents, the maximum allowable amount is posted in the laboratory and may not be exceeded. Because of fire safety considerations it is acceptable to have less than the posted amount, but never more. For other chemicals, the maximum amount is determined by the volume which can be stored and used within a reasonable amount of time within an individual laboratory. If a new chemical needs to be added to the inventory or if inventories must be increased, this must be coordinated with the CHO. Chemical supplies found to be improperly stored will be removed from service by the user if the integrity is undermined. Reagents, chemicals, solvents and standard reference materials (excluding high demand items) should be purchased in small quantities to minimize extended shelf storage.

2.3.3 Identifying and Labeling

The CHO and analysts will ensure that chemical standards, reagents and reference materials are uniquely identified and correctly labeled. Labels on all chemicals will include the name, concentration, manufacturer or vendor, lot number, date received, date opened and expiration date. Specific hazard information for each chemical is addressed in its MSDS, which should be kept in the laboratory in which the chemical is used.

Labels on stock and intermediate chemicals will show the chemical name, and either reflect or be traceable to its concentration, manufacturer or vendor, lot number, date opened/prepared or expiration date, special storage conditions and hazard warnings. Additional chemical hazard information is specifically addressed in the MSDS, and generally addressed in the SESD annual laboratory safety training.

2.3.4 Verification of Laboratory Supplies

The quality of chemicals, reagents, solvents and standards used in the laboratory is determined by the sensitivity and specificity of the analytical techniques being used. Reagents of lesser purity than specified by a method will not be used. When not specified by the method, analytical reagent grade materials should be used.

Suitability of routine reagents is documented through method blanks. A clean method blank documents that all reagents used in the associated batch were suitable for use. A contaminated method blank requires corrective action to determine whether the contamination is the result of unsuitable reagents, or contamination introduced in the sample handling process.

Where integrity may be compromised or in question, or when no certificate of analysis is available, chemical standards and reference materials will be tested and the test results compared to those of similar materials from independent sources for verification.

2.4 Records

Records shall be maintained on reagent, standard and reference material preparation. These records shall indicate traceability to purchased stocks, reference to the method of preparation, date of preparation, expiration date and preparer's initials. A unique ID shall be assigned to each prepared reagent and standard. Procedures for achieving traceability are documented either in the individual method SOPs or stand-alone procedure documents for procedures which may apply across a variety of methods. The unique ID and expiration date shall be recorded on each standard container. The preparation date shall be recorded on each reagent container. A cross-reference to the Element ID shall be recorded in standard preparation records and on the certificate-of-analysis.

2.5 Chemical Disposal

Chemicals will be disposed of in accordance with the SHEMP Manual. The CHO will track chemicals via the Chemical Inventory throughout storage, use and disposal.

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Packing, Marking, Labeling and Shipping of Environmental and Waste Samples**

Effective Date: April 20, 2011	**Number:** SESDPROC-209-R2

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-209-R2, *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, replaces SESDPROC-209-R1. **Title Page:** Changed EIB Branch Chief from Antonio Quinones to Archie Lee. Changed Field Quality Manager from Laura Ackerman to Liza Montalvo. **Revision History:** Previous versions of the document will be maintained by the Document Control Coordinator (DCC). Changed from Field Quality Manager to DCC. **Section 1.2:** Added the following statement: Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use. **Section 1.3:** Changed requirement so that the DCC is responsible for ensuring the most recent version of the procedure is placed on the SESD LAN and for maintaining records of review conducted prior to its issuance. Deleted reference to the H: drive. **Section 3, fifth paragraph**: On item #2 on the list, replaced "be sure" with "ensure that." On item #3, deleted the last sentence that stated that only "Up to three VOA vials may be packed in one Whirl-Pak container or bag." Deleted outdated item #4 referencing shipment of VOA vials in metal cans. On items #5 and #6, removed references to vermiculite in favor of generic "absorbent material."	April 20, 2011
SESDPROC-209-R1, *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, replaces SESDPROC-209-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove's title from Acting Chief to Chief.	November 1, 2007

Section 1.3 Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Alphabetized and revised the referencing style for consistency. Added reference to the SHEMP Procedures and Policy Manual. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	
SESDPROC-209-R0, Packing, Marking, Labeling and Shipping of Environmental and Waste Samples, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

Regulations for packing, marking, labeling, and shipping of dangerous goods by air transport are promulgated by Department of Transportation under 49 CFR, Subchapter C, Hazardous Materials Regulations, and the International Air Transport Authority (IATA), which is equivalent to United Nations International Civil Aviation Organization (UN/ICAO). Transportation of hazardous materials (dangerous goods) by EPA personnel is covered by EPA Order 1000. This document describes general and specific procedures, methods and considerations to be used and observed by SESD field investigators when packing, marking, labeling and shipping environmental and waste samples to ensure that all shipments are in compliance with the above regulations and guidance.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when packing, marking, labeling, and shipping environmental samples and dangerous goods by air transport. Samples collected during field investigations or in response to a hazardous materials incident must be classified prior to shipment, as either environmental or hazardous materials (dangerous goods) samples.

In general, environmental samples include drinking water, most groundwater and ambient surface water, soil, sediment, treated municipal and industrial wastewater effluent, biological specimens, or any samples not expected to be contaminated with high levels of hazardous materials. Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require shipment as dangerous goods.

Government employees transporting samples or hazardous materials (i.e., preservatives or waste samples) in government vehicles are not subject to the requirements of this section in accordance with 49 CFR 171.1(d)(5). EPA contractors, however, are not covered by this exemption and may not transport these materials without full compliance with 49 CFR.

Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version.

Title 40 Code of Federal Regulations (CFR), Pt. 136.3, Identification of Test Procedures, July 1, 2001. See Table II, Footnote 3.

Title 49 CFR, Pt. 171.1(d)(5), Applicability of Hazardous Materials Regulations (HMR) to Persons and Functions.

United States Department of Transportation (US DOT). 2003. Letter from Edward T. Mazzullo, Director, Office of Hazardous Materials Standards, to Henry L. Longest II, Acting Assistant Administrator, USEPA, Ref No. 02-0093, February 13, 2003.

US Environmental Protection Agency (US EPA) Order 1000.18, February 16, 1979.

US EPA. 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), April 13, 1981.

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA.

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version.

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when packing, marking, labeling, and shipping environmental or waste samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional.

2 Shipment of Dangerous Goods

The project leader is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, IATA, then that sample must be identified, packaged, marked, labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of the waste sample or highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

In addition, the shipment of pre-preserved sample containers or bottles of preservatives (e.g., NaOH pellets, HCL, etc.) which are designated as dangerous goods by IATA is regulated. Shipment of nitric acid is strictly regulated. Consult the IATA Dangerous Goods Regulations for guidance. ***Dangerous goods must not be offered for air transport by any personnel except SESD's dangerous goods shipment designee or other personnel trained and certified by IATA in dangerous goods shipment.***

3 Shipment of Environmental Samples

Guidance for the shipment of environmental laboratory samples by personnel is provided in a memorandum dated March 6, 1981, subject "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples". By this memorandum, the shipment of the following unpreserved samples is not regulated:

- Drinking water
- Treated effluent
- Biological specimens
- Sediment
- Water treatment plant sludge
- POTW sludge

In addition, the shipment of the following preserved samples is not regulated, provided the amount of preservative used does not exceed the amounts found in 40 CFR 136.3 or the USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version. This provision is also discussed in correspondence between DOT and EPA (Department of Transportation, Letter from Edward T. Mazzullo, Director, Office of Hazardous Materials Standards, to Henry L. Longest II, Acting Assistant Administrator, USEPA, Ref No.: 02-0093, February 13, 2003). It is the shippers' (individual signing the air waybill) responsibility to ensure that proper amounts of preservative are used:

- Drinking water
- Ambient water
- Treated effluent
- Biological specimens
- Sediment
- Wastewater treatment plant sludge
- Water treatment plant sludge

Samples determined by the project leader to be in these categories are to be shipped using the following protocol, developed jointly between USEPA, OSHA, and DOT. This procedure is documented in the "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples."

Untreated wastewater and sludge from Publicly Owned Treatment Works (POTWs) are considered to be "diagnostic specimens" (not environmental laboratory samples). However, because they are not considered to be etiologic agents (infectious) they are not restricted and may be shipped using the procedures outlined below.

Environmental samples should be packed prior to shipment by air using the following procedures:

1. Allow sufficient headspace (ullage) in all bottles (except VOA containers with a septum seal) to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

2. Ensure that the lids on all bottles are tight (will not leak).

3. Place bottles in separate and appropriately sized polyethylene bags and seal the bags. If available, the use of Whirl-Pak bags is preferable, if unavailable seal regular bags with tape (plastic electrical tape).

4. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape inside and outside. Line the cooler with a large heavy duty plastic bag.

5. Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers.

6. Put "blue ice" (or ice that has been "double bagged" in heavy duty polyethylene bags and properly sealed) on top of and/or between the containers. Fill all remaining space between the containers with absorbent material.

7. Securely fasten the top of the large garbage bag with tape (preferably plastic electrical tape).

8. Place the Chain-of-Custody Record or the CLP Traffic Report Form (if applicable) into a plastic bag, and tape the bag to the inner side of the cooler lid.

9. Close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Chain-of-custody seals should be affixed to the top and sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Soil Gas Sampling**

Effective Date: September 8, 2010	**Number:** SESDPROC-307-R2

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Revision History

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History	Effective Date
SESDPROC-307-R2, *Soil Gas Sampling*, replaces SESDPROC-307-R1 **Title Page:** Changed Enforcement and Investigations Branch Chief from Antonio Quinones to Archie Lee. **Revision History:** Changed Field Quality Manager to Document Control Coordinator. **Section 1.2:** Added the following statement: "Mention of trade names or commercial products does not constitute endorsement or recommendation for use." **Section 1.3:** Omitted reference to the H: drive. Changed the Field Quality Manager to the Document Control Coordinator. **Section 1.4:** Updated references. **Section 2.2**: Two bullets added to bullet list **Section 2.4:** Quality Control section re-written with four bulleted definitions. **Sections 3, 4 and 5:** Sections re-written to reflect separate installation procedures (Sections 3 and 4) and sampling procedures (Section 5). **Section 3**: PRT installation procedures re-written. Decommissioning procedures added. **Section 4:** Permanent Soil Gas Implant procedures re-written. Decommissioning procedures added. **Section 5:** Sampling PRT and Permanent Soil Gas Installations added as separate sampling procedures section. Sampling procedures revised.	September 8, 2010
SESDPROC-307-R1, *Soil Gas Sampling*, replaces SESDPROC-307-R0 **General** Updated referenced operating procedures due to	November 1, 2007

changes in title names and/or to reflect most recent version. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	
SESDPROC-307-R0, Soil Gas Sampling, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil gas samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil gas samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil gas sample, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

Geoprobe® Systems Tools and Equipment Catalog, Kejr Engineering, Inc., Salinas, Kansas, 1997.

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-104, Most Recent Version)

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

The Yellow Field Book©, Kejr Engineering, Inc., Salinas, Kansas, 2000.

US EPA. 1999. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS); Center for Environmental Research Information, Office of Research and Development, Cincinnati, OH; EPA/625/R-96/010b

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. April 13, 1981. Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples. Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273)

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling & Monitoring, Technical Bulletin No. MK3098, Prepared May, 2006.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting soil gas samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines should be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting soil gas samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) and/or International Air Transportation Association (IATA) hazardous materials shipping requirements.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader and stored in a secure place.

2 Special Sampling Considerations

2.1 Special Considerations for Sampling

The tubing used as part of either of the described sampling systems should be Teflon® or stainless steel. As most soil gas sampling will be conducted to investigate the presence or extent of organic compounds, Teflon® tubing is required to ensure the integrity of the sample.

2.2 Special Precautions for Soil Gas Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should be changed any time during sample collection when their cleanliness is compromised.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Use O-rings on all tooling, adapters and probe rods to ensure that the entire sampling train is air-tight. This is necessary to prevent soil ingress during installation and to maintain sample integrity by ensuring that no ambient air is introduced into the sample during collection.
- When using the Post-Run Tubing (PRT) sampling system, excavate a small depression around the rods after driving the distance of the intended open interval. Fill the depression with bentonite crumbles (not pellets) and hydrate with tap water to ensure sealing at the ground surface. Special care should be taken to keep the rod string aligned with the push axis of the probe machine.

2.3 Sample Handling Requirements

1. Soil gas samples will typically be collected by directly filling evacuated, specially-prepared stainless steel canisters (SUMMA or SilcoSteel® canisters), after sample delivery line purging.

2. The canister will be labeled and identified according to SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples (SESDPROC-209).

2.4 Quality Control

Quality control sampling for soil gas sampling investigations will consist of collection of the following types of samples, as appropriate.

- Control Sample: If applicable to the study or investigation, a control sample should be collected from a location not affected by the possible contaminants of concern and submitted with the other samples.
- Field Blank: A canister field blank, prepared prior to the investigation by ASB personnel, should also be submitted with the sample set during the investigation.
- Equipment rinsate blank: Equipment rinsate blanks should be collected if equipment, such as PRT adapters, probe rod or other sampling equipment is field cleaned and re-used to document that low-level contaminants were not introduced into the sample by the decontaminated equipment.
- Field Split: Field split samples, at a minimum frequency of one for every twenty samples, should be collected. Split samples are collected by attaching the center leg of a Swagelok® "T" to the end of the sample tubing. The remaining legs of the "T" are connected to two sample containers which are opened and filled simultaneously.

2.5 Records

Information generated or obtained by SESD personnel will be organized and accounted for in accordance with SESD records management procedures found in the SESD Operating Procedure for Control of Records (SESDPROC-002). Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation according to the procedures found in SESD Operating Procedure Logbooks (SESDPROC-010) and SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3 Geoprobe® PRT System Installation

3.1 General

Single event or grab sampling may be conducted using the Post-Run Tubing System (PRT). Using this system, soil gas samples can be collected quickly and with a high degree of assurance that the samples are representative of the targeted depth, i.e., using this method, there is no leakage at probe rod joints that will compromise the integrity of the sample.

The downhole components of the PRT system include:

- Sample delivery tubing
- Probe rods
- PRT Adapter
- Expendable point holder
- Expendable point

O-ring seals are used on the PRT Adapter, the expendable point holder and at all rod joints. The O-rings prevent soil ingress which can prevent air-tight docking of the PRT adapter.

3.2 PRT System Installation Procedures

The following procedures are used to collect soil gas samples using the Geoprobe® PRT system. The PRT system is available for 1.0-inch, 1.25-inch and 1.5-inch diameter probe rod. In SESD practice, 1.25-inch rods are used. All parts or accessories used in the PRT system must be selected with the appropriate diameter probe rod in mind to ensure compatibility of all components.

1. Place O-ring on PRT expendable point holder and attach to initial section of probe rod.

2. Place O-ring on expendable point and press into expendable point holder.

3. Add drive cap to probe rod and push PRT system into ground the distance of the intended open-interval. Take special care to assure that the rods are in line with the push axis of the probe machine. Dig a small depression around the rod string. Fill the depression with bentonite crumbles (not pellets) and hydrate with tap water.

4. At the desired sampling depth, attach a point popper to an extension rod and insert extension rod string into rods so that the point popper rests on the expendable point. Using the rod puller, and taking special care to maintain probe alignment with the rods, begin pulling the rods while maintaining pressure on the extension

rods. The extension rods should drop when the pull is started, indicating that the expendable point has been ejected. The rods can then be pulled to expose the desired open sampling interval.

5. Using a properly decontaminated water level sounder, check, if conditions warrant, to make sure groundwater is not present prior to proceeding with Step 6.

6. Secure the PRT adapter to a length of tubing sufficient to reach from the sampling interval to the surface, with several feet of excess tubing extending beyond the top of the probe rod to facilitate sampling. The adapter is secured tightly to the tubing using electrical tape. This will not compromise the integrity of the sample to be collected, as the sample is pulled directly through the adapter and is never exposed to the tape.

7. Run the tubing and adapter into the probe rod and, using steady downward pressure, turn the tubing counter-clockwise to dock the adapter into the top of the expendable point holder. Tug gently on the tubing to ensure that the adapter engaged with the expendable point holder. Continue rotating tubing until the adapter is firmly seated. Failure to dock could indicate that soil intruded during the push or that the expendable point was lost during the push.

8. At this point, the PRT system has been installed and is ready for sampling. If the sample can not be collected immediately, the end of the tubing should be capped with a stainless steel Swagelok® cap. Sampling is conducted using one of the procedures described in Section 5, Sampling PRT and Permanent Soil Gas Installations

3.3 Decommissioning PRT Sample Locations

Because it is impractical to pump grout through the PRT adapter on the lead probe rod, the entire string of rod must be removed before decommissioning can commence. The following methods are available, depending on conditions related to sample depth and post-removal probe hole wall stability:

1. **Direct Placement of Pellets or Grout** - If the sampling depth was fairly shallow, on the order of ten feet or less, grouting/sealing the open hole can be accomplished by directly placing bentonite pellets, hydrated in lifts, or pouring a 30% solids bentonite grout mixture from the surface. The acceptable maximum depth for this option is somewhat dependent on the stability of the hole and these methods may be used at slightly greater depths if the holes do not collapse after removal of the rod.

2. **Re-entry Grouting** - For locations where sampling was conducted at somewhat greater depths or where the surficial formations tend to collapse, the only viable option for grout placement may be to re-probe the entire depth with an expendable point. After reaching the original sample depth, the expendable point

is ejected and the hole is grouted by directly injecting grout through the inside of the rod string, as it is removed. Use of this option is dependent on the relative degree of hole stability.

4 Geoprobe® Permanent Soil Gas Implant Installation

4.1 General

Long-term soil gas sampling may be conducted using permanent soil gas sampling implants installed with the Geoprobe®. Stainless steel implants may be installed at any depth achievable by the Geoprobe® and may be installed using 1.0-inch, 1.25-inch or 1.5-inch diameter probe rod. In SESD practice, 1.25-inch probe rods are used. The implants may be installed in custom lengths, configured using a wide assortment of available implant lengths and connections. The implant screens are double-woven stainless steel mesh with 0.0057-inch (0.15 mm) pore openings.

Permanent soil gas sampling implants may also be installed using 2.125-inch diameter rods utilizing an advancing thin-walled corer to facilitate placement of the implant (see Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling & Monitoring, Technical Bulletin No. MK3098 for details of this application).

4.2 Installation of Permanent Soil Gas Sampling Implants (Typical)

The following procedures are used by to install a permanent soil gas sampling implant using the Geoprobe®. These are the general procedures which are used with 1.25-inch diameter probe rod.

1. Attach O-ring to implant point anchor.

2. Press implant point anchor into point holder and attach to first section of probe rod.

3. Push implant point anchor to the desired depth for implant installation. Using O-rings on all rod joints will prevent soil intrusion.

4. When the desired depth has been reached, attach the implant to the sample delivery tubing. This is accomplished by loosening or removing the Swagelok® fitting and pressing the tubing into the implant. When the end of the tubing is sufficiently engaged in the end of the implant, the Swagelok® fitting is tightened to secure the tubing in the implant. The Swagelok® tightening recommendation is 1 and ¼ turns after finger-tightening. It is critical that the tubing be securely attached to the implant so that it does not pull off during subsequent steps of the installation.

5. Feed the tubing into the probe rod until the implant reaches the implant point anchor. At this point, cut the tubing to allow enough tubing to remain for sampling, usually three to four feet.

6. Rotate the tubing and implant counter-clockwise, threading the implant into the anchor. If there was any soil intrusion during the push, the implant may not dock. If the implant does not dock, it is possible to salvage the installation by removing the implant and sealing the small hole on the bottom of the implant, if present, with foil or with a small sheet metal screw, then returning the implant to the hole.

7. After the implant has been docked, use a pull cap and pull the probe rod approximately one foot, exposing the implant. Observe the tubing to make sure that anchor remained in place and is not being pulled with the rod.

8. If the implant remained in place, slowly pour a measured amount of 60-100 mesh glass beads down the inside of the probe rod. The glass beads are used as a filter pack around the implant. The implant should be covered with beads to approximately six inches above the top of the implant. The volume of beads should be calculated based on the length of implant used. While pouring the beads, it is advisable to gently shake the tubing to prevent the beads from bridging inside the probe rod.

9. After placing the beads, the implant is sealed using a flowable mixture of the glass beads and fine-powdered bentonite. To accomplish this, two to three feet of rod is pulled and the mixture is slowly poured into the rod above the bead-packed implant. As with the bead placement, similar care should be taken to avoid bridging of this mixture. After placement of the bead/bentonite seal, hydrate by pouring one gallon of de-ionized water above the seal.

10. After placement and hydration of the seal, the rod string is removed and the resultant annular space is grouted using one of the following procedures, which are dependent on the depth and stability of the open hole.

    a. If the resultant open hole is shallow (ten feet or less) and the hole walls are stable, the hole may either be filled with bentonite pellets, hydrated in lifts, or grouted using a 30% solids bentonite grout, poured from the surface.

    b. If the hole is deeper than ten to fifteen feet, better results may be obtained by using a tremie pipe to place a pumpable grout. ½-inch PVC tremie pipe or Geoprobe nylon grout tubing is threaded down the annulus to the top of the bead/bentonite seal. The tremie is pulled off the bottom to prevent jetting out the seal and grout is pumped until the annulus is filled. Procedures are similar to those for well annular seals described in SESDGUID-101, Section 2.3.5.

11. For permanent or long-term installations the tubing should be protected by an appropriate surface completion, such as a flush vault or well protective casing, similar to well protective casings, as described in SESDGUID-101. The finish should be performed after 24 hours of grout curing.

12. After installation is complete the soil gas implant is sampled using one of the methods described in Section 5, Sampling PRT and Permanent Soil Gas Installations.

5 Sampling PRT and Permanent Soil Gas Installations

Soil gas samples may be collected from PRT and permanent soil gas implant installations using one of several methods, listed below. Canister sampling is the most common method utilized by SESD.

- Canister Sampling for Laboratory Analysis – After installation is complete and immediately prior to sampling, a flow-limiting device, consisting of a sintered stainless steel filter and a critical orifice, is attached at the sampling end of the tubing. After the device is connected to the Teflon® tubing, it is necessary to remove all stagnant or ambient air from the sample string. This volume, equal to approximately three times the volume of the sample string, should be estimated or calculated and attention must be given to not over-purging the estimated or calculated volume of the tubing and sample interval prior to sampling. Line purging can be accomplished using a low-flow pump, such as a personal air sampling pump, or a TVA1000.

  After all stagnant/ambient air has been removed, the purging pump is removed and an evacuated canister is attached using a Swagelok® or other suitable secure connection. After connection, the valve on the canister is opened, pulling soil gas from the implant into the canister. Typically the sample is collected over a one-hour period, at which time the canister valve is closed and the canister tagged with pertinent sampling information. Alternatively, in some situations a mass-flow controller will be required to collect a sample over a specified, longer period of time period. This type of sampler is typically out-fitted with a gauge that will display the canister vacuum during the sampling period. When using this type of device, it is advisable to check the canister vacuum throughout the sampling period to verify filling Gauge pressure/vacuum reading should be recorded in the project logbook.

- Real-time Field Analytical Methods – Real-time analytical measurements may be obtained from PRT or soil gas implant installations using appropriate instrumentation. The soil gas to be analyzed may be drawn directly into the instrument by the instrument pump or the instrument may be placed in line and the sample drawn into the instrument using a suitable pump connected to the discharge side of the instrument. Results may be qualitative, such as those obtained with flame ionization or photoionization detectors, or they may be quantitative, for instruments which can be calibrated to specific compounds.

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Soil Sampling**

Effective Date: December 20, 2011	**Number:** SESDPROC-300-R2

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-300-R2, *Soil Sampling*, replaces SESDPROC-300-R1. **General:** Corrected any typographical, grammatical and/or editorial errors. **Title Page:** Updated the Enforcement and Investigations Branch Chief to Archie Lee, and the Field Quality Manager to Bobby Lewis. **Revision History:** On the third sentence, replaced Field Quality Manager with Document Control Coordinator. **Section 1.2:** Added the following statement: Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use. **Section 1.3:** Revised the last sentence to reflect that the official copy of this procedure resides on the SESD local area network (LAN), and that the Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN. **Section 1.4:** Unused references removed. Reference to Method 5035 added. Alphabetized. **Section 1.5.2:** Added bullets #8 and #9. (Bullet #8 – Discussion of sampling in landscaped areas. Bullet #9 – Discussion of sampling in non-landscaped areas.) **Section 2:** The discussion of Method 5035 has been moved to its own Section (Section 3) for clarity. Subsequent Sections were re-numbered. **Section 4.1:** Added paragraphs #2 and #3. (The information on these paragraphs originally appeared as bullets #2 and #3 in Section 4.2.1.) In addition, determining the initial sampling depth is now defined in paragraph #2. **Section 4.2.1:** As mentioned above, deleted bullets #2 and #3 from this Section and moved this information to paragraphs #2 and #3 in Section 4.1. **Section 5.1:** On paragraph #1, rewrote sentences #2 and #3 for clarity. Added the last sentence. Added paragraph #2.	December 20, 2011

Section 5.3: Rewrote the last sentence in the paragraph to clarify that, "although the Macro-Core® sampler can be used as an open-barrel sampler, in SESD usage, the piston point is always used to prevent the collection of slough from the borehole sides." **Section 5.5:** Rewrote bullet #1 to clarify acceptable materials for liners. Rewrote bullet #3 (Core Catchers) to clarify that, given the limited sample contact that core-catchers have with the sample material, most standard core-catchers available for a tool system will be acceptable. Added bullets #4 (Decontamination) and #5 (Decommissioning). **Section 6.1:** Added paragraph #2 to this section. (Determining the initial sampling depth is now defined.) **Section 7.1:** Added paragraph #2 to this section. (Determining the initial sampling depth is now defined.) **Section 8.1:** Added paragraph #2 to this section. (Determining the initial sampling depth is now defined.)	
SESDPROC-300-R1, *Soil Sampling*, replaces SESDPROC-300-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Updated referenced operating procedures due to changes in title names. Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual. **Section 1.5.2, 4th bullet** Added references to the CFR and IATA's Dangerous Goods Regulations. **Section 2.7** Updated referenced operating procedures due to changes in title names.	November 1, 2007
SESDPROC-300-R0, Soil Sampling, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil sample, the variant procedure will be documented in the field logbook and subsequent investigation report, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN, and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field X-Ray Fluorescence (XRF) Measurement, SESDPROC-107, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

Title 49 Code of Federal Regulations, Pts. 171 to 179, Most Recent Version

US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, Most Recent Version (Method 5035)

US EPA. Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting soil samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting soil samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.

- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader in the project files.
- Sampling in landscaped areas: When sampling in landscaped areas, cuttings should be placed on plastic sheeting and returned to the borehole upon completion of the sample collection. Any 'turf plug' generated during the sampling process should be returned to the borehole.
- Sampling in non-landscaped areas: Return any unused sample material back to the auger, drill or push hole from which the sample was collected.

2 Special Sampling Considerations

2.1 Special Precautions for Trace Contaminant Soil Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different sample is collected and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be collected, handled and stored separately.
- All background samples shall be segregated from obvious high-concentration or waste samples. Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area. Samples of waste or highly-contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other member(s) collect the samples.
- Samplers must use new, verified/certified-clean disposable or non-disposable equipment cleaned according to procedures contained in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205), for collection of samples for trace metals or organic compound analyses.

2.2 Sample Homogenization

1. If sub-sampling of the primary sample is to be performed in the laboratory, transfer the entire primary sample directly into an appropriate, labeled sample container(s). Proceed to step 4.

2. If sub-sampling the primary sample in the field or compositing multiple primary samples in the field, place the sample into a glass or stainless steel homogenization container and mix thoroughly. Each aliquot of a composite sample should be of the same approximate volume.

3. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible of the sample media. ***Samples for VOC analysis are not homogenized.*** The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

- The material in the sample pan should be divided into quarters and each quarter should be mixed individually.
- Two quarters should then be mixed to form halves.
- The two halves should be mixed to form a homogenous matrix.

  This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

4. Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.

2.3 Dressing Soil Surfaces

Any time a vertical or near vertical surface is sampled, such as achieved when shovels or similar devices are used for subsurface sampling, the surface should be dressed (scraped) to remove smeared soil. This is necessary to minimize the effects of contaminant migration interferences due to smearing of material from other levels.

2.4 Quality Control

If possible, a control sample should be collected from an area not affected by the possible contaminants of concern and submitted with the other samples. This control sample should be collected as close to the sampled area as possible and from the same soil type. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by sampling tools. SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011) contains other procedures that may be applicable to soil sampling investigations.

2.5 Records

Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation, as described in the SESD Operating Procedure for Logbooks (SESDPROC-010) and the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3 Method 5035

The procedures outlined here are summarized from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, Method 5035.*

3.1 Soil Samples for Volatile Organic Compounds (VOC) Analysis

If samples are to be analyzed for volatile organic compounds, they should be collected in a manner that minimizes disturbance of the sample. For example, when sampling with an auger bucket, the sample for VOC analysis should be collected directly from the auger bucket (preferred) or from minimally disturbed material immediately after an auger bucket is emptied into the pan. The sample shall be containerized by filling an En Core® Sampler or other Method 5035 compatible container. ***Samples for VOC analysis are not homogenized.*** Preservatives may be required for some samples with certain variations of Method 5035. Consult the method or the principal analytical chemist to determine if preservatives are necessary.

3.2 Soil Sampling (Method 5035)

The following sampling protocol is recommended for site investigators assessing the extent of volatile organic compounds (VOCs) in soils at a project site. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

3.2.1 Equipment

Soil for VOC analyses may be retrieved using any of the SESD soil sampling methods described in Sections 4 through 8 of this procedure. Once the soil has been obtained, the En Core® Sampler, syringes, stainless steel spatula, standard 2-oz. soil VOC container, or pre-prepared 40 mL vials may be used/required for sub-sampling. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various sub-sampling methods are described below.

3.2.2 Sampling Methodology - Low Concentrations (<200 µg/kg)

When the total VOC concentration in the soil is expected to be less than 200 µg/kg, the samples may be collected directly with the En Core® Sampler or syringe. If using the syringes, the sample must be placed in the sample container (40 mL pre-prepared vial) immediately to reduce volatilization losses. The 40 mL

vials should contain 10 mL of organic-free water for an un-preserved sample or approximately 10 mL of organic-free water and a preservative. It is recommended that the 40 mL vials be prepared and weighed by the laboratory (commercial sources are available which supply preserved and tared vials). When sampling directly with the En Core® Sampler, the vial must be immediately capped and locked.

A soil sample for VOC analysis may also be collected with conventional sampling equipment. A sample collected in this fashion must either be placed in the final sample container (En Core® Sampler or 40 mL pre-prepared vial) immediately or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 2-oz. soil jar) is used, the sample must be transferred to the final sample container (En Core® Sampler or 40 mL pre-prepared vial) as soon as possible, not to exceed 30 minutes.

NOTE: After collection of the sample into either the En Core® Sampler or other container, the sample must immediately be stored in an ice chest and cooled.

Soil samples may be prepared for shipping and analysis as follows:

En Core® Sampler - the sample shall be capped, locked, and secured in the original foil bag. All foil bags containing En Core® samplers are then placed in a plastic bag and sealed with custody tape, if required.

Syringe - Add about 3.7 cc (approximately 5 grams) of sample material to 40-mL pre-prepared containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag. Note: When using the syringes, it is important that no air is allowed to become trapped behind the sample prior to extrusion, as this will adversely affect the sample.

Stainless Steel Laboratory Spatulas - Add between 4.5 and 5.5 grams (approximate) of sample material to 40 mL containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag.

3.2.3 Sampling Methodology - High Concentrations (>200 µg/kg)

Based upon the data quality objectives and the detection level requirements, this high level method may also be used. Specifically, the sample may be packed into a single 2-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils\sediments containing high total VOC concentrations may also be collected as described in Section 3.2.2, Sampling Methodology - Low Concentrations, and preserved using 10 mL methanol.

3.2.4 Special Techniques and Considerations for Method 5035

Effervescence

If low concentration samples effervesce from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or un-preserved, as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence (rapid formation of bubbles) then preservation by acidification is not acceptable, and the sample must be collected un-preserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed into the vial. The sample may then be collected as an un-preserved sample. Note that the amount of organic free water placed into the vials will have to be accurately measured.

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size and the lack of sample mixing, sample representativeness for VOCs may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Sample holding times are specified in the Analytical Support Branch *Laboratory Operations and Quality Assurance Manual* (ASBLOQAM), Most Recent Version. Field investigators should note that the holding time for an un-preserved VOC soil/sediment sample on ice is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

Percent Moisture and Preservative Compatibility (MOICA)

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are

being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 oz.) for percent moisture determination will be required. The sample collected for percent moisture may also be used by the laboratory to check for preservative compatibility.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. Shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities.

The summary table on the following page lists the options available for compliance with SW846 Method 5035. The advantages and disadvantages are noted for each option. SESD's goal is to minimize the use of hazardous material (methanol and sodium bisulfate) and minimize the generation of hazardous waste during sample collection.

Table 1: Method 5035 Summary

OPTION	PROCEDURE	ADVANTAGES	DISADVANTAGES
1	Collect two 40 mL vials with ≈ 5 grams of sample, and one 2 oz. glass jar w/septum lid for screening, % moisture and preservative compatibility.	Screening conducted by lab.	Presently a 48-hour holding time for unpreserved samples. Sample containers must be tared.
2	Collect three En Core® samplers, and one 2 oz. glass jar w/septum lid for screening, % moisture and preservative compatibility.	Lab conducts all preservation/preparation procedures.	Presently a 48- hour holding time for preparation of samples.
3	Collect two 40 mL vials with 5 grams of sample and preserve w/methanol or sodium bisulfate, and one 2-oz. glass jar w/septum lid for screening, % moisture and preservative compatibility.	High level VOC samples may be composited. Longer holding time.	Hazardous materials used in the field. Sample containers must be tared.
4	Collect one 2-oz. glass jar w/septum lid for analysis, % moisture and preservative compatibility (high level VOC only).	Lab conducts all preservation/preparation procedures.	May have significant VOC loss.

4 Manual Soil Sampling Methods

4.1 General

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The most common interval is 0 to 6 inches; however, the data quality objectives of the investigation may dictate another interval, such as 0 to 3 inches for risk assessment purposes. The shallow subsurface interval may be considered to extend from approximately 12 inches below ground surface to a site-specific depth at which sample collection using manual collection methods becomes impractical.

If a thick, matted root zone, gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials.

When compositing, make sure that each composite location (aliquot) consist of equal volumes, i.e., same number of equal spoonfuls.

4.2 Spoons

Stainless steel spoons may be used for surface soil sampling to depths of approximately 6 inches below ground surface where conditions are generally soft and non-indurated, and there is no problematic vegetative layer to penetrate.

4.2.1 Special Considerations When Using Spoons

- When using stainless steel spoons, consideration must be given to the procedure used to collect the volatile organic compound sample. If the soil being sampled is cohesive and holds its in situ texture in the spoon, the En Core® Sampler or syringe used to collect the sub-sample for Method 5035 should be plugged directly from the spoon. If, however, the soil is not cohesive and crumbles when removed from the ground surface for sampling, consideration should be given to plugging the sample for Method 5035 directly from the ground surface at a depth appropriate for the investigation Data Quality Objectives.

4.3 Hand Augers

Hand augers may be used to advance boreholes and collect soil samples in the surface and shallow subsurface intervals. Typically, 4-inch stainless steel auger buckets with cutting heads are used. The bucket is advanced by simultaneously pushing and turning using an attached handle with extensions (if needed).

4.3.1 Surface Soil Sampling

When conducting surface soil sampling with hand augers, the auger buckets may be used with a handle alone or with a handle and extensions. The bucket is advanced to the appropriate depth and the contents are transferred to the homogenization container for processing. Observe precautions for volatile organic compound sample collection found in Section 3, Method 5035.

4.3.2 Subsurface Soil Sampling

Hand augers are the most common equipment used to collect shallow subsurface soil samples. Auger holes are advanced one bucket at a time until the sample depth is achieved. When the sample depth is reached, the bucket used to advance the hole is removed and a clean bucket is attached. The clean auger bucket is then placed in the hole and filled with soil to make up the sample and removed.

The practical depth of investigation using a hand auger depends upon the soil properties and depth of investigation. In sand, augering is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow or collapse. Hand augers may also be of limited use in tight clays or cemented sands. In these soil types, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torqueing of the hand auger extensions. At some point these problems become so severe that power equipment must be used.

4.3.3 Special Considerations for Soil Sampling with the Hand Auger

- Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
- Observe precautions for volatile organic compound sample collection found in Section 3, Method 5035. Collect the VOC sample directly from the auger bucket, if possible.
- Power augers, such as the Little Beaver® and drill rigs may be used to advance boreholes to depths for subsurface soil sampling with the hand auger. They may not be used for sample collection. When power augers are used to advance a borehole to depth for sampling, care must be taken that exhaust fumes, gasoline and/or oil do not contaminate the borehole or area in the immediate vicinity of sampling.
- When moving to a new sampling location, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

5 Direct Push Soil Sampling Methods

5.1 General

These methods are used primarily to collect shallow and deep subsurface soil samples. Three samplers are available for use within the Division's direct push tooling inventory. All of the sampling tools involve the collection and retrieval of the soil sample within a thin-walled liner. The following sections describe each of the specific sampling methods that can be accomplished using direct push techniques, along with details specific to each method. While SESD currently uses the sample tooling described, tooling of similar design and materials is acceptable.

If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with these devices.

5.2 Large Bore® Soil Sampler

The Large Bore® (LB) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of depth-discrete subsurface soil samples. The sample barrel is approximately 30-inches (762 mm) long and has a 1.5-inch (38 mm) outside diameter. The LB® sampler is capable of recovering a discrete sample core 22 inches x 1.0 inch (559 mm x 25 mm) contained inside a removable liner. The resultant sample volume is a maximum of 283 mL.

After the LB® sample barrel is equipped with the cutting shoe and liner, the piston-rod point assembly is inserted, along with the drive head and piston stop assembly. The assembled sampler is driven to the desired sampling depth, at which time the piston stop pin is removed, freeing the push point. The LB® sampler is then pushed into the soil a distance equal to the length of the LB® sample barrel. The probe rod string, with the LB® sampler attached, is then removed from the subsurface. After retrieval, the LB® sampler is then removed from the probe rod string. The drive head is then removed to allow removal of the liner and soil sample.

5.3 Macro-Core® Soil Sampler

The Macro-Core® (MC) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of either continuous or depth-discrete subsurface soil samples. Although other lengths are available, the standard MC® sampler has an assembled length of approximately 52 inches (1321 mm) with an outside diameter of 2.2 inches (56 mm). The MC® sampler is capable of recovering a discrete sample core 45 inches x 1.5 inches (1143 mm x 38 mm) contained inside a removable liner. The resultant sample volume is a maximum of 1300 mL. The MC® sampler may be used in either an open-tube or closed-point configuration. Although the

MC® sampler can be used as an open-barrel sampler, in SESD usage, the piston point is always used to prevent the collection of slough from the borehole sides.

5.4 Dual Tube Soil Sampling System

The Dual Tube 21 soil sampling system is a direct push system for collecting continuous core samples of unconsolidated materials from within a sealed outer casing of 2.125-inch (54 mm) OD probe rod. The samples are collected within a liner that is threaded onto the leading end of a string of 1.0-inch diameter probe rod. Collected samples have a volume of up to 800 mL in the form of a 1.125-inch x 48-inch (29 mm x 1219 mm) core. Use of this method allows for collection of continuous core inside a cased hole, minimizing or preventing cross-contamination between different intervals during sample collection. The outer casing is advanced, one core length at a time, with only the inner probe rod and core being removed and replaced between samples. If the sampling zone of interest begins at some depth below ground surface, a solid drive tip must be used to drive the dual tube assembly and core to its initial sample depth.

5.5 Special Considerations When Using Direct Push Sampling Methods

- *Liner Use and Material Selection* – Direct Push Soil Samples are collected within a liner to facilitate removal of sample material from the sample barrel. The liners may only be available in a limited number of materials for a given sample tool, although overall, liners are available in brass, stainless steel, cellulose acetate butyrate (CAB), polyethylene terepthalate glycol (PETG), polyvinyl chloride (PVC) and Teflon®. For most SESD investigations, the standard polymer liner material for a sampling tool will be acceptable. When the study objectives require very low reporting levels or unusual contaminants of concern, the use of more inert liner materials such as Teflon® or stainless steel may be necessary.

- *Sample Orientation* – When the liners and associated sample are removed from the sample tubes, it is important to maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely the depth at which an aliquot was collected. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of the liner and black caps on the bottom to maintain proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.

- *Core Catchers* – Occasionally the material being sampled lacks cohesiveness and is subject to crumbling and falling out of the sample liner. In cases such as these, the use of core catchers on the leading end of the sampler may help retain the sample until it is retrieved to the surface. Core catchers may only be available in specific materials and should be evaluated for suitability.

However, given the limited sample contact that core-catchers have with the sample material, most standard core-catchers available for a tool system will be acceptable.

- *Decontamination* – The cutting shoe and piston rod point are to be decontaminated between each sample, using the procedures specified for the collection of trace organic and inorganic compounds found in Field Equipment and Decontamination – SESDPROC-205, most recent version. Within a borehole, the sample barrel, rods, and drive head may be subjected to an abbreviated cleaning to remove obvious and loose material, but must be cleaned between boreholes using the procedures specified for downhole drilling equipment in Field Equipment and Decontamination – SESDPROC-205, most recent version.

- *Decommissioning* – Boreholes must be decommissioned after the completion of sampling. Boreholes less than 10 feet depth that remain open and do not approach the water table may be decommissioned by pouring 30% solids bentonite grout from the surface, or pouring bentonite pellets from the surface, hydrating the pellets in lifts. Boreholes deeper than 10 feet, or any borehole that intercepts groundwater, must be decommissioned by pressure grouting with 30% solids bentonite grout, either through a re-entry tool string or through tremie pipe introduced to within several feet of the borehole bottom.

- *VOC Sample Collection* – Observe precautions for volatile organic compound sample collection found in Section 3 of this procedure.

6 Split Spoon/Drill Rig Methods

6.1 General

Split spoon sampling methods are used primarily to collect shallow and deep subsurface soil samples. All split spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end. The leading end is held together with a beveled threaded collar that functions as a cutting shoe. The other end is held together with a threaded collar that serves as the sub used to attach the spoon to the string of drill rod. Two basic methods are available for use, including the smaller diameter standard split spoon, driven with the drill rig safety hammer, and the larger diameter continuous split spoon, advanced inside and slightly ahead of the lead auger during hollow stem auger drilling. The following sections describe each of the specific sampling methods, along with details specific to each method.

If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with these devices.

6.2 Standard Split Spoon

A drill rig is used to advance a borehole to the target depth. The drill string is then removed and a standard split spoon is attached to a string of drill rod. Split spoons used for soil sampling must be constructed of stainless steel and are typically 2.0-inches OD (1.5-inches ID) and 18-inches to 24-inches in length. Other diameters and lengths are common and may be used if constructed of the proper material. After the spoon is attached to the string of drill rod, it is lowered into the borehole. The safety hammer is then used to drive the split spoon into the soil at the bottom of the borehole. After the split spoon has been driven into the soil, filling the spoon, it is retrieved to the surface, where it is removed from the drill rod string and opened for sample acquisition.

6.3 Continuous Split Spoon

The continuous split spoon is a large diameter split spoon that is advanced into the soil column inside a hollow stem auger. Continuous split spoons are typically 3 to 5 inches in diameter and either 5 feet or 10 feet in length, although the 5-foot long samplers are most common. After the auger string has been advanced into the soil column a distance equal to the length of the sampler being used it is returned to the surface. The sampler is removed from inside the hollow stem auger and the threaded collars are removed. The split spoon is then opened for sampling.

6.4 Special Considerations When Using Split Spoon Sampling Methods

- Always discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the borehole wall after removal of the drill string prior to and during inserting the split spoon.
- Observe precautions for volatile organic compound sample collection found in Section 3, Method 5035.

7 Shelby Tube/Thin-Walled Sampling Methods

7.1 General

Shelby tubes, also referred to generically as thin-walled push tubes or Acker thin-walled samplers, are used to collect subsurface soil samples in cohesive soils and clays during drilling activities. In addition to samples for chemical analyses, Shelby tubes are also used to collect relatively undisturbed soil samples for geotechnical analyses, such as hydraulic conductivity and permeability, to support hydrogeologic characterizations at hazardous waste and other sites.

If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with this device.

7.2 Shelby Tube Sampling Method

A typical Shelby tube is 30 inches in length and has a 3.0-inch OD (2.875-inch ID) and may be constructed of steel, stainless steel, galvanized steel, or brass. They also typically are attached to push heads that are constructed with a ball-check to aid in holding the contained sample during retrieval. If used for collecting samples for chemical analyses, it must be constructed of stainless steel. If used for collecting samples for standard geotechnical parameters, any material is acceptable.

To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed material by hydraulic force. After retrieval to the surface, the tube containing the sample is then removed from the sampler head. If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition. If the sample is collected for geotechnical parameters, the tube is typically capped, maintaining the sample in its relatively undisturbed state, and shipped to the appropriate geotechnical laboratory.

7.3 Special Considerations When Using Split Spoon Sampling Methods

Observe precautions for volatile organic compound sample collection found in Section 3, Method 5035.

8 Backhoe Sampling Method

8.1 General

Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. If possible, the sample should be collected without entering the trench. Samples may be obtained from the trench wall or they may be obtained directly from the bucket at the surface. The following sections describe various techniques for safely collecting representative soil samples with the aid of a backhoe.

The depth measurement for the sample begins at the top of the soil horizon.

8.2 Scoop-and-Bracket Method

If a sample interval is targeted from the surface, it can be sampled using a stainless steel scoop and bracket. First a scoop and bracket are affixed to a length of conduit and is lowered into the backhoe pit. The first step is to take the scoop and scrape away the soil comprising the surface of the excavated wall. This material likely represents soil that has been smeared by the backhoe bucket from adjacent material. After the smeared material has been scraped off, the original stainless steel scoop is removed and a clean stainless steel scoop is placed on the bracket. The clean scoop can then be used to remove sufficient volume of soil from the excavation wall to make up the required sample volume.

8.3 Direct-from-Bucket Method

It is also possible to collect soil samples directly from the backhoe bucket at the surface. Some precision with respect to actual depth or location may be lost with this method but if the soil to be sampled is uniquely distinguishable from the adjacent or nearby soils, it may be possible to characterize the material as to location and depth. In order to ensure representativeness, it is also advisable to dress the surface to be sampled by scraping off any smeared material that may cross-contaminate the sample.

8.4 Special Considerations When Sampling with a Backhoe

- Do not physically enter backhoe excavations to collect a sample. Use either procedure 8.2, Scoop-and-Bracket Method, or procedure 8.3, Direct-from-Bucket Method to obtain soil for sampling.
- Smearing is an important issue when sampling with a backhoe. Measures must be taken, such as dressing the surfaces to be sampled (see Section 2.3), to mitigate problems with smearing.

- Paint, grease and rust must be removed and the bucket decontaminated prior to sample collection.
- Observe precautions for volatile organic compound sample collection found in Section 3, Method 5035.

FDEP

FC 1000. CLEANING / DECONTAMINATION PROCEDURES

1. PERFORMANCE CRITERIA

1.1. The cleaning/decontamination procedures must ensure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest.

1.2. The detergents and other cleaning supplies cannot contribute analytes of interest or interfering constituents unless these are effectively removed during a subsequent step in the cleaning procedure.

1.3. The effectiveness of any cleaning procedure (including all cleaning reagents) must be supported by equipment blanks with reported non-detected values.

The cleaning procedures outlined in this SOP are designed to meet the above-mentioned performance criteria. Alternative cleaning reagents or procedures may be used. However, the organization must be prepared to demonstrate through documentation (i.e., company-written protocols and analytical records) and historical data (i.e., absence of analytes of interest in equipment blanks) that it consistently meets these performance criteria. Field quality control measures (see FQ 1210) must support the use of alternative reagents or procedures.

FC 1001. *Cleaning Reagents*

Recommendations for the types and grades of various cleaning supplies are outlined below. The recommended reagent types or grades were selected to ensure that the cleaned equipment is free from any detectable contamination.

1. DETERGENTS: Use Luminox (or a non-phosphate solvent based equivalent), Liqui-Nox (or a non-phosphate equivalent) or Alconox (or equivalent). EPA recommends Luminox (or equivalent) since solvent rinses can be eliminated from the cleaning process. Liquinox (or equivalent) may be substituted (solvent rinses, when applicable, must be performed), and Alconox (or equivalent) may be substituted if the sampling equipment will not be used to collect phosphorus or phosphorus-containing compounds.

2. SOLVENTS

Note: If the detergent Luminox (or equivalent) is used, solvent rinses are not required.

2.1. Use pesticide grade isopropanol as the rinse solvent in routine equipment cleaning procedures. This grade of alcohol must be purchased from a laboratory supply vendor.

2.2. Other solvents, such as acetone or methanol, may be used as the final rinse solvent if they are pesticide grade. However, methanol is more toxic to the environment and acetone may be an analyte of interest for volatile organics.

2.2.1. **Do not use** acetone if volatile organics are of interest.

2.3. Properly dispose of all wastes according to applicable regulations. Containerize all solvents (including rinsates) for on-site remediation or off-site disposal, as required.

2.4. Pre-clean equipment that is heavily contaminated (see FC 1120, section 3) with organic analytes with reagent grade acetone and hexane or other suitable solvents.

2.5. Use pesticide grade methylene chloride when cleaning sample containers.

2.6. Store all solvents away from potential sources of contamination (gas, copier supplies, etc.).

3. ANALYTE-FREE WATER SOURCES

3.1. Analyte-free water is water in which all analytes of interest and all interferences are below method detection limits.

3.2. Maintain documentation (such as results from equipment blanks) to demonstrate the reliability and purity of analyte-free water source(s).

3.3. The source of the water must meet the requirements of the analytical method and must be free from the analytes of interest. In general, the following water types are associated with specific analyte groups:

- Milli-Q (or equivalent polished water): suitable for all analyses.
- Organic-free: suitable for volatile and extractable organics.
- Deionized water: not suitable for volatile and extractable organics if the analytes of interest are present in concentrations that affect the result.
- Distilled water: not suitable for volatile and extractable organics, metals or ultra-trace metals.

3.4. Use analyte-free water for blank preparation and the final decontamination water rinse.

3.5. In order to minimize long-term storage and potential leaching problems, obtain or purchase analyte-free water just prior to the sampling event. If obtained from a source (such as a laboratory), fill the transport containers and use the contents for a single sampling event. Empty the transport container(s) at the end of the sampling event.

3.6. Discard any analyte-free water that is transferred to a dispensing container (such as a wash bottle) at the end of each sampling day.

4. ACIDS

4.1. Reagent Grade Nitric Acid: 10 - 15% (one volume concentrated nitric acid and five volumes deionized water).

4.1.1. Use for the acid rinse unless nitrogen components (e.g., nitrate, nitrite, etc.) are to be sampled.

4.1.2. If sampling for ultra-trace levels of metals, use an ultra-pure grade acid.

4.2. Reagent Grade Hydrochloric Acid: 10% hydrochloric acid (one volume concentrated hydrochloric and three volumes deionized water).

4.2.1. Use when nitrogen components are to be sampled.

4.3. If samples for both metals and the nitrogen-containing components (see FC 1001, section 4.1.1 above) are collected with the equipment, use the hydrochloric acid rinse, or thoroughly rinse with hydrochloric acid after a nitric acid rinse.

4.4. If sampling for ultra trace levels of metals, use an ultra-pure grade acid.

4.5. Freshly prepared acid solutions may be recycled during the sampling event or cleaning process. Dispose appropriately at the end of the sampling event, cleaning process or if acid is discolored or appears otherwise contaminated (e.g., floating particulates).

4.5.1. Transport only the quantity necessary to complete the sampling event.

4.6. Dispose of any unused acids according to FDEP and local ordinances.

FC 1002. *Reagent Storage Containers*

The contents of all containers must be clearly marked.

1. DETERGENTS: Store in the original container or in a high density polyethylene (HDPE) or polypropylene (PP) container.

2. SOLVENTS

2.1. Store solvents to be used for cleaning or decontamination in the original container until use in the field. If transferred to another container for field use, the container must be either glass or Teflon.

2.2. Use dispensing containers constructed of glass, Teflon, or stainless steel. Note: if stainless steel sprayers are used, any components (including gaskets and transfer lines) that contact the solvents must be constructed of inert materials.

3. ANALYTE-FREE WATER: Transport in containers appropriate to the type of water to be stored. If the water is commercially purchased (e.g., grocery store), use the original containers when transporting the water to the field. Containers made of glass, Teflon, polypropylene, or Polyethylene (PE) are acceptable.

3.1. Use glass, Teflon, polypropylene or PE to transport organic-free sources of water on-site.

3.2. Dispense water from containers made of glass, Teflon, PE or polypropylene.

3.3. Do not store water in transport containers for more than three days before beginning a sampling event.

3.4. Store and dispense acids using containers made of glass, Teflon, PE or polypropylene.

FC 1003. *General Requirements*

1. Before using any equipment, clean/decontaminate all sampling equipment (pumps, tubing, lanyards, split spoons, etc.) that are exposed to the sample.

1.1. Before installing, clean (or obtain as certified precleaned) all equipment that is dedicated to a single sampling point and remains in contact with the sample medium (e.g., permanently installed groundwater pump (see FS 2220, section 3.3.4).

1.2. Clean this equipment any time it is removed for maintenance or repair.

1.3. Replace dedicated tubing if discolored or damaged.

2. Clean all equipment in a designated area having a controlled environment (house, laboratory, or base of field operations) and transport to the field precleaned and ready to use, unless otherwise justified.

3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

4. Whenever possible, transport sufficient clean equipment to the field so that an entire sampling event can be conducted without the need for cleaning equipment in the field.

5. Segregate equipment that is only used once (i.e., not cleaned in the field) from clean equipment and return to the in-house cleaning facility to be cleaned in a controlled environment.

6. Protect decontaminated field equipment (including well sounders) from environmental contamination by securely wrapping and sealing with one of the following:

6.1. Aluminum foil (commercial grade is acceptable);

6.2. Untreated butcher paper; or

6.3. Clean, untreated, disposable plastic bags. Plastic bags may be used:

- For all analyte groups except volatile and extractable organics;
- For volatile and extractable organics, if the equipment is first wrapped in foil or butcher paper or if the equipment is completely dry.

7. Containerize all solvent rinsing wastes, detergent wastes and other chemical wastes requiring off-site or regulated disposal. Dispose of all wastes in conformance with applicable regulations.

FC 1100. Cleaning Sample Collection Equipment

FC 1110. ON-SITE/IN-FIELD CLEANING

1. Cleaning equipment on-site is not recommended because:

1.1. Environmental conditions cannot be controlled.

1.2. Wastes (solvents and acids) must be containerized for proper disposal.

2. If performed, follow the appropriate cleaning procedure as outlined in FC 1130. Ambient temperature water may be substituted in the hot, sudsy water bath, and hot water rinses.

Note: Properly dispose of all solvents and acids.

3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

FC 1120. HEAVILY CONTAMINATED EQUIPMENT

In order to avoid contaminating other samples, isolate heavily contaminated equipment from other equipment and thoroughly decontaminate the equipment before further use. Equipment is considered heavily contaminated if it:

- Has been used to collect samples from a source known to contain significantly higher levels than background;
- Has been used to collect free product; or
- Has been used to collect industrial products (e.g., pesticides or solvents) or their by-products.

1. Cleaning heavily contaminated equipment in the field is not recommended.

2. ON-SITE PROCEDURES

2.1. Protect all other equipment, personnel and samples from exposure by isolating the equipment immediately after use.

2.2. At a minimum, place the equipment in a tightly sealed untreated plastic bag.

2.3. Do not store or ship the contaminated equipment next to clean, decontaminated equipment, unused sample containers, or filled sample containers.

2.4. Transport the equipment back to the base of operations for thorough decontamination.

2.5. If cleaning must occur in the field, and in order to document the effectiveness of the procedure, collect and analyze blanks on the cleaned equipment (see FQ 1000).

3. CLEANING PROCEDURES

3.1. If organic contamination cannot be readily removed with scrubbing and a detergent solution, prerinse equipment by thoroughly rinsing or soaking the equipment in acetone.

3.1.1. Do not use solvent soaks or rinses if the material is clear acrylic.

3.1.2. Use hexane only if preceded and followed by acetone.

3.2. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with routine cleaning procedures.

3.3. After the solvent rinses (and/or steam cleaning), use the appropriate cleaning procedure (see FC 1130).

3.3.1. Scrub, rather than soak all equipment with sudsy water.

3.3.2. If high levels of metals are suspected and the equipment cannot be cleaned without acid rinsing, soak the equipment in the appropriate acid. Do not use stainless steel equipment when heavy metal contamination is suspected or present, since stainless steel cannot be exposed to prolonged acid soaks.

3.4. If the field equipment cannot be cleaned utilizing these procedures, discard unless further cleaning with stronger solvents and/or oxidizing solutions is effective as evidenced by visual observation and blanks.

3.5. Clearly mark or disable all discarded equipment to discourage use.

FC 1130. GENERAL CLEANING

Follow these procedures when cleaning equipment under controlled conditions. See FC 1110 for modifications if cleaning is performed on-site. Check manufacturer's instructions for cleaning restrictions and/or recommendations.

FC 1131. *Procedure for Teflon, Stainless Steel and Glass Sampling Equipment*

This procedure must be used when sampling for **ALL** analyte groups: extractable organics, metals, nutrients, etc. or if a single decontamination protocol is desired to clean all Teflon, stainless steel and glass equipment.

1. Rinse equipment with hot tap water.

2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).

3. If necessary, use a brush to remove particulate matter or surface film.

4. Rinse thoroughly with hot tap water.

5. If samples for trace metals or inorganic analytes will be collected with the equipment and the equipment **is not** stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4).

6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.

7. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water (see FC 1001, section 3).

8. Allow to air dry. Wrap and seal according to FC 1003, section 6 as soon as the equipment is air-dried.

9. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse (see FC 1131, section 8 above); however, **the equipment must be completely dry before wrapping or use**.

10. Wrap clean sampling equipment according to the procedure described in FC 1003, section 6.

FC 1132. *General Cleaning Procedure for Plastic Sampling Equipment*

1. Rinse equipment with hot tap water.

2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).

3. If necessary, use a brush to remove particulate matter or surface film.

4. Rinse thoroughly with hot tap water.

5. Thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4). Check manufacturer's instructions for cleaning restrictions and/or recommendations.

6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water. Allow to air dry as long as possible.

7. Wrap clean sampling equipment according to the procedure described in FC 1003, section 6.

FC 1133. *Cleaning Procedure by Analyte Group*

See Table FC 1000-1 for the procedures to be used to decontaminate equipment based on construction of sampling equipment, and analyte groups to be sampled.

FC 1140. AUTOMATIC SAMPLERS, SAMPLING TRAINS AND BOTTLES

1. When automatic samplers are deployed for extended time periods, clean the sampler using the following procedures when routine maintenance is performed. Inspect deployed samplers prior to each use. At a minimum, change the tubing if it has become discolored or has lost elasticity (FC 1140, section 2.3 below).

2. Clean all automatic samplers (such as ISCO) as follows:

   2.1. Wash the exterior and accessible interior portions of the automatic samplers (excluding the waterproof timing mechanisms) with laboratory detergent (see FC 1001, section 1) and rinse with tap water.

2.2. Clean the face of the timing case mechanisms with a clean, damp cloth.

2.3. Check all tubing (sample intake and pump tubing). Change the tubing every six months (if used frequently) or if it has become discolored (i.e., affected by mold and algae) or if it has lost its elasticity.

2.4. See FC 1160, section 4 for the procedures associated with cleaning the tubing in the pump head.

3. AUTOMATIC SAMPLER ROTARY FUNNEL AND DISTRIBUTOR

3.1. Clean with hot sudsy water and a brush (see FC 1001, section 1 for appropriate detergent type).

3.2. Rinse thoroughly with analyte-free water.

3.3. Air dry.

3.4. Replace in sampler.

4. SAMPLER METAL TUBE: Clean as outlined in FC 1160, section 5.

5. REUSABLE GLASS COMPOSITE SAMPLE CONTAINERS

5.1. If containers are used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the container several times with reagent-grade acetone before the detergent wash. If material cannot be removed with acetone, discard the container.

5.2. Wash containers following the procedure outlined in FC 1131 above. End with a final solvent rinse if organics are to be sampled.

5.3. Invert containers to drain and air dry for at least 24 hours.

5.4. Cap with aluminum foil, Teflon film or the decontaminated Teflon-lined lid.

5.5. After use, rinse with water in the field, seal with aluminum foil to keep the interior of the container wet, and return to the laboratory or base of operations.

5.6. **Do not recycle or reuse containers if**:

5.6.1. They were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;

5.6.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or

5.6.3. The containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers must be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.

5.6.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest **before** use. If found to be contaminated, (i.e., constituents of interest are found at method detection levels or higher), then **discard the containers**.

6. REUSABLE PLASTIC COMPOSITE SAMPLE CONTAINERS

6.1. Follow FC 1132.

6.2. Inspect the containers. Determine if the containers can be reused by the criteria in FC 1140, section 5 above.

7. GLASS SEQUENTIAL SAMPLE BOTTLES FOR AUTOMATIC SAMPLER BASED FOR SEQUENTIAL MODE

7.1. Clean glass sequential sample bottles to be used for collecting inorganic samples by using a laboratory dishwasher (see FC 1140, sections 7.1.1 through 7.1.3 below) or manually following the procedures in FC 1131.

7.1.1. Rinse with appropriate acid solution (see FC 1001, section 4).

7.1.2. Rinse thoroughly with tap water.

7.1.3. Wash in dishwasher at wash cycle, using laboratory detergent cycle, followed by tap and analyte-free water rinse cycles.

7.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.

7.3. Rinse bottles in the field with water as soon as possible after sampling event.

8. Glass Sequential Sample Bottles (Automatic Sampler based for Sequential Mode) to be used for Collecting Samples for Organic Compounds

8.1. Use cleaning procedures outlined in FC 1131. Allow containers to thoroughly air dry before use.

8.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.

9. BOTTLE SIPHONS USED TO TRANSFER SAMPLES FROM COMPOSITE CONTAINERS

9.1. Rinse tubing with solvent and dry overnight in a drying oven.

9.2. Cap ends with aluminum foil and/or Teflon film for storage.

9.3. Seal in plastic for storage and transport.

9.4. Flush siphon thoroughly with sample before use.

10. REUSABLE TEFLON COMPOSITE MIXER RODS

10.1. Follow procedures outlined in FC 1131.

10.2. Wrap in aluminum foil for storage.

FC 1150. FILTRATION EQUIPMENT

1. Dissolved Constituents using in-line, Molded and Disposable Filter Units

1.1. <u>Peristaltic Pump</u>

1.1.1. Clean the pump following procedures in FC 1170, section 2.2.

1.1.2. Clean the pump head tubing following FC 1160, section 4.

1.1.3. If Teflon tubing is used, clean following the procedures in FC 1160, section 3.

1.1.4. Clean other tubing types such as polyethylene according to the appropriate procedures listed in FC 1160, section 7.

1.2. <u>Other Equipment Types (e.g., pressurized Teflon bailer)</u>

1.2.1. Follow the appropriate cleaning regimen specified in FC 1131 through FC 1132 for other types of equipment that utilize in-line, molded and disposable filters.

2. Dissolved Constituents using Non-disposable Filtration Units (e.g., syringes, "tripod assembly")

2.1. Stainless Steel or Glass Units

2.1.1. Follow FC 1131, assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.

2.1.2. Remove and clean any transfer tubing according to the appropriate cleaning procedures (see FC 1160).

2.1.3. Assemble the unit and cap both the pressure inlet and sample discharge lines (or whole unit if a syringe) with aluminum foil to prevent contamination during storage.

2.1.4. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.

2.2. Reusable In-Line Filter Holders

2.2.1. Clean, using FC 1131, (if Teflon, glass or stainless steel) or FC 1132 (if plastic) assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.

2.2.2. Assemble the unit and wrap with aluminum foil to prevent contamination during storage.

2.2.3. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.

3. FILTERS

3.1. Do not clean filters. Instructions for rinsing the filters prior to use are discussed in the applicable sampling SOPs (FS 2000 - FS 8000).

FC 1160. SAMPLE TUBING DECONTAMINATION

1. Check tubing:

1.1. For discoloration: Remove discolored tubing from use until it can be cleaned. If the discoloration cannot be removed, discard the tubing.

1.2. For elasticity (if used in a peristaltic-type pump): Discard any tubing that has lost its elasticity.

2. Transport all tubing to the field in precut, **precleaned** sections.

3. TEFLON, POLYETHYLENE AND POLYPROPYLENE TUBING

3.1. New Tubing: Follow this procedure unless the manufacturer/supplier provides certification that the tubing is clean.

3.1.1. Teflon

3.1.1.1. Rinse outside of tubing with pesticide-grade solvent (see FC 1001, section 2).

3.1.1.2. Flush inside of tubing with pesticide-grade solvent.

3.1.1.3. Dry overnight in drying oven or equivalent (zero air, nitrogen, etc.).

3.1.2. Polyethylene and Polypropylene

3.1.2.1. Clean the exterior and interior of the tubing by soaking in hot, sudsy water.

3.1.2.2. Thoroughly rinse the exterior and interior of the tubing with tap water, followed by analyte-free water.

3.2. Reused Tubing

Use the following procedure for in-lab cleaning. **Field cleaning is not recommended**:

3.2.1. Clean the exterior of the tubing by soaking in hot, sudsy water (see FC 1001, section 1) in a stainless steel sink (or equivalent non-contaminating material). Use a brush to remove any particulates, if necessary.

3.2.2. Use a small bottle brush and clean the inside of the tubing ends where the barbs are to be inserted or cut 1-2 inches from the ends of the tubing after cleaning.

3.2.3. Rinse tubing exterior and ends liberally with tap water.

3.2.4. Rinse tubing surfaces and ends with the appropriate acid solution (see FC 1001, section 4), tap water, isopropanol (see FC 1001, section 2), and finally analyte-free water.

3.2.4.1. Note: Eliminate the isopropanol rinse for polyethylene or polypropylene tubing.

3.2.5. Place tubing on fresh aluminum foil or clean polyethylene sheeting. Connect all of the precut lengths of tubing with Teflon inserts or barbs.

3.2.6. Cleaning configuration:

3.2.6.1. Place cleaning reagents: [sudsy water (see FC 1001, section 1); acid (see FC 1001, section 4); isopropanol (see FC 1001, section 2)] in an appropriately cleaned container (2-liter glass jar is recommended).

3.2.6.2. Place one end of the Teflon tubing into the cleaning solution.

3.2.6.3. Attach the other end of the Teflon tubing set to the influent end of a pump.

3.2.6.4. Recycle the effluent from the pump by connecting a length of Teflon tubing from the effluent to the glass jar with the cleaning reagents.

3.2.6.5. Recycling as described above may be done for all reagents listed in FC 1160, section 3.2.6.1 above, **except** the final isopropanol rinse and the final analyte-free water rinse. Disconnect the tubing between the effluent end of the pump and the jar of cleaning reagents.

3.2.6.6. Containerize isopropanol in a waste container for proper disposal.

3.2.6.7. Analyte-free water may be discarded down the drain.

3.2.7. Using the above configuration described in FS 1160, section 3.2.6 above:

3.2.7.1. Pump hot, sudsy water through the connected lengths. Allow the pump to run long enough to pump at least three complete tubing volumes through the tubing set.

3.2.7.2. Using the same procedure, successively pump tap water, the acid solution(s), tap water, isopropanol, and finally analyte-free water through the system.

3.2.7.3. Leave the Teflon inserts or barbs between the precut lengths and cap or connect the remaining ends.

3.2.8. After the interior has been cleaned as described in FC 1160, section 3.2.7 above, rinse the exterior of the tubing with analyte-free water.

3.2.9. Wrap the connected lengths in aluminum foil or untreated butcher paper and store in a clean, dry area until use.

4. Flexible Tubing used in Pump Heads of Automatic Samplers and other Peristaltic Pumps

Replace tubing after each sampling point if samples are collected through the tubing. Unless the pump is deployed to collect samples from the same location over a long period of time, remove and wash the tubing after each sampling event (see FC 1140, section 1).

4.1. Flush tubing with hot tap water then sudsy water (see FC 1001, section 1).

4.2. Rinse thoroughly with hot tap water.

4.3. Rinse thoroughly with analyte-free water.

4.4. If used to collect metals samples, flush the tubing with an appropriate acid solution (see FC 1001, section 4), followed by thorough rinsing with analyte-free water. If used to collect both metals and nitrogen components use hydrochloric acid (see FC 1001, section 4.1.1).

4.5. Install tubing in peristaltic pump or automatic sampler.

4.6. Cap both ends with aluminum foil or equivalent.

Note: Change tubing at specified frequencies as part of routine preventative maintenance.

5. STAINLESS STEEL TUBING

Clean the exterior and interior of stainless steel tubing as follows:

5.1. Using sudsy water (see FC 1001, section 1), scrub the interior and exterior surfaces.

5.2. Rinse with hot tap water.

5.3. Rinse with analyte-free water.

5.4. If volatile or extractable organics are to be sampled, rinse all surfaces with isopropanol (see FC 1001, section 2). Use enough solvent to wet all surfaces with free flowing solvent.

5.5. Allow to air dry or thoroughly rinse with analyte-free water.

6. GLASS TUBING

6.1. Use new glass tubing.

6.2. If volatile or extractable organics are to be sampled, rinse with isopropanol (see FC 1001, section 2).

6.3. Air dry for at least 24 hours.

6.4. Wrap in aluminum foil or untreated butcher paper to prevent contamination during storage.

6.5. Discard tubing after use.

7. MISCELLANEOUS NON-INERT TUBING TYPES (TYGON, RUBBER, PVC, ETC.)

7.1. New Tubing

7.1.1. As a general rule, new tubing may be used without preliminary cleaning.

7.1.2. Protect new tubing from potential environmental contamination by wrapping in aluminum foil and sealing in untreated plastic bags or keep in the original sealed packaging until use.

7.1.3. If new tubing is exposed to potential contamination, rinse the exterior and interior tubing surfaces with hot tap water followed by a thorough rinse with analyte-free water.

7.1.4. If new tubing is to be used to collect samples, thoroughly rinse the tubing with sample water (i.e., pump sample water through the tubing) before collecting samples.

7.2. Reused Tubing

7.2.1. Flush tubing with sudsy solution of hot tap water and laboratory detergent (see FC 1001, section 1).

7.2.2. Rinse exterior and interior thoroughly with hot tap water.

7.2.3. Rinse exterior and interior thoroughly with analyte-free water.

7.2.4. If used to collect only metals samples, flush the tubing with nitric acid (see FC 1001, section 4.1), followed by a thorough rinse with analyte-free water.

7.2.5. If used to collect metals and nitrogen-containing compounds, see FC 1001, section 4.3.

7.2.6. Cap ends in aluminum foil and store in clean, untreated plastic bags to prevent contamination during storage and transport.

FC 1170. PUMPS

1. SUBMERSIBLE PUMPS

1.1. Pumps used for Purging and Sampling Metals and/or Volatile and Extractable Organics

1.1.1. Construction of pump body and internal mechanisms (bladders, impellers, etc.), including seals and connections, must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.

1.1.2. Tubing material must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.

1.1.3. Clean pump exterior following FC 1132. Note: omit the solvent rinse if the pump body is constructed of plastic (e.g., ABS, PVC, etc.).

1.1.4. Clean the pump internal cavity and mechanism as follows:

1.1.4.1. If used only for purging, thoroughly flush the pump with water before purging the next well.

1.1.4.2. When used for purging and sampling, completely disassemble the pump (if practical) and decontaminate between each well.

1.1.4.3. When used for purging and sampling and the pump cannot be (practicably) disassembled, then clean the internal cavity/mechanism by pumping

several gallons of sudsy water (see FC 1001, section 1), followed by several gallons of tap water, and finally, several gallons of analyte-free water.

1.1.4.4. If multiple sampling points are located in an area that is not accessible by a vehicle, and it is difficult to return to the vehicle for cleaning or to transport all cleaning materials to the staging location, at a minimum thoroughly rinse the pump with water.

1.1.5. Refer to FC 1160, section 3 to clean Teflon tubing.

1.1.6. Refer to FC 1160, section 5 for stainless steel tubing.

1.1.7. Clean other types of tubing according to FC 1160, sections 6 and 7.

1.2. Pumps used for Purging and Sampling all Analytes except Metals, Volatile and Extractable Organics

1.2.1. Pump construction: no restrictions.

1.2.2. Pump tubing material: no restrictions.

1.2.3. Scrub the exterior of the pump with appropriate metal-free, phosphate-free or ammonia-free detergent solution.

1.2.4. Rinse the exterior with tap water and analyte-free water.

1.2.5. Rinse the interior of the pump and tubing by pumping tap or analyte-free water through the system using a clean bucket or drum.

2. ABOVE-GROUND PUMPS USED FOR PURGING AND SAMPLING

2.1. Pumps used only for Purging

2.1.1. The exterior of the pump must be free of oil and grease.

2.1.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.

2.1.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

2.2. Pumps used for Sampling

2.2.1. Clean the exterior of the pump with a detergent solution followed by a tap water rinse. Use clean cloths or unbleached paper towels that have been moistened with the appropriate solution to wipe down the pump.

2.2.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.

2.2.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

FC 1180. ANALYTE-FREE WATER CONTAINERS

This section pertains to containers that are purchased to transport, store and dispense analyte-free water. It does not apply to water that has been purchased in containers. See FC 1002, section 3 for appropriate construction materials.

1. NEW CONTAINERS

1.1. Wash containers and caps according to FC 1131, omitting the solvent rinse if plastic (polyethylene or polypropylene) containers are being cleaned.

1.2. Cap with Teflon film or the bottle cap. The bottle cap must be composed of the same material as the container and cannot be lined.

2. REUSED CONTAINERS

2.1. Immediately after emptying, cap with aluminum foil, Teflon film or the container cap.

2.2. Wash the exterior of the container with lab-grade detergent solution (see FC 1001, section 1) and rinse with analyte-free water.

2.3. Rinse the interior thoroughly with analyte-free water.

2.4. Invert and allow to drain and dry.

FC 1190. ICE CHESTS AND SHIPPING CONTAINERS

1. Wash the exterior and interior of all ice chests with laboratory detergent (see FC 1001, section 1) after each use.

2. Rinse with tap water and air dry before storing.

3. If the ice chest becomes severely contaminated with concentrated waste or other toxic or hazardous materials clean as thoroughly as possible, render unusable, and properly dispose.

FC 1200. Field Instruments and Drilling Equipment

FC 1210. FIELD INSTRUMENTS (TAPES, METERS, ETC.)

Follow manufacturer's recommendations for cleaning instruments. At a minimum:

1. Wipe down equipment body, probes, and cables with lab-grade detergent solution (see FC 1001, section 1). Check manufacturer's instructions for recommendations and/or restrictions on cleaning.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with analyte-free water.

4. Store equipment according to the manufacturer's recommendation or wrap equipment in aluminum foil, untreated butcher paper or untreated plastic bags to eliminate potential environmental contamination.

FC 1220. SOIL BORING EQUIPMENT

This section pertains only to equipment that is not used to collect samples. Clean split spoons, bucket augers and other sampling devices according to FC 1131.

1. Remove oil, grease, and hydraulic fluid from the exterior of the engine and power head, auger stems, bits and other associated equipment with a power washer or steam jenny or wash by hand with a brush and sudsy waster (no degreasers).

2. Rinse thoroughly with tap water.

FC 1230. WELL CASING CLEANING

These are recommended procedures for cleaning well casing and riser pipes. Use procedures specified by a FDEP contract, order, permit, or rule, if different or more stringent than the procedures outlined below.

1. FDEP recommends only using casing that is designed for subsurface environmental groundwater monitoring.

2. Casing that has been contaminated with grease, hydraulic fluid, petroleum fuel, etc. may require additional cleaning or deemed unusable.

3. All casings and riser pipes should be cleaned before installation, unless the casing is received wrapped and ready for installation:

3.1. Steam clean all casings and riser pipes except PVC. Steam cleaning criteria shall meet the following: water pressure - 2500 psi; water temperature - 200°F.

3.2. Rinse thoroughly with tap (potable) water. This tap water must be free of the analytes of interest.

FC 1300. Sample Containers

FC 1310. OBTAINING CLEAN CONTAINERS

1. Obtain clean sample containers in one of three ways:

1.1. From commercial vendors as precleaned containers. The cleaning grades must meet EPA analyte specific requirements. Keep all records for these containers (lot numbers, certification statements, date of receipt, etc.) and document the container's intended uses;

1.2. From internal groups within the organization that are responsible for cleaning and maintaining containers according to the procedures outlined in FC 1320; or

1.3. From a subcontracted laboratory that is accredited under the National Environmental Laboratory Accreditation Program (NELAP).

1.3.1. The contractor must verify that the laboratory follows the container cleaning procedures outlined in FC 1320.

1.3.2. If the laboratory cleaning procedures are different, the contractor must require that the laboratory use the following cleaning procedures or provide documentation and historical records to show that their in-house procedure produces containers that are free from the analytes of interest.

FC 1320. CONTAINER CLEANING PROCEDURES

1. Refer to Table FC 1000-2. Follow the cleaning steps in the order specified in the chart.

2. Cleaning procedures that are different from those outlined in FC 1320 may be used as long as blanks collected in the containers are free from the analytes of interest and any analytical interferences and the cleaning procedures are supported by historical and continuing documentation.

3. Inspect all containers before cleaning.

3.1. **Do not recycle or reuse containers if**:

3.1.1. Containers were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;

3.1.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or

3.1.3. Containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers shall be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.

3.1.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest before use. If found to be contaminated (i.e., analytes of interest are found at MDL levels or higher), discard the containers.

FC 1400. Documentation

Document cleaning procedures described below for the indicated activities. See FD 1000 for additional information about required records and retention of documents.

FC 1410. FIELD EQUIPMENT

1. IN-FIELD CLEANING

   1.1. Initially identify the procedures that are used to clean equipment in the field by SOP numbers and dates of usage.

   1.2. Record the date and time that equipment was cleaned.

2. IN-HOUSE CLEANING

   2.1. Retain any cleaning certificates, whether from a laboratory or commercial vendor.

   2.2. Identify the procedure(s) that are used to clean equipment by the SOP number and dates of usage.

   2.3. Record the date that the equipment was cleaned.

FC 1420. SAMPLE CONTAINERS

1. Organizations that order precleaned containers must retain the packing slips, and lot numbers of each shipment, any certification statements provided by the vendor and the vendor cleaning procedures.

2. Organizations that clean containers must maintain permanent records of the following:

   2.1. Procedure(s) used to clean containers by SOP number and dates of usage.

   2.2. If containers are certified clean by the laboratory the laboratory must record:

   - Type of container;
   - Date cleaned;
   - SOP used;
   - Person responsible for cleaning;
   - Lot number (date of cleaning may be used) of the batch of containers that were cleaned using the same reagent lots and the same procedure;
   - The results of quality control tests that were run on lot numbers; and
   - Any additional cleaning or problems that were encountered with a specific lot.

FC 1430. REAGENTS AND OTHER CLEANING SUPPLIES

Maintain a record of the lot number with the inclusive dates of use for all acids, solvents, and other cleaning supplies.

Appendix FC 1000
Tables, Figures and Forms

Table FC 1000-1 Procedures for Decontamination at the Base of Operations or On-site

Table FC 1000-2 Container Cleaning Procedures

Table FC 1000-1
Procedures for Decontamination at the Base of Operations or On-Site

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
Teflon or Glass	All	FC 1131	Follow as written	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Extractable & Volatile Organics Petroleum Hydrocarbons		May omit acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution May omit acid rinse
	Metals[1] Radionuclides For ultra trace metals, refer to FS 8200		May omit solvent rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution May omit solvent rinse
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		May omit solvent rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
	Microbiological – Viruses Microbiological - Bacteria		Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
Metallic (stainless steel, brass, etc.)	All Extractable & Volatile Organics Petroleum Hydrocarbons	FC 1131	Omit the acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution Omit the acid rinse
	Metals Radionuclides		Omit the acid rinse May omit the solvent rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution Omit the acid rinse May omit the solvent rinse
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		Omit solvent rinse May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

Table FC 1000-1
Procedures for Decontamination at the Base of Operations or On-Site

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
	Microbiological – Viruses Microbiological - Bacteria		Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
Plastic (Polyethylene, polypropylene, PVC, silicone, acrylic	Volatile and Extractable Organics;	FC 1132	Follow as written.	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
	Microbiological – Viruses Microbiological - Bacteria		Omit acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

[i] Do not use glass if collecting samples for boron or silica.

Table FC 1000-2
Container Cleaning Procedures

ANALYSIS / ANALYTE GROUP	CLEANING STEPS See Description Below
Extractable Organics	1, 2, 4, 6 (not required if Luminox (or equivalent is used), (5 and 7 optional), 11
Volatile Organics	1, 2, 4, (6 optional, methanol only), 7
Metals	1, 2, 3, 4, 8, 11 ** **Procedures to clean containers for ultra-trace metals are found in FS 8200
Inorganic Nonmetallics, Radionuclides, Physical and Aggregate Properties, Aggregate Inorganics, and Volatile Inorganics	1, 2, 3*, 4, 8, 11 * For nutrients, replace nitric acid with hydrochloric acid, or use a hydrochloric acid rinse after the nitric acid rinse. See FC 1001, section 4
Petroleum Hydrocarbons, and Oil and Grease	1, 2, 3, 4, (5, 6, 7 optional), 11
Microbiological (all)	1, 2, 4, 8, 9, 11
Toxicity Tests (Includes Bioassays)	1, 2, 10, 2, 4, 6.1, (10 optional), 11

NOTE: Steps 1 and 2 may be omitted when cleaning new, uncertified containers.

1. Wash with hot tap water and a brush using a suitable laboratory-grade detergent:

   1.1. Volatile and Extractable Organics, Petroleum Hydrocarbon, Oil and Grease: Luminox, Liqui-Nox, Alconox or equivalent;

   1.2. Inorganic nonmetallics: Liqui-Nox or equivalent;

   1.3. Metals: Liqui-Nox, Acationox, Micro or equivalents:

   1.4. Microbiologicals (all): Must pass an inhibitory residue test.

2. Rinse thoroughly with hot tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse thoroughly with analyte-free water (deionized or better).
5. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide-grade isopropanol, acetone or methanol.

   6.1. For bioassays, use only acetone, and only when containers are glass.

7. Oven dry at 103°C to 125°C for at least 1 hour.

Table FC 1000-2
Container Cleaning Procedures

7.1. VOC vials and containers must remain in the oven in a contaminant-free environment until needed. They should be capped in a contaminant-free environment just prior to dispatch to the field.

8. Invert and air-dry in a contaminant-free environment.

9. Sterilize containers:

9.1. Plastic: 60 min at 170°C, loosen caps to prevent distortion.

9.2. Glass: 15 min at 121°C.

10. Rinse with 10% hydrochloric acid followed by a sodium bicarbonate solution.

11. Cap tightly and store in a contaminant-free environment until use. Do not use glass if collecting samples for boron or silica.

FD 1000. DOCUMENTATION PROCEDURES

1. INTRODUCTION:

   1.1. For the creation of clear, accurate and methodical records to document all field activities affecting sample data, implement the following standard operating procedures for sample collection, sample handling and field-testing activities.

2. SCOPE AND APPLICABILITY

   2.1. This SOP provides a detailed listing of the information required for documentation of all sampling procedures and field testing.

   2.2. Refer to the associated sampling or field testing SOP for any requirements for the chronological or sequential documentation of data.

3. QUALITY ASSURANCE

   3.1. Implement review procedures to monitor and verify accurate manual and automated data entry and recordkeeping for all documentation tasks outlined in this SOP.

FD 1100. Universal Documentation Requirements

Incorporate efficient archival design and concise documentation schemes for all record systems. Ensure that the history of a sample is clearly evident in the retained records and documentation and can be independently reconstructed.

1. CRITERIA FOR ALL DOCUMENTS

   1.1. Keep all applicable documentation available for inspection. Keep all original data and records as well as reduced or manipulated forms of the original data or records.

      1.1.1. Authorized representatives of DEP have the legal right to inspect and request copies of any records using paper, electronic media, or other media during any DEP audit of physical facilities or on-site sampling events, and for any data validations conducted for applicable project data submitted to DEP.

   1.2. Record enough information so that clarifications, interpretations, or explanations of the data are not required from the originator of the documentation.

   1.3. Clearly indicate the nature and intent of all documentation and all record entries.

   1.4. Link citations to SOPs and other documents by the complete name, reference or publication number, revision number, and revision date for the cited document, when applicable. Also assign this information to internally generated SOPs.

   1.5. Retain copies of all revisions of all cited documents as part of the documentation archives.

2. PROCEDURES

   2.1. Sign, initial or encode all documentation entries made to paper, electronic or other records with a link indicating the name and responsibility of the author making the data entry, clearly indicating the reason for the signature, initials or code (e.g., “sampled by”; “released by”; “prepared by”; “reviewed by”).

   2.2. In order to abbreviate record entries, make references to procedures written in internal SOPs or methodology and procedures promulgated by external sources.

2.2.1. Document the intent to use SOPs other than the DEP SOPs, or to use allowable modifications to the DEP SOPs by recording the effective date of use for all such SOPs or modifications.

2.2.1.1. Retain any correspondence with DEP regarding approval to use alternative procedures for any projects.

2.2.2. Authorize all internal SOPs with the signatures of the quality assurance officer(s) and manager(s) responsible for implementation of the SOPs. Record the dates of signature.

2.3. Employ straightforward archiving of records to facilitate documentation tracking and retrieval of all current and archived records for purposes of inspection, verification, and historical reconstruction of all procedures and measurement data.

2.4. Keep copies or originals of all documentation, including documentation sent to or received from external parties.

2.5. Use waterproof ink for all paper documentation.

2.6. Do not erase or obliterate entry errors on paper records. Make corrections by marking a line through the error so that it is still legible. Initial or sign the marked error and its correction.

2.7. Maintain electronic audit trails for all edited electronic records, if possible. Utilize software that allows tracking of users and data edits, if available. Software that prompts the user to double-check edits before execution is also preferred. See FD 1200.

2.8. Clearly link all documentation associated with a sample or measurement. Make cross-references to specific documentation when necessary.

2.9. Link final reports, data summaries, or other condensed versions of data to the original sample data, including those prepared by external parties.

3. RETENTION REQUIREMENTS

3.1. Per the DEP QA Rule, 62-160.220 & .340, F.A.C., keep all documentation archives for a minimum of 5 years after the date of project completion or permit cycle unless otherwise specified in a Department contract, order, permit, or Title 62 rules.

FD 1200. Electronic Documentation

Handle electronic (digital) data as with any data according to applicable provisions of FD 1100.

1. RETENTION OF AUTOMATIC DATA RECORDING PRODUCTS

1.1. For data not directly read from the instrument display and manually recorded, retain all products or outputs from automatic data recording devices, such as strip chart recorders, integrators, data loggers, field measurement devices, computers, etc. Store records in electronic, magnetic, optical, or paper form, as necessary.

1.1.1. Retain all original, raw output data. Ensure archiving of these data prior to subsequent reduction or other manipulation of the data.

1.2. Identify output records as to purpose, analysis date and time, field sample identification number, etc. Maintain clear linkage with the associated sample, other data source or measured medium and specific instrument used to make the measurement.

2. ELECTRONIC DATA SECURITY

2.1. Control levels of access to electronic data systems as required to maintain system security and to prevent unauthorized editing of data.

2.2. Do not alter raw instrumentation data or original manual data records in any fashion without retention of the original raw data.

2.3. Maintain secure computer networks and appropriate virus protection as warranted for each system design.

3. ELECTRONIC DATA STORAGE AND DOCUMENTATION

3.1. Store all electronic, magnetic, and optical media for easy retrieval of records.

3.1.1. Ensure that all records can be printed to paper if needed for audit or verification purposes.

3.1.2. If it is anticipated that the documentation archive will become unreadable due to obsolescence of a particular storage technology, retain a paper archive of the data or transfer to other suitable media.

3.2. For easy retrieval of records, link all stored data to the associated sample data or other data source.

3.3. Back up all data at a copy rate commensurate with the level of vulnerability of the data. Consider replicating all original data as soon as possible after origination.

4. SOFTWARE VERIFICATION

4.1. Ensure that any software used to perform automatic calculations conforms to required formulas or protocols.

4.2. Document all software problems and their resolution in detail, where these problems have irretrievably affected data records or linkage. Record the calendar date, time, responsible personnel, and relevant technical details of all affected data and software files. Note all software changes, updates, installations, etc. per the above concerns. File and link all associated service records supplied by vendors or other service personnel.

5. PROTECTION OF EQUIPMENT AND STORAGE MEDIA

5.1. Place stationary computers, instrumentation, and peripheral devices in locations of controlled temperature and humidity and away from areas where the potential for fluid leaks, fire, falling objects, or other hazards may exist. In the field, protect portable equipment from weather, excess heat or freezing, storage in closed vehicles, spillage from reagents and samples, etc.

5.2. Protect storage media from deteriorating conditions such as temperature, humidity, magnetic fields, or other environmental hazards as above.

6. ELECTRONIC SIGNATURES – Documents signed with electronic signatures must be consistent with the requirements of 62-160.405, F.A.C.:

6.1. the integrity of the electronic signature can be assured;

6.2. the signature is unique to the individual;

6.3. the organization using electronic signatures has written policies for the generation and use of electronic signatures; and

6.4. the organization using electronic signatures has written procedures for ensuring the security, confidentiality, integrity and auditability of each signature.

FD 1300. Documentation Using Other Media

1. UNIVERSAL REQUIREMENTS

   1.1. Handle documentation prepared using other media according to FD 1100.

2. PROTECTION OF STORED MEDIA

   2.1. Store media such as photographs, photographic negatives, microfilm, videotape, etc. under conditions generally prescribed for these media by manufacturers and conducive to long-term storage and protection from deterioration. See also FD 1200, section 5, above.

FD 2000. DOCUMENTATION OF CLEANED EQUIPMENT, SAMPLE CONTAINERS, REAGENTS AND SUPPLIES

When providing sample containers, preservation reagents, analyte-free water or sampling equipment, document certain aspects of these preparations.

1. EQUIPMENT CLEANING DOCUMENTATION

   1.1. Document all cleaning procedures by stepwise description in an internal SOP if cleaning procedures in the DEP SOP have been modified for use. Alternatively, cite the DEP SOP procedures in the cleaning record for the applicable equipment.

   1.2. Record the date of cleaning.

      1.2.1. If items are cleaned in the field during sampling activities for a site, document the date and time when the affected equipment was cleaned. Link this information with the site and the cleaning location at the site.

   1.3. Retain or make accessible any certificates of cleanliness issued by vendors supplying cleaned equipment or sample containers.

      1.3.1. Retain from the vendor or document for internal cleaning the following information for sample containers, as applicable:

- Packing slip and cleanliness certificates from vendors
- Container types and intended uses
- Lot numbers or other designations for groups of containers cleaned together using the same reagents and procedures
- Dates of cleaning
- Cleaning procedures or reference to internal cleaning SOPs or DEP SOPs
- Cleaning personnel names
- Results of quality control analyses associated with container lots
- Comments about problems or other information associated with container lots

2. SAMPLING KIT DOCUMENTATION

If supplied to a party other than internal staff, transmit to the recipient the following information pertaining to sampling equipment or other implements, sample containers, reagent containers, analyte-free water containers, reagents or analyte-free water supplied to the recipient.

- Quantity, description and material composition of all containers, container caps or closures or liners for caps or closures
- Intended application for each sample container type indicated by approved analytical method or analyte group(s)
- Type, lot number, amount and concentration of preservative added to clean sample containers and/or shipped as additional preservative
- Intended use for any additional preservatives or reagents provided
- Description of any analyte-free water (i.e., deionized, organic-free, etc.)
- Date of analyte-free water containerization
- Date of sampling kit preparation
- Description and material composition of all reagent transfer implements (e.g., pipets) shipped in the sampling kit and the analyte groups for which the implements have been cleaned or supplied
- Quantity, description and material composition of all sampling equipment and pump tubing (including equipment supplied for filtration) and the analyte groups for which the equipment has been cleaned or supplied
- Tare weight of VOC vials, as applicable (this item is necessary when EPA 5035 VOC sample vials are provided for soil samples)

3. DOCUMENTATION FOR REAGENTS AND OTHER CHEMICALS

3.1. Keep a record of the lot numbers and inclusive dates of use for all reagents, detergents, solvents and other chemicals used for cleaning and sample preservation.

3.1.1. See FD 4000 below for documentation requirements for reagents used for field testing.

FD 3000. DOCUMENTATION OF EQUIPMENT MAINTENANCE

1. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures, corrective actions performed during calibrations or verifications, and solution or parts replacement for instrument probes.

1.1. Include the calendar date for the procedures performed.

1.2. Record names of personnel performing the maintenance or repair tasks.

1.2.1. Describe any malfunctions necessitating repair or service.

2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This identifier may include a manufacturer name, model number, serial number, inventory number, or other unique identification.

3. Retain vendor service records for all affected instruments.

4. Record the following for rented equipment:

- Rental date(s)
- Equipment type and model or inventory number or other description

5. Retain the manufacturer's operating and maintenance instructions.

FD 4000. DOCUMENTATION FOR CALIBRATION OF FIELD-TESTING INSTRUMENTS AND FIELD ANALYSES

Document acceptable instrument or measuring system calibration for each field test or analysis of a sample or other measurement medium.

FD 4100. General Documentation for all Field Testing

1. STANDARD AND REAGENT DOCUMENTATION: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

1.1.1. Document acceptable verification of any standard used after its expiration date.

1.2. Record the concentration or other value for the standard in the appropriate measurement units.

1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

1.2.2.1. Record the grade of standard or reagent used.

1.3. When formulated in-house, document all calculations used to formulate calibration standards.

1.3.1. Record the date of preparation for all in-house formulations.

1.4. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

2. FIELD INSTRUMENT CALIBRATION DOCUMENTATION: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

2.1. Retain vendor certifications of all factory-calibrated instrumentation.

2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

2.3. Record the time and date of all initial calibrations and all calibration verifications.

2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

2.5. Record the name of the analyst(s) performing the calibration or verification.

2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Link to information recorded according to section 1 above

2.7. Retain manufacturers' instrument specifications.

2.8. Document whether successful initial calibration occurred.

2.9. Document whether each calibration verification passed or failed.

2.10. Document, according to records requirements of FD 3000, any corrective actions taken to modify instrument performance.

2.10.1. Document date and time of any corrective actions.

2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- "J" data qualifier code for estimated measurement or test sample value
- Reporting units for the measurement
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit used for the test (see 2.2 above)

FD 5000. DOCUMENTATION OF SAMPLE COLLECTION, PRESERVATION AND TRANSPORT

Follow these procedures for all samples. See FD 5100 - FD 5427 below for additional documentation for specific sampling activities. See example Forms in FD 9000 below for example formats for documenting specific sampling and testing procedures.

1. SAMPLE IDENTIFICATION REQUIREMENTS

1.1. Ensure that labels are waterproof and will not disintegrate or detach from the sample container when wet, especially under conditions of extended submersion in ice water typically accumulating in ice chests or other transport containers.

1.2. Label or tag each sample container with a unique field identification code that adequately distinguishes each sample according to the following criteria. The code must adequately link the sample container with all of the information about the sample contained in the permanent field record.

1.2.1. Link the unique field identification code to the sample source or sampling point identification, the date of sample collection, the time of sample collection (for maximum holding times equal to or less than 48 hours), the analytes of interest and the preservation technique.

1.2.2. Label or tag each sample container for the following types of samples with a unique field identification code:

- Quality control samples such as duplicate samples, other replicate samples or split samples collected for the same analyte or group of analytes
- Field samples or quality control samples collected using a different sample collection technique for the same analyte or group of analytes (for example, if both a bailer and a pump are used to collect samples for metals analysis, label the bailer sample to distinguish it from the pump sample)

1.2.3. The color, size, shape, or material composition of sample containers and caps cannot substitute for the information required in 1.2.1. – 1.2.2. Above.

1.2.4. The unique field identification code and any other information included on the container label or tag must allow the analyzing laboratory to independently determine the sample collection date, the sample collection time (for maximum holding times $\leq$ 48 hours), the sample preservation and the analytical tests to be performed on each container or group of containers.

1.3. Attach the label or tag so that it does not contact any portion of the sample that is removed or poured from the container.

1.4. Record the unique field identification code on all other documentation associated with the specific sample container or group of containers.

2. GENERAL REQUIREMENTS FOR SAMPLING DOCUMENTATION: Record the following information for all sampling:

2.1. Names of all sampling team personnel on site during sampling

2.2. Date and time of sample collection (indicate hours and minutes)

2.2.1. Use 24-hour clock time or indicate A.M. and P.M.

2.2.2. Note the exact time of collection for individual sample containers for time-sensitive analyses with a maximum holding time of 48 hours of less.

2.3. Ambient field conditions, to include, but not limited to information such as weather, tides, etc.

2.4. Comments about samples or conditions associated with the sample source (e.g., turbidity, sulfide odor, insufficient amount of sample collected)

2.5. Specific description of sample location, including site name and address

2.5.1. Describe the specific sampling point (e.g., monitoring well identification number, outfall number, station number, etc.).

2.5.2. Determine latitude and longitude of sampling source location (if required).

2.5.3. Locate sampling points on scaled maps or drawings where applicable.

2.6. Record the unique field identification code for each sample container and parameters to be analyzed, per section 1 above. The code must adequately link the sample container or group of containers with all of the information about the sample contained in the permanent field record.

2.7. Number of containers collected for each unique field identification code

2.8. Matrix sampled

2.9. Type of field sample collected, such as grab, composite or other applicable designation.

2.10. Field-testing measurement data:

2.10.1. See FD 4000 above for specific details.

2.11. Calibration records for field-testing equipment

2.11.1. See FD 4000 above for specific details.

2.12. Preservation for each container

2.12.1. Indicate whether samples are chemically preserved on-site by the sampling team or, alternatively, were collected in prepreserved (predosed) containers.

2.12.2. Indication of any tests performed in the field to determine the presence of analytical interferences in the sample.

2.12.3. Indication of any treatments of samples performed in the field to eliminate or minimize analytical interferences in the sample.

2.12.4. See FD 5100, section 1.

2.13. Purging and sampling equipment used, including the material composition of the equipment and any expendable items such as tubing.

2.14. Types, number, collection location and collection sequence of quality control samples

2.14.1. Include a list of equipment that was rinsed to collect any equipment blanks.

2.15. Use of fuel powered vehicles and equipment

2.16. Number of subsamples and amount of each subsample in any composite samples

2.16.1. Include sufficient location information for the composite subsamples per 2.4 above.

2.17. Depth of all samples or subsamples

2.18. Signature(s) or initials of sampler(s)

3. SAMPLE TRANSMITTAL RECORDS: Transmit the following information to the analytical laboratory or other receiving party. Link transmittal records with a given project and retain all transmittal records.

- Site name and address – Note: Client code is acceptable if samples are considered sensitive information and if the field records clearly trace the code to a specified site and address.
- Date and time of sample collection

- Name of sampler responsible for sample transmittal
- Unique field identification codes for each sample container
- Total number of samples
- Required analyses
- Preservation protocol
- Comments about sample or sample conditions
- Identification of common carrier (if used)

4. SAMPLE TRANSPORT

4.1. If shipping transmittal forms in the transport containers with the samples, place the forms in a waterproof enclosure and seal.

4.2. For common carrier shipping, seal transport containers securely with strapping tape or other means to prevent lids from accidentally opening.

4.2.1. Keep all shipping bills from common carriers with archived transmittal records.

5. ANCILLARY FIELD RECORDS: Link any miscellaneous or ancillary records (photographs, videotapes, maps, etc.) to specific sampling events such that these records are easily traceable in the data archives associated with the project, sampling date and sample source(s).

FD 5100. Documentation Specific To Aqueous Chemistry Sampling

1. SAMPLE PRESERVATION: Document preservation of all samples according to the following instructions.

1.1. List the chemical preservatives added to the sample.

1.2. Record the results of pH verification performed in the field, including the pH value of the sample (if applicable). Note any observations about changes in the sample as a result of adding preservative to the sample or mixing the sample with the preservative.

1.3. Record the amount of preservative added to samples and the amount of any additional preservative added. The amount dosed into sample containers supplied with premeasured preservatives must also be recorded.

1.3.1. For documentation of procedures for preservation for routine samples, cite DEP SOPs or internal SOPs for this information.

1.3.2. Record instances of deviation from preservation protocols found in SOPs when non-routine or problematic samples are collected.

1.4. Record the use of ice or other cooling method, when applicable.

2. GROUNDWATER SAMPLING

2.1. Record or establish a documentation link to the following information for all samples. See section 3 below for in-place plumbing:

- Well casing composition and diameter of well casing
- A description of the process and the data used to design the well

- The equipment and procedure used to install the well
- The well development procedure
- Pertinent lithologic or hydrogeologic information
- Ambient conditions at the wellhead or sampling point that are potential sources of unrepresentative sample contamination
- Water table depth and well depth
- Calculations used to determine purge volume
- Total amount of water purged
- Date well was purged
- Purging equipment used
- Sampling equipment used
- Well diameter
- Total depth of well
- Depth to groundwater
- Volume of water in the well
- Purging method
- Placement depth of tubing or pump intake
- Depth and length of screened interval
- Times for beginning and ending of purging
- Total volume purged
- Times of stabilization parameter measurements
- Purging rate, including any changes in rate
- Temperature measurements
- pH measurements
- Specific conductance measurements
- Dissolved oxygen measurements
- Turbidity measurements
- Site or monitoring well conditions impacting observed dissolved oxygen and turbidity measurements
- Color of groundwater
- Odor of groundwater

2.2. Record the following for Water Level and Purge Volume Determination (FS 2211):

- Depth to groundwater
- Total depth of well

- Length of water column
- Well diameter
- Volume of water in the well
- Volume of pump
- Tubing diameter
- Length of tubing
- Volume of flow cell
- Volume in the pumping system

2.3. Record the following for Well Purging (FS 2212)

- Calculations for pumping rates, including any changes in rates
- Flow meter readings
- Volume of water purged
- Placement depth of tubing or pump intake
- Depth and length of screened interval
- Time needed to purge one (1) well volume or purging equipment volume
- Well volumes or purging equipment volumes purged
- Temperature measurements
- pH measurements
- Specific conductance measurements
- Dissolved oxygen measurements
- Turbidity measurements
- Purging rate, including any changes in rate
- Drawdown in the well

3. IN-PLACE PLUMBING SOURCES INCLUDING DRINKING WATER SYSTEMS

3.1. Record the following for all samples:

- Plumbing and tap material construction (if known)
- Flow rate at which well was purged
- Amount of time well was allowed to purge
- Flow rate at time of sample collection
- Public water system identification number (if applicable)
- Name and address of water supply system and an emergency phone number for notification of sample results (if applicable)

4. SURFACE WATER SAMPLING

- Sample collection depth

- Beginning and ending times (24 hr) for timed composite sampling
- Type of composite (e.g., flow-proportioned, continuous, etc.)

5. WASTEWATER SAMPLING
   - Beginning and ending times (24 hr) for timed composite sampling
   - Type of composite (e.g. flow-proportioned, continuous, etc.)

FD 5120. RECORDS FOR NON-AQUEOUS ENVIRONMENTAL SAMPLES

Document the following information for all samples when using the indicated procedures.

FD 5130. DOCUMENTATION SPECIFIC TO SOIL SAMPLING (FS 3000)

1. GENERAL SOIL SAMPLING
   - Sample collection depth
   - Areal location of sample
   - Sample collection device
2. Sampling for Volatile Organic Compounds (VOC) per EPA Method 5035
   - Tare weight of VOC sample vial (if applicable)
   - Weight of sample (if applicable)

FD 5140. DOCUMENTATION SPECIFIC TO SEDIMENT SAMPLING (FS 4000)

1. General Sediment Sampling
   - Sample collection depth
   - Areal location of sample
   - Sample collection device
2. Sampling for Volatile Organic Compounds (VOC) per EPA Method 5035
   - Tare weight of VOC sample vial (if applicable)
   - Weight of sample (if applicable)

FD 5200. Documentation Specific to Waste Sampling (FS 5000)

1. DRUM SAMPLING

   1.1. Record the following information for each drum:

   - Type of drum and description of contents
   - Drum number, if applicable
   - Terrain and drainage condition
   - Shape, size and dimensions of drum
   - Label wording or other markings

- Dimensional extent of leaks or spills associated with the drum
- Drum location (or location map)

1.2. Record the following information for the drum sample(s):

- Description of phases, colors, crystals, powders, sludges, etc.
- Stratified layers sampled, including aliquot amounts for composites, if applicable

1.3. Record the following for field testing results on opened drums and drum samples:

- Background readings for OVA meters
- Sample readings for OVA meters
- Type of OVA probe
- Radiation background reading and sample radiation reading
- Type of radiation monitor used
- Oxygen and LEL readings from container opening
- Water reactivity results
- Specific gravity
- PCB test results
- Water solubility results
- pH of aqueous wastes
- Results of chemical test strips
- Ignitability results
- Results of other chemical hazard test kits
- Miscellaneous comments for any tests

2. Documentation for Tanks

2.1. Record the following information for the tank:

- Type of tank, tank design and material of construction of tank
- Description of tank contents and markings
- Tank number or other designation, if applicable
- Terrain and drainage condition
- Shape, size and dimensions of tank
- Label or placard wording or other markings
- Dimensional extent of leaks or spills associated with the tank
- Tank location (or location map)

2.2. Record the following information for the tank sample(s):

- Description of phases, colors, crystals, powders, sludges, etc.

- Stratified layers sampled, including aliquot amounts for composites, if applicable

2.3. Record the following for field testing results on opened tanks and tank samples:

- Background readings for OVA meters
- Sample readings for OVA meters
- Type of OVA probe
- Radiation background reading and sample radiation reading
- Type of radiation monitor used
- Oxygen and LEL level from container opening
- Water reactivity results
- Specific gravity
- PCB test results
- Water solubility results
- pH of aqueous wastes
- Results of chemical test strips
- Ignitability results
- Results of other chemical hazard test kits
- Miscellaneous comments for any tests

3. DOCUMENTATION FOR WASTE LEACHATE AND WASTE SUMP SAMPLES

3.1. Document information specific to leachate and sump sampling according to the documentation requirements for the respective DEP SOPs employed to collect samples (FS 2100, FS 2200, FS 4000, FS 5100 and FS 5200).

4. DOCUMENTATION FOR WASTE PILE SAMPLES

4.1. Document information specific to waste pile sampling according to associated regulatory requirements for the project.

5. DOCUMENTATION FOR WASTE IMPOUNDMENT AND WASTE LAGOON SAMPLES

5.1. Document information specific to impoundment and lagoon sampling according to the documentation requirements for the respective DEP SOPs employed to collect samples (FS 2100, FS 4000, FS 5100, and FS 5200).

FD 5300. Documentation for Biological Sampling

The following SOP sections list required documentation items for specific biological sampling procedures, as indicated.

FD 5310. DOCUMENTATION FOR BIOLOGICAL AQUATIC HABITAT CHARACTERIZATION

Minimum documentation required for biological habitat characterization and sampling is listed below according to requirements as specified in the indicated sampling and field-testing DEP SOPs.

FD 5311. *Physical/Chemical Characterization for Biological Sampling (FT 3001)*

1. Record the following information or use the Physical/Chemical Characterization Field Sheet (Form FD 9000-3):

- Submitting agency code
- Submitting agency name
- STORET station number
- Sample date
- Sample location including county
- Field identification
- Receiving body of water
- Time of sampling
- Percentage of land-use types in the watershed that drain to the site
- Potential for erosion within the portion of the watershed that affects the site
- Local non-point-source pollution potential and obvious sources
- Typical width of 100-meter section of river or stream
- Size of the system or the size of the sample area within the system (lake, wetland, or estuary)
- Three measurements of water depth across the typical width transect
- Three measurements of water velocity, one at each of the locations where water depth was measured
- Vegetated riparian buffer zone width on each side of the stream or river or at the least buffered point of the lake, wetland or estuary
- Presence of artificial channelization in the vicinity of the sampling location (stream or river)
- Description of state of recovery from artificial channelization
- Presence or absence of impoundments in the area of the sampling location
- Vertical distance from the current water level to the peak overflow level
- Distance of the high water mark above the stream bed
- Observed water depth at high water mark location
- Percentage range that best describes the degree of shading in the sampling area
- Any odors associated with the bottom sediments
- Presence or absence of oils in the sediment
- Any deposits in the area, including the degree of smothering by sand or silt
- Depth of each water quality measurement
- Temperature

- pH
- Dissolved oxygen
- Specific conductance
- Salinity
- Secchi depth
- Type of aquatic system sampled
- Stream magnitude (order designation)
- Description of any noticeable water odors
- Term that best describes the relative coverage of any oil on the water surface
- Term that best describes the amount of turbidity in the water
- Term that best describes the color of the water
- Weather conditions during the time of sampling
- Any other conditions/observations that are helpful in characterizing the site
- Relative abundances of periphyton, fish, aquatic macrophytes and iron/sulfur bacteria
- List and map of dominant vegetation observed
- Sampling team designation
- Signature(s) of sampler(s)
- Signature date

2. For streams and rivers, draw a grid sketch of the site (optionally use Form FD 9000-4), showing the location and amount of each substrate type (as observed by sight or touch). Using the grid sketch, count the number of grid spaces for each substrate type. Divide each of these numbers by the total number of grid spaces contained within the site sketch. Record this percent coverage value for each substrate type. If the substrates are sampled, record the number of times each substrate is sampled by an indicated method.

3. For lakes, divide the site map into twelve sections and note visual markers that will assist in distinguishing those sections.

4. Photographs of the sampling area are also useful tools for documenting habitat conditions and identifying station location.

FD 5312. *Stream and River Biological Habitat Assessment Records (FT 3100)*

1. Record the following information or use Form FD 9000-5, Stream/River Habitat Assessment Field Sheet:

- Submitting organization name and/or code
- STORET station number
- Assessment date
- Sampling location including county
- Field identification

- Receiving body of water
- Time of sampling upon arrival at the site

2. Additionally record the following:

- Substrate diversity score
- Substrate availability score
- Water velocity score
- Habitat smothering score
- Artificial channelization score
- Bank stability score for each bank
- Riparian buffer zone width score for each bank
- Riparian zone vegetation quality score for each bank
- Primary habitat components score
- Secondary habitat components score
- Habitat assessment total score
- Additional comments and observations
- Signatures

3. Record the following information or use Form FD 9000-4, Stream/River Habitat Sketch Sheet for each 100-meter segment assessed.

- Link to the waterbody name, location of 100-meter segment, analyst name(s) and date of the assessment
- Code, symbol or icon used to map each substrate observed in the segment
- Proportionate sketch or map of the abundance of each habitat (substrate) observed in the 100-meter segment, oriented to the direction of flow
- Location of velocity measurements taken within the segment
- Location of habitats smothered by sand or silt
- Location of unstable, eroding banks
- Locations along the segment where the natural, riparian vegetation is altered or eliminated
- Plant taxa observed
- Additional notes and observations

FD 5313. *Lake Biological Habitat Assessment Records (FT 3200)*

1. Document the following information or use the Lake Habitat Assessment Field Sheet (Form FD 9000-6):

- STORET station number

- Sampling date
- Sampling location including lake name
- Eco-region
- Field identification number
- County name
- Lake size
- Features observed
- Description of the hydrology of the system (water residence time)
- Lake water color
- Secchi depth score
- Vegetation quality score
- Stormwater inputs score
- Bottom substrate quality score
- Lakeside adverse human alterations score
- Upland buffer zone score
- Adverse watershed land use score
- Habitat assessment total score
- Additional comments and observations
- Name and Signature of analyst

FD 5320. BIOLOGICAL AQUATIC COMMUNITY SAMPLING RECORDS (FS 7000)

Minimum documentation required for biological sampling for procedures described in FS 7000 is listed below according to requirements as specified in the indicated sampling DEP SOPs.

FD 5321. *Periphyton Sampling Records (FS 7200)*

For each sample, record the following:

- Station sampled
- Date collected

FD 5322. *Qualitative Periphyton Sampling Records (FS 7220)*

Complete the Physical/Chemical Characterization Field Sheet (Form FD 9000-3), Stream/River Habitat Sketch Sheet (Form FD 9000-4) or site map and Stream/River Habitat Assessment Field Sheet (Form FD 9000-5), as appropriate for the water body sampled (see FT 3000 – FT 3100). Other customized formats may be used to record the information prompted on the above forms.

FD 5323. *Rapid Periphyton Survey Records (FS 7230)*

For each 100-meter reach surveyed, record the following information or use Form FD 9000-8, Rapid Periphyton Survey Field Sheet:

- Site or waterbody name
- Survey date
- Name(s) of analyst(s)
- Transect mark number (10-meter segment within the 100-meter reach)
- Transect point (1 – 9)
- Algae sample collected
- Algal thickness rank (per FS 7230 procedure)
- Algae type
- Canopy cover (per FS 7230 procedure)
- Bottom visibility
- Water color
- Additional comments or observations

FD 5324. *Lake Vegetation Index Records (FS 7310)*

Record the following information or use Form FD 9000-7, Lake Vegetation Index Data Field Sheet:

- Waterbody name
- Assessment or sampling date
- County name
- Name of analyst(s)
- STORET station number
- Signature(s) of analyst(s)
- Lake water level
- Presence of algal mats
- Lake units sampled (12-sector procedure per FS 7310)
- Taxa observed in each selected unit
- Dominant and co-dominant taxa in each unit
- Taxa collected for further identification
- Approximate water depth for each taxon collected

FD 5325. *Rapid Bioassessment (Biorecon) Records (FS 7410)*

Record the following information or use the Biorecon Field Sheet (Form FD 9000-1).

- STORET station number
- Location, including latitude and longitude
- Watershed or basin name
- Family or genus of all organisms from all material in all four dipnet sweeps
- Total taxa tallies
- Taxa richness, Ephemeroptera taxa, Trichoptera taxa, Long-lived taxa, Clinger taxa, and Sensitive taxa
- Abundance code for each taxon
- Name(s) of analysts collecting and sorting samples
- Habitat types (substrates) sampled
- Name(s) of analyst(s) performing quality control
- Signatures
- Collection date and time

FD 5326. *Stream Condition Index (D-frame Dipnet) Sampling Records (FS 7420)*

1. Complete the Physical/Chemical Characterization Field Sheet (Form FD 9000-3), Stream/River Habitat Sketch Sheet (Form FD 9000-4) or site map and Stream/River Habitat Assessment Field Sheet (Form FD 9000-5) forms appropriate for the water body sampled (see FT 3000 – FT 3400). Other customized formats may be used to record the information prompted on the above forms.
2. Record the following for each sample:
   - Number of sweeps for each habitat
   - Number of containers per sample

FD 5327. *Sediment Core Biological Grab Sampling Records (FS 7440)*

Record the sampling location of site grab core samples.

FD 5328. *Sediment Dredge Biological Grab Sampling Records (FS 7450)*

Record the sampling location of site grab dredge samples.

FD 5329. *Lake Condition Index (Lake Composite) Sediment Dredge Biological Grab Sampling Records (FS 7460)*

Record the following or use DEP Form FD 9000-2 (Composite Lake Sampling Sheet):

- Sampling date
- Lake name
- Sampling equipment used
- Comments and observations

- Dredge drop number (1 – 12)
- Sampling depth for each drop number
- Sampling location of site grab dredge sample for each drop (include lake sector map)
- Sediment type(s) in grab dredge sample for each drop
- Location of any water quality measurements

FD 6000. QUALITY CONTROL DOCUMENTATION

1. Document all field quality control samples in the permanent field records.
2. At a minimum, record the following information:
   - The type, time and date that the quality control sample was collected; and
   - The preservative(s) (premeasured or added amount) and preservation checks performed.
3. If blanks are collected/prepared by the field organization, maintain records of the following:
   - Type of analyte-free water used;
   - Source of analyte-free water (include lot number if commercially purchased);
   - A list of the sampling equipment used to prepare the blank.

   If items above are specified in an internal SOP, you may reference the SOP number and revision date in the field notes. Note any deviations to the procedure in the field notes.
4. For trip blanks, record the following:
   - Date and time of preparation
   - Storage conditions prior to release to the sample collecting organization
   - Type of analyte-free water used
   - Source and lot number (if applicable) of analyte-free water

     4.1. Include trip blank information in the sampling kit documentation per FD 2000, section 2.
5. For duplicates, record the technique that was used to collect the sample.
6. For split samples, identify the method used to collect the samples and the source(s) of the sample containers and preservatives.

FD 7000. LEGAL OR EVIDENTIARY DOCUMENTATION

1. Scope: The use of legal or evidentiary Chain-of-Custody (COC) protocols is not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance, for example, unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.
2. <u>General Procedural Instructions</u>

   2.1. Follow applicable requirements in FD 1000 – FD 5000 for all evidence samples.

2.2. Establish and maintain the evidentiary integrity of samples and/or sample containers. Demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.

2.2.1. Document and track all time periods and the physical possession and storage of sample containers and samples from point of origin through the final analytical result and sample disposal.

FD 7100. General Requirements for Evidentiary Documentation

1. CHAIN OF CUSTODY RECORDS: Use the Chain-of-Custody (COC) records to establish an intact, contiguous record of the physical possession, storage, and disposal of sample containers, collected samples, sample aliquots, and sample extracts or digestates. For ease of discussion, the above-mentioned items are referred to as “samples”.

1.1. Account for all time periods associated with the physical samples.

1.2. Include signatures of all individuals who physically handle the samples.

1.2.1. The signature of any individual on any record that is designated as part of the Chain-of-Custody is their assertion that they personally handled or processed the samples identified on the record.

1.2.2. Denote each signature with a short statement that describes the activity of the signatory (e.g., “sampled by”, “received by”, “relinquished by”, etc.).

1.2.3. In order to simplify recordkeeping, minimize the number of people who physically handle the samples.

2. CONSOLIDATION OF RECORDS: The COC records need not be limited to a single form or document. However, limit the number of documents required to establish COC, where practical, by grouping information for related activities in a single record. For example, a sample transmittal form may contain both certain field information and the necessary transfer information and signatures for establishing delivery and receipt at the laboratory.

3. LIABILITY FOR CUSTODY DOCUMENTATION: Ensure appropriate personnel initiate and maintain sample chain-of-custody at specified times.

3.1. Begin legal chain-of-custody when the precleaned sample containers are dispatched to the field.

3.1.1. Omit the transmittal record for precleaned sample containers if the same party provides the containers and collects the samples.

3.2. Sign the COC record upon relinquishing the prepared sample kits or containers.

3.3. Sign the COC record upon receipt of the sample kits or containers.

3.4. Thereafter, ensure that all parties handling the samples maintain sample custody (i.e., relinquishing and receiving) and documentation until the samples or sampling kits are relinquished to a common carrier.

3.4.1. The common carrier should not sign COC forms.

3.4.2. Indicate the name of the common carrier in the COC record, when used. Retain shipping bills and related documents as part of the record.

3.4.3. Ensure that all other transferors and transferees releasing or accepting materials from the common carrier sign the custody record.

3.5. Chain-of-custody is relinquished by the party who seals the shipping container and is accepted by the party who opens it.

3.5.1. Indicate the date and time of sealing of the transport container for shipment.

3.5.2. See FD 7200, section 3 below regarding the use of custody seals.

4. SAMPLE SHIPPING OR TRANSPORTING

4.1. Affix tamper-indicating custody seals or evidence tape before shipping samples.

4.1.1. Seal sample container caps with tamper-indicating custody seals or evidence tape before packing for shipping or transport.

4.1.2. Seal sample transport or shipping containers with strapping tape and tamper-indicating custody seals or evidence tape.

4.1.3. If the same party collects then possesses (or securely stores), packs and transports the samples from time of collection, omit any use of custody seals or evidence tape.

4.2. Keep the COC forms with the samples during transport or shipment. Place the COC records in a waterproof closure inside the sealed ice chest or shipping container.

FD 7200. Required Documentation for Evidentiary Custody

1. GENERAL CONTENT REQUIREMENTS: Document the following in COC tracking records by direct entry or linkage to other records:

- Time of day and calendar date of each transfer or handling procedure
- Signatures of transferors, transferees and other personnel handling samples
- Location of samples (if stored in a secured area)
- Description of all handling procedures performed on the samples for each time and date entry recorded above
- Storage conditions for the samples, including chemical preservation and refrigeration or other cooling
- Unique identification for all samples
- Final disposition of the physical samples
- Common carrier identity and related shipping documents

2. DOCUMENTATION CONTENT FOR SAMPLE TRANSMITTAL

Provide a Chain-of-Custody record for all evidentiary samples and subsamples that are transmitted or received by any party. Include the following information in the COC record of transmittal:

- Sampling site name and address
- Date and time of sample collection
- Unique field identification code for each sample source and each sample container
- Names of personnel collecting samples
- Signatures of all transferors and transferees

- Time of day and calendar date of all custody transfers
- Clear indication of number of sample containers
- Required analyses by approved method number or other description
- Common carrier usage
- Sample container/preservation kit documentation, if applicable

3. CHAIN-OF-CUSTODY SEALS: If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

3.1. Place the seal so that the closure cannot be opened without breaking the seal.

3.2. Record the time, calendar date, and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.

3.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FD 7300. Documenting Controlled Access to Evidence Samples

Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times. See FS 1000 for additional discussion about procedures for handling evidence samples.

1. Limit the number of individuals who physically handle the samples as much as practicable.

2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.

3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.

4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals.

FD 7400. Documenting Disposal of Evidence Samples

1. Dispose of the physical samples only with the concurrence of the affected legal authority, sample data user, and/or submitter/owner of the samples.

2. Record all conditions of disposal and retain correspondence between all parties concerning the final disposition of the physical samples.

3. Record the date of disposal, the nature of disposal (i.e., sample depleted, sample flushed into sewer, sample returned to client, etc.), and the name of the individual who performed the disposal. If samples are transferred to another party, document custody transfer in the same manner as other transfers (see FD 7000 – FD 7200).

FD 8000. (RESERVED)

FD 9000. FORMS

Forms to facilitate documentation of sampling, field-testing, and biological laboratory calculation activities are available on the Department's website. These forms are for unrestricted public use and are presented in example formats. *The use of these forms is not mandatory. However,* ***some*** *of the data elements and other information denoted by the form prompts comprise* ***required documentation*** *items*. *Not all required documentation is illustrated in the form examples.* Customize these forms as needed. These forms are available as separate document files. The following forms are incorporated into the indicated SOPs for convenience of use:

- Form FD 9000-1 Biorecon Field Sheet (FS 7000)
- Form FD 9000-2 Composite Lake Sampling Sheet for <1000 Acres (FS 7000)
- Form FD 9000-3 Physical/Chemical Characterization Field Sheet (FT 3000)
- Form FD 9000-4 Stream/River Habitat Sketch Sheet (FT 3000)
- Form FD 9000-5 Stream/River Habitat Assessment Field Sheet (FT 3000)
- Form FD 9000-6 Lake Habitat Assessment Field Sheet (FT 3000)
- Form FD 9000-7 Lake Vegetation Index Data Field Sheet (FS 7000)
- Form FD 9000-8 Rapid Periphyton Survey Field Sheet (FS 7000)

FQ 1000. FIELD QUALITY CONTROL REQUIREMENTS

Field quality control measures monitor the sampling event to ensure that the collected samples are representative of the sample source.

Field-collected blanks must demonstrate that the collected samples have not been contaminated by:

- The sampling environment
- The sampling equipment
- The sample container
- The sampling preservatives
- Sample transport
- Sample storage

FQ 1100. Sample Containers

Sample containers must be free from contamination by the analytes of interest or any interfering constituents and must be compatible with the sample type.

FQ 1200. Sampling Operations

1. When collected, analyze all quality control samples for the same parameters as the associated samples.

1.1. When collected, collect blanks for the following parameter groups and tests:

- Volatile Organics
- Extractable Organics
- Metals
- Ultratrace Metals
- Inorganic Nonmetallics
- Radionuclides
- Petroleum Hydrocarbons and Oil & Grease
- Volatile Inorganics
- Aggregate Organics except Biochemical Oxygen Demand

1.2. Blanks are not required for:

- Microbiological (all types)
- Toxicity
- Field parameters such as pH, Specific Conductance, Residual Chlorine, Temperature, Light Penetration, Dissolved Oxygen, ORP and Salinity
- Radon

- Algal Growth Potential
- Biological Community
- Physical and Aggregate Properties
- Biochemical Oxygen Demand

2. Preserve, transport, document and handle all quality control samples as if they were samples. Once collected, they must remain with the sample set until the laboratory has received them.

3. Except for trip blanks, prepare all quality control samples **on-site in the field**.

   3.1. Do not prepare precleaned equipment blanks in advance at the base of operations.

   3.2. Do not prepare field-cleaned equipment blanks after leaving the sampling site.

4. Perform and document any field QC measures specified by the analytical method (such as trip blanks for volatile organics).

FQ 1210. QUALITY CONTROL BLANKS

FQ 1211. *Precleaned Equipment Blanks*

1. USE: Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions for water, waste, soil, or sediment samples.

2. Collect these blanks using sampling equipment that has been brought to the site precleaned and ready for use. The cleaning procedures used for the blank collection must be identical to those used for the field sample collection.

3. Collect these blanks before the equipment set has been used.

4. Prepare equipment blanks by rinsing the sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers (see FQ 1100).

FQ 1212. *Field-Cleaned Equipment Blanks*

1. USE: Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions.

2. Collect these blanks using sampling equipment that has been cleaned in the field (i.e., between sampling points). The cleaning procedures used for the blank collection must be identical to those used for the field sample collection.

3. Prepare field-cleaned equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.

4. Prepare equipment blanks by rinsing the sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers (see FQ 1100).

   4.1. For intermediate sampling devices or equipment, site-water rinsing is defined as the decontamination step, if this is the only cleaning that will be performed on the equipment prior to collecting the sample.

4.1.1. In this case, collect the equipment blank after rinsing the intermediate device 3 times with site water

4.1.2. Follow the site-water rinses with 3 rinses using analyte-free water.

4.1.3. Collect the equipment blank with a subsequent rinse of the device using additional analyte-free water to collect sufficient blank volume.

FQ 1213. *Trip Blanks*

1. USE: Monitors sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions.

2. The organization that is providing the VOC vials must provide the trip blanks by filling two or more VOC vials with analyte-free water and preservatives (if needed).

2.1. To prevent degradation of the trip blank, long-term storage of prepared trip blanks is not recommended.

3. These blanks are applicable if samples are to be analyzed for volatile constituents (volatile organics, methyl mercury, etc.) in water, waste, soils, or sediments.

4. Place a set of trip blanks in each transport container used to ship/store empty VOC vials. They must remain with the VOC vials during the sampling episode and must be transported to the analyzing laboratory in the same shipping or transport container(s) as the VOC samples.

5. Trip blanks must be opened **only** by the laboratory after the blank and associated samples have been received for analysis.

FQ 1214. *Field Blanks*

1. USE: Monitors on-site sampling environment, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions for water, waste, soil or sediment samples.

2. Prepare field blanks by pouring analyte-free water into sample containers for each parameter set to be collected.

3. Field blanks are not required if equipment blanks (FQ 1211 or FQ 1212) are collected.

FQ 1220. FIELD DUPLICATES

1. USE: Designed to measure the variability in the sampling process.

2. GENERAL CONSIDERATIONS:

2.1. Collect duplicates by **repeating** (simultaneously or in rapid succession) the entire sample acquisition technique that was used to obtain the first sample.

2.1.1. Collect, preserve, transport and document duplicates in the same manner as the samples. **These samples are not considered laboratory duplicates**.

2.2. When collected, analyze field duplicates for the same parameters as the associated samples.

2.3. If possible, collect duplicate samples from sampling locations where contamination is present.

2.4. Field duplicates must be collected if required by the analytical method and as required by a DEP program.

FQ 1221. *Water Duplicates*

Collect water duplicates by sampling from successively collected volumes (i.e., samples from the next volume of sample water).

FQ 1222. *Soil Duplicates*

Collect soil duplicates from the same sample source (i.e., soil from the same soil sampling device).

FQ 1230. MANDATORY FIELD QUALITY CONTROLS

1. The respondent, permittee or contractor and the sampling organization are responsible for ensuring that blanks (excluding trip blanks) are collected at a minimum of 5% of each reported test result/matrix combination for the life of a project.

1.1. Collect at least one blank for each reported test result/matrix combination each year for each project.

1.2. If a party wishes to claim that a positive result is due to external contamination sources during sample collection, transport or analysis, then at least one field collected blank (excludes trip blanks) must have been collected at the same time the samples were collected and analyzed with the same sample set.

1.3. A project will be defined by the organization responsible for collecting the samples for the project.

1.3.1. When applicable, define the scope of the project in conjunction with the appropriate DEP authority.

2. When collecting a set of blanks, use the following criteria:

2.1. <u>Equipment Blanks</u>:

2.1.1. Collect field-cleaned equipment blanks if any sample equipment decontamination is performed in the field.

2.1.2. If no decontamination is performed in the field, collect precleaned equipment blanks if the equipment is not certified clean by the vendor or the laboratory providing the equipment.

2.1.3. Equipment blanks are not required for volatile organic compounds.

2.2. <u>Field Blanks</u>:

2.2.1. Collect field blanks if no equipment except the sample container is used to collect the samples or if the sampling equipment is certified clean by the vendor or the laboratory providing the equipment.

2.2.1.1. If a sample container is used as an intermediate sample collection device, collect an equipment blank by rinsing the decontaminated collection container as the substitute for the field blank.

2.2.2. Field blanks are not required for volatile organic compounds.

2.3. <u>Trip Blanks:</u>

2.3.1. These blanks are applicable if samples are to be analyzed for volatile organic compounds. See FQ 1213 for frequency, preparation and handling requirements.

3. OPTIONAL QUALITY CONTROL MEASURES

3.1. The method or project may require collection of additional quality control measures as outlined in FQ 1210 (Blanks), FQ 1220 (Duplicates) and FQ 1240 (Split Samples).

FQ 1240. SPLIT SAMPLES

The DEP or the client may require split samples as a means of determining compliance or as an added measure of quality control. Unlike duplicate samples that measure the variability of both the sample collection and laboratory procedures, split samples measure only the variability **between** laboratories. Therefore, the laboratory samples must be subsamples of the same parent sample and every attempt must be made to ensure sample homogeneity.

Collect, preserve, transport and document split samples using the same protocols as the related samples. In addition, attempt to use the same preservatives (if required).

If split samples are incorporated as an added quality control measure, the DEP recommends that all involved parties agree on the logistics of collecting the samples, the supplier(s) of the preservatives and containers, the analytical method(s), and the statistics that will be used to evaluate the data.

FQ 1241. *Soils, Sediments, Chemical Wastes and Sludges*

Collecting split samples for these matrices is not recommended because a true split sample in these matrices is not possible.

FQ 1242. *Water*

Collect split samples for water in one of two ways:

1. Mix the sample in a large, appropriately precleaned, intermediate vessel (a churn splitter is recommended). This method shall not be used if volatile or extractable organics, oil and grease or total petroleum hydrocarbons are of interest. While continuing to thoroughly mix the sample, pour aliquots of the sample into the appropriate sample containers. Alternatively:

2. Fill the sample containers from consecutive sample volumes **from the same sampling device**. If the sampling device does not hold enough sample to fill the sample containers, use the following procedure:

2.1. Fill the first container with half of the sample, and pour the remaining sample into the second container.

2.2. Obtain an additional sample, pour the first half into the **second** container, and pour the remaining portion into the first container.

2.3. Continue with steps described in sections 2.1 and 2.2 above until both containers are filled.

FQ 1250. QUALITY CONTROL DOCUMENTATION

1. Document all field quality control samples in the permanent field records.

2. At a minimum, record the following information:

- The type, time and date that the quality control sample was collected; and
- The preservative(s) (premeasured or added amount) and preservation checks performed.

3. If blanks are collected/prepared by the field organization, maintain records of the following:
   - Type of analyte-free water used;
   - Source of analyte-free water (include lot number if commercially purchased);
   - A list of the sampling equipment used to prepare the blank.

   If items above are specified in an internal SOP, you may reference the SOP number and revision date in the field notes. Note any deviations to the procedure in the field notes.

4. For trip blanks, record the following:
   - Date and time of preparation
   - Storage conditions prior to release to the sample collecting organization
   - Type of analyte-free water used
   - Source and lot number (if applicable) of analyte-free water

     4.1. Include trip blank information in the sampling kit documentation per FD 2000, section 2.

5. For duplicates, record the technique that was used to collect the sample.

6. For split samples, identify the method used to collect the samples and the source(s) of the sample containers and preservatives.

FS 1000. GENERAL SAMPLING PROCEDURES

See also the following Standard Operating Procedures:

- FA 1000 and 2000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000-9000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements

FS 1001. *Preliminary Activities*

1. Begin each sampling trip with some planning and coordination. Refer to FM 1000 for recommendations and suggestions on laboratory selection and communication, and field mobilization.

   1.1. DEP recommends that a minimum of two people be assigned to a field team. In addition to safety concerns, the process of collecting the samples, labeling the containers and completing the field records is much easier if more than one person is present.

   1.2. If responding to incidents involving hazardous substances, DEP recommends that four or five people be assigned to the team.

2. EQUIPMENT

   2.1. Select appropriate equipment based on the sampling source (see FS 2000 to FS 8200), the analytes of interest and the sampling procedure.

      2.1.1. If properly cleaned, sample containers may be used as collection devices or intermediate containers.

   2.2. The equipment construction must be consistent with the analytes or analyte groups to be collected (see Tables FS 1000-1 and FS 1000-2).

   2.3. Bring precleaned equipment to the field or use equipment that has been certified clean by the vendor or laboratory.

3. DEDICATED EQUIPMENT STORAGE

   3.1. Store all dedicated equipment (except dedicated pump systems or dedicated drop pipes) in a controlled environment.

   3.2. If possible, store equipment in an area that is located away from the sampling site. If equipment other than dedicated pumps or dedicated drop pipes is stored in monitoring wells, suspend the equipment above the formation water.

   3.3. Securely seal the monitoring well in order to prevent tampering between sampling events.

   3.4. Decontaminate all equipment (except dedicated pumps or drop pipes) before use according to the applicable procedures in FC 1000.

4. SAMPLE CONTAINERS

   4.1. The analyses to be performed on the sample determine the construction of sample containers.

4.2. Inspect all containers and lids for flaws (cracks, chips, etc.) before use. Do not use any container with visible defects or discoloration.

FS 1002. *Contamination Prevention and Sample Collection Order*

1. CONTAMINATION PREVENTION

1.1. Take special effort to prevent cross contamination and contamination of the environment when collecting samples. Protect equipment, sample containers and supplies from accidental contamination.

1.1.1. Do not insert pump tubing, measurement probes, other implements, fingers, etc. into sample containers or into samples that have been collected for laboratory analysis.

1.1.1.1. If it is necessary to insert an item into the container or sample, ensure that the item is adequately decontaminated for the analytes of interest to be analyzed in the sample.

1.1.2. If possible, collect samples from the least contaminated sampling location (or background sampling location) to the most contaminated sampling location.

1.1.2.1. Collect the ambient or background samples first and store them in separate ice chests or shipping containers.

1.1.3. Collect samples in flowing water from downstream to upstream.

1.1.4. Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same ice chest or shipping container with other environmental samples.

1.1.4.1. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc.

1.1.4.2. Use a clean, untreated plastic bag to line the ice chest or shipping container.

2. SAMPLE COLLECTION ORDER

2.1. Sampling order is a recommendation to be modified depending on site circumstances. Unless field conditions justify other sampling regimens, collect samples in the following order:

- Volatile Organics and Volatile Inorganics
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil & Grease
- Total Metals
- Dissolved Metals
- Inorganic Nonmetallics, Physical and Aggregate Properties, and Biologicals
- Radionuclides
- Microbiological

Note: If the pump used to collect groundwater samples cannot be used to collect volatile or extractable organics, then collect all other parameters, withdraw the pump and tubing, and collect the volatile and extractable organics.

3. COMPOSITE SAMPLES

3.1. Do not collect composite samples unless required by permit or DEP program.

3.2. If compositing is required, use the following procedure:

3.2.1. Select sampling points from which to collect each aliquot.

3.2.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

3.2.3. Record the approximate amount of each aliquot (volume or weight).

3.2.4. Add preservative(s), if required.

3.2.5. Label container and make appropriate field notes (see FD 1000-9000).

3.2.6. Notify the laboratory that the sample is a composite sample.

3.2.7. When collecting soil or sediment samples, combine the aliquots of the sample directly in the sample container with no pre-mixing. Notify the laboratory that the sample is an unmixed composite sample, and request that the laboratory thoroughly mix the sample before sample preparation or analysis.

3.2.8. When collecting water composites see FS 2000, section 1.3 or pertinent sections of other water matrix SOPs for specific details on collection.

FS 1003. *Protective Gloves*

1. Gloves serve a dual purpose to:

- Protect the sample collector from potential exposure to sample constituents
- Minimize accidental contamination of samples by the collector

2. The DEP recommends wearing protective gloves when conducting all sampling activities. They must be worn except when:

- The sample source is considered to be non-hazardous
- The samples will not be analyzed for trace constituents
- The part of the sampling equipment that is handled without gloves does not contact the sample source

3. Do not let gloves come into contact with the sample or with the interior or lip of the sample container.

4. Use clean, new, unpowdered and disposable gloves.

4.1. DEP recommends latex gloves, however, other types of gloves may be used as long as the construction materials do not contaminate the sample or if internal safety protocols require greater protection.

4.2. Note that certain materials (as might be potentially present in concentrated effluent) may pass through certain glove types and be absorbed in the skin. Many vendor catalogs provide information about the permeability of different gloves and the circumstances under which the glove material might be applicable.

4.3. The powder in powdered gloves can contribute significant contamination and DEP does not recommend wearing powdered gloves unless it can be demonstrated that the powder does not interfere with the sample analysis.

5. If gloves are used, change:
    - After preliminary activities such as pump placement;
    - After collecting all the samples at a single sampling point; or
    - If torn, or used to handle extremely dirty or highly contaminated surfaces.
6. Properly dispose of all used gloves.

FS 1004. *Container and Equipment Rinsing*

When collecting aqueous samples, rinse the sample collection equipment with a portion of the sample water before taking the actual sample. Sample containers do not need to be rinsed. In the case of petroleum hydrocarbons, oil & grease or containers with premeasured preservatives, the sample containers cannot be rinsed.

FS 1005. *Fuel-Powered Equipment and Related Activities*

1. Place all fuel-powered equipment away from, and downwind of, any site activities (e.g., purging, sampling, decontamination). If field conditions preclude such placement (i.e., the wind is from the upstream direction in a boat), place the fuel source(s) as far away as possible from the sampling activities and describe the conditions in the field notes.

2. Handle fuel (i.e., filling vehicles and equipment) prior to the sampling day. If such activities must be performed during sampling, the personnel must wear disposable gloves. Dispense all fuels, dispose of gloves downwind, and well away from the sampling activities.

3. If sampling at active gas stations, stop sample collection activities during fuel deliveries.

FS 1006. *Preservation, Holding Times and Container Types*

1. Preserve all samples according to the requirements specified in Tables FS 1000-4 through FS 1000-10.

    1.1. The information listed in the above-referenced tables supersedes any preservation techniques, holding time or container type that might be discussed in individual analytical methods.

    1.2. If samples are collected only for total phosphorus and are not for NPDES compliance, thermal preservation (ice) is not required if the sample containers are pre-preserved with acid.

2. The preservation procedures in the referenced tables specify immediate preservation. "Immediate" is defined as "within 15 minutes of sample collection." Perform all preservation on-site (in the field).

    2.1. Preservation is not required if samples can be transported back to the laboratory within 15 minutes of collecting the sample and

        2.1.1. The laboratory begins sample analysis within the 15-minute window and documents the exact time the analysis began, or

        2.1.2. The laboratory adds the appropriate preservatives (including thermal preservation) within 15 minutes of sample collection and documents the exact time that the preservation was done.

3. PRESERVING COMPOSITE WATER SAMPLES

3.1. If the sample preservation requires thermal preservation (e.g., <6°C), the samples must be cooled to the specified temperature.

3.1.1. Manually collected samples to be composited must be refrigerated at a temperature equal to or less than the required temperature.

3.1.2. Automatic samplers must be able to maintain the required temperature by packed ice or refrigeration.

3.2. When chemical preservation is also required, begin the preservation process within 15 minutes of the last collected sample.

3.3. Holding Times for Automatic Samplers:

3.3.1. If the collection period is 24 hours or less, the holding time begins at the last scheduled sample collection;

3.3.2. If the collection period exceeds 24 hours, the holding time begins with the time that the first sample is collected.

4. pH ADJUSTED PRESERVATION - Check the pH of pH-adjusted samples according to these frequencies:

4.1. During the first sampling event at a particular site, check **all** samples (includes each groundwater monitoring well, surface water location, or influent/effluent sampling location) that are pH-adjusted except volatile organics.

4.2. During subsequent visits to a particular site, check at least one sample per parameter group that must be pH-adjusted.

4.3. If the frequency of sample collection at a specified location is greater than once per month (i.e., weekly or daily), check the pH of at least one sample per parameter group (except volatile organics) according to the following schedule:

4.3.1. Weekly sampling: 1 pH check per month

4.3.2. Daily sampling: 1 pH check per week

4.4. If the frequency of sample collection at a specified location is once per month, check the pH of at least one sample per parameter group (except volatile organics) quarterly.

4.5. If site conditions vary from sampling event to sampling event, perform pH checks at increased intervals.

5. THERMAL PRESERVATION

5.1. When preservation requirements indicate cooling to a specific temperature, samples must be placed in wet ice within 15 minutes of sample collection (see 1006, section 2 above). Unless specified, do not freeze samples.

5.2. All supplies (ice, dry ice, etc.) necessary to meet a thermal preservation requirement must be onsite for immediate use.

5.3. Ship samples in wet ice. If samples are cooled to the required temperature before shipment, samples may be shipped with frozen ice packs if the specified temperature is maintained during shipment. The sample temperature must not exceed the specified temperature.

5.4. If immediate freezing is required, dry ice must be available in the field to begin the freezing process.

FS 1007. *Preventive and Routine Maintenance*

Preventive maintenance activities are necessary to ensure that the equipment can be used to obtain the expected results and to avoid unusable or broken equipment while in the field. Equipment is properly maintained when:

- It functions as expected during mobilization; and
- It is not a source of sample contamination (e.g., dust).

1. Follow the manufacturer's suggested maintenance activities and document all maintenance. At a minimum, DEP recommends the activities listed on Table FS 1000-12.

2. Maintain documentation for the following information for each piece of equipment or instrumentation. See FD 3000 also.

2.1. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This identifier may include a manufacturer name, model number, serial number, inventory number or other unique identification.

2.2. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures and solution or parts replacement for instrument probes.

2.3. Include the calendar date for the procedures performed.

2.4. Record names of personnel performing the maintenance or repair tasks.

2.5. Describe any malfunctions necessitating repair or service.

2.6. Retain vendor service records for all affected instruments.

2.7. Record the following for rented equipment:

- Rental date(s)
- Equipment type and model or inventory number or other description

2.8. Retain the manufacturer’s operating and maintenance instructions.

FS 1008. *Documentation and References*

1. REFERENCES: All sampling references must be available for consultation in the field. These include:

- DEP SOPs;
- Internal SOPs;
- Sampling and analysis plans; and/or
- Quality Assurance Project Plans.

2. DOCUMENTATION: Complete and sign all documentation (see FD 1000).

FS 1009. *Sample Documentation and Evidentiary Custody*

1. SAMPLE DOCUMENTATION

1.1. Document all activities related to a sampling event, including sample collection, equipment calibration, equipment cleaning and sample transport.

1.2. The required documentation related to each sampling or other field activity is specified in the associated SOPs; i.e., FQ 1000, FC 1000, the FS series, and the FT series.

1.3. The documentation requirements are also summarized in FD 1000, Field Documentation. FD 1000 additionally contains a list of example forms published with the SOPs that may be used to document various activities or as templates for creating customized forms.

2. Legal Chain of Custody (COC)

The use of legal or evidentiary Chain-of-Custody (COC) protocols is not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.

Evidentiary sample custody protocols are used to demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.

When a client or situation requires legal COC, use the procedures in FD 7000 to document and track all time periods associated with the physical possession and storage of sample containers, samples, and subsamples from point of origin through the final analytical result and sample disposal.

When legal or evidentiary COC is required, samples must be:

- In the actual possession of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician);
- In the view of the same person after being in their physical possession;
- Secured by the same person to prevent tampering; or
- Stored in a designated secure area.

2.1. Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times.

2.1.1. Limit the number of individuals who physically handle the samples as much as practicable.

2.1.2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.

2.1.3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.

2.1.4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals. Ice chests or other storage containers used to store sample containers in hotel rooms may be sealed instead of sealing each sample container stored within.

2.2. Use a Chain of Custody form or other transmittal record to document sample transfers to other parties. Other records and forms may be used to document internal activities if they meet the requirements for legal chain of custody.

2.3. Legal COC begins when the precleaned sample containers are dispatched to the field.

2.3.1. The person who relinquishes the prepared sample kits or containers and the individual who receives the sample kits or containers must sign the COC form unless the same party provides the containers and collects the samples.

2.3.2. All parties handling the empty sample containers and samples are responsible for documenting sample custody, including relinquishing and receiving samples, except commercial common carriers.

2.4. Shipping Samples under Legal COC

2.4.1. Complete all relevant information on the COC transmittal form or record (see FD 7200, section 2).

2.4.2. Internal records must document the handling of the samples and shipping containers in preparation for shipment. The names of all persons who have prepared the shipment must be recorded. All time intervals associated with handling and preparation must be accounted for.

2.4.3. Place the forms in a sealed waterproof bag and place in the shipping container with the samples.

2.4.4. Seal the shipping container with tamper-proof seals (see 2.6 below) so that any tampering can be clearly seen by the individual who receives the samples.

2.4.5. Note: The common carrier does not sign COC records. However, the common carrier (when used) must be identified.

2.5. Delivering Samples to the Laboratory

2.5.1. All individuals who handle and relinquish the sample containers must sign the transmittal form. The legal custody responsibilities of the field operations end when the samples are relinquished to the laboratory.

2.6. Chain of Custody Seals: If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

2.6.1. Place the seal so that the closure cannot be opened without breaking the seal.

2.6.2. Record the time, calendar date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.

2.6.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FS 1010. *Health and Safety*

Implement all local, state and federal requirements relating the health and safety.

FS 1011. *Hazardous Wastes*

Follow all local, state and federal requirements pertaining to the storage and disposal of any hazardous or investigation-derived wastes.

1. Properly manage all investigation-derived waste (IDW) so contamination is not spread into previously uncontaminated areas.

1.1. IDW includes all water, soil, drilling mud, decontamination wastes, discarded personal protective equipment (PPE), etc. from site investigations, exploratory borings, piezometer and monitoring well installation, refurbishment, and abandonment, and other investigative activities. Containerize the IDW at the time it is generated.

1.2. Determine if the IDW must be managed as Resource Conservation and Recovery Act (RCRA) regulated hazardous waste through appropriate testing or generator knowledge. Manage all IDW that is determined to be RCRA regulated hazardous waste according to the local state and federal requirements.

1.3. Properly dispose of IDW that is not a RCRA-regulated hazardous waste but is contaminated above the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality.

1.4. IDW that is not contaminated or contains contaminants below the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality may be disposed of onsite as long as the IDW will not cause a surface water violation.

1.5. Maintain all containers holding IDW in good condition:

1.5.1. Periodically inspect the containers for damage

1.5.2. Ensure that all required labeling (DOT, RCRA, etc.) are clearly visible.

Appendix FS 1000
Tables, Figures and Forms

Table FS 1000-1 Equipment Construction Materials

Table FS 1000-2 Construction Material Selection for Equipment and Sample Containers

Table FS 1000-3 Equipment Use and Construction

Table FS 1000-4 40 CFR Part 136 Table II: Required Containers, Preservation Techniques, and Holding Times (Water/Wastewater Samples)

Table FS 1000-5 Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times for Analytes not found in 40 CFR Part 136

Table FS 1000-6 Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples.

Table FS 1000-7 Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035

Table FS 1000-8 Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Table FS 1000-9 Containers, Preservation and Holding Times for Biosolids Samples and Protozoans

Table FS 1000-10 Container Materials, Preservation, and Holding Times for Fish and Shellfish

Table FS 1000-11 Holding Times for SPLP or TCLP Extraction, Sample Preparation and Determinative Analysis

Table FS 1000-12 Preventive Maintenance Tasks

Figure FS 1000-1 Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump

Table FS 1000-1

Equipment Construction Materials

Construction Material[1]	**Acceptable Analyte Groups**	**Precautions**
Metals		
316 Stainless Steel	All analyte groups. Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted.[2]
300-Series Stainless Steel (304, 303, 302)	Suitable for all analyte groups (if used, check for corrosion before use). Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted.[2] If corroded, there is a potential for samples to be contaminated with iron, chromium, copper or nickel. Check for compatibility with water chemistry for dedicated applications. Do not use in low pH, high chloride, or high TDS waters.
Low Carbon Steel Galvanized Steel Carbon Steel	Inorganic nonmetallics only.	Coring devices are acceptable for all analyte groups **if** appropriate liners are used. Use Teflon liners for organics. Use plastic or Teflon liners for metals. Do not use if weathered, corroded or pitted.[2] If corroded, there is a potential for samples to be contaminated with iron and manganese. Galvanized equipment will also contaminate with zinc and cadmium. If used to collect large samples (e.g., dredges), collect organic and metal samples may be collected from portions of the interior of the collected material.
Brass	Inorganic nonmetallics only.	Do not use if weathered, corroded or pitted.[2]
Plastics[3]		
Teflon and other fluorocarbon polymers	All analyte groups. Especially recommended for trace metals and organics.	Easily scratched. Do not use if scratched or discolored.
Polypropylene Polyethylene (All Types)	All analyte groups.	Easily scratched. Do not use if scratched or discolored.
Polyvinyl chloride (PVC)	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organics samples.

Table FS 1000-1

Equipment Construction Materials

Construction Material[1]	Acceptable Analyte Groups	Precautions
Tygon, Silicone, Neoprene	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organic samples. Do not use silicone if sampling for silica.
Viton	All analyte groups except extractable and volatile organics.[4]	Minimize contact with sample. Use only if no alternative material exists.
Glass		
Glass, borosilicate	All analyte groups except silica and boron.	

Adapted from USGS Field Manual, Chapter 2, January 2000.

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[1] Refers to construction material of the portions of the sampling equipment that come in contact with the sample (e.g., housing of variable speed submersible pump must be stainless steel if extractable organics are sampled; the housing of a variable speed submersible pump used to sample metals may be plastic.)

[2] Corroded/weathered surfaces are active sorption sites for organic compounds.

[3] Plastics used in connection with inorganic trace element samples (including metals) must be uncolored or white.

[4] May be allowable for specialized parts where no alternative material exists (e.g., Viton seals are the best available seal for some dedicated pump systems), however, contact with the sample must be minimized.

Table FS 1000-2
Construction Material Selection for Equipment and Sample Containers

Analyte Group	Acceptable Materials
Extractable Organics	Teflon Stainless steel Glass Polypropylene (All types) Polyethylene (All types) All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Volatile Organics	Teflon Stainless steel Glass Polypropylene (All types) Polyethylene (All types) All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Metals	Teflon Stainless steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass (except silica and boron)
Ultratrace Metals	Teflon Polyethylene (All types) Polypropylene (All types) Polycarbonate Mercury must be in glass or Teflon
Inorganic Nonmetallics	Teflon Stainless steel Low carbon, Galvanized or Carbon steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass Brass

Table FS 1000-2
Construction Material Selection for Equipment and Sample Containers

Analyte Group	Acceptable Materials
Microbiological samples	Teflon Stainless steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass Sterilize all **sample** containers. Thoroughly clean **sampling equipment** and rinse several times with sample water before collection. Sampling equipment **does not require** sterilization **Do not rinse sample containers**

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION HOUSING[1]	CONSTRUCTION TUBING	USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
WATER SAMPLING					
GROUNDWATER					
1 Positive displacement pumps[2]					
a. Submersible (turbine, helical rotor, gear driven)	SS, Teflon	SS, Teflon, PE, PP	Purging	All analyte groups	[3,4,5]; must be variable speed
			Sampling	All analyte groups	[3,4,5] must be variable speed
	SS, Teflon	Non-inert[6]	Purging	All analyte groups	[3,4,5] must be variable speed; polishing required[7]
			Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
	Non-inert[6]	Non-inert[6]	Purging	All analyte groups	[3,4,5] must be variable speed; polishing required[7]
			Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
b. Bladder pump (no gas contact)	SS, Teflon, PE, PP or PVC if permanently installed	SS, Teflon, PE, PP	Purging	All analyte groups	[3,4,5] must be variable speed
			Sampling	All analyte groups	[3,4] must be variable speed Bladder must be Teflon if sampling for volatile or extractable organics or PE or PP if used in portable pumps
	SS, Teflon, PE, PP	Non-inert[6]	Purging	All analyte groups	[3,4] must be variable speed; polishing required[7] **This configuration is not recommended**
			Sampling	All analyte groups except volatile and extractable organics	[3,4] must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
	Non-inert[6]	Non-inert[6]	Purging	All analyte groups	[3,4] must be variable speed; polishing required[7]
			Sampling	All analyte groups except volatile and extractable organics	[3,4] must be variable speed; polishing required[7] If sampling for metals, the tubing must be non-metallic if not SS

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION HOUSING[1]	CONSTRUCTION TUBING	USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
2. Suction lift pumps					
a. Centrifugal	N/A	SS, Teflon, PE, PP	Purging	All analyte groups	[4] foot-valve required Must be variable speed
	N/A	Non-inert[6]	Purging	All analyte groups	[4] foot-valve required; polishing required[7] Must be variable speed
b. Peristaltic	N/A	SS, Teflon, PE, PP	Purging	All analyte groups	[4] foot-valve required; polishing required[7] or continuous pumping required Must be variable speed
			Sampling	All analyte groups <u>except</u> volatile organics	[4] Silicone tubing in pump head Must be variable speed
	N/A	Non-inert[6]	Purging	All analyte groups	[4] foot-valve required Must be variable speed
			Sampling	All analyte groups <u>except</u> volatile and extractable organics	[4] Silicone tubing in pump head Must be variable speed
3. Bailers	SS, Teflon, PE, PP	N/A	Purging	All analyte groups	None; **<u>not recommended</u>**
		N/A	Sampling	All analyte groups	None; **<u>not recommended</u>**
	Non-inert[6]	N/A	Purging	All analyte groups <u>except</u> volatile and extractable organics	None; **<u>not recommended</u>** If sampling for metals, the tubing must be non-metallic if not SS
			Sampling	All analyte groups <u>except</u> volatile and extractable organics	None; **<u>not recommended</u>** If sampling for metals, the tubing must be non-metallic if not SS
<u>SURFACE WATER</u>					
1. Intermediate containers such as pond sampler, scoops, beakers, buckets, and dippers	SS, Teflon, Teflon-coated, PE, PP	N/A	Grab sampling	All analyte groups	None
	Glass	N/A		All analyte groups except boron and fluoride	None
	Non-inert[6]	N/A		All analyte groups <u>except</u> volatile and extractable organics	None

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION HOUSING[1]	CONSTRUCTION TUBING	USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
2. Nansen, Kemmerer, Van Dorn, Alpha and Beta Samplers, Niskin (or equivalent)	SS, Teflon, Teflon-coated, PE, PP	N/A	Specific depth grab sampling	All analyte groups	None
	Non-inert[6]	N/A		All analyte groups <u>except</u> volatile and extractable organics	None
3. DO Dunker	SS, Teflon, glass, PE, PP	N/A	Water column composite sampling	All analyte groups	None
4 Bailers – double valve	SS, Teflon, PE, PP	N/A	Grab sampling	All analyte groups	None
	Non-inert[6]	N/A	Grab sampling	All analyte groups <u>except</u> volatile and extractable organics	None If sampling for metals, the tubing must be non-metallic if not SS
5. Peristaltic pump	N/A	SS, Teflon, PE, PP	Specific depth sampling	All analyte groups <u>except</u> volatile organics	Silicone tubing in pump head Must be variable speed
	N/A	Non-inert[6]		All analyte groups <u>except</u> volatile and extractable organics	Silicone tubing in pump head Must be variable speed
<u>FIELD FILTRATION UNITS</u>	N/A		Dissolved constituents	Inorganic nonmetallics and metals in surface water	Must use a 0.45 μm filter
				Inorganic nonmetallics in groundwater	Must use a 0.45 μm filter
				Metals in groundwater and static wastewater and surface water	Must use in-line, high capacity, one-piece molded filter that is connected to the outlet of a pump; no intermediate vessels; positive pressure PE, PP & Teflon bailers acceptable Must use a 1 μm filter in groundwater, a 0.45 μm filter in surface water
				Metals in moving surface water (i.e., river/stream)	Must use positive pressure device, but an intermediate vessel may be used. Use a 0.45 μm filter

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION HOUSING[1]	CONSTRUCTION TUBING	USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
SOLID SAMPLING					
SOILS					
1. Core barrel (or liner)	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups[8]	[9, 10, 11]
	Non-inert[6] nonmetallics	N/A	Sampling	All analyte groups	[12]
	Non-inert[6] metals	N/A	Sampling	All analyte groups	[12]
2. Trowel, scoop, spoon or spatula	SS, Teflon, Teflon-coated, PE, PP	N/A	Sampling	All analyte groups[8]	
			Compositing	All analyte groups except volatile organics	Samples for volatile organics must grab samples
	Plastic	N/A	Sampling and compositing	All analyte groups except volatile and extractable organics	None Must be nonmetallic if not SS
3. Mixing tray (pan)	SS, Teflon, glass, Teflon-coated, aluminum , PE, PP	N/A	Sampling	All analyte groups[8]	[11]
			Compositing or homogenizing	All analyte groups except volatile organics	[11]
	Non-inert[6]	N/A	Compositing or homogenizing	All analyte groups	[10,11,12] must be nonmetallic if not SS
4. Shovel, bucket auger	SS	N/A	Sampling	All analyte groups[8]	None
	Non-SS	N/A	Sampling	All analyte groups[8]	[10,11,12]
5. Split spoon	SS or carbon steel w/ Teflon insert	N/A	Sampling	All analyte groups[8]	[10,11,12]
6. Shelby tube	SS	N/A	Sampling	All analyte groups[8]	[9]
	Carbon steel	N/A	Sampling	All analyte groups	[9,10,12]
SEDIMENT					
1. Coring devices	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups[8]	[9,10,11]

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION HOUSING[1]	CONSTRUCTION TUBING	USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	Non-inert[6] nonmetallics	N/A	Sampling	All analyte groups	[12]
	Non-inert[6] metals	N/A	Sampling	All analyte groups	[9,10,11]
2. Grab – Young, Petersen, Shipek	Teflon, Teflon-lined, SS	N/A	Sampling	All analyte groups[8]	None
	Carbon steel	N/A	Sampling	All analyte groups	[10,11]
3. Dredges – Eckman, Ponar, Petit Ponar Van Veen	SS	N/A	Sampling	All analyte groups[8]	None
	Carbon steel, brass	N/A	Sampling	All analyte groups	[10,11]
4. Trowel, scoop, spoon or spatula	SS, Teflon, Teflon-coated, PE, PP	N/A	Sampling	All analyte groups[8]	
			Compositing	All analyte groups except volatile organics	Samples for volatile organics be grab samples
	Plastic	N/A	Sampling and compositing	All analyte groups <u>except</u> volatile and extractable organics	None must be nonmetallic if not SS
5. Mixing tray (pan)	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups[8]	[11]
			Compositing or homogenizing	All analyte groups except volatile organics	[11]
	Non-inert[6]	N/A	Compositing or homogenizing	All analyte groups <u>except</u> volatile and extractable organics	none [11] must be nonmetallic if not SS
WASTE[13]					
Scoop	SS	N/A	Liquids, solids & sludges	All analyte groups[8]	Cannot collect deeper phases
Spoon	SS	N/A	Solids, sludges	All analyte groups[8]	Cannot collect deeper phases
Push tube	SS	N/A	Solids, sludges	All analyte groups[8]	Cannot collect deeper phases
Auger	SS	N/A	Solids	All analyte groups[8]	None

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION HOUSING[1]	CONSTRUCTION TUBING	USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
Sediment sampler	SS	N/A	Impoundments, piles	All analyte groups[8]	None
Ponar dredge	SS	N/A	Solids, sludges & sediments	All analyte groups[8]	None
Coliwasa, Drum thief	Glass	N/A	Liquids, sludges	All analyte groups	None
Mucksucker, Dipstick	Teflon		Liquids, sludges	All analyte groups	Not recommended for tanks > 11 feet deep
Bacon bomb	SS	N/A	Liquids	All analyte groups[8]	Not recommended for viscous wastes
Bailer	SS, Teflon	N/A	Liquids	All analyte groups[8]	Do not use with heterogeneous wastes Not recommended for viscous wastes
Peristaltic pump	N/A	Teflon, Glass	Liquids	All analyte groups except volatile organics	Do not use in flammable atmosphere Not recommended for viscous wastes
Backhoe bucket	Steel	N/A	Solids, Sludges		Difficult to clean Volatiles and metals must be taken from the interior part of the sample
Split spoon	SS	N/A	Solids	All analyte groups[8]	
Roto-Hammer	Steel	N/A	Solids	All analyte groups[8]	Physically breaks up sample Not for flammable atmospheres

Acronyms:

N/A	not applicable
SS	stainless steel
HDPE	high-density polyethylene
PE	polyethylene
PVC	polyvinyl chloride
PP	polypropylene

Table FS 1000-3
Equipment Use and Construction

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[1] Refers to tubing and pump housings/internal parts that are in contact with purged or sampled water (interior and exterior of delivery tube, inner lining of the discharge tube, etc.).

[2] If used to collect volatile or extractable organics, all power cords and other tubing must be encased in Teflon, PE or PP.

[3] If used as a non-dedicated system, pump must be completely disassembled, if practical, and cleaned between wells.

[4] Delivery tubing must be precleaned and precut at the base of operations or laboratory. If the same tubing is used during the sampling event, it must be cleaned and decontaminated between uses.

[5] In-line check valve required.

[6] "Non-inert" pertains to materials that are reactive (adsorb, absorb, etc.) to the analytes being sampled. For organics, materials include rubber, plastics (except PE and PP), and PVC. For metals, materials include brass, galvanized, and carbon steel.

[7] "Polishing": When purging for volatile or extractable organics, the entire length of tubing or the portion which comes in contact with the formation water must be constructed of Teflon, SS, PE or PP. If other materials (e.g., PVC, garden hoses, etc.) are used, the following protocols must be followed: 1) slowly withdraw the pump from the water column during the last phase of purging, to remove any water from the well that may have contacted the exterior of the pump and/or tubing; 2) remove a single well volume with the sampling device before sampling begins. **Do not use Tygon** for purging if purgeable or extractable organics are of interest. Polishing **is not recommended;** use of sampling equipment constructed of appropriate materials is preferred.

[8] Do not use if collecting for hexavalent chromium (Chromium^{+6})

[9] If samples are sealed in the liner for transport to the laboratory, the sample for VOC analysis must be taken from the interior part of the core.

[10] If a non-stainless steel (carbon steel, aluminum) liner, core barrel or implement is used, take the samples for metals, purgeable organics and organics from the interior part of the core sample.

[11] Aluminum foil, trays or liners may be used only if aluminum is not an analyte of interest.

[12] If non-inert-liner, core barrel or implement is used, take samples from the interior part of the collected sample.

[13] If disposable equipment of alternative construction materials is used, the construction material must be compatible with the chemical composition of the waste, cannot alter the characteristics of the waste sample in any way, and cannot contribute analytes of interest or any interfering components.

Table FS1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times

Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container[1]	Preservation[2, 3]	Maximum holding time[4]
Table IA—Bacterial Tests:			
1–5. Coliform, total, fecal, and *E. coli*	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$ [5]	6 hours[6, 7]
6. Fecal streptococci	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$ [5]	6 hours[6]
7. Enterococci	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$ [5]	6 hours[6]
8. Salmonella	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$ [5]	6 hours[6]
Table IA— Aquatic Toxicity Tests:			
9–11. Toxicity, acute and chronic	P, FP, G	Cool, ≤6 °C [8]	36 hours
Table IB—Inorganic Tests:			
1. Acidity	P, FP, G	Cool, ≤6 °C[9]	14 days
2. Alkalinity	P, FP, G	Cool, ≤6 °C[9]	14 days
4. Ammonia	P, FP, G	Cool, ≤6 °C[9], H_2SO_4 to pH<2	28 days
9. Biochemical oxygen demand	P, FP, G	Cool, ≤6 °C[9]	48 hours
10. Boron	P, FP, or Quartz	HNO_3 to pH<2	6 months
11. Bromide	P, FP, G	None required	28 days
14. Biochemical oxygen demand, carbonaceous	P, FP G	Cool, ≤6 °C[9]	48 hours
15. Chemical oxygen demand	P, FP, G	Cool, ≤6 °C[9], H_2SO_4 to pH<2	28 days
16. Chloride	P, FP, G	None required	28 days
17. Chlorine, total residual	P, G	None required	Analyze within 15 minutes
21. Color	P, FP, G	Cool, ≤6 °C[9]	48 hours
23–24. Cyanide, total or available (or CATC)	P, FP, G	Cool, ≤6 °C[9], NaOH to pH>12[10], reducing agent [5]	14 days
25. Fluoride	P	None required	28 days
27. Hardness	P, FP, G	HNO_3 or H_2SO_4 to pH<2	6 months
28. Hydrogen ion (pH)	P, FP, G	None required	Analyze within 15 minutes
31, 43. Kjeldahl and organic N	P, FP, G	Cool, ≤6 °C[9], H_2SO_4 to pH<2	28 days
Table IB—Metals:			
7 18. Chromium VI	P, FP, G	Cool, ≤6 °C[9], pH = 9.3–9.7[12]	28 days
35. Mercury (CVAA)	P, FP, G	HNO_3 to pH<2	28 days

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40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times

Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container[1]	Preservation[2, 3]	Maximum holding time[4]
35. Mercury (CVAFS)	FP, G; and FP-lined cap[13]	5 mL/L 12N HCl or 5 mL/L BrCl[13]	90 days[13]
3, 5–8, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70– 72, 74, 75. Metals, except boron, chromium VI, and mercury.	P, FP, G	HNO_3 to pH<2, or at least 24 hours prior to analysis[14]	6 months
38. Nitrate	P, FP, G	Cool, ≤6 °C[9]	48 hours
39. Nitrate-nitrite	P, FP, G	Cool, ≤6 °C[9], H_2SO_4 to pH<2	28 days
40. Nitrite	P, FP, G	Cool, ≤6 °C[9]	48 hours
41. Oil and grease	G	Cool, ≤6 °C[9], HCl or H2SO4 to pH<2	28 days
42. Organic Carbon	P, FP, G	Cool, ≤6 °C[9], HCl, H_2SO_4, or H_3PO_4 to pH<2.	28 days
44. Orthophosphate	P, FP, G	Cool, ≤6 °C[9]	Filter within 15 minutes; Analyze within 48 hours
46. Oxygen, Dissolved Probe	G, Bottle and top	None required	Analyze within 15 minutes
47. Winkler	G, Bottle and top	Fix on site and store in dark	8 hours
48. Phenols	G	Cool, ≤6 °C[9], H_2SO_4 to pH<2	28 days
49. Phosphorous (elemental)	G	Cool, ≤6 °C[9]	48 hours
50. Phosphorous, total	P, FP, G	Cool, ≤6 °C[9], H_2SO_4 to pH<2	28 days
53. Residue, total	P, FP, G	Cool, ≤6 °C[9]	7 days
54. Residue, Filterable	P, FP, G	Cool, ≤6 °C[9]	7 days
55. Residue, Nonfilterable (TSS)	P, FP, G	Cool, ≤6 °C[9]	7 days
56. Residue, Settleable	P, FP, G	Cool, ≤6 °C[9]	48 hours
57. Residue, Volatile	P, FP, G	Cool, ≤6 °C[9]	7 days
61. Silica	P or Quartz	Cool, ≤6 °C[9]	28 days
64. Specific conductance	P, FP, G	Cool, ≤6 °C[9]	28 days
65. Sulfate	P, FP, G	Cool, ≤6 °C[9]	28 days
66. Sulfide	P, FP, G	Cool, ≤6 °C[9], add zinc acetate plus sodium hydroxide to pH>9	7 days
67. Sulfite	P, FP, G	None required	Analyze within 15 minutes
68. Surfactants	P, FP, G	Cool, ≤6 °C[9]	48 hours

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Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container[1]	Preservation[2, 3]	Maximum holding time[4]
69. Temperature	P, FP, G	None required	Analyze
73. Turbidity	P, FP, G	Cool, ≤6 °C[9]	48 hours

Table IC—Organic Tests 8			
13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 76, 104, 105, 108–111, 113. Purgeable Halocarbons	G, FP-lined septum	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5]	14 days
6, 57, 106. Purgeable aromatic hydrocarbons	G, FP-lined septum	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5], HCl to pH 2[16]	14 days[16]
3, 4. Acrolein and acrylonitrile	G, FP-lined septum	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5], pH to 4–5[17]	14 days[17]
23, 30, 44, 49, 53, 77, 80, 81, 98, 100, 112. Phenols[18]	G, FP-lined cap	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5]	7 days until extraction, 40 days after extraction
7, 38. Benzidines [18,19]	G, FP-lined cap	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5]	7 days until extraction[20]
14, 17, 48, 50–52. Phthalate esters [18]	G, FP-lined cap	Cool, ≤6 °C[9]	7 days until extraction, 40 days after extraction
82–84. Nitrosamines [18,21]	G, FP-lined cap	Cool, ≤6 °C[9], store in dark, 0.008% $Na_2S_2O_3$ [5]	7 days until extraction, 40 days after extraction
88–94. PCBs[18]	G, FP-lined cap	Cool, ≤6 °C[9]	1 year until extraction, 1 year after extraction
54, 55, 75, 79. Nitroaromatics and isophorone[18]	G, FP-lined cap	Cool, ≤6 °C[9], store in dark, 0.008% $Na_2S_2O_3$ [5]	7 days until extraction, 40 days after extraction
1, 2, 5, 8–12, 32, 33, 58, 59, 74, 78, 99, 101. Polynuclear aromatic hydrocarbons[18]	G, FP-lined cap	Cool, ≤6 °C[9], store in dark, 0.008% $Na_2S_2O_3$ [5]	7 days until extraction, 40 days after extraction
15, 16, 21, 31, 87. Haloethers[18]	G, FP-lined cap	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5]	7 days until extraction, 40 days after extraction
29, 35–37, 63–65, 107. Chlorinated hydrocarbons[18]	G, FP-lined cap	Cool, ≤6 °C[9]	7 days until extraction, 40 days after extraction
60–62, 66–72, 85, 86, 95–97, 102, 103. CDDs/CDFs[18]			
Aqueous Samples: Field and Lab Preservation	G	Cool, ≤6 °C[9], 0.008% $Na_2S_2O_3$ [5], pH<9	1 year

Table FS1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times

Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container[1]	Preservation[2, 3]	Maximum holding time[4]
Solids and Mixed-Phase Samples: Field Preservation	G	Cool, ≤6 °C[9]	7 days
Tissue Samples: Field Preservation	G	Cool, ≤6 °C[9]	24 hours
Solids, Mixed-Phase, and Tissue Samples: Lab Preservation	G	Freeze, ≤-10 °C	1 year
Table ID—Pesticides			
Tests: 1–70. Pesticides[18]	G, FP-lined cap	Cool, ≤6 °C[9], pH 5–9[22]	7 days until extraction, 40 days after extraction
Table IE—Radiological Tests:			
1–5. Alpha, beta, and radium	P, FP, G	HNO_3 to pH<2	6 months
Table IH—Bacterial Tests:			
1. *E. coli*			
2. Enterococci	PA, G	Cool, <10 °C, 0.008% $Na_2S_2O_3$ [5]	6 hours[6]
Table IH—Protozoan Tests:			
8. Cryptosporidium	LDPE; field filtration	0–8 °C	96 hours.[23]
9. Giardia	LDPE; field filtration	0–8 °C	96 hours[23]

Reference: This table is adapted from Table II, 40 CFR Part 136, 2007

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[1] ‘‘P’’ is polyethylene; ‘‘FP’’ is fluoropolymer (polytetrafluoroethylene (PTFE; Teflon®), or other fluoropolymer, unless stated otherwise in this Table II; ‘‘G’’ is glass; ‘‘PA’’ is any plastic that is made of a sterlizable material (polypropylene or other autoclavable plastic); ‘‘LDPE’’ is low density polyethylene.

[2] Except where noted in this Table II and the method for the parameter, preserve each grab sample within 15 minutes of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), refrigerate the sample at ≤6 °C during collection unless specified otherwise in this Table II or in the method(s). For a composite sample to be split into separate aliquots for preservation and/or analysis, maintain the sample at ≤6 °C, unless specified otherwise in this Table II or in the method(s), until collection, splitting, and preservation is completed. Add the preservative to the sample container prior to sample collection when the preservative will not compromise the integrity of a grab sample, a composite sample, or an aliquot split from a composite sample; otherwise, preserve the grab sample, composite sample,

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Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

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or aliquot split from a composite sample within 15 minutes of collection. If a composite measurement is required but a composite sample would compromise sample integrity, individual grab samples must be collected at prescribed time intervals (e.g., 4 samples over the course of a day, at 6-hour intervals). Grab samples must be analyzed separately and the concentrations averaged. Alternatively, grab samples may be collected in the field and composited in the laboratory if the compositing procedure produces results equivalent to results produced by arithmetic averaging of the results of analysis of individual grab samples. For examples of laboratory compositing procedures, see EPA Method 1664A (oil and grease) and the procedures at 40 CFR 141.34(f)(14)(iv) and (v) (volatile organics).

[3] When any sample is to be shipped by common carrier or sent via the U.S. Postal Service, 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 II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (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); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before the start of analysis and still be considered valid (e.g., samples analyzed for fecal coliforms may be held up to 6 hours prior to commencing analysis). Samples may be held for longer periods only if the permittee or monitoring laboratory has data on file to show that, for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). For a grab sample, the holding time begins at the time of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), the holding time begins at the time of the end of collection of the composite sample. For a set of grab samples composited in the field or laboratory, the holding time begins at the time of collection of the last grab sample in the set. 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 it knows that a shorter time is necessary to maintain sample stability. See § 136.3(e) for details. The date and time of collection of an individual grab sample is the date and time at which the sample is collected. For a set of grab samples to be composited, and that are all collected on the same calendar date, the date of collection is the date on which the samples are collected. For a set of grab samples to be composited, and that are collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14–15. For a composite sample collected automatically on a given date, the

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date of collection is the date on which the sample is collected. For a composite sample collected automatically, and that is collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14–15.

[5] Add a reducing agent only if an oxidant (e.g., chlorine) is present. Reducing agents shown to be effective are sodium thiosulfate ($Na_2S_2O_3$), ascorbic acid, sodium arsenite ($NaAsO_2$), or sodium borohydride ($NaBH_4$). However, some of these agents have been shown to produce a positive or negative cyanide bias, depending on other substances in the sample and the analytical method used. Therefore, do not add an excess of reducing agent. Methods recommending ascorbic acid (e.g., EPA Method 335.4) specify adding ascorbic acid crystals, 0.1–0.6 g, until a drop of sample produces no color on potassium iodide (KI) starch paper, then adding 0.06 g (60 mg) for each liter of sample volume. If $NaBH_4$ or $NaAsO_2$ is used, 25 mg/L $NaBH_4$ or 100 mg/L $NaAsO_2$ will reduce more than 50 mg/L of chlorine (see method ‘‘Kelada-01’’ and/or Standard Method

4500–CN^- for more information). After adding reducing agent, test the sample using KI paper, a test strip (e.g. for chlorine, SenSafeTM Total Chlorine Water Check 480010) moistened with acetate buffer solution (see Standard Method 4500–Cl.C.3e), or a chlorine/oxidant test method (e.g., EPA Method 330.4 or 330.5), to make sure all oxidant is removed. If oxidant remains, add more reducing agent. Whatever agent is used, it should be tested to assure that cyanide results are not affected adversely.

[6] Samples analysis should begin immediately, preferably within 2 hours of collection. The maximum transport time to the laboratory is 6 hours, and samples should be processed within 2 hours of receipt at the laboratory.

[7] For fecal coliform samples for sewage sludge (biosolids) only, the holding time is extended to 24 hours for the following sample types using either EPA Method 1680 (LTB–EC) or 1681 (A–1): Class A composted, Class B aerobically digested, and Class B anaerobically digested.

[8] Sufficient ice should be placed with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, it is necessary to immediately measure the temperature of the samples and confirm that the preservation temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature.

[9] Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ‘‘≤°C’’ is used in place of the ‘‘4 °C’’ and ‘‘< 4 °C’’ sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three

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significant figures are specified so that rounding down to 6 °C may not be used to meet the ≤6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

[10] Sample collection and preservation: Collect a volume of sample appropriate to the analytical method in a bottle of the material specified. If the sample can be analyzed within 48 hours and sulfide is not present, adjust the pH to > 12 with sodium hydroxide solution (e.g., 5% w/v), refrigerate as specified, and analyze within 48 hours. Otherwise, to extend the holding time to 14 days and mitigate interferences, treat the sample immediately using any or all of the following techniques, as necessary, followed by adjustment of the sample pH to > 12 and refrigeration as specified. There may be interferences that are not mitigated by approved procedures. Any procedure for removal or suppression of an interference may be employed, provided the laboratory demonstrates that it more accurately measures cyanide. Particulate cyanide (e.g., ferric ferrocyanide) or a strong cyanide complex (e.g., cobalt cyanide) are more accurately measured if the laboratory holds the sample at room temperature and pH > 12 for a minimum of 4 hours prior to analysis, and performs UV digestion or dissolution under alkaline (pH=12) conditions, if necessary.

(1) SULFUR: To remove elemental sulfur (S8), filter the sample immediately. If the filtration time will exceed 15 minutes, use a larger filter or a method that requires a smaller sample volume (e.g., EPA Method 335.4 or Lachat Method 01). Adjust the pH of the filtrate to > 12 with NaOH, refrigerate the filter and filtrate, and ship or transport to the laboratory. In the laboratory, extract the filter with 100 mL of 5% NaOH solution for a minimum of 2 hours. Filter the extract and discard the solids. Combine the 5% NaOH-extracted filtrate with the initial filtrate, lower the pH to approximately 12 with concentrated hydrochloric or sulfuric acid, and analyze the combined filtrate. Because the detection limit for cyanide will be increased by dilution by the filtrate from the solids, test the sample with and without the solids procedure if a low detection limit for cyanide is necessary. Do not use the solids procedure if a higher cyanide concentration is obtained without it. Alternatively, analyze the filtrates from the sample and the solids separately, add the amounts determined (in µg or mg), and divide by the original sample volume to obtain the cyanide concentration.

(2) SULFIDE: If the sample contains sulfide as determined by lead acetate paper, or if sulfide is known or suspected to be present, immediately conduct one of the volatilization treatments or the precipitation treatment as follows: Volatilization—Headspace expelling. In a fume hood or well-ventilated area, transfer 0.75 liter of sample to a 4.4 L collapsible container (e.g., CubitainerTM). Acidify with concentrated hydrochloric acid to pH
< 2. Cap the container and shake vigorously for 30 seconds. Remove the cap and expel the headspace into the fume hood or open area by collapsing the container without expelling the sample. Refill the headspace by expanding the container. Repeat expelling a total of five headspace volumes. Adjust the pH to > 12, refrigerate, and ship or transport to the laboratory. Scaling to a smaller or larger sample volume must maintain the air to sample volume ratio. A larger volume of air will result in too great a loss of cyanide (> 10%). Dynamic stripping: In a fume hood or well- ventilated area, transfer 0.75 liter of sample to a container of the material specified and acidify with concentrated hydrochloric acid to pH < 2. Using a calibrated air sampling pump or flowmeter, purge the acidified sample into the fume hood or open area through a fritted glass aerator at a flow rate of 2.25 L/min for 4 minutes. Adjust the pH to >

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

12, refrigerate, and ship or transport to the laboratory. Scaling to a smaller or larger sample volume must maintain the air to sample volume ratio. A larger volume of air will result in too great a loss of cyanide (> 10%). Precipitation: If the sample contains particulate matter that would be removed by filtration, filter the sample prior to treatment to assure that cyanide associated with the particulate matter is included in the measurement. Ship or transport the filter to the laboratory. In the laboratory, extract the filter with 100 mL of 5% NaOH solution for a minimum of 2 hours. Filter the extract and discard the solids. Combine the 5% NaOH-extracted filtrate with the initial filtrate, lower the pH to approximately 12 with concentrated hydrochloric or sulfuric acid, and analyze the combined filtrate. Because the detection limit for cyanide will be increased by dilution by the filtrate from the solids, test the sample with and without the solids procedure if a low detection limit for cyanide is necessary. Do not use the solids procedure if a higher cyanide concentration is obtained without it. Alternatively, analyze the filtrates from the sample and the solids separately, add the amounts determined (in µg or mg), and divide by the original sample volume to obtain the cyanide concentration. For removal of sulfide by precipitation, raise the pH of the sample to > 12 with NaOH solution, then add approximately 1 mg of powdered cadmium chloride for each mL of sample. For example, add approximately 500 mg to a 500-mL sample. Cap and shake the container to mix. Allow the precipitate to settle and test the sample with lead acetate paper. If necessary, add cadmium chloride but avoid adding an excess. Finally, filter through 0.45 micron filter. Cool the sample as specified and ship or transport the filtrate and filter to the laboratory. In the laboratory, extract the filter with 100 mL of 5% NaOH solution for a minimum of 2 hours. Filter the extract and discard the solids. Combine the 5% NaOH-extracted filtrate with the initial filtrate, lower the pH to approximately 12 with concentrated hydrochloric or sulfuric acid, and analyze the combined filtrate. Because the detection limit for cyanide will be increased by dilution by the filtrate from the solids, test the sample with and without the solids procedure if a low detection limit for cyanide is necessary. Do not use the solids procedure if a higher cyanide concentration is obtained without it. Alternatively, analyze the filtrates from the sample and the solids separately, add the amounts determined (in µg or mg), and divide by the original sample volume to obtain the cyanide concentration. If a ligand-exchange method is used (e.g., ASTM D6888), it may be necessary to increase the ligand-exchange reagent to offset any excess of cadmium chloride.

(3) SULFITE, THIOSULFATE, OR THIOCYANATE: If sulfite, thiosulfate, or thiocyanate is known or suspected to be present, use UV digestion with a glass coil (Method Kelada-01) or ligand exchange (Method OIA–1677) to preclude cyanide loss or positive interference.

(4) ALDEHYDE: If formaldehyde, acetaldehyde, or another water-soluble aldehyde is known or suspected to be present, treat the sample with 20 mL of 3.5% ethylenediamine solution per liter of sample.

(5) CARBONATE: Carbonate interference is evidenced by noticeable effervescence upon acidification in the distillation flask, a reduction in the pH of the absorber solution, and incomplete cyanide spike recovery. When significant carbonate is present, adjust the pH to ≥12 using calcium hydroxide instead of sodium hydroxide. Allow the precipitate to settle and decant or filter the sample prior to analysis (also see Standard Method 4500–CN.B.3.d).

Table FS1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times

Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

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(6) CHLORINE, HYPOCHLORITE, OR OTHER OXIDANT: Treat a sample known or suspected to contain chlorine, hypochlorite, or other oxidant as directed in footnote 5.

[11] For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically.

[12] To achieve the 28-day holding time, use the ammonium sulfate buffer solution specified in EPA Method 218.6. The allowance in this footnote supersedes preservation and holding time requirements in the approved hexavalent chromium methods, unless this supersession would compromise the measurement, in which case requirements in the method must be followed.

[13] Samples collected for the determination of trace level mercury (<100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. A sample collected for dissolved trace level mercury should be filtered in the laboratory within 24 hours of the time of collection. However, if circumstances preclude overnight shipment, the sample should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. If sample integrity will not be maintained by shipment to and filtration in the laboratory, the sample must be filtered in a designated clean area in the field within the time period necessary to maintain sample integrity. A sample that has been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

[14] An aqueous sample may be collected and shipped without acid preservation. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. If the sample must be analyzed within 24 hours of collection, add the acid immediately (see footnote 2). Soil and sediment samples do not need to be preserved with acid. The allowances in this footnote supersede the preservation and holding time requirements in the approved metals methods.

[15] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[16] If the sample is not adjusted to pH 2, then the sample must be analyzed within seven days of sampling.

[17] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

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40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times

Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

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[18] When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity (i.e., use all necessary preservatives and hold for the shortest time listed). When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to ≤6 °C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (regarding the requirement for thiosulfate reduction), and footnotes 19, 20 (regarding the analysis of benzidine).

[19] If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

[20] Extracts may be stored up to 30 days at < 0 °C.

[21] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7–10 with NaOH within 24 hours of sampling

[22] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[23] Holding time is calculated from time of sample collection to elution for samples shipped to the laboratory in bulk and calculated from the time of sample filtration to elution for samples filtered in the field

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
For Analytes not Found in 40 CFR 136

Analyte	Methods	Reference [1]	Container[2]	Preservation[3]	Maximum Holding Time[4]
Bromine	DPD Colorimetric[5]	SM 4500-Cl-G	P, G	None required	Analyze immediately
Bromates	Ion Chromatography	EPA 300.0 [6]	P, G	Cool 4°C	30 days
Chlorophylls	Spectrophotometric	SM 10200 H	P, G[7]	Dark 4°C Filtered, dark, ¯20°C	48 hours chilled until filtration[8], and analyze immediately or 48 hours chilled until filtration[8],and 28 days (frozen)after filtration
Corrosivity	Calculated ($CaCO_3$ Stability, Langelier Index)	SM 2330 ASTM D513-92	P, G	Cool 4°C[9]	7 days[9]
FL-PRO	Gas Chromatography	DEP (11/1/95)	G only	Cool 4°C, H_2SO_4 or HCl to pH<2	7 days until extraction, 40 days after extraction
Odor	Human Panel	SM 2150	G only	Cool 4°C	6 hours
Salinity	Electrometric [10] Hydrometric[10]	SM 2520 B SM 2520 C	G, wax seal	Analyze immediately or use wax seal	30 days[10]
Taste	Human Panel	SM 2160 B, C, D ASTM E679-91	G only	Cool 4°C	24 hours
Total Dissolved Gases	Direct-sensing Membrane-diffusion	SM 2810	_____	_____	Analyze in-situ
Total Petroleum Hydrocarbons	Gravimetry	EPA 1664	G only	Cool 4°C, H_2SO_4 or HCl to pH<2	28 days
Transparency	Irradiometric[11]	62-302.200(6), FAC	_____	_____	Analyze in-situ
Un-ionized Ammonia	Calculated[12]	DEP-SOP[13]	P, G	Cool 4°C $Na_2S_2O_3$ [12]	8 hours unpreserved 28 days preserved [12]
Organic Pesticides[14]	GC and HPLC	EPA (600-series) [14]	[15]	[15]	[15]

[1] SM XXXX = procedures from "Standard Methods for the Examination of Water and Wastewater", APHA-AWWA-WPCF, 20th edition, 1998 and Standard Methods Online.

ASTM XXXX-YY = procedure from "Annual Book of ASTM Standards", Volumes 11.01 and 11.02 (Water I and II), 1999.

[2] P = plastic, G = glass.

[3] When specified, sample preservation should be performed immediately upon sample collection.

[4] The times listed are the maximum times that samples may be held before analysis and still be considered valid.

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
For Analytes not Found in 40 CFR 136

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[5] The approved procedure is for residual chlorine. However, in the absence of chlorine, the DPD colorimetric procedure can be adapted to measure bromine content of the sample. In such case, the validity of this assumption must be verified by using another procedure for chlorine which is not affected by the presence of bromine (i.e., negligible interference).

[6] The Determination of Inorganic Anions in Water by Ion Chromatography", EPA Method 300.0, Revised August 1993, by John D. Pfaff, U. S. EPA Cincinnati, Ohio 45268.

[7] Collect samples in opaque bottles and process under reduced light.

[8] Samples must be filtered within 48 hours of collection. Add magnesium carbonate to the filter while the last of the sample passes through the filter..

[9] Temperature and pH must be measured on site at the time of sample collection. 7 days is the maximum time for laboratory analysis of total alkalinity, calcium ion and total solids.

[10] The electrometric and hydrometric analytical methods are suited for field use. The argentometric method is suited for laboratory use. Samples collected for laboratory analysis, when properly sealed with paraffin waxed stopper, may be held indefinitely. The maximum holding time of 30 days is recommended as a practical regulatory limit.

[11] Transparency in surface waters is defined as a compensation point for photosynthetic activity, i.e., the depth at which one percent of the light intensity entering at the water surface remains unabsorbed. The DEP Chapter 62-302, FAC requires that the light intensities at the surface and subsurface be measured simultaneously by irradiance meters such as the Kahlsico Underwater Irradiometer, Model No. 268 WA 310, or an equivalent device having a comparable spectral response.

[12] The results of the measurements of pH, temperature, salinity (if applicable) and the ammonium ion concentration in the sample are used to calculate the concentration of ammonia in the unionized state. Temperature, pH and salinity must be measured on-site at the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H_2SO_4 to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

[13] DEP Central Analytical Laboratory, Tallahassee, FL, Revision No. 2, 2-12-2001. The document is available from the DEP Standards & Assessment Section..

[14] Other pesticides listed in approved EPA methods (608.1, 608.2, 614, 614.1, 615, 617, 618, 619, 622, 622.1, 627, 629, 631, 632, 632.1, 633, 642, 643, 644 and 645) that are not included in Table ID of 40 CFR Part 136 (July 2007).

[15] Container, preservation and holding time as specified in each individual method must be followed.

Table FS 1000-6
Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples

Analyte	Methods	References	Container	Preservation	Maximum Holding Times
Volatile Organics	Purge-and-Trap GC and GC-MS	8015, 8260, 8021, 5035	See Table 1000-7		
Semivolatile Organics	GC, HPLC, and GC-MS	8041, 8061, 8070, 8081, 8082, 8091, 8111, 8121, 8131, 8141, 8151, 8270, 8275, 8280, 8290, 8310, 8315, 8316, 8318, 8321, 8325, 8330, 8331, 8332, 8410, 8430, 8440, FL-PRO	Glass, 8 oz widemouth with Teflon® -Lined lid	Cool 4°C [1]	14 days until extraction, 40 days after extraction
Dioxins		8290	Amber Glass, 8 oz widemouth with Teflon® -Lined lid	Cool 4°C[1] in dark	30 days until extraction, 45 days after extraction
Total Metals-except mercury and chromium VI methods	Flame AA, Furnace AA, Hydride and ICP	All 7000-series (except 7195, 7196, 7197, 7198, 7470 and 7471), and 6010 (ICP)	Glass or plastic 8 oz widemouth (200 grams sample)	None	6 months
Chromium VI	Colorimetric, Chelation with Flame AA (200 gram sample)	7196 and 7197 (prep 3060)	Glass or plastic, 8 oz widemouth (200 gram sample)	Cool 4°± 2°C[1]	1 month until extraction, 4 days after extraction [2]
Mercury	Manual Cold Vapor AA	7471	Glass or plastic 8 oz widemouth (200 grams sample)	Cool 4°± 2°C[1]	28 days
Microbiology (MPN)		MPN	Sterile glass or plastic	Cool 4°C[1]	24 hours
Aggregate Properties			Glass or plastic	Cool 4°C[1]	14 days
Inorganic nonmetallics all except:			Glass or plastic	Cool 4°C[1]	28 days
Sulfite, Nitrate, Nitrite & o-phosphate			Glass or plastic		48 hours
Elemental Phosphorus			Glass		48 hours

Table FS 1000-6
Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples

The term “residuals” include: (1) sludges of domestic origin having no specific requirements in Tables FS-1000-4 or FS-1000-9; (2) sludges of industrial origin; and (3) concentrated waste samples.

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[1] Keep soils, sediments and sludges cool at 4°C from collection time until analysis. No preservation is required for concentrated waste samples.

[2] Storage Temperature is 4°C, ±2°C

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035

			Sample Container					
Conc. Level	Sampling Device	Collection Procedure	Type	Vial Preparation	Preservation	Sample Preparation	Max HT①	Determinative Procedure
≤200 ug/kg	Coring Device	5035 - Section 6.2.1	Glass Vial w/ PTFE-silicone Septum	5035 - 6.1.1	$NaHSO_4$ / 4ºC	5035 - Section 7.2	14 D	Any recognized VOC Method
				5035 - 6.1.1②	4ºC	5035 - Section 7.2	48 H	Any recognized VOC Method
				5035 - 6.1.1②	4ºC / -10ºC③,④	5035 - Section 7.2	48 H / 14 D⑤	Any recognized VOC Method
	EnCore or equivalent	5035 - Section 6.2.1	EnCore or equivalent	5035 - 6.1.1②,⑥,⑦	4ºC	5035 - Section 7.2	48 H	Any recognized VOC Method
		5035 - Section 6.2.1	EnCore or equivalent	5035 - 6.1.1⑥,⑦	$NaHSO_4$ / 4ºC	5035 - Section 7.2⑤	48 H / 14 D⑤	Any recognized VOC Method
		5035 - Section 6.2.1	EnCore or equivalent	5035-6.1.1②⑥⑦	4ºC / -10ºC③,④	5035 - Section 7.2⑤	48 H / 14 D⑤	Any recognized VOC Method
>200 ug/kg	EnCore or equivalent	5035 - Section 6.2.2.3⑥	EnCore or equivalent	5035 - 6.1.3⑥,⑦	4ºC	5035 - Sections 7.3.2 & 7.3.3⑤	48 H / 14 D⑤	Any recognized VOC Method
>200 ug/kg⑧	Coring Device	5035 - Section 6.2.2.3⑨	Glass Vial w/ PTFE-silicone Septum	6.1.3⑨	Methanol/PEG + 4ºC	5035 - Section 7.3.4	14 D	Any recognized VOC Method
	Conventional Devices	DEP SOP - Section 4.3	Glass w/ PTFE-silicone Septum	6.1.2	4ºC	5035 - Sections 7.3.1 - 7.3.3	14 D	Any recognized VOC Method
Oily Waste	Conventional Devices	5035 - Section 6.2.4.2	Glass w/ PTFE-silicone Septum	6.1.4	4ºC	5035 - Sections 7.4.1 - 7.4.2	14 D	Any recognized VOC Method
	Conventional Devices	5035 - Section 6.2.4.1	Glass w/ PTFE-silicone Septum	6.1.4	Methanol/PEG + 4ºC	5035 - Sections 7.4.3	14 D	Any recognized VOC Method
Dry Wt.	Conventional Devices		Glass with Teflon liner		4ºC	5035 - Section 7.5		
Soil Screen	Conventional Devices	DEP SOP - Section 4.3	Glass w/ PTFE-silicone Septum		4ºC	5035 - Section 7.1	14 D	Any recognized VOC Method

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035

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① Maximum time allowable from time/date of collection to sample analysis.

② Eliminate 6.1.1.2; use only organic-free water.

③ Contents of sampling device must be transported to the laboratory at 4ºC and stored at -10ºC.

④ In order to ensure that vials do not break during freezing, they should be stored on their side or at a slanted angle to maximize surface area.

⑤ Maximum allowable time at 4ºC is 48 hours; maximum allowable time to sample analysis is 14 days (from time of sample collection).

⑥ Conducted in the laboratory.

⑦ Entire contents of sampling device are extruded into the sample analysis vial containing the appropriate solvent.

⑧ Procedures are limited only to those situations or programs in which the maximum contamination level does not exceed 200 ug/kg.

⑨ Methanolic preservation in the field is not recommended, but may be used if approved by an DEP program.

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte	Preservation[1]	Holding Time[2]	Holding Time for Extract[3]	Container[4]
MICROBIOLOGICAL-BACTERIA	Cool < 10°C, $Na_2S_2O_3$[5]			P or G
Total Coliforms, fecal coliforms & *E. coli* in drinking water	Cool < 10°C[6], $Na_2S_2O_3$[5]	30 Hours[7]		P or G
Total coliforms and fecal coliforms in source water Heterotrophic bacteria in drinking water	Cool < 10°C, $Na_2S_2O_3$[5]	8 hours		P or G
Gross Alpha	Conc. HCl or HNO_3 to pH <2 [8,9]	6 mo		P or G
Gross beta	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Strontium-89	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Strontium-90	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Radium-226	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Radium-228	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Cesium-134	Concentrated HCl to pH <<2[8,9]	6 mo		P or G
Iodine-131	None	8 da		P or G
Tritium	None	6 months		G
Uranium	Conc. HCl or HNO_3 to pH <2[8,9]	6 mo		P or G
Photon emitters	Conc. HCl or HNO_3 to pH <2[8,9]	6 mo		P or G
Asbestos	Cool 4°C	48 hours		P or G
Bromate	Ethylenediamine (50mg/L)	28 days		P or G
Cyanide	Cool, 4C, Ascorbic acid (if chlorinated), NaOH pH>12	14 days		P or G
Nitrate	Cool, 4°C	48 hours		P or G
Nitrate (chlorinated source)	Cool, 4°C	14 days		P or G
Odor	Cool 4°C	24 hours		G
502.2	Sodium Thiosulfate or Ascorbic Acid, 4°C HCl pH<2 if Ascorbic Acid is used	14 days		Glass with PFTE Lined Septum

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte	Preservation[1]	Holding Time[2]	Holding Time for Extract[3]	Container[4]
504.1	Sodium Thiosulfate Cool, 4°C,	14 days	4°C, 24 hours	Glass with PFTE-Lined Septum
505	Sodium Thiosulfate Cool, 4°C	14 days (7 days for Heptachlor)	4°C, 24 hours	Glass with PFTE-Lined Septum
506	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
507	Sodium Thiosulfate Cool, 4°C, Dark	14 days (see method for exceptions)	4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
508	Sodium Thiosulfate Cool, 4°C, Dark	7 days (see method for exceptions)	4°C, dark, 14 days	Glass with PFTE-lined Cap
508A	Cool, 4°C	14 days	30 days	Glass with PFTE-lined Cap
508.1	Sodium Sulfite, HCl pH<2, Cool, 4°C	14 days (see method for exceptions)	30 days	Glass with PFTE-lined Cap
515.1	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 28 days	Amber Glass with PFTE-lined Cap
515.2	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	≤ 4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
515.3	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	≤ 4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
515.4	Sodium Sulfite, HCl pH<2, Cool, ≤10°C for first 48 hours ≤6°C thereafter, Dark	14 days	≤0°C, 21 days	
524.2	Ascorbic Acid, HCl pH<2, Cool 4°C	14 days		Glass with PFTE-lined Septum
525.2	Sodium Sulfite, Dark, Cool, 4°C, HCl pH<2	14 days (see method for exceptions)	≤ 4°C, 30 days from collection	Amber Glass with PFTE-lined Cap
531.1, 6610	Sodium Thiosulfate Monochloroacetic acid, pH<3, Cool, 4°C	Cool 4°C, 28 days		Glass with PFTE-lined Septum
531.2	Sodium Thiosulfate, Potassium Dihydrogen Citrate buffer to pH 4,	28 days		

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte	Preservation[1]	Holding Time[2]	Holding Time for Extract[3]	Container[4]
	dark, ≤10°C for first 48 hr, ≤6°C thereafter			
547	Sodium Thiosulfate Cool, 4°C	14 days (18 mo. frozen)		Glass with PFTE-lined Septum
548.1	Sodium Thiosulfate (HCl pH 1.5-2 if high biological activity), Cool, 4°C, Dark	7 days	≤4°C 14 days	Amber Glass with PFTE-lined Septum
549.2	Sodium Thiosulfate (H_2SO_4 pH<2 if biologically active), Cool, 4°C, Dark	7 days	21 days	High Density Amber Plastic or Silanized Amber Glass
550, 550.1	Sodium Thiosulfate Cool, 4°C, HCl pH<2	7 days	550, 30 days 550.1, 40 days Dark, 4°C	Amber Glass with PFTE-lined Cap
551.1	Sodium Thiosulfate, Sodium Sulfite, Ammonium Chloride, pH 4.5-5.0 with phosphate buffer, Cool, 4°C	14 days		Glass with PFTE-lined Septum
552.1	Ammonium chloride, Cool, 4°C, Dark	14 days	≤4°C, dark 48 hours	Amber Glass with PFTE-lined cap
552.2	Ammonium chloride, Cool, 4°C, Dark	14 days	≤4°C, dark 7 days ≤-10°C 14 days	Amber Glass with PFTE-lined cap
555	Sodium Sulfite, HCl, pH ≤ 2, Dark, Cool 4°C	14 days		Glass with PFTE-lined cap
1613B	Sodium Thiosulfate, Cool, 0-4°C, Dark		Recommend 40 days	Amber Glass with PFTE-lined Cap

[1] Preservation, when required, must be done immediately upon sample collection.

[2] Stated values are the maximum regulatory holding times. Sample processing must begin by the stated time.

[3] Stated time is the maximum time a prepared sample extract may be held before analysis.

[4] (P) polyethylene or (G) or glass. For microbiology, plastic sample containers must be made of sterilizable materials (poly-propylene or other autoclavable plastic).

[5] Addition of sodium thiosulfate is only required if the sample has a detectable amount of residual chlorine, as indicated by a field test using EPA Method 330.4 or 330.2 or equivalent.

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

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[6] Temperature requirement applies only to source water samples, however once received by the laboratory, if sample processing does not begin on the same working day, samples must be refrigerated.

[7] If samples are analyzed after 30 hours, but within 48 hours of collection, the laboratory is to indicate in the analytical report that the data may be invalid because of excessive delay in sample processing. No samples received after 48 hours are to be accepted or analyzed for compliance with the regulations of the Department of Environmental Protection or the Department of Health.

[8] It is recommended that the preservative be added at the time of collection unless suspended solids activity is to be measured. It is also recommended that samples be filtered, if suspended or settleable solids are present, prior to adding preservative, at the time of collection. However, if the sample has to be shipped to a laboratory or storage area, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

[9] If HCl is used to acidify samples, which are to be analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

Table FS 1000-9
Containers, Preservation and Holding Times for Biosolids Samples and Protozoans

ANALYTE NAME	***CONTAINER***	***PRESERVATION***	***MAX HOLDING TIME***
Fecal Coliform	Plastic or Glass	Cool 4°C	24 hours
Salmonella	Plastic or Glass	< 10°C	24 hours
Enteric Viruses	Plastic or Glass	Up to 25°C	2 hours
Enteric Viruses	Plastic or Glass	2 to 10°C	48 hours
Specific Oxygen Uptake Rate	Plastic or Glass	None	As Soon As Possible
Helminth OVA	Plastic or Glass	< 4°C (Do not Freeze)	24 hours
Cryptosporidium/Giardia	Plastic or Glass	0 - 8°C (Do not Freeze)*	96 Hours
Total Solids	Plastic or Glass	≤6°C (Do not Freeze)	7 days
Metallics	Plastic or Glass	See Tables FS 1000-4, FS 1000-5 and FS 1000-6	
Other Inorganic Pollutants	Plastic or Glass	See Tables FS 1000-4, FS 1000-5 and FS 1000-6	

***Dechlorinate bulk samples when applicable**

Table FS 1000-10
Container Materials, Preservation, and Holding Times for Fish and Shellfish

Analyte	Matrix	Sample Container	Field (Transport to Lab)		Laboratory	
			Preservation	Maximum Shipping Time	Storage	Holding Time
	Whole Organism (Fish, shellfish, etc.	Foil-wrap each organism (or composite for shellfish) and transport in waterproof plastic bag	Cool in wet ice or: ——— Freeze on dry ice	24 hours ——— 48 hours		
Mercury	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE			Freeze at <-20°C	28 days
Other metals	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE			Freeze at <-20°C	6 months
Organics	Tissue (fillets and edible portions, homogenates)	Borosilicate glass, PTFE, quartz, aluminum foil			Freeze at <-20°C	1 year
Dioxin	Tissue (fillets and edible portions, homogenates)	Amber containers: Borosilicate glass, PTFE, quartz, aluminum foil			Freeze at <-20°C	30 days until extraction, 15 days after extraction
Lipids	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE			Freeze at <-20°C	1 year

PTFE = Polytetrafluoroethylene (Teflon)

Table FS 1000-11
Holding Times for SPLP or TCLP Extraction, Sample Preparation and Determinative Analysis

Holding Time (Days)				
	From: Field Collection To: SPLP or TCLP Extraction	From: SPLP or TCLP Extraction To: Preparative Extraction	From: Preparative Extraction To: Determinative Analysis	Total Elapsed Time
Volatiles	14	NA	14	28
Semi-Volatiles	14	7	40	61
Mercury	28	NA	28	56
Metals, except Mercury	180	NA	180	360

NA – Not Applicable

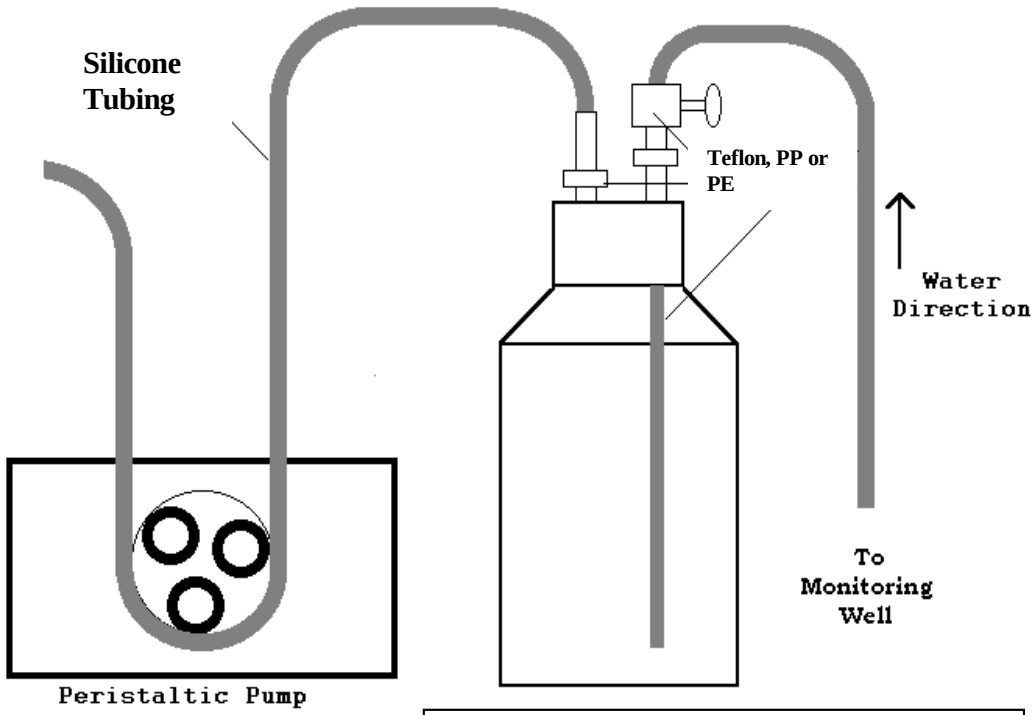
Table FS 1000-12
Preventive Maintenance Tasks

INSTRUMENT/ACTIVITY	FREQUENCY
REFRIGERATORS, INCUBATORS, OVENS	
Clean interior	Monthly
Check thermometer temperature against certified thermometer or equivalent	Annually
ANYTICAL BALANCES	
Clean pan and compartment	Daily[1]
Check with Class S weights	Monthly
Manufacturer cleaning and calibration	Annually
pH AND ION SELECTIVE ELECTRODES	
PROBE	
Check probe for cracks and proper levels of filling solution; check reference junction; clean electrode	Daily, Replace as necessary
Check response time	Daily[1]
METER	
Check batteries and electronics for loose connections and cracked leads	Daily[1], Replace as necessary
TURBIDIMETER	
Clean instrument housing	Monthly
Clean cells	Daily[1]
CONDUCTIVITY METER	
Check batteries and probe cables	Daily[1]
Replatinize Probe	Per manufacturer's recommendations
DISSOLVED OXYGEN METERS	
PROBE	
Check membrane for deterioration; check filling solution	Daily[1], Replace as necessary
METER	
Battery level and electronics checked	Daily[1], Replace as necessary
THERMOMETERS	
Check for cracks and gaps in the mercury	Daily[1], Replace as necessary
TEMPERATURE PROBE	
Check connections, cables	Daily[1]
Check against calibrated thermometer	Daily[1]
AUTOMATIC SAMPLE COLLECTION SYSTEMS (e.g., ISCO, Sigma)	
Check sampler operation (forward, reverse, automatic through three cycles of the purge-pump-purge cycle)	Daily[1]Prior to Sampling Event
Check purge-pump-purge cycle when sampler is installed	Daily[1]Prior to Sampling Event
Check the flow pacer that activates the sampler to assure proper operation	Daily[1]Prior to Sampling Event
Check desiccant	Daily[1], Replace as Necessary
Check batteries	Daily[1], Replace as Necessary
Check pumping rate against manufacturer's specifications	Daily[1], Replace as Necessary

[1]Daily is defined as prior to use or a 12-hour period if equipment is run continuously

Figure FS 1000-1

Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump



The glass sample bottle must be threaded to use a reusable sampling cap lined and installed with fittings made of Teflon, polypropylene or polyethylene, similar to the design shown.

FS 2200. Groundwater Sampling

1. INTRODUCTION AND SCOPE

1.1 Use these Standard Operating Procedures to collect groundwater samples. They are designed to ensure that the collected samples will be representative of water in the aquifer or target formation and that the samples have not been altered or contaminated by the sampling and handling procedures. These procedures apply to permanently and temporarily installed monitoring wells, wells constructed using “direct-push” techniques, wells with installed plumbing, remedial groundwater treatment systems and excavations where groundwater is present. Use of alternative, DEP-approved and properly documented procedures (e.g., Corporate SOP, ASTM Standards, alternative equipment, etc.) is acceptable if they meet the intent (e.g., sample representativeness and integrity) of this standard (see FA 1000).

1.2 The topics in this SOP include equipment and supply selection, equipment construction materials, and purging and sampling techniques.

1.3 Use the following DEP SOPs in conjunction with FS 2200:

- FA 1000 Regulatory Scope and Administrative Procedures for Use of DEP SOPs
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FS 2000 General Aqueous Sampling
- FT 1000 Field Testing and Measurement
- FT 1100 Field pH
- FT 1200 Field Specific Conductance
- FT 1400 Field Temperature
- FT 1500 Field Dissolved Oxygen
- FT 1600 Field Turbidity

2. Groundwater samples may be collected from a number of different configurations. Each configuration is associated with a unique set of sampling equipment requirements and techniques:

3. Wells without Plumbing: These wells require that equipment be brought to the well to purge and sample unless dedicated equipment is placed in the well.

4. Wells with In-Place Plumbing: Wells with in-place plumbing do not require that equipment be brought to the well to purge and sample. In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply. They are generally found at wellfields, industrial facilities, and private residences. See FS 2300 for procedures to sample potable water wells. Air Strippers or Remedial Systems: These types of systems are installed as remediation devices. Sample these wells like drinking water wells (see FS 2300).

FS 2201 *Equipment and Supplies*

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging technique, and the analytes of interest. Refer to Tables FS 1000-1, FS 1000-2, FS 1000-3 and FS 2200-1 for selection of appropriate equipment.

Additional supplies such as reagents, preservatives, and field measurement equipment are often necessary.

1. FLOW CONTAINER: DEP recommends using a flow-through cell or container when collecting measurements for purging stabilization. The design must ensure that fresh formation water continuously contacts the measuring devices and does not aerate the sample or otherwise affect the groundwater properties.

2. PUMPS: All pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface. Avoid the resuspension of sediment particles (turbidity) at the bottom of the well or adhered to the well casing during positioning of the pump or tubing.

2.1 Above-Ground Pumps

2.1.1 Variable Speed Peristaltic Pump: Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20-25 feet below land surface (BLS). If the water levels are deeper than 18-20 feet BLS, the pumping velocity will decrease.

2.1.1.1 A variable speed peristaltic pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.1.1.2 Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate. See Table FS 1000-3 for proper tubing selection and pump configurations.

2.1.2 Variable Speed Centrifugal Pump: A variable speed centrifugal pump can be used to purge groundwater from 2-inch and larger internal diameter wells. Do not use this type of pump to collect groundwater samples.

2.1.2.1 When purging is complete, do not allow the water that remains in the tubing to fall back into the well. Install a check valve at the end of the purge tubing, and withdraw the tubing slowly from the well while the pump is still running.

2.1.2.2 See Table FS 1000-3 for proper tubing selection and allowable analyte groups.

2.2 Submersible Pumps

2.2.1 Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells.

2.2.1.1 A variable speed submersible pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or

formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.1.2 Make sure that the pump housing, fittings, check valves and associated hardware are constructed of stainless steel. Make sure that any other materials are compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.1.3 Install a check valve at the output side of the pump to prevent backflow.

2.2.1.4 If purging and sampling for organics:

- The entire length of the delivery tube must be Teflon, Polyethylene or Polypropylene (PP) tubing.
- The electrical cord must be sealed in Teflon, Polyethylene or PP and any cabling must be sealed in Teflon, Polyethylene or PP, or be constructed of stainless steel.
- All interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon.

2.2.2 Variable Speed Bladder Pump: A variable speed positive displacement bladder pump (no-gas contact) can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.

2.2.2.1 A variable speed bladder pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.2.2 The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor or compressed gas supply.

2.2.2.3 The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon, Polyethylene, PP and stainless steel. Other materials must be compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.2.4 If purging and sampling for organics:

- The pump body must be constructed of stainless steel and the valves and bladder must be Teflon, Polyethylene or PP
- The entire length of the delivery tube must be Teflon, Polyethylene or PP.
- Any cabling must be sealed in Teflon, Polyethylene or PP, or be constructed of stainless steel.
- Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

3. BAILERS:

3.1 Purging: DEP does not recommend using bailers for purging unless no other equipment can be used or purging with a bailer has been specifically authorized by a DEP program, permit, contract or order (see Table FS 2200-3). Use a bailer if there is non-aqueous phase liquid (free product) in the well or non-aqueous phase liquid is suspected to

be in the well. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager. If a bailer is used, follow FS 2213, section 4, with no deviations.

3.2 Sampling: Bailers may be used to routinely collect some analyte groups or under specific circumstances for other analyte groups (see Table FS 2200-3).

3.3 Construction and Type:

3.3.1 Bailers must be constructed of materials compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

3.3.2 Stainless steel, Teflon, Polyethylene and PP bailers may be used to sample all analytes.

3.3.3 Use disposable bailers when sampling grossly contaminated sample sources.

3.3.4 DEP recommends using dual check valve bailers when collecting samples.

3.3.5 Use bailers with a controlled flow bottom when collecting volatile organic samples.

3.3.6 Use bailers that can be pressurized when collecting filtered samples for metals.

3.4 Contamination Prevention:

3.4.1 Keep the bailer wrapped (foil, butcher paper, etc.) until just before use.

3.4.2 Use protective gloves to handle the bailer once it is removed from its wrapping.

3.4.3 Handle the bailer by the lanyard to minimize contact with the bailer surface.

4. LANYARDS

4.1 Lanyards must be made of non-reactive, non-leachable material such as cotton twine, nylon, or stainless steel; or, coated with Teflon, Polyethylene or PP.

4.1.1 Evaluate the appropriateness of the lanyard material with analyses of equipment blanks for the analytes of interest, as necessary.

4.2 Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.

4.3 Decontaminate stainless steel, coated Teflon, Polyethylene and PP lanyards between monitoring wells (see FC 1003). They do not need to be decontaminated between purging and sampling operations.

4.4 Securely fasten lanyards to downhole equipment (bailers, pumps, etc.).

4.5 Do not allow lanyards used for downhole equipment to touch the ground surface.

FS 2210. GROUNDWATER PURGING

Perform procedures in the following sections to calculate purging parameters and to purge groundwater from monitoring wells, wells with installed plumbing, high-volume wells, air stripper systems and other remedial treatment systems.

FS 2211 *Water Level and Purge Volume Determination*

Collect representative groundwater samples from the aquifer. The amount of water that must be purged from a well is determined by the volume of water and/or field parameter stabilization.

1. GENERAL EQUIPMENT CONSIDERATIONS

1.1 Selection of appropriate purging equipment depends on the analytes of interest, the well diameter, transmissivity of the aquifer, the depth to groundwater and other site conditions.

1.2 Use a pump to purge the well.

1.3 Use a bailer if there is non-aqueous phase liquid in the well or non-aqueous phase liquid is suspected to be in the well.

1.4 Bailers may be used if approved by a DEP program, or if bailer use is specified in a permit, contract or DEP order (see Table FS 2200-3). If used, bailers must be of appropriate type and construction, and the user must follow the procedure outlined in FS 2213, section 4, with no deviations. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager. DEP does not recommend using bailers because improper bailing:

1.4.1 Introduces atmospheric oxygen which precipitates metals (i.e., iron) or causes other changes in the chemistry of the water in the sample (i.e., pH)

1.4.2 Agitates groundwater which biases volatile and semi-volatile organic analyses due to volatilization

1.4.3 Agitates the water in the aquifer and resuspends fine particulate matter

1.4.4 Surges the well, loosening particulate matter in the annular space around the well screen

1.4.5 Introduces dirt into the water column if the sides of the casing wall are scraped

2. INITIAL INSPECTION

2.1 Verify the identification of the monitoring well by examining markings, sign plates, placards or other designations.

2.2 Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well cap.

2.3 Inspect the exterior protective casing of the monitoring well for damage and document the results of the inspection if there is a problem.

2.4 It is recommended that you place a protective covering around the well head. Replace the covering if it becomes soiled or ripped.

2.5 Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

3. WATER LEVEL MEASUREMENTS: Use an electronic probe or chalked tape to determine the water level.

3.1 General Procedures

Perform these steps using either the electronic probe or chalked tape method.

3.1.1 Decontaminate all equipment that will contact the groundwater in the well before use.

3.1.2 Measure the depth to groundwater from the top of well casing to the nearest 0.01 foot and always measure from the same reference point or survey mark on the well casing. If there is no reference mark, measure from the north side of the casing.

3.1.3 Record the measurement and the reference point.

3.2 Electronic Probe

3.2.1 Follow the manufacturer's instructions for use.

3.2.2 Record the measurement.

3.3 Chalked Line Method: This method is not recommended if collecting samples for organic or inorganic parameters.

3.3.1 Lower chalked tape into the well until the lower end is in the water (usually determined by the sound of the weight hitting the water).

3.3.2 Record the length of the tape relative to the reference point (see section 3.2 above).

3.3.3 Quickly remove the tape from the well.

3.3.4 Record the length of the wetted portion to the nearest 0.01 foot.

3.3.5 Determine the depth to water by subtracting the length of the wetted portion (see section 3.5.3 above) from the total length (see section 3.5.2 above). Record the result.

4. WATER COLUMN DETERMINATION

4.1 Do not determine the total depth of the well by lowering the probe to the bottom of the well immediately before purging and sampling. If the well must be sounded, delay purging and sampling activities for at least 24 hours after the well was sounded or for a time sufficient to meet the purge stabilization criterion for turbidity. Alternatively, collect samples before sounding the well.

4.2 Subtract the depth to the top of the water column from the total well depth to determine the length of the water column.

4.3 The total well depth depends on the well construction. Some wells may be drilled in areas of sinkhole or karst formations or rock leaving an open borehole. Attempt to find the total borehole depth in cases where there is an open borehole below the cased portion.

5. WELL WATER VOLUME

5.1 Calculate the total volume of water in gallons in the well using the following equation:

V = (0.041)d x d x h

Where: V = volume in gallons

d = well diameter in inches

h = height of the water column in feet

5.2 The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (Gallons per Foot of Water) for the appropriate diameter well:

V = [Gallons per Foot of Water] x h

Where: V = volume in gallons

h = height of the water column in feet

Casing Internal Diameter	Approximate Gallons per Foot of Water
0.75”	0.02
1”	0.04
1.25”	0.06
2”	0.16
3”	0.37
4”	0.65
5”	1.02
6”	1.47
12”	5.88

5.3 Record all measurements and calculations in the field records.

6. Purging Equipment Volume

Calculate the total volume of the pump, associated tubing and container that is used for in situ measurements (flow container), if used, using the following equation:

V = p + ((0.041)d x d x l) + fc

Where: V = volume in gallons

p = volume of pump in gallons

d = tubing diameter in inches

l = length of tubing in feet

fc = volume of flow cell in gallons

7. When collecting samples from multiple wells on a site, if the groundwater elevation data are to be used to construct groundwater elevation contour maps, all water level measurements must be taken within the same 24-hour time interval unless a shorter time period is required by a DEP program. If the site is tidally influenced, complete the water level measurements within the time frame of an incoming or outgoing tide.

FS 2212 *Well Purging Techniques*

The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity. The intent of proper purging is to stabilize the water level in the well and minimize the hydraulic stress to the hydrogeologic formation.

Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging completion criteria.

A flowchart which summarizes purging procedure options is presented in Figure FS 2200-2.

Select equipment using the construction and configuration requirements specified in Table FS 2200-1. See the discussions in FS 2201.

1. MEASURING THE PURGE VOLUME: The volume of water that is removed during purging must be recorded. Measure the volume during the purging operation.

1.1 Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, or

1.2 Estimate the volume based on pumping rate. Use this technique only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time or use a flow meter.

1.2.1 Calculate the amount of water that is discharged per minute:

$$D = \frac{\text{Measured amount}}{\text{Total time in minutes}}$$

1.2.2 Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume:

$$\text{Time} = \frac{V}{D}$$

Where: V = well volume determined from FS 2211, section 5, or purging equipment volume

D = discharge rate calculated in section 1.2.1. above

1.2.3 Make new measurements (see section 1.2.1 above) each time the pumping rate is changed, or

1.3 Use a totalizing flow meter.

1.3.1 Record the reading on the totalizer prior to purging.

1.3.2 Record the reading on the totalizer at the end of purging.

1.3.3 Subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging to obtain the volume purged.

1.4 Record in the field records the times that purging begins and ends.

2. Stabilization Measurement Frequency

2.1 Begin to record stabilization measurements after pumping the minimum volume as prescribed in options 2.3 – 2.5 below. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

2.2 If the well screened interval is not known, use option 2.3, below.

2.3 <u>Wells with Fully Submerged Screen and Pump or Intake Tubing Placed at the Top of the Water Column (conventional purge):</u> Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) well volume prior to collecting measurements of the stabilization parameters. Allow at least one quarter (1/4) well volume to purge between subsequent measurements.

2.4 <u>Wells with Fully Submerged Screen and Pump or Intake Tubing Placed Within the Screened Interval (minimizing purge volume):</u> Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) volume of the pump, associated tubing and flow container (if used) prior to collecting measurements of the stabilization parameters. Take measurements of the stabilization parameters no sooner

than two (2) minutes apart. Purge at least three (3) volumes of the pump, associated tubing and flow container, if used, prior to collecting a sample.

If the water level drops into the screened interval during purging, lower the pump or tubing intake as in FS 2213, section 1.3 below and follow purging procedures for partially submerged well screens (2.5 below).

2.5 Wells with a Partially Submerged Well Screen: Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) well volume prior to collecting measurements of the stabilization parameters. Take measurements of the stabilization parameters no sooner than two (2) minutes apart.

3. PURGING COMPLETION: DEP recommends the use of a flow-through container to measure the stabilization parameters discussed below. Alternatively, measure all parameters *in situ* by inserting measurement probes into the well at the depth appropriate for the purging option. Purging is considered complete if the criteria in section 3.1, 3.2 or 3.3 below are satisfied. Make every attempt to satisfy the criteria in section 3.1. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

3.1 Three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits. The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements of temperature, pH and specific conductance cannot exceed the stated limits. The last three consecutive measurements of dissolved oxygen and turbidity must all be at or below the listed thresholds.

- Temperature: ± 0.2° C
- pH: ± 0.2 Standard Units
- Specific Conductance: ± 5.0% of reading
- Dissolved Oxygen: ≤20% Saturation
- Turbidity: ≤20 NTU

3.2 Naturally occurring conditions may prevent attaining the ≤20% saturation criterion for dissolved oxygen, typically in surficial aquifers. See section 3.5, below.

3.3 Naturally occurring conditions may prevent attaining the ≤20 NTU criterion for turbidity. However, when collecting groundwater samples for metals or certain inorganic (e.g., phosphorus forms) or extractable organic (e.g. polynuclear aromatic hydrocarbons) chemicals, make every attempt to reduce turbidity to ≤20 NTU to avoid a potential turbidity-associated bias for these analytes. See section 3.5, below.

3.4 Document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.

- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.5 If the criteria in section 3.1 above for dissolved oxygen and/or turbidity cannot be met, then three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits.

3.5.1 The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits.

- Temperature: ± 0.2° C
- pH: ± 0.2 Standard Units
- Specific Conductance: ± 5.0% of reading
- Dissolved Oxygen: ± 0.2 mg/L or 10%, whichever is greater
- Turbidity: ± 5 NTUs or 10%, whichever is greater

3.5.2 Additionally, document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of conditions at the site that cause the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open borehole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.5.3 If from review of the submitted data the Department determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the Department cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that caused the affected parameter(s) to be high is required to be submitted in future reports.

3.6 If the stabilization parameters in either section 3.1 or 3.2 cannot be met, and all attempts have been made to minimize the drawdown, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. All measurements that were made during the attempt must be documented. The sampling team leader may decide whether or

not to collect a sample or to continue purging after five (5) well volumes (conventional purge section 2.1 or 2.3 above) or five (5) volumes of the screened interval (minimizing purge volumes in section 2.2 above).

Further, the report in which the data are submitted must include the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- Drawdown in the well, if any.
- A description of conditions at the site that caused the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open borehole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that caused the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If from review of the submitted data the DEP determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the DEP cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that caused the affected parameter(s) to be high is required to be submitted in future reports.

3.7 One fully dry purge (not recommended). This criterion applies only if purging was attempted per FS 2212, FS 2213, and section 3.4.1 below, and if it is impossible to balance the pumping rate with the rate of recharge at very low pumping rates (< 100 mL/minute).

3.7.1 If wells have previously and consistently purged dry, when purged according to FS 2212 and FS 2213, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

3.7.1.1 Place the pump or tubing intake within the well screened interval.

3.7.1.2 Use very small diameter Teflon, Polyethylene or PP tubing and the smallest possible pump chamber volume to minimize the total volume of water pumped from the well and to reduce drawdown.

3.7.1.3 Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.

3.7.1.4 Pump at the lowest possible rate (100 mL/minute or less) to reduce drawdown to a minimum.

3.7.1.5 Purge at least two (2) volumes of the pumping system (pump, tubing and flow cell, if used).

3.7.1.6 Measure pH, Specific Conductance, Temperature, Dissolved Oxygen and Turbidity and begin to collect the samples (see FS 2222).

4. Collect samples immediately after purging is complete.

4.1 The time period between completing the purge and sampling cannot exceed six (6) hours.

4.2 If sample collection does not occur within one (1) hour of purging completion, re-measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity just prior to collecting the sample.

4.2.1 If the measured values are not within 10 percent of the previous measurements, re-purge the well.

4.2.2 See section 3.4 above when collecting samples from wells that have purged dry.

FS 2213 *Purging Wells Without Plumbing (Monitoring Wells)*

1. TUBING/PUMP PLACEMENT

1.1 Do not lower the pump or intake hose (tubing) to the bottom of the well. Pump or tubing placement procedures will be determined by the purging option selected in FS 2212, section 2 above or FS 2214 below.

1.1.1 Minimizing Purge Volume: If the following conditions can be met, position the intake hose (tubing) or pump in the screened or open borehole interval.

- The same pump must be used for both purging and sampling,
- The well screen or borehole interval must be less than or equal to 10 feet, and
- The well screen or borehole must be fully submerged.

1.1.2 If the position or length of the screened interval or open borehole is unknown or estimated, place the intake hose (tubing) or pump to perform conventional purging in 1.2 below.

1.1.3 Position the pump or intake hose when purging large-diameter deep wells with open boreholes using the procedure in FS 2214 below.

1.2 Conventional Purging: Position the pump or intake tubing in the top one foot of the water column or no deeper than necessary for the type of pump.

1.2.1 If purging with a bailer, see section 4 below.

1.3 Partially Submerged Screened Interval: If the well screen or open borehole is partially submerged, and the pump will be used for both purging and sampling, position the pump or intake hose (tubing) in the portion of the water column within the submerged screened or open borehole interval.

1.3.1 If the position or length of the screened interval or open borehole is unknown or estimated, place the intake hose (tubing) or pump to perform conventional purging in 1.2 above.

1.3.2 Purge large-volume, high-recharge wells as in FS 2214 below.

1.3.3 If purging with a bailer, see section 4 below.

2. NON-DEDICATED (PORTABLE) PUMPS

2.1 Variable Speed Peristaltic Pump

2.1.1 Install a new, 1-foot maximum length of silicone tubing in the peristaltic pump head.

2.1.2 Attach a short section of tubing to the discharge side of the pump-head silicone tubing and into a graduated container.

2.1.3 Attach one end of a length of new or precleaned transport tubing to the intake side of the pump head silicone tubing.

2.1.4 Place the transport tubing in the monitoring well per one of the options in FS 2213, section 1 above.

2.1.5 Measure the depth to groundwater at frequent intervals.

2.1.6 Record these measurements.

2.1.7 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.1.8 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.1.9 If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.1.10 Record the purging rate each time the rate changes.

2.1.11 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.1.12 Record this measurement.

2.1.13 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.2 Variable Speed Centrifugal Pump

2.2.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.2.2 Place the decontaminated suction hose so that water is always pumped from the top of the water column.

2.2.3 Equip the suction hose with a foot valve to prevent purge water from re-entering the well.

2.2.4 Measure the depth to groundwater at frequent intervals.

2.2.5 Record these measurements.

2.2.6 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.2.7 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.2.8 If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.2.9 Record the purging rate each time the rate changes.

2.2.10 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.2.11 Record this measurement.

2.2.12 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.3 Variable Speed Electric Submersible Pump

2.3.1 Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.3.2 Carefully position the decontaminated pump per one of the options in FS 2213, section 1 above.

2.3.3 Measure the depth to groundwater at frequent intervals.

2.3.4 Record these measurements.

2.3.5 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.3.6 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.3.7 If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.3.8 Record the purging rate each time the rate changes.

2.3.9 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.3.10 Record this measurement.

2.3.11 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.4 Variable Speed Bladder Pump

2.4.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.4.2 Attach the tubing and carefully position the pump per one of the options in FS 2213, section 1 above.

2.4.3 Measure the depth to groundwater at frequent intervals.

2.4.4 Record these measurements.

2.4.5 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.4.6 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.4.7 If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.4.8 Record the purging rate each time the rate changes.

2.4.9 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.4.10 Record this measurement.

2.4.11 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

3. DEDICATED PORTABLE PUMPS: Place dedicated pumps per one of the options in FS 2213, section 1 above.

3.1 Variable Speed Electric Submersible Pump

3.1.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

3.1.2 Measure the depth to groundwater at frequent intervals.

3.1.3 Record these measurements.

3.1.4 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

3.1.5 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal with the recharge rate.

3.1.6 Record the purging rate each time the rate changes.

3.1.7 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

3.1.8 Record this measurement.

3.2 Variable Speed Bladder Pump

3.2.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

3.2.2 Measure the depth to groundwater at frequent intervals.

3.2.3 Record these measurements.

3.2.4 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

3.2.5 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal with the recharge rate.

3.2.6 Record the purging rate each time the rate changes.

3.2.7 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

3.2.8 Record this measurement.

4. BAILERS: DEP recommends against using bailers for purging except as a last contingency, or if free product is present in the well or suspected to be in the well. However, they may be used if approved by a DEP program, or specified in a permit, contract or DEP order (see Table FS 2200-3 and FS 2211, section 1.3). If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager.

4.1 Minimize handling the bailer as much as possible.

4.1.1 Remove the bailer from its protective wrapping just before use.

4.1.2 Attach a lanyard of appropriate material (see FS 2201, section 4).

4.1.3 Use the lanyard to move and position the bailer.

4.2 Lower and retrieve the bailer slowly and smoothly.

4.3 Lower the bailer carefully into the well to a depth approximately a foot above the water column.

4.3.1 Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column. Ensure that the length of the bailer does not exceed the length of the water column.

4.3.2 Allow time for the bailer to fill with aquifer water as it descends into the water column.

4.4 Carefully raise the bailer.

4.4.1 Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

4.5 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

4.5.1 Record the volume of the bailer.

4.6 Continue to carefully lower and retrieve the bailer as described above until the purging completion conditions specified in FS 2212, section 3, have been satisfied.

4.6.1 Remove at least one (1) well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least one quarter (1/4) well volume between measurements.

FS 2214 *Purging Large-Volume, High-Recharge Wells With Portable Pumps*

If a well originally constructed for high-flow-rate pumping will be sampled as a monitoring well, use these guidelines to develop a purging procedure applicable to the specific details of the well construction. Typical wells constructed for this purpose may be deep, large-diameter wells with a section of open borehole. Evaluate each well on a case-by-case basis and consider any available information on the construction and hydraulic performance of the well.

1. PURGING PROCEDURE

1.1 Place the pump at the top of the open borehole segment of the well.

1.2 Start purging while monitoring stabilization parameters as in FS 2212, section 3 above.

1.3 Purge at least one equipment volume before measuring stabilization parameters.

1.4 If the well is being purged for the first time using these guidelines, monitor stabilization parameters for an extended period until confident that sufficient volume has been pumped from the open borehole to draw fresh formation water into the pump tubing and flow-through container. Use the information obtained from the first-time purging of the well to determine the pumping rate and duration of purging required for future sampling events at the well.

1.5 Purge at least three equipment volumes before evaluating purging completion.

2. PURGING COMPLETION

2.1 Complete the purging of the well when the last three consecutive measurements of the purge stabilization parameters have met the applicable criteria specified in FS 2212, section 3 above.

3. Collect samples from the well using the procedures in FS 2221, section 1 below.

FS 2215. *Purging Wells With Plumbing (production wells or permanently installed pumps equipped with sampling ports or sampling spigots)*

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc. Depending on the sampling objective for collecting samples using installed plumbing, purge the system and collect samples closest to the point of consumption, or, as close to the source well as possible. When purging is required and the purge volume of the plumbing system is not known, purge the system until the purging completion criteria in FS 2212, section 3, have been met.

1. CONTINUOUSLY RUNNING PUMPS

1.1 Select the spigot that is closest to the pump and before any storage tanks (if possible).

1.2 Remove all hoses, aerators and filters (if possible).

1.3 Open the spigot and purge at maximum flow.

1.4 If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.

1.5 If the spigot is before any storage tank, purge until sufficient volume is removed to flush the stagnant water from the spigot and the tap line to the spigot.

1.6 Reduce the flow rate to ≤ 500 mL/minute (a 1/8” stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to ≤100 mL/minute before collecting the samples.

2. INTERMITTENTLY RUNNING PUMPS

2.1 Select the spigot that is closest to the pump and before any storage tanks (if possible).

2.2 Remove all hoses, aerators and filters (if possible).

2.3 Open the spigot and purge sufficient volume at a maximum, practical flow rate to flush the spigot and lines and until the purging completion criteria in FS 2212, section 3, have been met.

2.4 If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.

2.5 Ensure that the purge stabilization measurement of dissolved oxygen is not biased with aeration of the sample by a high flow rate in the flow-through container.

2.6 Reduce the flow rate to ≤ 500 mL/minute (a 1/8” stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to ≤ 100 mL/minute before collecting the samples.

FS 2216. *Purging Airstrippers and Remedial Treatment Systems*

If collecting samples for groundwater contamination monitoring, follow FS 2215above.

FS 2220. GROUNDWATER SAMPLING TECHNIQUES

1. Purge wells using the techniques outlined in FS 2210.

2. Replace the protective covering around the well if it is soiled or torn after completing the purging operations.

3. EQUIPMENT CONSIDERATIONS

Follow all notes and restrictions as indicated in Table FS 2200-1 and as discussed in FS 2201.

NOTE: The only pumps that are currently approved for use in collecting volatile organic samples through the pump are stainless steel and Teflon variable speed submersible pumps, stainless steel and Teflon or Polyethylene variable speed bladder pumps, and permanently installed PVC bodied pumps (variable speed bladder or submersible pumps) as long as the pump remains in contact with the water in the well at all times.

3.1 Collect the sample into the sample container from the sampling device. **Do not** use intermediate containers.

3.2 In order to avoid contaminating the sample or loss of analytes from the sample:

3.3 Handle the sampling equipment as little as possible.

3.3.1 Minimize the equipment that is exposed to the sample.

3.3.2 Minimize aeration of samples collected for VOC analysis.

3.3.3 Reduce sampling pump flow rates to $\leq$ 100 mL/minute when collecting VOC samples.

3.4 Dedicated Sampling Equipment

3.4.1 Whenever possible, use dedicated equipment because it significantly reduces the chance of cross-contamination.

3.4.2 Dedicated is defined as equipment that is to be used solely for one location for the life of that equipment (e.g., permanently mounted pump).

3.4.3 All material construction and restrictions from Table FS 2200-1 also apply to dedicated equipment. Purchase equipment with the most sensitive analyte of interest in mind.

3.5 Cleaning/Decontamination

3.5.1 Clean or ensure dedicated pumps are clean before installation. They do not need to be cleaned prior to each use but must be cleaned if they are withdrawn for repair or servicing.

3.5.2 Clean or make sure any permanently mounted tubing is clean before installation.

3.5.3 Change or clean tubing when the pump is withdrawn for servicing.

3.5.4 Clean any replaceable or temporary parts as specified in FC 1000.

3.5.5 Collect equipment blanks on dedicated pumping systems when the tubing is cleaned or replaced.

3.5.6 Clean or ensure dedicated bailers are clean before placing them into the well.

3.5.7 Collect an equipment blank on dedicated bailers before introducing them into the water column.

3.5.8 Suspend dedicated bailers above the water column if they are stored in the well.

FS 2221. *Sampling Wells Without Plumbing*

1. SAMPLING WITH PUMPS: Variable speed stainless steel and Teflon submersible pumps and stainless steel, Teflon or Polyethylene bladder pumps, and permanently installed PVC-bodied variable speed submersible or bladder pumps, as long as the pump remains in contact with the water in the well at all times, may be used to sample for all organics. The delivery tubing must be Teflon, Polyethylene or PP. **Extractable organics** may be collected through a peristaltic pump if ≤ 1 foot of silicone tubing is used in the pump head or a vacuum trap is used (see Figure FS 2200-1 for specific configuration). Follow all notes and restrictions as defined in Table FS 2200-1 and discussed in Equipment and Supplies (FS 2201) when using pumps to collect samples.

Do not lower the pump or tubing to the bottom of the well.

1.1 Peristaltic Pump

1.1.1 Volatile Organics Using Manual Fill and Drain Method: Collect volatile organics last. If the pump tubing is placed within the screened interval, the tubing cannot be reinserted into the well, and steps 1.1.1.3 through 1.1.1.6 below are prohibited.

1.1.1.1 Ensure that there is sufficient tubing volume to fill the requisite number of VOC vials.

1.1.1.2 Remove the drop tubing from the inlet side of the pump.

1.1.1.3 Submerse the drop tubing into the water column and allow it fill.

1.1.1.4 Remove the drop tubing from the well.

1.1.1.5 Prevent the water in the tubing from flowing back into the well.

1.1.1.6 Carefully allow the groundwater to drain by gravity into the sample vials. Avoid turbulence. Do not aerate the sample. The flow rate must be ≤ 100 mL/minute.

1.1.1.7 Repeat steps 1.1.1.3 - 1.1.1.6 until enough vials are filled.

1.1.2 Volatile Organics Using the Pump to Fill and Drain the Tubing: Collect volatile organics last. If the pump tubing is placed within the screened interval, the tubing cannot be reinserted into the well, and steps 1.1.2.2 through 1.1.2.8 below are prohibited.

1.1.2.1 Ensure that there is sufficient tubing volume to fill the requisite number of VOC vials.

1.1.2.2 Submerse the drop tubing into the water column.

1.1.2.3 Use the pump to fill the drop tubing.

1.1.2.4 Quickly remove the tubing from the pump.

1.1.2.5 Prevent the water in the tubing from flowing back into the well.

1.1.2.6 Remove the drop tubing from the well and fill the vials using the pump or gravity-drain methods in steps 1.1.2.7 or 1.1.2.8 below.

1.1.2.7 Reverse the flow on the peristaltic pump to deliver the sample into the vials at a slow, steady rate. The flow rate must be ≤ 100 mL/minute.

1.1.2.8 Or, remove the drop tubing from the inlet side of the pump and carefully allow the groundwater to drain into the sample vials. Avoid turbulence. Do not aerate the sample. The flow rate must be ≤ 100 mL/minute.

1.1.2.9 Repeat steps 1.1.2.2 through 1.1.2.8 until enough vials are filled.

1.1.3 Extractable Organics Collected Through Silicone Pump-Head Tubing:

1.1.3.1 Ensure that a 1-foot maximum length of new silicone tubing was installed in the peristaltic pump head assembly before the well was purged if the same pump is being used to purge and sample the well. Otherwise, install a new length of tubing as described above.

1.1.3.2 Collect extractable organic samples directly from the effluent delivery tubing (attached to discharge side of the silicone pump head tubing) into the sample container.

1.1.3.3 If there is a concern that sample analytes are absorbed, adsorbed, leached or otherwise affected or lost by pumping through the silicone pump-head tubing, sample the well using the organic trap assembly in 1.1.4 below.

1.1.4 Extractable Organics Using an Optional Organic Trap Assembly

1.1.4.1 Assemble the components of the pump and trap according to Figure FS 2200-1.

1.1.4.2 The sample container should be the trap bottle.

1.1.4.3 All equipment that contacts the groundwater **before** the sample container must be constructed of Teflon, Polyethylene, PP, stainless steel or glass, including the transport tubing to and from the sample container, the interior liner of the container cap and all fittings. **Do not use a rubber stopper as a cap.**

1.1.4.4 Connect the outflow tubing from the container to the influent side of the peristaltic pump.

1.1.4.5 Prevent the water in the down-hole delivery tubing from flowing back into the well while performing this connection.

1.1.4.6 Turn the pump on and reduce the flow rate to a smooth and even flow.

1.1.4.7 Discard a small portion of the sample to allow an air space.

1.1.4.8 Preserve (if required), label and complete the field notes.

1.1.5 Inorganics

1.1.5.1 Inorganic samples may be collected from the effluent tubing.

1.1.5.2 If samples are collected from the pump, decontaminate all tubing (including the tubing in the head) or change it between wells.

1.1.5.3 Preserve (if required), label and complete field notes.

1.2 Variable Speed Bladder Pump

1.2.1 If sampling for organics the pump body must be constructed of stainless steel and the valves and bladder must be Teflon. All tubing must be Teflon, Polyethylene, or PP and any cabling must be sealed in Teflon, Polyethylene or PP, or made of stainless steel.

1.2.2 After purging to a smooth even flow, reduce the flow rate.

1.2.3 When sampling for volatile organic compounds, reduce the flow rate to 100 mL/minute or less, if possible.

1.3 Variable Speed Submersible Pump

1.3.1 The housing must be stainless steel.

1.3.2 If sampling for organics, the internal impellers, seals and gaskets must be constructed of stainless steel, Teflon, Polyethylene or PP. The delivery tubing must be Teflon, Polyethylene or PP and the electrical cord must be sealed in Teflon and any cabling must be sealed in Teflon or constructed of stainless steel.

1.3.3 After purging to a smooth even flow, reduce the flow rate.

1.3.4 When sampling for volatile organic compounds, reduce the flow rate to 100 mL/minute or less, if possible.

2. SAMPLING WITH BAILERS: A high degree of skill and coordination are necessary to collect representative samples with a bailer. When properly used, bailers may be used to collect samples for certain analyte groups and under specific conditions (see Table FS 2200-3). They must be of an appropriate type and construction (see FS 2201, section 3), and must be used as outlined below. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager.

2.1 General Considerations

2.1.1 Minimize handling the bailer as much as possible.

2.1.1.1 Wear sampling gloves.

2.1.1.2 Remove the bailer from its protective wrapping just before use.

2.1.1.3 Attach a lanyard of appropriate material (see FS 2201, section 4).

2.1.1.4 Use the lanyard to move and position the bailers.

2.1.2 Do not allow the bailer or lanyard to touch the ground.

2.1.3 Rinsing

2.1.3.1 If the bailer is certified precleaned, no rinsing is necessary.

2.1.3.2 If both a pump and a bailer are to be used to collect samples, rinse the exterior and interior of the bailer with sample water from the pump before removing the pump.

2.1.3.3 If the purge pump is not appropriate for collecting samples (e.g., non-inert components), rinse the bailer with by collecting a single bailer of the groundwater to be sampled. Use the technique described in section 2.2, Bailing Technique, below.

2.1.3.4 Discard the water appropriately.

2.1.3.5 **Do not** rinse the bailer if Oil & Grease, TRPHs, etc., (see FS 2006) are to be collected.

2.2 Bailing Technique

2.2.1 Collect all samples that are required to be collected with a pump before collecting samples with the bailer.

2.2.2 Raise and lower the bailer gently to minimize stirring up particulate matter in the well and the water column which can increase sample turbidity.

2.2.3 Lower the bailer carefully into the well to a depth approximately a foot above the water column. Ensure that the length of the bailer does not exceed the length of the water column.

2.2.3.1 When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached (see section 2.2.3 above).

2.2.4 Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column.

2.2.5 Allow time for the bailer to fill with aquifer water as it descends into the water column.

2.2.6 Do not allow the bailer to touch the bottom of the well or particulate matter will be incorporated into the sample.

2.2.6.1 Carefully raise the bailer (see section 2.2.2 above). Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

2.2.7 Lower the bailer to approximately the same depth each time.

2.2.8 Collect the sample.

2.2.8.1 Install a device to control the flow from the bottom of the bailer and discard the first few inches of water. Reduce the flow to $\leq$ 100 mL/minute when collecting VOC samples.

2.2.8.2 Fill the appropriate sample containers by allowing the sample to slowly flow down the side of the container. Minimize aeration of VOC samples.

2.2.8.3 Discard the last few inches of water in the bailer.

2.2.9 Repeat steps 2.2.1 through 2.2.8.3 for additional samples.

2.2.10 Measure the DO, pH, temperature, turbidity and specific conductance after the final sample has been collected.

2.2.10.1 Record all measurements and note the time that sampling was completed.

3. SAMPLING WELLS WITH FLOATING NON-AQUEOUS PHASE LIQUID: DEP does not recommend the sampling of wells with floating non-aqueous phase liquid for trace contaminants. This concerns primarily petroleum related sites, but includes any chemical product (e.g., solvent) that floats on the water table. Sampling is acceptable if the information is to be used for the purpose of remedial design.

Sample data from such wells cannot provide useful information regarding the level of contamination. Furthermore, these wells typically do not provide legitimate data because of permanent chemical contamination from product contact with the well casing for an extended period of time.

DEP does reserve the right to require sampling of these wells, not for levels of trace contaminants, but for confirmation of an appropriate remediation technique. This type of sampling is performed **below** the non-aqueous phase layer (see section 3.2 below).

3.1 Non-Aqueous Phase Liquid Sampling: Non-aqueous phase liquid may be evident in a cased monitoring well or in an open excavation.

3.1.1 Non-aqueous phase liquid is normally sampled for two reasons:

- Documentation for its existence and thickness; and
- Determination of the type of product so that the proper analyses can be performed to determine extent. This is only feasible for relatively recent releases as it may not be possible to identify weathered product.

3.1.2 Disposable plastic (acrylic, clear PVC) bailers are recommended for sampling. Disposable Polyethylene and PP bailers are also acceptable. Other wide mouth vessels may be used for sampling non-aqueous phase liquid in an excavation.

3.1.3 Monitoring Well

3.1.3.1 If a non-aqueous phase liquid is identified in a monitoring well during the water level measurement, measure its thickness in the well. If the thickness of the non-aqueous phase liquid is greater than 0.01 foot or product globules are present, collect a sample using a precleaned disposable bailer.

3.1.3.2 Measure the product thickness to the nearest 0.01 foot after withdrawing the bailer.

3.1.3.3 Pour a portion of the product into a glass sample container.

3.1.3.4 This sample is considered a concentrated waste. Therefore, package the container in protective wrapping to prevent breakage, isolate from other samples, and ice to 4°C.

3.1.4 Excavation

3.1.4.1 If non-aqueous phase liquid is observed in an open excavation, a glass sample container or a precleaned intermediate vessel may be used to collect the sample.

3.1.4.2 Securely tie a lanyard to the container and lower it into the excavation.

3.1.4.3 Gently lower and retrieve the container so that no solid material is released or collected.

3.1.4.4 If sufficient water is available, a bailer can be used.

3.1.4.5 Although not recommended, screened casing can be placed (or augered and placed) in the bottom of the excavation and the product sampled with a bailer.

3.1.4.6 Avoid dangerous situations, such as standing too close to the edge of an excavation, riding in the backhoe bucket, or entering a trench or excavation that may collapse.

3.1.4.7 Follow all applicable OSHA regulations.

3.2 Sampling Below Product

3.2.1 This type of depth-specific sampling to attempt to sample the dissolved constituents in the water column below the product layer is performed only at the request of DEP or its designee.

3.2.2 These data provide information that helps define adequate groundwater treatment. Without these data, incorrect (and sometimes unnecessarily expensive) remediation techniques may be designed for a situation where they are not required.

3.2.3 There are some substantial logistical problems involved with sending a sampler through non-aqueous phase liquid to sample the groundwater below. Although there are some products designed specifically for this type of sampling, they are expensive and the results may not be commensurate with their cost. The use of “self-engineered” equipment or coverings may be the best option.

3.2.4 These data are only to be used for qualitative use and will aid in deciding on an appropriate remediation technique.

3.2.5 Wrapping bailers and tubing in plastic seems to be the most popular technique in getting past the product layer.

3.2.6 Although not recommended, some have wrapped submersible pumps in several layers of plastic and retrieved each layer by a separate lanyard. One suggestion would be to use a rigid piece of stainless steel tubing wrapped in plastic.

3.2.6.1 Once the covered tubing is past the layer, pull up on the plastic, piercing the plastic and exposing the (somewhat) clean tubing inlet.

3.2.6.2 Introduce the wrapped hose slowly to not entrain any more product into the dissolved layer located below.

3.2.6.3 Also, perform this procedure with a peristaltic pump or a vacuum pump linked to a trap bottle. To use this setup, the water table must be no deeper than 15-20 feet, realizing that actual sampling may be occurring several feet below the product layer.

FS 2222. *Sampling Low Permeability Aquifers or Wells That Have Purged Dry*

1. Collect the sample(s) after the well has been purged according to FS 2212, section 3.4. Minimize the amount of water removed from the well by using the same pump to purge and collect the sample. If the well has purged dry, collect samples as soon as sufficient sample water is available.

2. Measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity at the time of sample collection.

3. Advise the analytical laboratory and the client that the usual amount of sample for analysis may not be available.

FS 2223. *Sampling Wells With In-Place Plumbing*

1. If a storage tank is present, locate a cold water spigot, valve or other sampling point close to the well head between the pump and the storage tank. If there is no sampling location between the pump and the storage tank, locate the spigot, valve or other sampling point closest to the tank.

1.1 Depending on the sampling objective for collecting samples using installed plumbing, purge the system and collect samples closest to the point of consumption, or, as close to the source well as possible.

2. Remove all screens or aerators and reduce the flow rate to no more than 500 mL/minute. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less. Collect the samples directly into the appropriate containers.

FS 2224. *Sampling Airstripper and Remedial Treatment System Sampling*

1. Reduce the flow rate to less than 500 mL/minute and begin sample collection.

2. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less.

3. Collect the samples directly into the appropriate containers.

FS 2225. *Filtering Groundwater Samples*

Filtered groundwater samples can only be collected after approval from the DEP program or project manager. If filtering is approved, the DEP program or permit condition may require both filtered and unfiltered samples to be collected, analyzed and reported.

1. FILTERING GROUNDWATER FOR METALS:

1.1 Unless specified otherwise by the DEP program, use a new, disposable, high capacity, 1-µm in-line filter.

1.2 Use a variable speed peristaltic, bladder or submersible pump with the in-line filter fitted on the outlet end.

1.2.1 Peristaltic pumps, bladder pumps or submersible pumps can be used when water levels are no greater than 20 to 25 feet deep.

1.2.2 Bladder pumps or submersible pumps must be used when water levels are greater than 20 to 25 feet deep.

1.3 Ensure that a 1-foot maximum length of new, silicone tubing was installed in the peristaltic pump head assembly before the well was purged if the same pump is being used to purge and sample the well. Otherwise, install a new length of tubing as described above.

1.4 Ensure that new or precleaned delivery tubing was assembled with the peristaltic pump before the well was purged if the same pump is being used to purge and sample the well. Otherwise, assemble the pump with new or precleaned delivery tubing and the new filter.

1.5 Insert the filter on the high pressure side (i.e., on the delivery side) of the pump.

1.5.1 Flush the filter before attaching to the pump tubing assembly with 30-50 mL of analyte free water or an inert gas (nitrogen) to remove atmospheric oxygen;

1.5.2 Or, with the filter attached to the pump tubing assembly, hold the filter upright with the inlet and outlet in the vertical position and pump water from the aquifer through the filter until all atmospheric oxygen has been removed.

1.6 Collect the filtered samples directly into the sample container from the high-pressure (delivery) side of the pump tubing assembly.

1.6.1 Collect filtered samples by either of the methods in 1.6.1.3 or 1.6.1.4 below if the static water level in the well is too deep for a variable speed peristaltic pump and a variable speed electric submersible pump or variable speed bladder pump is not available.

1.6.1.1 Do not agitate the sample or expose it to atmospheric oxygen.

1.6.1.2 **Do not** pour the sample into any intermediate vessel for subsequent filtration.

1.6.1.3 Collect the sample in a Polyethylene, Teflon or PP bailer that can be pressurized. When the bailer has been retrieved, immediately connect the filter and begin to pressurize the bailer;

1.6.1.4 Or, collect the sample with a bailer and immediately place the intake tube of the peristaltic pump into the full bailer and begin pumping the water through the filter as described in section 1.2 above.

1.7 **Do not** use the following equipment for filtering groundwater samples for metals:

1.7.1 Any pump and apparatus combination in which the filter is on the vacuum (suction) side of the pump.

1.7.2 Any type of syringe or barrel filtration apparatus.

1.7.3 Any filter that is not encased in a one-piece, molded unit.

2. Filtering groundwater for non-metallic analytes

2.1 The following analytes cannot be filtered:

- Oil and Grease
- Total Recoverable Petroleum Hydrocarbons (TRPH)
- FL-PRO
- Volatile Organic Compounds (VOC)
- Microbiological Analytes
- Volatile Inorganic Compounds (e.g., Hydrogen Sulfide)

2.2 Unless specified otherwise by the regulatory program, use a new, disposable, high capacity, 0.45 µm in-line filter.

2.3 Assemble the pump, tubing and filter as in 1.2 – 1.5 above.

2.4 Flush the filter as in 1.5.1 or 1.5.2 above.

2.5 Collect the samples as in 1.6 – 1.6.1.4 above.

Appendix FS 2200

Tables, Figures and Forms

Table FS 2200-1 Equipment for Collecting Groundwater Samples
Table FS 2200-2 Dissolved Oxygen Saturation
Table FS 2200-3 Allowable Uses for Bailers
Figure FS 2200-1 Pump and Trap for Extractable Organics
Figure FS 2200-2 Groundwater Purging Procedure
Form FD 9000-24 Groundwater Sampling Log

Table FS 2200-1
Equipment for Collecting Groundwater Samples

Activity	Equipment Type
Well Purging	Variable speed centrifugal pump Variable speed submersible pump Variable speed bladder pump Variable speed peristaltic pump Bailer with lanyard: Not Recommended
Well Stabilization	pH meter DO meter Conductivity meter Thermometer/Thermistor Turbidimeter Flow-through cell Multi-function meters
Sample Collection	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Bailer with lanyard (See Table FS 2200-3)
Filtration	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Pressurized bailer 1.0 µm high capacity molded filter 0.45 µm high capacity molded filter
Groundwater Level	Electronic sensor Chalked tape

Table FS 2200-2
Dissolved Oxygen Saturation

TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L
deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%
15.0	10.084	2.017	19.0	9.276	1.855	23.0	8.578	1.716	27.0	7.968	1.594
15.1	10.062	2.012	19.1	9.258	1.852	23.1	8.562	1.712	27.1	7.954	1.591
15.2	10.040	2.008	19.2	9.239	1.848	23.2	8.546	1.709	27.2	7.940	1.588
15.3	10.019	2.004	19.3	9.220	1.844	23.3	8.530	1.706	27.3	7.926	1.585
15.4	9.997	1.999	19.4	9.202	1.840	23.4	8.514	1.703	27.4	7.912	1.582
15.5	9.976	1.995	19.5	9.184	1.837	23.5	8.498	1.700	27.5	7.898	1.580
15.6	9.955	1.991	19.6	9.165	1.833	23.6	8.482	1.696	27.6	7.884	1.577
15.7	9.934	1.987	19.7	9.147	1.829	23.7	8.466	1.693	27.7	7.870	1.574
15.8	9.912	1.982	19.8	9.129	1.826	23.8	8.450	1.690	27.8	7.856	1.571
15.9	9.891	1.978	19.9	9.111	1.822	23.9	8.434	1.687	27.9	7.842	1.568
16.0	9.870	1.974	20.0	9.092	1.818	24.0	8.418	1.684	28.0	7.828	1.566
16.1	9.849	1.970	20.1	9.074	1.815	24.1	8.403	1.681	28.1	7.814	1.563
16.2	9.829	1.966	20.2	9.056	1.811	24.2	8.387	1.677	28.2	7.800	1.560
16.3	9.808	1.962	20.3	9.039	1.808	24.3	8.371	1.674	28.3	7.786	1.557
16.4	9.787	1.957	20.4	9.021	1.804	24.4	8.356	1.671	28.4	7.773	1.555
16.5	9.767	1.953	20.5	9.003	1.801	24.5	8.340	1.668	28.5	7.759	1.552
16.6	9.746	1.949	20.6	8.985	1.797	24.6	8.325	1.665	28.6	7.745	1.549
16.7	9.726	1.945	20.7	8.968	1.794	24.7	8.309	1.662	28.7	7.732	1.546
16.8	9.705	1.941	20.8	8.950	1.790	24.8	8.294	1.659	28.8	7.718	1.544
16.9	9.685	1.937	20.9	8.932	1.786	24.9	8.279	1.656	28.9	7.705	1.541
17.0	9.665	1.933	21.0	8.915	1.783	25.0	8.263	1.653	29.0	7.691	1.538
17.1	9.645	1.929	21.1	8.898	1.780	25.1	8.248	1.650	29.1	7.678	1.536
17.2	9.625	1.925	21.2	8.880	1.776	25.2	8.233	1.647	29.2	7.664	1.533
17.3	9.605	1.921	21.3	8.863	1.773	25.3	8.218	1.644	29.3	7.651	1.530
17.4	9.585	1.917	21.4	8.846	1.769	25.4	8.203	1.641	29.4	7.638	1.528
17.5	9.565	1.913	21.5	8.829	1.766	25.5	8.188	1.638	29.5	7.625	1.525
17.6	9.545	1.909	21.6	8.812	1.762	25.6	8.173	1.635	29.6	7.611	1.522
17.7	9.526	1.905	21.7	8.794	1.759	25.7	8.158	1.632	29.7	7.598	1.520
17.8	9.506	1.901	21.8	8.777	1.755	25.8	8.143	1.629	29.8	7.585	1.517
17.9	9.486	1.897	21.9	8.761	1.752	25.9	8.128	1.626	29.9	7.572	1.514
18.0	9.467	1.893	22.0	8.744	1.749	26.0	8.114	1.623	30.0	7.559	1.512
18.1	9.448	1.890	22.1	8.727	1.745	26.1	8.099	1.620	30.1	7.546	1.509
18.2	9.428	1.886	22.2	8.710	1.742	26.2	8.084	1.617	30.2	7.533	1.507
18.3	9.409	1.882	22.3	8.693	1.739	26.3	8.070	1.614	30.3	7.520	1.504
18.4	9.390	1.878	22.4	8.677	1.735	26.4	8.055	1.611	30.4	7.507	1.501
18.5	9.371	1.874	22.5	8.660	1.732	26.5	8.040	1.608	30.5	7.494	1.499
18.6	9.352	1.870	22.6	8.644	1.729	26.6	8.026	1.605	30.6	7.481	1.496
18.7	9.333	1.867	22.7	8.627	1.725	26.7	8.012	1.602	30.7	7.468	1.494
18.8	9.314	1.863	22.8	8.611	1.722	26.8	7.997	1.599	30.8	7.456	1.491
18.9	9.295	1.859	22.9	8.595	1.719	26.9	7.983	1.597	30.9	7.443	1.489

Derived using the formula in Standard Methods for the Examination of Water and Wastewater, Page 4-101, 18th Edition, 1992

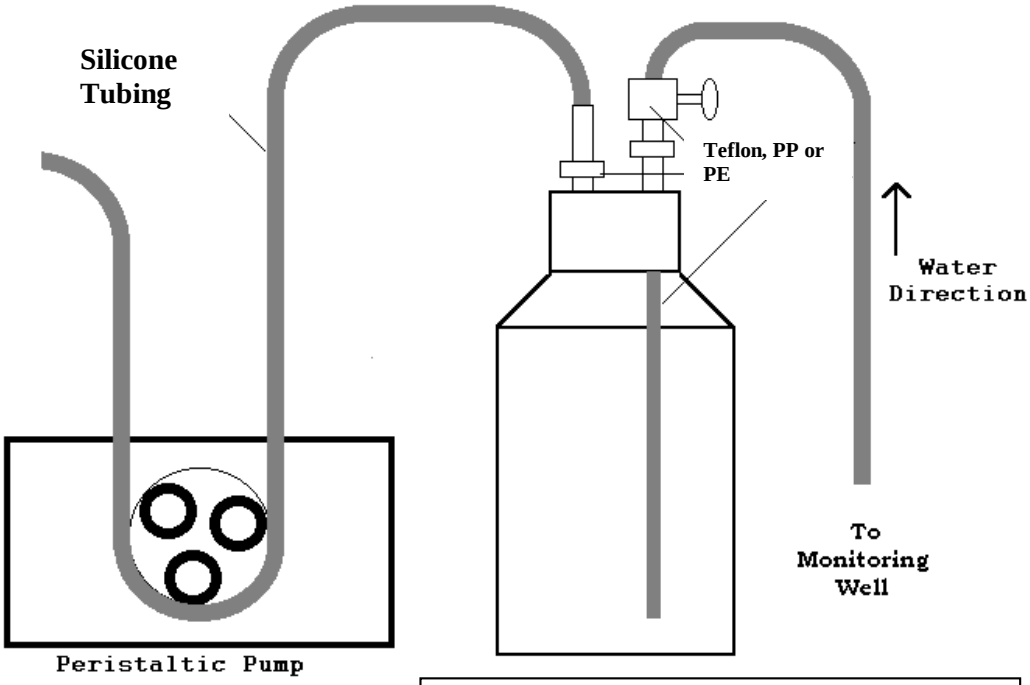
Table FS 2200-3
Allowable Uses for Bailers

• **ANALYTE GROUP(S)**	• **PURGING** (Not Recommended)	• **SAMPLING**	
	Use:	Use:	Not Recommended:
Volatile Organics Extractable Organics Radionuclides, including Radon Metals Volatile Sulfides	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If concentrations exceed action levels, the purpose is to monitor effective treatment, and the DEP program allows the use of bailers; or If specified by DEP permit, program, contract or order. or If operated by a skilled individual with documented training in proper techniques and using appropriate equipment. Field documentation must demonstrate that the procedure in FS 2221, section 2 was followed without deviation.	If concentrations are near or below the stated action levels; or If a critical decision (e.g., clean closure) will be made based on the data; or If data are to demonstrate compliance with a permit or order.
Petroleum Hydrocarbons (TRPH) & Oil & Grease	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	Only if allowed by permit, program, contract or order as samples should be collected into the container without intermediate devices.	Unless allowed by permit, program, contract or order.

• **ANALYTE GROUP(S)**	• **PURGING** (Not Recommended)	• **SAMPLING**	
	Use:	Use:	Not Recommended:
Biologicals Inorganic Non-Metallics Aggregate Organics Microbiological Physical and Aggregate Properties	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If all analytes collected from the well can be collected with a bailer; or If collected <u>after</u> collecting all analytes that require the use of a pump.	Before collecting any analytes that must be collected with a pump.
Ultra-Trace Metals	Never	Never	

Figure 2200-1

Pump and Trap for Extractable Organics



The glass sample bottle must be threaded to use a reusable sampling cap lined and installed with fittings made of Teflon, polypropylene or polyethylene, similar to the design shown.

Scenario 1: WELL SCREEN COMPLETELY SUBMERGED

Option 1a: Minimal Purge Volume: Pump or tubing is placed within the middle of the screen interval. The following conditions must be met to use this option:

1. The well screen interval is ≤ 10 feet.
2. Although drawdown may occur in the well when purging is initiated, the drawdown has to stabilize (Aquifer Recovery Rate = Purge Rate).
3. The samples will be obtained with the same equipment that was used to purge the well. Therefore, centrifugal pumps and bailers are not suitable for use in Option 1a.

If one or more of these conditions do not apply, use Option 1b.

Option 1b: Conventional Purge: Pump, tubing, or bailer [1] is placed above the screen at the top of the water column.

[1] DEP does not recommend the use of a bailer for purging; however, if a bailer is used it shall be lowered and raised at the rate of 2 cm/sec in the top of the water column.

Scenario 2: WELL SCREEN PARTIALLY SUBMERGED

Option 2a: A bailer [1] is placed at the top of the water column and is used to purge and sample the well.

Option 2b: Pump or tubing is placed within the middle of the saturated portion of the screen interval.

If the pump or tubing that was used for purging will not be used to obtain the sample, then position the pump or tubing at the top of the water column for purging.

Purging Procedure #1

1. After the drawdown in the well stabilizes, purge at least one equipment volume then collect the first set of stabilization parameters.
2. Thereafter, collect stabilization parameters ≥ 2 to 3 minutes apart.
3. Purge at least three equipment volumes before sampling.

Purging Procedure #2

1. Purge at least one well volume then collect first set of stabilization parameters.
2. Thereafter, collect stabilization parameters ≥ every 1/4 well volume.

Purging Procedure #3

1. Purge at least one well volume then collect first set of stabilization parameters.
2. Thereafter, collect stabilization parameters ≥ 2 to 3 minutes apart.

Purging Completion

If Dissolved Oxygen is ≤ 20% of saturation for the measured temperature and Turbidity is ≤ 20 NTUs, then purging is complete when three consecutive readings of the parameters listed below are within the following ranges:

Temperature ± 0.2 °C
pH ± 0.2 Standard Units
Specific Conductance ± 5.0% of reading

If Dissolved Oxygen (DO) is > 20% of saturation for the measured temperature and/or Turbidity is > 20 NTUs after every attempt has been made to reduce DO and/or turbidity, then purging is complete when three consecutive readings of the parameters listed below are within the following ranges:

Temperature ± 0.2 °C
pH ± 0.2 Standard Units
Specific Conductance ± 5.0% of reading
Dissolved Oxygen ± 0.2 mg/L or readings are within 10% (whichever is greater).
Turbidity ± 5 NTUs or readings are within 10% (whichever is greater).

If the well is expected to purge dry, position the pump or tubing within the screened interval and purge at ≤ 100 mL/minute until two equipment volumes are removed. Use the same pump for purging and sampling.

If the well purges dry at the lowest achievable flow rate (pumping at 100 mL/minute or less), then after a sufficient amount of water recharges in the well, collect the samples.

In either case listed above, before samples are collected, measure (once) pH, temperature, specific conductance, dissolved oxygen, and turbidity.

If one or more parameters do not stabilize after 5 volumes of the screened interval (purging procedure #1) or 5 well volumes (purging procedure #s 2 & 3) are removed, purging may be discontinued at the discretion of the sampling team leader.

FS 3000. SOIL

See also the following Standard Operating Procedures:

- FA 1000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FT 1000 – FT 2000 Field Testing and Calibration

1. Introduction and Scope

1.1. Use these SOPs during field investigations to collect soil samples that are representative of current site conditions. It is very important to ensure that the collected samples are neither altered nor contaminated by sampling and handling techniques.

1.2. The following topics include: equipment choice, equipment construction materials, grab and areal or depth composite sampling techniques. Sample collection methods fall into three general depth classifications: surface, shallow subsurface, and deep subsurface. Once the samples are acquired, the handling procedures are very similar and are described below.

2. GENERAL

2.1. Select sampling equipment based on the type of sample to be collected and the analytes of interest. Choose soil sampling locations such that a representative portion of the soil is collected with minimal disturbance. Locations where natural vegetation is stressed or dead and/or areas that have surficial soil staining may be indicative of improper waste disposal practices.

2.2. If background and/or quality control sampling is warranted and feasible as determined in the site's work plan or by the project manager, select an up gradient, undisturbed location for obtaining the background and/or quality control samples. Be aware that differences in soil types may affect these background samples (e.g., sands vs. clays).

2.3. **Do not collect** samples for chemical analysis from auger flights or cuttings from hollow stem auger flights, except for waste characterization purposes for disposal.

2.4. Do not use samples that are collected for geological/lithological or vapor meter determinations for chemical analyses.

3. EQUIPMENT AND SUPPLIES

3.1. All equipment must be constructed of materials consistent with the analytes of interest. Refer to FS 1000, Tables FS 1000-1, FS 1000-2 and FS 1000-3 for selection of appropriate equipment and materials.

3.2. For information on sample container size and construction, see FS 1000, Table FS 1000-6.

3.3. For information on sampling equipment cleaning requirements, see FC 1000.

3.4. For information on preservation and holding time requirements, see FS 1000, Table FS 1000-6.

3.5. For information on documentation requirements, see FD 1000.

4. PROCEDURES FOR COMPOSITING

4.1. The following is not a complete discussion regarding all available sampling protocols nor the appropriateness or inappropriateness of compositing soil samples. The appropriateness of compositing soil samples will depend on the data quality objectives of the project. However, it is sometimes advantageous to composite soil samples to minimize the number of samples to be analyzed when sampling highly contaminated areas. Obtain permission from the DEP program.

4.1.1. Select sampling points from which to collect each aliquot.

4.1.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

4.1.3. **Combine the aliquots of the sample directly in the sample container with no pre-mixing**.

4.1.4. Record the amount of each aliquot (volume or weight).

4.1.5. Label container, preserve on wet ice to 4°C and complete field notes.

4.1.6. Notify the laboratory that the sample is an unmixed composite sample, and request that the sample be thoroughly mixed before sample preparation or analysis.

5. SPECIFIC PROCEDURES FOR VOLATILE ORGANIC COMPOUNDS

Follow the procedures specified in EPA Method 5035 for sample collection and sample preparation. The protocols listed below **do not replace Method 5035** but clarify and/or modify certain method procedures. Therefore, it is essential that all organizations have a copy of Method 5035 as a reference document.

5.1. <u>Container Preparation</u>

5.1.1. All containers must be cleaned according to the FC 1000 sample container cleaning procedures for volatile organics.

5.1.2. Sample Vials: If sample vials are filled in the field, they must be provided with all reagents, stirring devices, label **and vial cap** to be used during sample analysis. These vials must be preweighed by the laboratory and records must be maintained so that there is an unambiguous link between the tare weight and the filled sample vial.

5.2. <u>Collection Procedure</u>

5.2.1. The sample vials (when used) will contain a premeasured amount of liquid. The laboratory must weigh the vials before sending into the field, and must weigh them again after receipt. Therefore:

- Do not lose any of the liquid either through evaporation or spillage
- Do not use a vial if some of the contents has spilled, or if it appears that some has leaked during transport
- Use the laboratory-supplied container label for identification information. **DO NOT apply any additional labels to the container**

- Do not interchange vial caps or septa

5.2.2. Minimize exposure to air by obtaining the sample directly from the sample source, using a coring device or a commercially designed sampling tool.

5.2.2.1. The sample collection device must be designed to fit tightly against the mouth of the vial or be small enough to be inserted into the vial. Use:

- EnCore or equivalent sampling devices or
- Disposable plastic syringes with the syringe end cut off prior to sampling (use **once** per sampling location).

5.2.2.2. Extrude the sample directly into the sample container.

5.2.3. Follow the method procedures for field transfer into the vial.

5.2.4. Procedures for determining the sample weight in the field are not required unless the project manager requires an accurate determination of the 5-gram sample size.

5.2.4.1. If the vials are returned to the laboratory for weighing, the sampler must be proficient in estimating the requisite 5-gram weight necessary for each sample.

5.2.4.2. If an accurate estimate of the 5-gram sample size is desired prior to starting sample collection activities, use a balance with a sensitivity of 0.1 gram. Check the balance calibration before each day's use with a set of weights that have been calibrated against NIST-traceable weights at least annually.

5.2.5. If the sampling device is transported to the laboratory with a sample, make sure the seals are intact, especially if collecting samples from sandy soils.

5.2.6. Collect at least two replicate samples from the same soil stratum and within close proximity to the original sample location.

5.2.7. Collect an additional aliquot of sample for screening and dry weight determinations.

5.3. <u>Preservation (see FS 1000, Table FS 1000-7)</u>

5.3.1. <u>Low Level (≤ 200 µg/kg volatile organics)</u>

5.3.1.1. Method 5035 discusses the use of sodium bisulfate, which is an acid. Since Florida soils contain significant amounts of calcium carbonate that reacts with acids, DEP does not recommend using this preservative.

5.3.1.2. Properly pack the samples (see FS 2004, section 5), and place all samples on wet ice.

5.3.1.3. Analyze unpreserved samples (no acid) within 48 hours.

5.3.1.4. Analyze acid-preserved samples within the specified 14-day holding time.

5.3.1.5. Analyze unpreserved samples that have been collected in a septum vial with premeasured analyte-free water within 48 hours.

5.3.1.6. If unpreserved samples collected in a septum vial with premeasured analyte-free water are frozen to -10°C at the laboratory within 48 hours of sample collection, analyze the samples within 14 days.

5.3.1.7. Analyze samples that have been collected with and transported in a sealed coring device within 48 hours.

5.3.1.8. If unpreserved samples collected in a sealed coring device are extruded from the corer into an appropriate liquid and frozen to -10°C at the laboratory within 48 hours of sample collection, analyze the samples within 14 days.

5.3.2. High Level (> 200 µg/kg volatile organics)

5.3.2.1. Properly pack the samples (see FS 2004, section 5), and place all samples on wet ice.

5.3.2.2. Analyze samples that have been collected with and transported in a sealed coring device within 48 hours.

5.3.2.3. If unpreserved samples collected in a sealed coring device are extruded from the corer into an appropriate liquid and stored at 4°C at the laboratory within 48 hours of sample collection, analyze the samples within 14 days.

5.3.2.4. Analyze samples that that have been preserved in methanol in the field within 14-days.

6. BULK SAMPLES: The collection of bulk samples will depend on the data quality objectives of the project.

6.1. Do not composite or mix VOC samples unless required by the DEP program or if mandated by a formal DEP document (permit, order or contract).

6.2. Select sampling points from which to collect each aliquot.

6.3. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

6.3.1. **Combine the aliquots of the sample directly in the sample container with no pre-mixing**..

6.3.2. Pack soil tightly minimizing as much headspace as possible in the sample container.

6.3.3. Cap container tightly with Teflon side facing sample.

6.4. Record the amount of each aliquot (volume or weight) in the field notes.

6.5. Label container. Refer to FS 1000, Table FS 1000-7 for preservation and holding time requirements.

6.6. Notify the laboratory that the sample is an unmixed composite sample, and request that the sample be thoroughly mixed before sample preparation or analysis.

FS 3100. Surface Soil Sampling

Surface soil is generally classified as soil between the ground surface and 6-12 inches below ground surface.

1. Remove leaves, grass and surface debris from the area to be sampled.
2. Collect samples for volatile organic analyses as described in FS 3000, section 5.
3. Select an appropriate precleaned sampling device and collect the sample.
4. Transfer the sample to the appropriate sample container.
5. Clean the outside of the sample container to remove excess soil.

6. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

FS 3200. Subsurface Soil Sampling

Interval begins at approximately 12 inches below ground surface.

FS 3210. SAMPLE COLLECTION PROCEDURE

Use the following after the desired depth has been reached by one of the methods outlined in FS 3220.

1. Collect samples for volatile organic analyses as described in FS 3000, section 5.
2. For other analyses, select an appropriate precleaned sampling device and collect the sample.
3. Transfer the sample to the appropriate sample container.
4. Clean the outside of the sample container to remove excess soil.
5. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

FS 3220. REACHING THE APPROPRIATE DEPTH

1. SHOVELS AND DIGGERS: Used for soils from approximately 12 inches to a point when using the implement becomes impractical.

   1.1. Dig a hole or trench to the required depth.

   1.2. Follow the sample collection procedures outlined in FS 3210.

2. BACKHOE: Used for soils from approximately 12 inches to a point when using the implement becomes impractical.

   2.1. Dig a trench to the appropriate depth.

   2.2. Expose the sample, in the trench, by using a precleaned spoon, spatula or equivalent to clean away the soil that came in contact with the backhoe bucket.

   2.3. Use a **second** precleaned utensil to actually collect the sample from the trench.

   2.4. Follow the procedures outlined in FS 3210 to collect the sample.

3. BUCKET AUGERS AND HOLLOW CORERS: Suitable to reach soils from approximately 12 inches to a point when using the implement becomes impractical.

   3.1. Push and rotate the auger into the soil until the bucket is filled.

   3.2. Addition of a non-contaminating sleeve may allow an undisturbed soil sample to be obtained.

      3.2.1. The device consists of a standard auger head with a removable sleeve, which is inserted into the auger barrel. In this case it is the sleeve, which fills with soil.

      3.2.2. Remove the sleeve from the auger and cap.

   3.3. If the auger hole is prone to collapse due to low cohesion in some soils, DEP recommends inserting a temporary rigid PVC casing into the hole. The casing prevents hole collapse and minimizes cross-contamination between soil zones as the auger is advanced.

3.4. Remove the sample from the sampler by pushing or scraping the soil with an appropriate precleaned utensil into an appropriately precleaned tray or aluminum foil.

3.5. Remove any portion of the sample that has been disturbed and discard.

3.6. Follow the sample collection procedures outlined in FS 3210.

NOTE: If a confining layer has been breached during sampling, grout the hole to land surface with Type-1 Portland cement. This requirement may be different throughout Florida; contact the local Water Management District office for local requirements.

4. SPLIT SPOON SAMPLER: Suitable for reaching soils from approximately 12 inches to depths greater than 10 feet.

4.1. A split spoon sampler, useful for sampling unconsolidated soil, consists of two half cylinders (spoons) that fit together to form a tube approximately two feet in length and two inches in diameter.

4.1.1. The cylindrical arrangement is maintained by a retaining head and bit rings that screw on at each end of the split spoon.

4.1.2. The bit ring has beveled edges to facilitate sampling as the split spoon is forced into the ground.

4.1.3. Advance the sampler using the weight of the drilling stem and rods or a mechanical hammer.

4.1.4. Insert a catcher device in the head ring to prevent loss of unconsolidated sample during recovery.

4.2. After retrieving the split spoon sampler, expose the soil by unscrewing the bit and head rings and splitting the barrel.

4.3. If the recovery is enough to accommodate discarding a portion of the sample, discard the top and bottom two to three inches of the sample.

4.4. For volatile organic compounds collect the sample immediately from the **center portion of the split spoon** using the procedures described in FS 3000, section 5.

4.5. For other analyses, slice the sample from the center portion of the split spoon using a clean, decontaminated utensil.

4.6. Select an appropriate precleaned sampling device and collect the sample.

4.7. Transfer the sample to the appropriate sample container.

4.8. Clean the outside of the sample container to remove excess soil.

4.9. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

5. DIRECT PUSH RIGS: May be used for depths greater than 10 feet below ground surface.

5.1. Liners: The clear liners are used with direct push rigs. This method is appropriate only for unconsolidated materials. The sampling depth that can be achieved varies depending on the rig and the lithologies that are encountered. Typically, the rig operator will:

- Place the liner inside the metal probe rod
- Select a point holder with an opening appropriate for the site lithology and screw it on the probe rod
- Advance the rod a full rod length
- Retrieve the rod
- Remove the point holder
- Remove the liner, and
- Slice the liner to expose the soil.

5.2. After the liner has been sliced, follow the procedures outlined in FS 3210, collecting volatile organic samples (if needed) immediately after the liner is sliced.

5.3. If samples for organic vapor analysis screening are required, collect them by slicing the sample(s) using a clean, decontaminated utensil and place them in 8-ounce (preferred) or 16-ounce jars, immediately cover the opening with aluminum foil and screw on the lid ring. If the contamination is derived from petroleum products, it is acceptable to use a clean gloved hand to transfer the sample(s) to the sample container(s).

5.4. For other analyses, slice the sample from the center portion of the split spoon using a clean, decontaminated utensil.

5.5. Select an appropriate precleaned sampling device and collect the sample.

5.6. Transfer the sample to the appropriate sample container.

5.7. Clean the outside of the sample container to remove excess soil.

5.8. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

6. SHELBY TUBE SAMPLER

6.1. The Shelby tube sampler is used to sample unconsolidated soil and consists of a tube approximately 30 inches long and two inches (or larger) in diameter.

6.2. One end of the tube has edges beveled into a cutting edge. The other end can be mounted to an adapter, which allows attachment to the drilling rig assembly.

6.3. After drilling to the required depth with an auger or rotary drill bit, a soil sample is obtained through the auger or directly in the borehole.

6.4. Push the Shelby tube into the soil using the drilling rig's hydraulic ram or manually with a sledge hammer.

6.5. Remove the tube from the sampler head.

6.6. Extrude the sample from the Shelby tube.

6.7. Use a decontaminated utensil to remove any portion of the sample that has been disturbed.

6.8. Collect samples for volatile organics immediately from the center portion of the Shelby tube using the procedures described in FS 3000, section 5.

6.9. For other analyses, slice the sample from the center portion of the Shelby tube using a clean, decontaminated utensil.

6.10. Transfer the sample to the appropriate sample container.

6.11. Clean the outside of the sample container to remove excess soil.

6.12. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

7. CORE BARREL

7.1. A standard core barrel is utilized when consolidated samples (such as limestone or dolomite) are to be sampled.

7.1.1. The core barrel is a cylinder approximately three feet long and two inches in diameter.

7.1.2. The barrel has a removable head ring with small embedded diamonds which allow the device to cut through rock or consolidated soil as the drilling rods are rotated.

7.2. Retrieve the sample core by unscrewing the head ring and sliding the sample into a precleaned container.

7.3. Use a decontaminated utensil to remove any portion of the sample that has been disturbed.

7.4. Remove the sample from the sampler (corer) with a precleaned tool.

7.5. Transfer the sample to the appropriate sample container.

7.6. Clean the outside of the sample container to remove excess soil.

7.7. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

FS 5000. WASTE SAMPLING

1. INTRODUCTION: Use the procedures in FS 5000 to sample media and matrices of industrial origin.

1.1. Use the following DEP SOPs in conjunction with FS 5000:

- FA 1000 Regulatory Scope and Administrative Procedures for Use of DEP SOPs
- FC 1000 Cleaning / Decontamination Procedures
- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FT 1000 – FT 2000 General Field Testing and Measurement

1.1.1. Use additional DEP SOPs as required for specific applications.

2. EQUIPMENT AND SUPPLIES: Refer to Table FS 5000-1 for approved waste sampling equipment.

3. PRESERVATION, TRANSPORT AND HANDLING OF WASTE SAMPLES

3.1. Do not preserve waste samples with chemical preservatives or cool waste samples where the potential for an inadvertent chemical reaction of samples with the preservative might occur, or where cooling might otherwise alter the original sample characteristics. Protect samples from sunlight in order to minimize any potential reaction due to possible light sensitivity of samples. Appropriate handling and storage precautions should be taken if samples have the potential to be shock sensitive.

3.2. After the samples have been collected and containerized, clean the outside of the containers with water, paper towels or other absorbent materials to remove any spilled sample from the exterior of the container.

3.3. Place each labeled container in a separate, resealable plastic bag and then repackage in a second resealable plastic bag. Apply an evidentiary custody seal to container closure before bagging, if applicable. If transporting the samples presents a possibility for breaking glass sample containers, pack the sample containers with non-combustible, absorbent cushioning material and place in a shipping container that has been lined with plastic. Waste samples that are suspected of being acutely toxic or extremely hazardous must be packed in paint cans or other suitable containers and filled with absorbent materials prior to being placed in a cooler.

3.4. See Table FS 1000-6 for preservation procedures.

4. DOCUMENTATION

4.1. See FD 5300 for a complete listing of documentation requirements specific to waste sampling.

4.2. Additional guidance on documentation requirements specific to each type of waste sampling is included in the associated DEP SOPs below.

FS 5010. SAMPLING HAZARDS AND PERSONNEL SAFETY

Waste sampling requires specialized training, safety protocols and personal protective equipment (PPE). The degree and type of safety measures and PPE required depends on the unique characteristics of the waste to be sampled.

1. REFERENCE FOR REQUIRED SAFETY PROTOCOLS, TRAINING AND PPE: As applicable, adhere to safety procedures, training requirements and prescribed PPE described in Occupational Safety and Health Administration (OSHA) Rule 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response).

2. MINIMUM SAFETY PLANNING AND PROCEDURES: It is beyond the scope of this field sampling SOP to describe safety protocols for every contingency. Follow the listed minimum safety procedures below, where applicable:

2.1. Ensure that all personnel are appropriately trained and qualified per OSHA requirements.

2.2. Ensure that sampling personnel meet employer and OSHA medical requirements.

2.3. Conduct site reconnaissance and identify hazards.

2.4. Produce a written site safety plan and review with all personnel.

2.5. Designate a site safety and health officer.

2.6. Produce a written sampling plan and review with all personnel.

2.7. Provide appropriate PPE and sampling equipment to all samplers.

2.8. Establish site control (exclusion zones, access corridors, etc.).

2.9. Conduct preliminary and continuous on-site air monitoring (combustible gases, oxygen deficiency, toxic gases, radiation).

2.10. Establish decontamination areas for samplers.

2.11. Prepare for emergencies (backup personnel, spill containment, fire equipment, first aid, evacuations, etc.).

2.12. Follow additional health and safety procedures developed by the facility owner, as applicable.

FS 5020. PRELIMINARY WASTE CHARACTERIZATION

1. Conduct a preliminary waste characterization prior to collecting samples for laboratory analysis. Use the waste characterizations to establish proper safety protocols and protections for sampling personnel, to make decisions regarding staging, bulking, compositing, segregation, shipping and disposal of wastes and to refine the selection of appropriate laboratory analyses for collected waste samples.

2. Classify the wastes into the following general categories: reactive wastes, explosives, acids, bases, ignitable wastes, heavy metals, pesticides, halogenated compounds, cyanides and oxidizers. In cases where sufficient information is not available, conduct further analyses to identify the material.

3. The field waste characterization tests listed below are designed to gain a quick, preliminary assessment of the types and levels of chemicals in the wastes. Perform the field methods below according to the manufacturers' instructions.

- HazCat Chemical Identification System
- Dräger Tubes
- Clor-N-Oil Test Kit
- Spill-fyter Chemical Classifier Strips
- Setaflash (ignitability)

4. Record the results of the preliminary characterization, including the results of any field waste characterization tests performed.

FS 5100. Drum Sampling

1. PRECAUTIONS FOR DRUM SAMPLING

1.1. Opening closed containers and drums of unknown content is a hazardous activity. Give maximum attention to sampling team safety by establishing and following clear and proper procedure and wearing appropriate personal protection equipment. *Remote sampling technique may be required for some situations*. ***Conduct all sampling activities using appropriate personal protective equipment (PPE) for the level of hazard encountered. See FS 5010. If the contents of drums or their hazards are unknown, use Level B protection at a minimum.***

1.2. Exercise caution when excavating, inspecting, staging and sampling drums because of the potential presence of explosive or flammable gases, toxic vapors or other hazardous materials. Assume that labeled drums are mislabeled. In general, assume that all drums contain hazardous material until the contents have been independently characterized.

1.3. Refer to 29 CFR Part 1910.120(j) for OSHA standards required for drum and container handling.

2. DRUM EXCAVATION: ***All excavation activities must include appropriate personal protective equipment for the level of hazard encountered. See FS 5010. If the contents of drums or their hazards are unknown, wear Level B protection, at a minimum.***

2.1. Utilize geophysical techniques to approximate buried drum locations and depths.

2.2. Locate all utility lines, poles and pipes above and below ground. Ensure adequate clearance between all utilities or structures and the drum excavation area.

2.3. Use heavy equipment and equipment operators with drum removal experience to excavate, remove or handle drums. Avoid digging directly into drums. Final excavation must be done manually, using non-sparking hand tools.

2.4. Monitor the area around exposed drums for volatile organic compounds, explosives or radioactive materials before proceeding.

2.5. Identify each drum that will be opened. Use paint sticks, spray paint, traffic cones, etc.

3. DRUM INSPECTION: ***All inspection activities must include appropriate personal protective equipment for the level of hazard encountered. See FS 5010. If the contents of drums or their hazards are unknown, wear Level B protection, at a minimum.***

3.1. Visually inspect all drums that are being considered for sampling for the following:

- Pressurization (bulging/dimples)
- Crystals around the drum opening
- Leaks, holes, stains
- Labels, markings, hazard warnings
- Composition and type (steel/plastic and open/bung)
- Dead vegetation around drum
- Condition, age, rust, potential shock sensitivity
- Sampling accessibility

3.1.1. Drums showing evidence of pressurization and crystals must be furthered assessed to determine if remote drum opening is needed. Do not tap or knock the drums to determine drum contents or volume.

3.2. Uniquely identify each drum with a tag, label, bands, spray paint or other means. Indicate drum category, as determined by visual inspection. Use color-coding as needed to distinguish categories of drums.

3.3. Record all observations made during drum inspection.

4. DRUM STAGING: ***All staging activities must include appropriate personal protective equipment for the level of hazard encountered. See FS 5010. If the contents of drums or their hazards are unknown, wear Level B protection, at a minimum.***

4.1. Use heavy equipment and qualified equipment operators with drum handling experience to stage drums, if necessary.

4.2. If ignitable, explosive or reactive characteristics are indicated by initial characterization of drum contents, locate the staging area away from the drum-opening area to prevent chain reaction should an opened drum explode or ignite.

4.3. The procedures for handling and sampling drums differ by drum category. Separate drums into the following categories, based on determination of contents:

- Liquids
- Lab packs
- Solids
- Empty

4.3.1. Segregate drums containing radioactive, explosive or shock-sensitive material from other drums and the drum-opening area. Place drums containing these hazards in a diked and fenced area where practical.

4.3.2. Separate drums containing acids or bases from each other. Similarly separate drums containing other wastes known to react with each other.

4.4. Move drums from the staging area to the opening area one at a time using forklift trucks equipped with drum grabbers or barrel grapplers or, move by roller conveyor or other means.

5. DRUM OPENING PROCEDURES:

5.1. <u>General Considerations</u>:

5.1.1. ***Wear personal protective equipment (PPE) as prescribed in the reference cited in FS 5010 for the level of hazard encountered with each drum.***

5.1.2. Use remote drum-opening procedures when possible to maximize personnel safety.

5.1.3. Use manual bung wrench or deheader drum-opening procedures only with structurally sound drums that are capable of withstanding the forces applied during bung opening or deheading.

5.1.4. Do not attempt to use a manual bung wrench or deheader on drums that contain shock-sensitive, reactive, explosive or flammable materials.

5.2. Procedures Required Prior to Drum Opening: Before opening, ground each metal drum that is not in direct contact with the earth using grounding wires, alligator clips and a grounding rod or metal structure. If a metal drum is in an overpack drum, ensure the metal drum is grounded.

5.2.1. Touch the drum opening equipment to the bung or lid and allow an electrically conductive path to form. Slowly remove the bung or drum ring and/or lid with spark resistant tools (brass/beryllium).

5.2.2. Screen drums for explosive gases and toxic vapor with air monitoring instruments as bung or drum lid is removed.

5.2.3. Record the results of all monitoring of drums.

5.3. Tools for Opening Drums: See specific instructions below for use of various drum opening tools.

All manual procedures require appropriate personal protective equipment (PPE) for all personnel working with the drum. The puncture or deheading of any drum may present a chemical splash hazard. The level of protection required is described in the reference cited in FS 5010 for the type of hazards encountered with each drum. If drum contents or hazards are unknown, wear Level B protection, at a minimum.

5.3.1. Manual Bung Wrench

5.3.1.1. ***Wear appropriate protective gear per FS 5010.***

5.3.1.2. Position top or side mounted bungs in upright position.

5.3.1.3. Pull slowly and steadily across the drum.

5.3.1.4. Use a handle extension for increased wrench leverage where necessary.

5.3.1.5. Watch for sparking even when using non-sparking bung wrenches.

5.3.2. Manual Drum Deheader

5.3.2.1. Position the cutting edge of the deheader just inside the top chime and tighten the deheader adjustment screw to hold the device tight against the side of the drum.

5.3.2.2. Slowly make an initial cut into the drumhead to release pressure (or use remote techniques to relieve pressure prior to deheading procedures).

5.3.2.3. Move the deheader handle up and down while sliding the device along the chime.

5.3.2.4. Decontaminate the drum deheader between drums, if contact between the deheader and drum contents have occurred. See FC 1000.

5.3.3. Hand Pick, Pickaxe and Hand Spike

5.3.3.1. Anticipate potential splashing with the use of these tools. ***Wear proper personal protective gear per FS 5010.***

5.3.3.2. Use these devices where the bung cannot be opened or the drumhead cannot be removed.

5.3.3.3. Decontaminate hand tools between drums. See FC 1000.

5.3.4. Remote Opening Using a Backhoe Spike: Use this procedure for greater personal safety. Mount a splash shield in front of the backhoe operator cage**.** ***The operator must wear appropriate personal protection gear per FS 5010.*** Provide air supply gear to the operator, if applicable.

5.3.4.1. Place drums in rows such that the backhoe can be maneuvered between them.

5.3.4.2. Punch a hole in the drumhead with the backhoe spike.

5.3.4.3. Decontaminate the backhoe spike between drums. See FC 1220.

5.3.5. Remote Opening Using Hydraulic Devices

5.3.5.1. Follow manufacturer's instructions to puncture the drum.

5.3.5.2. ***This procedure presents a splash hazard. Wear personal protective gear per FS 5010, as applicable.***

5.3.6. Remote Bung Opening Using Pneumatic Devices: ***This procedure does not allow slow release of accumulated pressure in the drum. Wear personal protective gear per FS 5010 and take safety precautions during this procedure, as applicable.***

5.3.6.1. Do not attempt to remove rusted bungs with this device.

5.3.6.2. Place drums in level, upright position.

5.3.6.3. Follow manufacturer's instructions to fit the opener to the bung, remotely remove the bung and detach the device.

5.4. Inspecting Drum Contents

5.4.1. Note the state, quantity, phases, and color of the drum contents.

5.4.2. Review the screening results with any pre-existing data to determine which drums will be sampled.

5.4.3. Monitor headspace gases from opened drums. Use an oxygen meter and explosimeter first, followed by organic vapor analyzer (OVA) monitoring.

5.4.4. Record all results from the inspection of drums.

5.5. General Instructions for Drum Sampling

5.5.1. If applicable for the sampling plan, account for any stratification of drum contents by appropriate choice of sampling tools and techniques. If the entire depth of the drum must be represented by the sample(s), collect all phases and strata of the drum either as a composite or as discrete phase and stratum samples, as required. Only profiling

samplers such as COLIWASA (COMPOSITE LIQUID WASTE SAMPLER), thiefs, sludge judges, etc. allow proportional sampling of strata and phases.

5.5.1.1. Filling Multiple Sample Containers Where Strata or Phases are Composited: Using a proportional sampler, dispense an entire sampler volume of waste into each required sample container in succession until all containers are adequately filled.

5.5.1.2. Filling Multiple Sample Containers Where Discrete Stratum or Phase Samples are Required: Fill the required number of containers in succession using a discrete sampler to collect samples from the appropriate phase or stratum.

5.5.2. Account for sludge depth in the drum by measuring depth to apparent bottom and subtracting from drum total depth (height).

5.5.3. Select the appropriate sampling equipment based on the physical state of the material and the type of container. Sampling equipment must be made of non-reactive materials that will not alter the chemical or physical properties of the material that is to be sampled.

5.5.4. Place absorbent pads, sampling equipment and sample containers near drum(s) to be sampled.

5.5.5. Record all observations made during sampling. Document sampling per FD 5300.

CONDUCT AIR MONITORING FOR TOXIC VAPORS, EXPLOSIVE GASES AND OXYGEN-DEFICIENT ATMOSPHERES DURING DRUM SAMPLING.

FS 5110. SAMPLING LIQUIDS FROM DRUMS

1. GLASS THIEF (TUBE)

1.1. General Considerations for Glass Thief

1.1.1. Use disposable glass tubes only.

1.1.2. Typical dimension for the glass thief is 6mm-16mm I.D. and 48 inches long.

1.2. Sampling Procedure for Glass Thief

1.2.1. Remove cap from sample container.

1.2.2. Insert thief into drum almost to bottom or until solid layer is reached. Allow one foot of tubing to extend out of the top of the drum.

1.2.3. Let the waste in the drum rise to its natural level in the thief.

1.2.4. Cap the top of the thief with a stopper or gloved thumb. Do not let waste liquid contact the stopper or thumb.

1.2.5. Withdraw the thief from the drum.

1.2.6. Insert open end of thief into the sample container and allow thief contents to drain into the container. Fill container 2/3 full.

1.2.7. When finished with the thief, break the thief into pieces and insert into the drum (if permitted by the sampling and disposal plans).

2. COLIWASA (COMPOSITE LIQUID WASTE SAMPLER)

2.1. General Considerations for COLIWASA Sampling

2.1.1. Use the COLIWASA to collect representative multiphase samples from the full depth of a drum, as applicable.

2.1.1.1. If it is not a disposable model, the COLIWASA may be too expensive for some applications and cannot be easily decontaminated in the field.

2.1.1.2. Variations in design of this sampling device may be available from different vendors but the operational principle is the same.

2.2. Sampling Procedure for COLIWASA

Follow manufacturer's directions for use if different from the following:

2.2.1. Configure the COLIWASA in the open position by lifting the stopper rod several inches above the closed position.

2.2.2. Slowly lower the sampler into the liquid waste at a rate that permits the levels of liquid inside and outside the sampler tube to rise to about the same heights. Failure to maintain equal heights inside and outside the tube will affect the representativeness of the sample. If the liquid level inside the tube is lower than the waste level outside the tube, the sampling rate is too fast.

2.2.3. When the sampler stopper hits the bottom of the drum, push the stopper rod to the closed position.

2.2.4. Slowly withdraw the sample from the waste liquid and simultaneously wipe the outside of the device with a disposable wipe.

2.2.5. Position the lower end of the COLIWASA in the sample container. Lift the stopper rod and carefully drain the waste liquid into the container.

2.3. Sampling Procedures for Other Devices: (Reserved)

FS 5120. SAMPLING SOLIDS AND SLUDGES FROM DRUMS

1. GENERAL CONSIDERATIONS

1.1. Use a long-handled dipper, push tube or other coring device, scoop, spoon, bucket auger, screw auger or, if conditions necessitate, a pneumatic hammer/drill to obtain samples of solids in drums.

1.2. If necessary for the sampling plan, take multiple samples from different areas of the drum.

2. PROCEDURE FOR CORING DEVICE OR PUSH TUBE

2.1. Insert device to bottom of drum. T-handle and extension attachments, where applicable, must extend above the top of the drum.

2.2. Rotate the corer or push the sampling tube to cut a core of material.

2.3. Slowly withdraw the device to retain the sample.

2.4. Use stainless steel laboratory spatulas or scoops to transfer the sample to containers.

3. PROCEDURES FOR OTHER SAMPLING DEVICES: (Reserved)

FS 5130. CLOSING DRUMS AND SEGREGATION OF EQUIPMENT AND WASTES AFTER SAMPLING

1. Close each drum when sampling of the drum is complete.

2. Segregate contaminated sampling equipment and investigation-derived wastes (IDW) containing incompatible materials as determined by the drum screening procedure.

3. Handle and dispose of IDW and contaminated disposable equipment according to local, state and federal regulations.

4. As required, wrap or bag contaminated reusable equipment in protective material or store in containers until cleaned.

FS 5200. Tank, Sump and Leachate Sampling

1. INTRODUCTION: Some procedures for tank, sump and leachate sampling will be identical to those for drum sampling. The depth or physical configuration of some waste units will prevent the use of some equipment or techniques, depending on the unit to be sampled.

2. EQUIPMENT AND SUPPLIES: See Table FS 5000-1 for approved sampling equipment.

FS 5201. *Presampling Considerations and Procedures for Tanks*

1. PRESAMPLING CONSIDERATIONS FOR TANKS

1.1. Sampling tanks is considered hazardous due to the potential for tanks to contain large volumes of hazardous materials. Follow appropriate safety protocols. Some tank sampling requires physical agility and manual dexterity in order to access the tank sampling points, carry equipment and supplies, open tank hatches and collect and containerize samples while wearing personal protective equipment. Personnel must be able to perform the appropriate procedures under these conditions.

1.1.1. **Wear p*ersonal protective equipment (PPE) as prescribed in the reference cited in FS 5010 for the level of hazard encountered with each tank. If the contents of a tank or its hazards are unknown, wear Level B protection while working in proximity to the tank.***

1.2. Unlike drums, tanks may be compartmentalized or have complex designs. Review preliminary information about the tank contents and configuration prior to the sampling operation to ensure the safety of sampling personnel and to ensure that study design objectives can be achieved.

1.3. In addition to having discharge valves near the bottom, most tanks and bulk storage units have hatches at the top. Collect samples from the top hatch because of the potential for tank contents to be stratified. *Do not collect samples from valves unless necessary and only if part of the sampling plan. See section 1.4 below*.

1.4. When sampling from the discharge valve, there is a possibility of a stuck or broken valve that could cause an uncontrolled release. Do <u>not</u> utilize valves on tanks or bulk storage devices unless the owner or operator of the facility operates them, or a containment plan is in place should the valve stick or break. If a tank must be sampled from a discharge valve, clearly understand the valving arrangement of the particular tank to ensure that the compartment of interest is sampled. Make sure that sampling from valves is specified in the sampling plan. *Valve sampling will not allow sampling of individual strata in the tank*.

1.5. If stratification of tank contents must be accounted for, choose appropriate sampling tools and techniques so that the entire depth of the tank is represented by the sample(s) collected. Sample all phases and strata of the tank either as a composite or as discrete phase and stratum samples, as required by the sampling plan. Only profiling samplers such as COLIWASA, thiefs, sludge judges, etc. allow proportional composite sampling of strata and phases. If proportional composite sampling of a tank is not practical, collect discrete samples from each phase or stratum in order to characterize the entire contents of the tank. If the sampling plan requires only approximate sampling or screening, collect a simple grab sample from the contents of the tank.

2. PRESAMPLING PROCEDURES FOR TANKS

2.1. Perform a structural integrity survey of the tank. Inspect the ladder, stairs, and catwalk that will be used to access the top hatch of larger tanks to ensure that they will support the combined weight of personnel and equipment.

2.2. Evaluate tank sampling points for safety, accessibility and sample quality.

2.3. Before opening, ground each metal tank using grounding wires, alligator clips and a grounding rod or metal structure.

2.4. Remove all sources of ignition from the immediate area.

2.5. Open any vents or pressure release valves slowly to allow the unit to vent to atmospheric pressure.

2.5.1. ***Monitor for explosive or flammable gases and toxic vapors during venting. If dangerous concentrations of gases evolve from the vent or the pressure is too great, close the system and leave the area immediately*.**

2.6. Touch tank opening equipment to the bolts in the hatch lid and allow an electrically conductive path to form. Slowly remove bolts and/or hatch with spark resistant tools (brass/beryllium).

2.6.1. ***If a pressure build up is encountered or detected, cease opening activities and leave the area.***

2.7. ***Screen the interior of tanks for explosive or flammable gases and toxic vapors with air monitoring instruments*.**

2.8. Depending on the study objectives and site conditions, conduct characteristic screening (e.g., pH, halogen, etc.) as required. Collect a small volume of sample for flash point testing, if warranted.

2.8.1. Note the state, quantity, number of phases and color of the tank contents.

2.8.2. Compare the screening results with any pre-existing data to determine if the tank should be sampled.

2.9. Determine depth of any and all liquids, solids and liquid/solid interfaces. Measure depth of any sludge. Use weighted tape measures, probe lines, sludge judges or other appropriate equipment to characterize tank stratification with depth.

2.10. Determine the inside diameter of the tank and calculate the volume of wastes in the tank using the depth measurements above. Do not assume that the external diameter of the tank approximates the inside diameter, since the tank construction may have insulation or support structures hidden under the external surface.

2.11. Record all observations, measurements and calculations made at the time of tank inspection. See FD 5300.

FS 5210. GENERAL SAMPLING INSTRUCTIONS FOR TANKS

1. GENERAL CONSIDERATIONS: Because of the many different types of designs and materials that may be encountered, only general sampling procedures that outline sampling a tank from the top hatch are listed below:

CONDUCT CONTINUOUS AIR MONITORING FOR TOXIC VAPORS, EXPLOSIVE GASES AND OXYGEN DEFICIENT ATMOSPHERES DURING TANK SAMPLING

1.1. Select the appropriate sampling equipment based on the physical state of the material and the type of tank. Use sampling equipment constructed of non-reactive materials that will not alter the chemical or physical properties of the material that is to be sampled. See Table FS 5000-1.

1.2. ***Wear required personal protective equipment (PPE) as prescribed in the reference cited in FS 5010 for the level of hazard encountered with each tank. If tank contents or hazards are unknown, wear Level B protection, at a minimum*.**

1.3. Where tanks are compartmented, collect at least one sample from each compartment.

1.4. Place absorbent pads, sampling equipment and sample containers near tanks(s) to be sampled.

1.5. Document all observations and procedures associated with sample collection per FD 5300.

2. SAMPLING LIQUIDS FROM TANKS

2.1. Collect liquid samples according to the objectives of the sampling plan, using appropriate samplers.

2.2. Slowly lower the bailer, bacon bomb, Dipstick™, COLIWASA, or Teflon® tubing to the desired sampling depth. ***In work areas where explosive or flammable atmospheres could occur, do not use peristaltic pumps powered by batteries.***

2.2.1. Close the sampling device or start pump.

2.2.2. Slowly remove the sampling device from the tank.

2.2.3. Release or pump the sample from the device into the sample container(s).

2.2.4. Repeat the procedure until a sufficient sample volume is obtained.

2.3. Inspect samples for phase differences or stratification.

2.3.1. If separate phases or strata are observed in any sample container, perform repeated iterative sampling, if discrete phase or stratum sampling is required by the sampling plan. Systematically collect additional samples by halving the depth between two discreet sampling points to determine the next sampling depth. Repeat this procedure until no phase difference or stratification is noted in the sample. Calculate phase and stratum boundary depths from these samplings.

2.3.2. If discrete phase or stratum sampling is not required by the sampling plan, collect composite samples using appropriate profiling samplers or collect simple grab samples, depending on sampling plan objectives.

2.4. If additional sampling ports are available, verify phase and stratum information with additional samples from the other ports, if practical.

2.5. If more than one sample container will be used to collect for the analytes of interest, use the following procedures for filling multiple sample containers.

2.5.1. Filling Multiple Sample Containers Where Strata or Phases are Composited: Using a proportional sampler, dispense an entire sampler volume of waste into each required sample container in succession until all containers are adequately filled.

2.5.2. Filling Multiple Sample Containers Where Discrete Stratum or Phase Samples are Required: Fill the required number of containers in succession using a discrete sampler to collect samples from the appropriate phase or stratum.

3. SAMPLING SOLIDS/SEMI-SOLIDS FROM TANKS

3.1. Use a long-handled dipper, push tube, bucket auger, screw auger, Mucksucker™, or if conditions permit, a pneumatic hammer/drill to obtain the sample. See specific instructions for each applicable sampling device in FS 5211 below.

3.2. Carefully extrude the sample from the sampling device or use a clean stainless steel spoon to place the sample into containers for analyses.

3.3. Close the tank when sampling is complete.

4. WASTE DISPOSAL AND CONTAMINATED EQUIPMENT

4.1. Segregate contaminated sampling equipment and investigation-derived wastes containing incompatible materials.

4.2. Manage all waste according to applicable local, state and federal regulations.

FS 5211. *Tank Sampling Instructions for Specific Sampling Devices*

Select the equipment described below for use based on the specific sampling requirements of the tank.

1. BACON BOMB SAMPLER: Use the bacon bomb sampler for discrete depth sampling in a tank.

1.1. Attach sampler retrieval line and plunger line, if necessary. The sampling line must be measured and marked for the predetermined collection depth required.

1.2. Slowly lower the bacon bomb to the required depth in the tank and pull and hold the plunger line to actuate filling of the sampler. Release the plunger line to stop filling and seal the sampler closed.

1.3. Retrieve the sampler by the sample line. Do not pull on the plunger line, or the sample will be lost or exchanged with the contents of the tank or a different phase or stratum. Wipe or rinse the exterior of the sampler before filling sample containers. Collect any rinsate for proper disposal.

1.4. Release contents into the sample container by pulling on the plunger line.

2. SLUDGE JUDGE: Use the sludge judge to obtain an accurate reading of the depth of settleable solids in any liquid and for collection of the sample for laboratory analysis.

2.1. Lower the sludge judge to the bottom of the tank and allow the sampler to fill to surface level and seat the check valve on the sampler.

2.2. Retrieve the sludge judge and raise it completely out of the tank liquid for determination of sludge depth.

2.3. Actuate release pin at the bottom of the sampler to release contents or fill a sample container.

3. SUBSURFACE GRAB SAMPLER: Use the subsurface grab sampler to collect samples at discreet depths in the tank.

3.1. Screw sample bottle onto the sampler head assembly.

3.2. Lower the sampler to the required depth and actuate the plunger mechanism.

3.3. Release the plunger to close the sampling head after filling the sample bottle and retrieve the sampler from the tank.

3.4. Remove and cap the sample bottle.

3.5. Decontaminate the exterior of the sample bottle.

4. GLASS THIEF (TUBE)

4.1. General Considerations for Glass Thief

4.1.1. Use disposable glass tubes only.

4.1.2. Typical dimension for the glass thief is 6mm - 16mm I.D. and 48 inches long.

4.1.3. Tanks greater than about 3 feet in depth cannot be sampled with a glass thief.

4.2. Sampling Procedure for Glass Thief

4.2.1. Remove cap from sample container.

4.2.2. Insert thief into tank almost to bottom or until solid layer is reached. Allow one foot of tubing to extend out of the top of the tank.

4.2.3. Let the waste in the tank rise to its natural level in the thief.

4.2.4. Cap the top of the thief with a stopper or gloved thumb. Do not let waste liquid contact the stopper or thumb.

4.2.5. Withdraw the thief from the tank.

4.2.6. Insert open end of thief into the sample container and allow thief contents to drain into the container. Fill container 2/3 full.

4.2.7. When finished with the thief, break the thief into pieces and insert into the tank (if permitted by the sampling and disposal plans).

4.2.8. Close tank cover.

5. BAILER

5.1. Slowly lower bailer into tank contents using non-reactive bailer line. Do not splash bailer into the liquid.

5.2. Retrieve the bailer after the bailer fills completely.

5.3. Slowly pour bailer contents into the sample container.

5.4. Close tank cover.

6. COLIWASA:

Follow manufacturer's directions for use if different from the following:

6.1. Configure the COLIWASA in the open position by lifting the stopper rod several inches above the closed position.

6.2. Slowly lower the sampler into the liquid waste at a rate that permits the levels of liquid inside and outside the sampler tube to rise to about the same heights. Failure to maintain equal heights inside and outside the tube will affect the representativeness of the sample. If the liquid level inside the tube is lower than the waste level outside the tube, the sampling rate is too fast.

6.3. When the sampler stopper hits the bottom of the drum, push the stopper rod to the closed position.

6.4. Slowly withdraw the sample from the waste liquid and simultaneously wipe the outside of the device with a disposable wipe.

6.5. Position the lower end of the COLIWASA in the sample container. Lift the stopper rod and carefully drain the waste liquid into the container.

7. ADDITIONAL SAMPLING DEVICES: Reserved

FS 5220. LEACHATE AND SUMP SAMPLING

1. As applicable, follow DEP SOP procedures for tank, drum, groundwater, surface water and sediment sampling. See FS 5100 and FS 5200 above, as well as FS 2100, FS 2200 and FS 4000.

2. Document leachate and sump sampling according to the documentation requirements for the respective DEP SOPs employed to collect samples, per the above. Document additional items per FD 1000.

FS 5300. Waste Pile Sampling

1. The number of samples, the type of sample(s) and the sample location(s) or sampling point(s) for waste pile sampling will be based on sampling plan objectives as determined by permitting or other regulatory criteria and according to the size, shape, material composition, compactness or other characteristics of the pile and the distribution of analytes, analyte concentrations and strata in the waste pile.

2. Follow directives of the sampling plan specific to the project.

3. Document waste pile sampling according to associated regulatory requirements for the project. Document additional items per FD 1000, as applicable.

4. Refer to FS 3000 for soil sampling procedures applicable to waste pile sampling.

FS 5400. Impoundment and Lagoon Sampling

1. Surface impoundments vary in size, shape, and waste content, and may vary in distribution of hazardous constituents and characteristics (strata). The number of samples, the type of sample(s), and the sample location(s) will be based on the sampling design objectives.

2. Commonly used equipment to collect samples from surface impoundments are listed in Table FS 5000-1. All equipment must be compatible with the waste to prevent any alteration of the sample.

3. *Because of the potential danger of sampling waste units suspected of containing elevated levels of hazardous constituents, do not attempt to sample surface hazardous waste impoundments from a boat. Conduct all sampling from the banks or piers of surface impoundments. Any exception must be approved per specific provisions in the applicable health & safety plans and sampling plans*.

4. Refer to FS 2100 and FS 4000 for general surface water and sediment sampling procedures applicable to waste impoundment sampling.

4.1. Additionally, some procedures and equipment applicable to drum and tank sampling may be useful for waste impoundment sampling. See FS 5100 and FS 5200 above.

5. Document impoundment and lagoon sampling procedures and observations per FD 1000 for the applicable procedures employed.

Appendix FS 5000

Tables, Figures and Forms

Table FS 5000-1 Waste Sampling Equipment

Table FS 5000-1 Waste Sampling Equipment

Equipment	Construction Material[1]	Phases	Waste Units or Sources	Limitations
Scoop with bracket and handle	Stainless Steel	Liquids, Solids, Sludges	Impoundments, Piles, Drums and Containers, Tanks	Depth constraint. Cannot collect deeper phase or stratum in stratified waste
Spoon	Stainless Steel	Solids, Sludges	Impoundments, Piles, Drums and Containers, Tanks	Depth constraint. Cannot collect deeper strata
Push Tube	Stainless Steel	Cohesive Solids, Sludges	Impoundments, Piles, Drums and Containers, Tanks	Depth constraints. Do not use to sample solids with dimensions >½ the diameter of the tube
Auger	Stainless Steel	Solids	Piles	Unusable for solidified wastes
Sediment Sampler	Stainless Steel	Solids, Sludges, Sediment	Impoundments, Piles	Do not use to sample solids with dimensions >½ the diameter of the tube
Ponar Dredge	Stainless Steel	Solids, Sludges, Sediments	Impoundments	Deployment constraints. Must have means to position equipment to desired sampling location. Difficult to decontaminate
COLIWASA, Drum Thief	Glass	Liquids, Sludges	Impoundments, Drums and Containers, Tanks	Depth constrained to length of sampling device. Not effective with viscous wastes
Mucksucker™ Dipstick™	Teflon	Liquids Sludges	Impoundments, Drums and Containers, Tanks	Not recommended for tanks >11 feet deep
Bacon Bomb	Stainless Steel	Liquids	Impoundments, Tanks	Not effective with viscous wastes
Bailer	Stainless Steel Teflon	Liquids	Impoundments, Tanks	Do not use with heterogeneous wastes. Not effective with viscous wastes
Peristaltic Pump with Vacuum Trap Assembly[2]	Teflon Glass	Liquids	Impoundments, Drums and Containers, Tanks	Do not use in flammable atmospheres. Not effective with viscous wastes
Backhoe Bucket	Steel	Solids Sludges	Piles	May be difficult to access desired sampling location. Difficult to clean. Loss of VOCs possible
Split Spoon	Stainless Steel	Solids	Piles	Requires drill rig
Roto-Hammer	Steel	Solids	Piles, Drums, Containers	Physically breaks up sample. May release volatiles. Not for flammable atmospheres

[1] If disposable equipment of alternative material construction is used, ensure that the equipment is compatible with the chemical composition of the waste and will not alter the characteristics of the waste sample in any way.

[2] A peristaltic pump may be used without an optional vacuum trap assembly if the flexible tubing used in the pump head is one foot or less in length. Do not pump samples for VOCs through the pump head or into a vacuum trap.

FT 1000. GENERAL FIELD TESTING AND MEASUREMENT

Use the following SOPs in conjunction with FT 1000:

- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FS 1000 General Sampling Procedures
- FT 1100 through FT 3000 Specific Field Testing Procedures

1. INTRODUCTION

1.1. Scope and Applicability: SOPs FT 1100 to FT 3000 outline procedures to conduct field testing measurements and observations. They include the parameters that are measured *in-situ* or in a field-collected sample. Additionally some samples with allowable extended holding times may be collected for laboratory measurement, as described in the specific FT-series SOPs. Included in SOPs FT 1100 to FT 3000 are:

- FT 1100 Field Measurement of Hydrogen Ion Activity (pH)
- FT 1200 Field Measurement of Specific Conductance (Conductivity)
- FT 1300 Field Measurement of Salinity
- FT 1400 Field Measurement of Temperature
- FT 1500 Field Measurement of Dissolved Oxygen (DO)
- FT 1600 Field Measurement of Turbidity
- FT 1700 Field Measurement of Light Penetration (Secchi Depth and Transparency)
- FT 1800 Field Measurement of Water Flow and Velocity
- FT 1900 Continuous Monitoring with Installed Meters
- FT 2000 Field Measurement of Residual Chlorine
- FT 3000 Aquatic Habitat Characterization

1.2. Exclusions: **If proposed for experimental purposes, field-screening procedures employing techniques not addressed in these SOPs** must be submitted to the DEP site or project manager. Such procedures must be addressed for each program or project dealing specifically with the planning and design of sampling events. Data quality objectives for quantitative assessment preclude the use of field-screening procedures for regulatory purposes.

1.3. Expectations and Requirements:

1.3.1. In some cases, specific instruments are identified in the SOP, with detailed instruction provided on their use. If you are using a different instrument from that identified in the SOP, follow the manufacturer's instructions for assembly, operation, and maintenance.

1.3.2. When required, the FT-series SOPs outline the instrument specifications. A field instrument must meet the stated requirements.

1.3.3. The FT-Series SOPs specify the calibration requirements for each method. Although instruments may vary in configuration or operation, the specified calibration requirements must be met.

1.3.3.1. Where applicable to the FT-series SOP, use the minimum number of calibration standards specified.

1.3.3.2. Do not establish the lower limit of the quantitative calibration bracket with "zero" solutions, quality control blanks or reagent dilution water.

1.3.4. Ensure that all equipment is in proper working condition, calibrated, and that batteries are properly charged before using the equipment for field testing measurements.

1.3.5. If reagents or standards are prepared from stock chemicals, they must be analytical reagent grade or better. Some procedures may specify a higher grade or assay of reagent or standard.

1.4. Recommendations for Use of Grab Samples or *in situ* Field Testing Measurements:

1.4.1. Use *in situ* readings where practical for field measurements in surface water and wastewater.

1.4.2. Use *in situ* readings or flow-through containers for field measurements for groundwater stabilization during purging and for other applications where groundwater monitoring measurements are required.

1.4.3. If grab samples are collected for measurement where allowed in the individual FT-series SOP, measure samples within fifteen (15) minutes of collection when immediate analysis is specified per Table FS 1000-4 and FS 1000-5. Otherwise, analyze grab samples within the applicable holding times specified in Table FS 1000-4 and FS 1000-5.

2. MINIMUM CALIBRATION REQUIREMENTS:

2.1. Calibration Definitions: This section outlines the essential calibration concepts that must be applied to each field test. Specific requirements for calibration are addressed in the individual SOPs.

2.1.1. Initial Calibration (IC): The instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., dissolved oxygen saturation) or a known value of a calibration standard.

2.1.2. Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following initial calibration by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.

2.1.3. Continuing Calibration Verification (CCV): 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 listed in the SOP.

2.1.4. Chronological Calibration Bracket: The interval of time between verifications within which environmental sample measurements must occur. The instrument or meter

is calibrated or verified before and verified after the time of environmental sample measurement(s).

2.1.5. Quantitative Calibration Bracket: The instrument or meter is calibrated or verified at two known values that encompass the range of observed environmental sample measurement(s).

2.1.6. Acceptance Criteria: The numerical limits within which calibration verifications are acceptable.

2.2. Calibration Activities: Specific calibration procedures are given in the individual SOPs.

2.2.1. Chronological Calibration Bracket:

2.2.1.1. Ensure that the field test result is preceded by an acceptable ICV or CCV and followed by an acceptable CCV.

2.2.1.2. Specific requirements for chronological bracketing are addressed in the individual FT-series SOPs.

2.2.2. Quantitative Calibration Bracket:

2.2.2.1. Choose two standards that bracket the range of sample measurements. These standards may be used for initial calibrations or for verifications.

2.2.2.2. Specific requirements for quantitative bracketing are addressed in the individual FT-series SOPs.

2.2.3. Initial Calibration: Calibrate if no initial calibration has been performed or if a calibration verification does not meet acceptance criteria. Do not reuse standards for initial calibrations.

Table FT 1000-1: Field Testing Acceptance Criteria

Parameter	Acceptance Criteria
pH (FT 1100)	**± 0.2 Standard pH Units of buffer or more stringent program criteria**
Specific Conductance (FT 1200)	**± 5% of standard value**
Temperature (FT 1400)	**± 0.2°C of NIST-traceable value (with correction factors) Verification over range of applicable values**
Dissolved Oxygen (FT 1500)	**± 0.3 mg/L of theoretical value (see Table FT 1500-1)**
Turbidity (FT 1600)	**0.1-10 NTU: ± 10% of standard value 11-40 NTU: ± 8% of standard value 41-100 NTU: ± 6.5% of standard value > 100 NTU: ± 5% of standard value**
Total Residual Chlorine (FT 2000)	**0.995 calibration curve correlation coefficient ± 10% of primary standard value ± 10% of secondary standard value Color comparator acceptance criterion: ± 10% of primary standard value**

2.2.4. Initial Calibration Verification:

2.2.4.1. Perform an ICV immediately after calibration. All ICVs must meet the calibration acceptance criteria specified in the applicable FT-series SOP. See Table FT 1000-1 for a list of acceptance criteria for the most common field testing procedures.

2.2.4.2. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

2.2.5. Continuing Calibration Verification: Perform a CCV at no more than 24-hour intervals from previous verification, except where noted for individual FT-series SOPs.

2.2.5.1. If historically generated data demonstrate that a specific instrument remains stable for longer periods of time, the time interval between calibration verifications may be increased.

2.2.5.2. Base the selected time interval on the shortest interval that the instrument maintains stability. If CCVs consistently fail, shorten the time period between verifications or replace/repair the instrument.

2.2.5.3. All CCVs must meet the calibration acceptance criteria specified in the applicable FT-series SOP. See Table FT 1000-1 for a list of acceptance criteria for the most common field testing procedures.

2.2.5.4. If a CCV fails to meet acceptance criteria perform one or more of the following procedures as necessary:

- Reattempt the CCV again within the chronological bracket time interval without changing the instrument calibration. Do not perform maintenance, repair, or cleaning of the instrument or probe. Probes may be rinsed with analyte-free water or fresh verification standard. The CCV may be reattempted with a fresh aliquot of verification standard.
- Perform the initial calibration, perform an ICV, re-analyze the sample(s), and perform a CCV.
- Report all results between the last acceptable calibration verification and the failed calibration verification as estimated (report the value with a "J"). Include a narrative description of the problem in the field notes.

2.2.5.5. For installed instruments that are deployed for extended periods of time or used for continuous monitoring, see FT 1900.

2.2.5.6. Shorten the time period between verification checks or replace/repair the instrument.

2.2.6. Determining the Values of Secondary Standards: Use only those standards recommended by the manufacturer for a specific instrument. Only use secondary standards for continuing calibration verifications. See the individual FT-series SOPs for specific procedures for use of secondary standards. At documented intervals, determine or verify the values of secondary standards immediately after performing an initial calibration or after verifying the calibration with primary standards. Read each secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10% of the stated standard value. If the +/- 10% 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.

2.2.7. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3. PREVENTIVE MAINTENANCE: Record all maintenance and repair notes in the maintenance logbook for each meter (see FS 1007). If rental equipment is used, a log is not required. However, the origin (i.e., rental company), rental date, equipment type, model number, and identification number (if applicable) must be entered into the field notes or a rental equipment notebook.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

4.1.1.1. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for pre-formulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

4.1.4.1. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. <u>Field Instrument Calibration Documentation</u>: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record the manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Manufacturer's tolerance range for secondary standards
- Link to information recorded according to section 4.1 above

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.10.1. Document the date and time of any corrective actions.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

Appendix FT 1000
Tables, Figures and Forms

Table FT 1000-1 Field Testing Acceptance Criteria

Table FT 1000-1: Field Testing Acceptance Criteria	
Parameter	**Acceptance Criteria**
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Turbidity (FT 1600)	**0.1-10 NTU: ± 10% of standard value 11-40 NTU: ± 8% of standard value 41-100 NTU: ± 6.5% of standard value > 100 NTU: ± 5% of standard value**
Total Residual Chlorine (FT 2000)	**0.995 calibration curve correlation coefficient ± 10% of primary standard value ± 10% of secondary standard value Color comparator acceptance criterion: ± 10% of primary standard value**

FT 1100. Field Measurement of Hydrogen Ion Activity (pH)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. Equipment and Supplies

1.1. Field Instrument: Use any pH meter consisting of a potentiometer, a glass electrode, a reference electrode, and a temperature-compensating device.

1.1.1. For routine fieldwork use a pH meter accurate and reproducible to at least 0.2-unit in the range of 0.0 to 14.0 units, and equipped with temperature-compensation adjustment. Record the pH value in pH units to one decimal place.

1.1.2. Advanced silicon chip pH sensors (with digital meters) may be used if demonstrated to yield equivalent performance to glass electrode sensors for the intended application.

1.2. Standards: Purchased or laboratory-prepared standard buffer solutions of pH values that bracket the expected sample pH range. Use buffers with nominal values of 4.0, 7.0 and 10.0 units for most situations. If the sample pH is outside the range of 4.0 to 10.0, then use two buffers that bracket the expected range with the pH 7 buffer being one of the two buffers. Alternatively, prepare appropriate standards per table I in method SM4500-H^+-B.

1.3. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms
- Indelible pens

2. Calibration and Use

2.1. General Concerns

2.1.1. The acceptance criterion for the initial calibration or the calibration verification is a reading of the standard within +/- 0.2-unit of the expected value.

2.1.2. On a weekly basis, check the calibration to ensure the % theoretical slope is greater than 90% (if applicable to your instrument type).

2.1.2.1. Note the % slope in the calibration records.

2.1.2.2. A % slope of less than 90% indicates a bad electrode that must be changed or repaired.

2.1.2.3. If % slope cannot be determined on your meter, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

2.2. Interferences

2.2.1. Sodium at pH $\geq$ 10.0 units can be reduced or eliminated by using a low sodium error electrode.

2.2.2. 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 acetone very sparingly so that the electronic surface is not damaged.

2.2.3. Temperature effects on the electrometric measurement of pH are controlled by using instruments having temperature compensation or by calibrating the meter at the temperature of the samples.

2.2.4. Poorly buffered solutions with low specific conductance (< 200 μmhos/cm) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

2.2.5. Ensure stable sample and sensor temperature before calibrating or taking sample readings. Drifting sensor or sample temperature may produce erroneous sample measurements, calibrations, or verifications.

2.2.6. Thoroughly rinse the pH sensor with deionized water or fresh buffer standard when calibrating or verifying the calibration or when taking sample measurements. For in-situ measurements, ensure adequate flushing of the sensor with fresh sample water prior to taking measurements. Any residual standard, sample or deionized water remaining on the sensor may affect the measurement of the subsequent standard or sample. This is especially true when samples or standards of widely different pH value are successively measured.

2.2.7. Drifting readings or an inability to calibrate the sensor may also indicate a fouled electrode. Clean the electrode per the manufacturer's instructions or replace.

2.3. Calibration: Follow the manufacturer's calibration instructions specific to your meter. Most instruments allow for a two-point calibration and a few models can perform a three-point calibration. Use the appropriate number of standard buffer solutions for calibration. Do not reuse buffers for initial calibrations.

2.3.1. Rinse the probe with de-ionized water (DI) before and between each standard buffer solution.

2.3.2. Follow the calibration activities specified in FT 1000, section 2.2.

2.3.2.1. Perform an initial calibration using at least two buffers. Always use a pH 7 buffer first.

2.3.2.2. If the pH sample range is expected to be wider than the range established by a two-point calibration (e.g., some samples at pH 4 and others at pH 8), then add a third calibration point. If the instrument cannot be calibrated with three buffers, the third buffer may be used as the initial calibration verification to extend the range.

2.3.2.3. After initial calibration, immediately perform an initial calibration verification (ICV). Read a buffer as a sample. To be acceptable, a calibration verification must be within +/- 0.2 pH units of the stated buffer value. For example, if reading the pH 4.0 buffer, the result must be in the 3.8 to 4.2 range. Certain regulatory programs may have more stringent acceptance criteria.

2.3.2.4. After sample measurement(s), perform a continuing calibration verification (CCV). Read a buffer as a sample. To be acceptable, a

calibration verification must be within +/- 0.2 pH units of the stated buffer value. This CCV (if within acceptance criteria) can be used as the beginning of the chronological bracket. Certain regulatory programs may have more stringent acceptance criteria.

2.4. Measuring pH *in situ*: After calibrating the multi-probe sensors as outlined in 2.3 above, follow the meter's instructions to select the display for reading the pH of the sample. Immerse the probe at the desired depth in the water and wait for stabilization of the reading before recording the measurement.

2.5. Measuring pH in Flow-through Cells: When using a flow-through cell, the procedure described above in section 2.4 is applicable.

2.6. Measuring pH in Samples: After an acceptable initial calibration or calibration verification, follow these procedures to take a pH reading of a freshly collected sample (within 15 minutes of collection).

2.6.1. Pour enough of the fresh sample into a clean cup to take the reading.

2.6.2. Place the pH electrode in the sample (in the cup) and swirl the electrode.

2.6.3. Wait for stabilization, and read the pH value.

2.6.4. Turn the meter off after the last sample reading, rinse the electrode thoroughly with de-ionized water and replace the electrode's cap.

3. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

4.1.1.1. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

4.1.4.1. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Link to information recorded according to section 4.1 above

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.10.1. Document date and time of any corrective action.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1200. Field Measurement of Specific Conductance (Conductivity)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling
- FD 1000 Documentation Procedures

1. INTRODUCTION: Specific conductance is a useful method to approximate the total amount of inorganic dissolved solids.

1.1. Conductivity varies with temperature. For example, the conductivity of salt water increases 3%/degree C at 0°C, and only 2%/degree C at 25°C.

1.2. Record the sample temperature or adjust the temperature of the samples prior to measuring specific conductance if the conductivity instrument does not employ automatic temperature compensation and correction of the instrument display value.

2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Any self-contained conductivity instrument suitable for field work, accurate and reproducible to 5% or better over the operational range of the instrument, and preferably equipped with temperature-compensation adjustment. See references in FT 1210 below for additional information about instruments.

2.2. Standards: Purchased or laboratory-prepared standard potassium chloride (KCl) solutions with conductivity values that bracket the expected samples' range. In the laboratory, prepare standards of appropriate conductivities per SM2510 (Conductivity, in *Standard Methods for the Examination of Water and Wastewater, American Public Health Association*). Do not reuse standards for initial calibrations.

2.3. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms
- Indelible pens

3. CALIBRATION AND USE

3.1. General Concerns

3.1.1. Follow the instrument manufacturer's instructions for the details of operating the instrument.

3.1.2. For instruments without automatic temperature compensation, attempt to adjust the temperature of the samples to 25°C. If the temperature cannot be adjusted, measure the temperature with a calibrated device (see FT 1400), record the temperature, correct for temperature (per section 3.4 below) and report the results corrected to 25°C. See references in FT 1210 below for further information about temperature correction.

3.1.3. Ensure stable sample and sensor temperature before calibrating or taking sample readings. Drifting sensor or sample temperature may produce erroneous sample measurements, calibrations or verifications.

3.1.4. Thoroughly rinse the conductivity sensor with deionized water and fresh standard when calibrating or verifying the calibration or when taking sample measurements. For in-situ measurements, ensure adequate flushing of the sensor with fresh sample water prior to taking measurements. Any residual standard, sample or deionized water remaining on the sensor may affect the measurement of the subsequent standard or sample. This is especially true when samples or low-concentration standards are measured subsequent to measuring high-concentration standards.

3.1.5. Drifting readings or an inability to calibrate the sensor may also indicate a fouled electrode. Clean the electrodes per the manufacturer's instructions.

3.1.6. When successful calibration and verification cannot be achieved after ensuring that temperatures have stabilized and the sensor electrodes are clean and free of residual sample or standard from the previous measurement, suspect opened containers of standards, especially after repeated openings, when near the manufacturer's expiration date or when little standard volume remains in the container. Low-concentration conductivity standards are seldom stable for an extended period after opening.

3.2. Calibration and Calibration Verification:

3.2.1. Follow the calibration activities specified in FT 1000, section 2.2.

3.2.2. Initial Calibration: Calibrate the meter prior to use according to the following steps:

3.2.2.1. **Do not "zero" in the meter using analyte-free water or air.**

3.2.2.2. When the sample measurements are expected to be 100 μmhos/cm or greater, use two standard potassium chloride solutions that bracket the range of expected sample conductivities. A single standard at 100 μmhos/cm standard potassium chloride solution is acceptable for situations in which all sample measurements are expected to be less than 100 μmhos/cm.

3.2.2.3. Calibrate the instrument with one of the two standards to create an upper or lower boundary for the quantitative bracket.

3.2.2.4. Verify the calibration of the instrument with the second standard, quantitatively bracketing the range of expected sample values.

3.2.2.5. If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values. The second standard in section 3.2.2.3 above may be used as an additional calibration standard.

3.2.2.6. Note: If all samples are expected to be less than 100 μmhos/cm, only one standard at 100 μmhos/cm standard potassium chloride solution is required.

3.2.3. Acceptability: Accept the calibration if the meter reads within +/- 5% of the value of any calibration standard used to verify the calibration. For example, the acceptance range for a 100 μmhos/cm standard is 95 to 105 μmhos/cm. If the meter does not read within +/- 5% of each calibration verification standard, determine the cause of the problem and correct before proceeding.

3.2.4. Temperature Correction: Most field instruments read conductivity directly. If the meter does not automatically correct values to 25°C, calculate correction factors using

the procedure in section 3.4 below. Record all readings and calculations in the calibration records.

3.2.5. Continuing Calibration Verification: Check the meter in read mode with at least one KCl standard with a specific conductance which quantitatively brackets the conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5% of the standard value (see 3.2.3 above).

3.2.5.1. If new environmental samples are encountered outside the range of the initial calibration in 3.2.2 above, verify the instrument calibration with an additional standard that brackets the range of new sample values. If these calibration verifications fail, recalibrate the instrument as in 3.2.2.

3.2.5.2. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3.3. Measuring Specific Conductance of Samples:

3.3.1. Follow manufacturer's instructions for sample measurement.

3.3.2. Immerse or place the conductivity probe or sensor in situ at a measuring location representative of the sampling source.

3.3.3. Allow the conductivity instrument to stabilize.

3.3.4. Measure the water temperature (if necessary for manual temperature compensation) and record the temperature. See FT 1400 for temperature measurement procedures.

3.3.5. If the meter is equipped with manual temperature compensation, adjust the conductivity meter to the water temperature per manufacturer's instructions.

3.3.6. If the conductivity meter has a set of positions that multiply the reading by powers of ten in order to measure the full range of potential conductivities, set this dial to the correct range in order to take a reading.

3.3.7. Record the sample conductivity measurement reading within 15 minutes of water sample collection.

3.3.8. Rinse off the probe with de-ionized water. Follow manufacturer's instructions for probe storage between use.

3.4 Calculations for Temperature Compensation

If the meter does not automatically correct for temperature (manual or automatic adjustment), or if a probe with a cell constant other than 1 is used, the following formula must be used to normalize the data to 25°C:

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

Where: K = conductivity in μmhos/cm at 25°C

K_m = measured conductivity in μmhos/cm at T degrees C

C = cell constant

T = measured temperature of the sample in degrees C

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

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

Refer to SM2510B, 20th edition, if other calculations (i.e., determining cell constant, etc.) are required. See FT 1210 below.

3.5 *In situ* Measurements at Depth or With Flow-through Cells: After calibrating the instrument as outlined in 3.2 above, follow the manufacturer's instructions to measure the conductivity of the sample.

3.5.1. For *in situ* measurements immerse the probe at the desired depth and wait for stabilization of the reading and record its value. Follow a similar procedure when using a flow-through cell.

3.5.1.1 Preferably measure groundwater sample conductivity *in situ* with a downhole probe or in a flow-through system.

4. PREVENTATIVE MAINTENANCE: Refer to FT 1000, section 3.

5. DOCUMENTATION

5.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications and sample measurements.

5.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

5.1.1.1. Document acceptable verification of any standard used after its expiration date.

5.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

5.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

5.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

5.1.3. Record the grade of standard or reagent used.

5.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

5.1.4.1. Record the date of preparation for all in-house formulations.

5.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

5.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

5.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

5.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

5.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

5.2.3. Record the time and date of all initial calibrations and all calibration verifications.

5.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

5.2.5. Record the name of the analyst(s) performing the calibration.

5.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., conductivity standard)
- Value of standard, including correct units (e.g., conductivity = 100 µmhos/cm)
- Link to information recorded according to section 5.1 above

5.2.7. Retain manufacturers' instrument specifications.

5.2.8. Document whether successful initial calibration occurred.

5.2.9. Document whether each calibration verification passed or failed.

5.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

5.2.10.1. Document date and time of any corrective action.

5.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

5.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

5.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1400. Field Measurement of Temperature

The use of this SOP is not required when using field temperature measurement devices to monitor groundwater stabilization during the purging of groundwater monitoring wells. Field temperature measurement devices used for temperature compensation (correction) for other measurements such as dissolved oxygen, specific conductance or pH are also exempted from the requirements of this SOP. FT 1400 must be used for all other field temperature measurements required by DEP.

Use this SOP in conjunction with the following DEP SOPs:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. EQUIPMENT AND SUPPLIES

1.1. Field Instruments: Use any of the following instrument types for performing field measurements:

- Digital thermistor (thermocouple type) and meter typical of field instruments
- Glass bulb, mercury-filled thermometer (not recommended for field ruggedness)
- Glass bulb, alcohol-filled thermometer with protective case
- Bi-metal strip/dial-type thermometer
- Advanced silicon chip temperature sensor and digital meter

1.1.1. Field instruments must be capable of measuring temperature in 0.1^{o}C increments.

1.2. Standard Thermometer: NIST-traceable Celsius certified thermometer with scale marks for every 0.1^{o}C increment, a range of 0°C to 100°C (or a range bracketing expected sample temperatures) and correction chart supplied with certification. The standard thermometer must have a valid certification for the period of measurement.

1.3. Recordkeeping and Documentation Supplies:

- Field notebook or forms \
- Indelible pens

2. CALIBRATION AND USE

2.1. General Concerns

2.1.1. Select a temperature measuring device meeting the requirements of section 1.1 above.

2.1.2. Dial-type and thermocouple-type devices with meters are preferred over the glass thermometers for fieldwork because of their durability and ease of reading.

2.1.2.1. Transport glass thermometers in protective cases.

2.1.2.2. Inspect glass thermometers for liquid separation. Do not use a thermometer if the liquid has separated.

2.1.2.3. Most instruments with digital display will provide more decimal figures than are significant. Record the temperature reading with only one rounded decimal figure (e.g., 25.9 instead of 25.86^{o}C).

2.2. Calibration

2.2.1. Follow the calibration activities specified in FT 1000, section 2.2.

2.2.2. Verify all thermistor (meter) devices and field thermometers against the NIST-traceable standard thermometer at several temperatures in the expected sample measurement range, using any correction factor indicated by the certificate supplied with the NIST-traceable thermometer.

2.2.2.1. See the US Geological Survey, National Field Manual for the Collection of Water-Quality Data, Book 9, Chapter A6, Field Measurements, Section 6.1, Temperature, Techniques of Water-Resources Investigations, 4/98 for additional guidance about making temperature comparisons with the standard thermometer.

2.2.2.2. Make note of the calibration in the calibration records. See section 4 below.

2.2.2.3. The field measurement device may be used with a linear correction factor provided that the observed temperature difference with the standard thermometer is documented at incremental temperatures over the range of expected sample temperatures.

2.2.2.4. Use the resulting correction factor when making temperature measurements of samples with the field measurement device.

2.2.2.5. Prominently display the correction factor on the field measurement device, with the date last verified. A calibration correction curve or plot may also be used.

2.2.2.6 To be acceptable, a calibration verification must be within +/- 0.5^{o}C of the corrected reading of the NIST-traceable thermometer.

2.2.2.7 Properly dispose of glass-bulb thermometers that do not meet the above calibration acceptance criteria.

2.2.3. Continuing Calibration Verifications:

2.2.3.1. Determine the maximum time between continuing calibration verifications for the specific field temperature measurement device based on instrument stability.

2.2.3.2. Verify the field measurement device against the standard NIST-traceable thermometer as in section 2.2.2 above.

2.2.4. Refer to additional calibration requirements in FT 1000, section 2.2.

2.2.5. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

2.3. Measuring Sample Temperature

2.3.1. Insert or place the thermometer or sensor *in situ* at a measuring location representative of the sampling source.

2.3.2. Allow the thermometer or temperature sensor to equilibrate to ambient *in situ* temperature.

2.3.2.1. Groundwater samples must be measured *in situ* with a downhole probe or in a flow-through container. Do not measure bailed or pumped samples in an intermediate container containing static sample.

2.3.3. Record the temperature to the nearest 0.1^{o}C after the reading stabilizes and remains constant.

3. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

4. DOCUMENTATION

4.1. Standards Documentation: Document information about the NIST-traceable standard thermometer in the calibration record, including:

- Unique identification for the thermometer
- Vendor certificate of calibration, including any correction factor
- Vendor's expiration date for the certificate of calibration

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the following information about initial calibration and calibration verifications and link to information recorded according to section 4.1 above:

- Details of the method used to compare the field measurement device to the NIST-traceable standard thermometer.
- Results of each calibration verification, including the expected reading (per the NIST-traceable standard thermometer)
- The actual reading of the field measurement device, using any established correction factors and correct units.

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance (such as a new correction factor) according to records requirements of FD 3000.

4.2.10.1. Document date and time of any corrective action.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1500. Field Measurement of Dissolved Oxygen (DO)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. EQUIPMENT AND SUPPLIES

1.1. Field Instruments

1.1.1. Membrane-type polarographic or galvanic electrode DO sensor with dedicated meter or configured with multi-parameter sonde

1.1.2. Luminescence-based DO sensor with dedicated meter or configured with multi-parameter sonde (see American Society for Testing and Materials, *Standard Test Methods for Dissolved Oxygen in Water*, Test Method C-Luminescence-based Sensor, D 888-05).

1.1.3. Select instrument assemblies that provide minimum precision of +/- 0.2 mg DO/L and a minimum accuracy of +/- 0.2 mg DO/L.

1.1.4. Compensate for temperature dependence of DO measurements by using instruments employing automatic temperature compensation or by manually correcting measurements in accordance with SM 4500-O G (see *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, American Water Works Association, Water Pollution Control Federation).

1.1.4.1. Calibrate on-board temperature sensors as described in FT 1400.

1.2. Standards

1.2.1. NIST-traceable Celsius thermometer with a scale marked for every 0.1^{o}C and a range of 0 to 100°C.

1.2.2. Access to an organization with capability to perform the Winkler titration procedure is recommended but not mandatory.

1.2.3. A “zero-DO standard”, prepared on-site with an aliquot of the sample water, is optional. Prepare by adding excess sodium sulfite and a trace of cobalt chloride to bring the DO to zero.

1.3. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms
- Indelible pens

2. CALIBRATION AND USE: the electrode method is predominantly used *in-situ* for dissolved oxygen determinations.

2.1. General Concerns

2.1.1. Turbulence is necessary to keep a constant flow of water across the membrane-sample interface. Make sure the appropriate mechanism is working before using the probe.

2.1.2. Follow instrument manufacturer's instructions for probe storage. For example, store the probe with a cover that creates a saturated atmosphere. A cap, with a wet sponge in it, will suffice for single-parameter probes. If the sensor is in a multi-probe device, keep the protective cap chamber moist during storage.

2.1.3. Before mobilizing, check to make sure there are no bubbles beneath the probe membrane, or any wrinkles or tears in the probe membrane. If so, replace the membrane and KCL solution. Check the leads, contacts, etc. for corrosion and/or shorts if meter pointer remains off-scale, does not calibrate, or drifts.

2.1.4. Dissolved inorganic salts interfere with the performance of DO probes. For example, DO readings in salt water are affected by the salinity and must be corrected. The DO meter may adjust automatically based on readings taken from the specific conductivity/salinity probe. If corrections are not automatic the appropriate calculations must be used to correct for salinity. If automatic adjustments are used the specific conductivity/salinity probe calibration must be verified or calibrated in accordance with FT1200.

2.1.5. Reactive gases, which pass through the membrane, may interfere. For example, chlorine will depolarize the cathode and cause a high probe output. Long-term exposures to chlorine will coat the anode with the chloride of the anode metal and eventually desensitize the probe. Sulfide (from H_2S) will undergo oxidation if high enough potential (voltage) is applied, creating current flow, yielding faulty readings. If such interferences are suspected, change the membrane electrode more frequently and calibrate at more frequent intervals.

2.1.6. Ensure that the temperature of the sensor and sample are stable. Unstable temperatures will produce erroneous calibrations, verifications or sample measurements.

2.1.7. Erroneous calibrations or verifications may result if the saturated air chamber is not vented to atmospheric pressure, properly humidified and protected from temperature fluctuations produced by common field conditions such as evaporation or fluctuation in sunlight intensity.

2.2. Follow the quality control requirements for calibration (see activities in FT 1000, section 2.2).

2.3. <u>Initial Calibration and Initial Calibration Verification</u>

2.3.1. <u>Air Calibration and Initial Calibration Verification (ICV)</u>: Calibrate the meter 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.

2.3.1.1. Allow an appropriate warm up period before initial field calibration.

2.3.1.2. 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% humidity).

2.3.1.3. Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate.

2.3.1.4. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table, what the DO saturation value should be at the observed temperature (see Table FT

1500-1, below). A stable and accurate temperature is required for a valid calibration. The acceptance criterion for DO calibration verification is +/- 0.3 mg DO/L at the observed temperature of the verification.

2.4. Continuous Calibration Verification

2.4.1. Air-Calibration Verification: DO sensor or instrument is calibrated against air that is saturated with water at a known temperature and ambient atmospheric pressure. Use Table FT 1500-1 below to verify calibration at specified temperature.

2.4.1.1. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops) and insert the sensor into the chamber (this ensures 100-percent humidity)

2.4.1.2. Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate.

2.4.1.3. Measure the temperature in the calibration chamber and observe the readings until the instrument stabilizes.

2.4.1.4. Use the oxygen solubility Table FT 1500-1 below to determine the DO saturation at a measured temperature and atmospheric pressure. Calculate values to the nearest tenth degree by interpolation or use an expanded version of this table found in FS 2200, which provides saturation data in 0.1 ^{o}C increments for a selected temperature range (see Table FS 2200-2).

2.4.1.5. Compare DO meter reading with value obtained from Table FT 1500-1 below to verify continuous calibration.

2.5. Additional Verifications: The following methods may be used as additional checks to verify calibration. These additional checks may be required as part of a specific permit.

2.5.1. Winkler method: This check is useful to assess the condition of the DO sensor (i.e., its degradation with time/use) and that the instrument can still maintain a valid calibration (see SM 4500-O C).

2.5.1.1. **Perform the Winkler method when required by permit or other regulation at the required calendar frequency.**

2.5.1.2. For an accuracy calibration verification using the Winkler method, follow SM 4500-O C.

2.5.1.3. Fill a clean bucket with uncontaminated or de-ionized water and place the probe into the bucket (with stirrer or equivalent mechanism turned off). Fill at least two biological oxygen demand (BOD) bottles without entraining atmospheric oxygen into the bottles. Carefully submerge the bottom of the bottle (one at a time) into the water and allow the water to fill the bottle. Place the bottle on the bottom of the bucket and carefully place stopper into it without adding atmospheric oxygen. Retrieve the bottles and determine their DO by the Winkler method (see SM4500-O-C for more details). Turn the stirrer or equivalent mechanism on and read the DO of the water in the bucket.

2.5.1.4. Adjust the DO meter according to manufacturer's instructions. Be sure to adjust the meter to the temperature of water in the bucket, and then calibrate the DO meter to read the average DO concentration of the two samples determined by the Winkler test.

2.5.2. Zero-DO Verification: The air calibration and the interfering effects of the sample can be further checked in the field by means of a "zero-DO standard"(SM 4500-O G).

2.5.2.1. Prepare this standard on-site with an aliquot of the sample by adding excess sodium sulfite and a trace of cobalt chloride to bring the DO to zero. Prepare this zero-DO standard in a beaker or a large-mouth sample container of appropriate size to insert the DO probe.

2.5.2.2. After adding the chemicals, gently swirl the water and let it sit for about 30 seconds before inserting the probe.

2.5.2.3. Read the DO of the sample. If the reading is outside the acceptance interval, the instrument must be recalibrated and/or zero-adjusted if the meter allows for this adjustment.

2.5.3. Air-Saturated Water: The DO sensor or instrument system is calibrated against water that is saturated with oxygen at a known temperature and ambient atmospheric pressure.

2.5.3.1. The temperature and conductivity of water used for calibration should be about the same as the temperature and conductivity of the water to be measured.

2.5.3.2. Place DO sensor and calibration water in a large beaker or open-mouth container.

2.5.3.3. Aerate the water for an adequate amount of time.

2.5.3.4. Determine if the water is 100 percent saturated with oxygen, and take a temperature reading. Temperature must be calibrated or verified for accuracy before DO calibration verification.

2.5.3.5. Use Table FT 1500-1 above to determine the DO saturation value at the measured water temperature. Compare DO meter reading with value obtained from Table FT 1500-1 to ensure continuous calibration.

2.6. Measuring DO in Samples:

2.6.1. Insert or place the DO probe *in situ* at a measuring location representative of the sampling source:

2.6.1.1. Take the DO of an effluent just before it enters the receiving water. If the effluent aerated prior to entering the surface water, take the DO reading in the receiving water right where it enters.

2.6.1.2. For well mixed surface waters, e.g., fast flowing streams, take the DO reading at approximately 1-2 feet below the surface or at mid-depth.

2.6.1.3. For still or sluggish surface waters, take a reading at one foot below the surface, one foot above the bottom, and at mid-depth.

2.6.1.4. If it is shallow surface waters, (less than two feet) take the reading at mid-depth.

2.6.1.5. Do not take a reading in frothy or aerated water unless required by the sampling plan.

2.6.1.6. Groundwater samples must be measured *in situ* with a downhole probe or in a flow-through container. Do not measure bailed or pumped samples in an intermediate container containing static sample.

2.6.2. Rinse probe with de-ionized water and keep the probe in the saturated atmosphere (see 2.1.2 above) between sites and events.

2.6.3. If the readings show distinct, unexplainable changes in DO levels, or when the probe has been in waters with high sulfides, recalibrate or perform maintenance per manufacturer's instructions. While taking a reading, if it is very low (e.g., below 1.0 mg/L), allow the meter to stabilize, record it and then, remove and rinse the probe, as the environment is very likely anoxic and may contain hydrogen sulfide, which can damage the probe.

2.6.4. Salinity and Temperature corrections may be necessary. Follow manufacturer instructions for automatic corrections or perform manual calculations (SM 4500-O G).

3. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for verifications.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

4.1.1.1. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for pre-formulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

4.1.4.1. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record the manufacturer name, model number and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the temperature associated with all calibration verifications.

4.2.6. Record the name of the analyst(s) performing the calibration.

4.2.7. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., saturation)
- Value of standard, including correct units (e.g., mg/L at ^{o}C)
- Link to information recorded according to section 4.1 above

4.2.8. Retain manufacturers' instrument specifications.

4.2.9. Document whether successful initial calibration occurred.

4.2.10. Document whether each calibration verification passed or failed.

4.2.11. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.11.1. Document the date and time of any corrective action.

4.2.11.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.12. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

Appendix FT 1500
Tables, Figures and Forms

Table FT 1500-1 Solubility of Oxygen in Water

Table FT 1500-1: Solubility of Oxygen in Water at Atmospheric Pressure[1,2]			
Temperature °C	Oxygen Solubility mg/L	Temperature °C	Oxygen Solubility 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		

1. The table provides three decimal places to aid interpolation

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

FT 1600. Field Measurement of Turbidity

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. INTRODUCTION: Turbidity measures the scattering effect that suspended solids have on the propagation of light through a body of water (surface or ground waters). The higher the effect (i.e., intensity of scattered light), the higher the turbidity value. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms cause turbidity in water.

This SOP describes the use of true nephelometric measurement using instruments meeting the specifications outlined in 2.1.

Exceptions to the requirements specified in 2.1 below include:

1.1. *In situ* probes with turbidity sensors used for screening purposes (e.g., groundwater purge stabilization measurements).

1.2. Non standard light sources, detectors or other turbidity measuring devices may be proposed for use in studies that entail comparison measurements (dredge and fill) or unattended deployment for monitoring purposes.

1.3. **Do not report results from "non standard" sensors or configurations for regulatory purposes such as permit compliance unless the Department has approved the use for the specific project.**

1.4. All "non standard" instrument must be calibrated/check according to the principles outlined in this SOP.

2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Use a turbidimeter (nephelometer) or a spectrophotometer consisting of a light source and one or more photoelectric detectors with a readout device to indicate the intensity of light. The instrument must meet these specifications:

2.1.1. The light source must have a tungsten-filament lamp operated at a color temperature between 2000 and 3000 K.

2.1.2. The distance traversed by the incident light and scattered light within the sample tube must not exceed 10 cm.

2.1.3. The light detector, positioned at 90° to the incident light, must have an acceptance angle that does not exceed $\pm$ 30° from 90°.

2.1.4. The detector and any filter system must have a spectral peak response between 400 and 600 nanometers.

2.1.5. The instrument sensitivity must permit detection of a turbidity difference of 0.02 NTU at the 0 – 1.0 NTU scale.

2.1.6. Note: using the appropriate equipment and following the procedures in this SOP, the field accuracy of this measurement is close to %R = 100 ± 10% for turbidities in the range of 1 to 100 NTU.

2.2. Sample Cells (cuvettes): Use sample cells or tubes of clear, colorless glass or plastic.

2.2.1. Keep cells clean, both inside and out, and discard if scratched or etched.

2.2.1.1. Never handle them where the light beam strikes the sample.

2.2.1.2. Clean sample cells by thorough washing with laboratory soap (inside and out) followed by multiple rinses with distilled or de-ionized water, and let air-dry.

2.2.2. Use a very thin layer of silicone oil on the outside surfaces to mask minor imperfections or scratches in the cells.

2.2.2.1. Use silicone oil with the same refractive index of the glass; making sure the cell appear to be nearly dry with little or no visible signs of oil.

2.2.3. Because small differences between cells significantly impact measurement, use either matched pairs or the same cell for standardization and sample measurement.

2.3. Standards:

2.3.1. Primary standards: Use these standards for initial calibration.

2.3.1.1. Formazin standards can be either obtained commercially or prepared according to method SM 2130B, section 3.b. See *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, American Water Works Association, Water Pollution Control Federation).

2.3.1.2. Some instruments may require the use of styrene divinylbenzene (SDVB) standards for calibration.

2.3.2. Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards must only be used for continuing calibration verifications according to the procedures in section 3.4 below. Determine or verify the values of secondary standards according to the procedure in section 3.3 below.

2.3.3. Turbidity-free water: Use filtered, laboratory reagent water demonstrated to be free of measurable turbidity (<0.01 NTU) or purchase commercially prepared turbidity-free water.

3. Calibration and Use

3.1. General Concerns

3.1.1. Light absorption by dissolved and suspended matter may cause a negative bias on the turbidity measurement. When present in significant concentrations, particles of light-absorbing materials such as activated carbon will cause a negative interference. Likewise, the presence of dissolved, color-causing substances that absorb light may also cause a negative interference. Some commercial instruments may have the capability of either correcting for slight color interference or optically blanking out the color effect.

3.1.2. Handle samples with natural effervescence as described in 3.5.5.1 below.

3.2. Calibration and Initial Calibration Verification

3.2.1. Follow the calibration activities in FT 1000, section 2.2.

3.2.2. Perform an initial calibration using at least two primary standards.

3.2.2.1. If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard per 3.2.3 below.

3.2.2.2. For measurement of samples of very low turbidity, select the lowest standard commercially available for bracketing the lower end of the anticipated sample turbidity range or dilute higher turbidity standards with turbidity-free water.

3.2.2.3. Do not use turbidity-free water as a calibration verification standard.

3.2.3. Perform an initial calibration verification by reading at least one primary standard as a sample. The acceptance criterion for the initial calibration verification depends on the range of turbidity of the standard value:

- Standard Value = 0.1-10 NTU: the response must be within 10% of the standard;
- Standard Value = 11-40 NTU: the response must be within 8% of the standard;
- Standard Value = 41-100 NTU: the response must be within 6.5% of the standard; and
- Standard Value > 100 NTU: the response must be within 5% of the standard.

3.3. Determining the Values of Secondary Standards

3.3.1. Use only those standards certified by the manufacturer for a specific instrument.

3.3.2. Use verified secondary standards only for continuing calibration verifications.

3.3.3. Determining the initial value(s) of secondary standard(s):

3.3.3.1. Calibrate or verify the instrument with primary standards. Select primary standards that bracket the range of the secondary standards.

3.3.3.2. Immediately after the an initial calibration with primary standards or verification with a primary standard, read each secondary standard as a sample use the reading from the instrument as the first assigned value.

3.3.4. Verifying Secondary Standards

3.3.4.1. At least once per quarter or at other documented intervals (see 3.3.5 below), determine or verify the values of secondary standards immediately after the instrument has been calibrated or verified with primary standards.

3.3.4.2. Read each secondary standard as a sample. This reading must be within the manufacturer's stated tolerance range and within the acceptance ranges of the assigned standard value as listed in 3.2.3., above. If the criteria in section 3.2.3., above are 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.

3.3.5. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3.4. Continuing Calibration Verification: Perform a continuing calibration verification using at least one primary or secondary standard. The calibration acceptance criteria are the same as those listed in section 3.2.3 above.

3.5. Measuring Turbidity in Samples

3.5.1. Gently agitate the sample and wait until air bubbles disappear.

3.5.2. Double-rinse the sample cell or cuvette with a small amount of the sample. Discard, and pour an aliquot into the sample cell or cuvette.

3.5.3. Gently dry out its external surface with lint-free paper.

3.5.4. Insert the cell in the instrument and read the turbidity directly from the meter display.

3.5.5. Do not use vacuum degassing, ultrasonic bath or other devices to remove bubbles from the sample. If the sample contains visible bubbles or if it effervesces (as in groundwater, with changes in pressure and temperature), make a note of this in the field records and collect a sample for laboratory measurement.

3.5.5.1. If effervescing samples are collected for laboratory analysis collect the sample without leaving headspace in the container and ship it as soon as possible to the laboratory (the holding time for this measurement is only 48 hrs). Ship this sample in wet ice at 4°C.

3.5.6. Pour out the sample, double-rinse the cuvette with de-ionized water in preparation for the next sample.

4. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

5. DOCUMENTATION

5.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

5.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

5.1.1.1. Document acceptable verification of any standard used after its expiration date.

5.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

5.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

5.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

5.1.3. Record the grade of standard or reagent used.

5.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

5.1.4.1. Record the date of preparation for all in-house formulations.

5.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

5.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

5.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

5.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

5.2.2.1. Record manufacturer name, model number, and identifying number (such as a serial number) for each instrument unit.

5.2.3. Record the time and date of all initial calibrations and all calibration verifications.

5.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

5.2.5. Record the name of the analyst(s) performing the calibration.

5.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., formazin)
- Value of standard, including correct units (e.g., 20 NTU)
- Link to information recorded according to section 5.1 above

5.2.7. Retain manufacturers' instrument specifications.

5.2.8. Document whether successful initial calibration occurred.

5.2.9. Document whether each calibration verification passed or failed.

5.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

5.2.10.1. Document date and time of any corrective action.

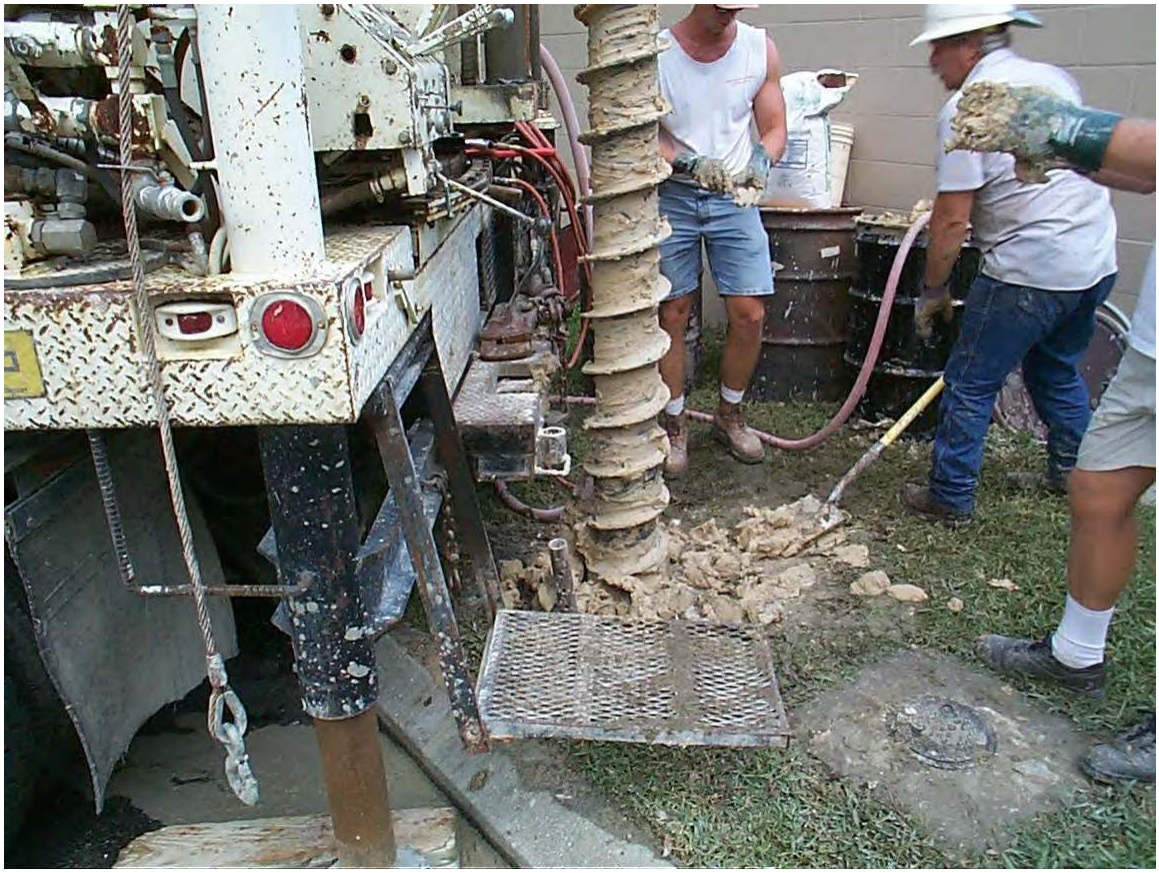
5.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

5.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

5.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

Monitoring Well Design and Construction Guidance Manual



Florida Department of Environmental Protection
Bureau of Water Facilities Regulation
2008

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Monitoring Well Design and Construction Guidance Manual

1.0 Introduction

1.1 Purpose

This guidance manual provides the protocols and recommended procedures for the proper design and construction of monitoring wells such that quality ground water samples representative of actual conditions can be collected. A properly designed, installed and developed ground water monitoring well provides ground water samples that exhibit the physical and chemical properties of that portion of the aquifer screened by the well.

1.2 Planning

Each monitoring well within a network requires a design that considers project objective, site geology, hydrology, site history, waste site operational history (if applicable), ground water quality, and anticipated contaminants of concern. Prior to monitoring well design and installation, development of a conceptual hydrogeologic framework that identifies potential flow path and the target monitoring zone(s) is necessary. The following site characterization data elements should be utilized to form a conceptual model of the site:

1) Site geology and hydrology;

2) Potential contaminant sources, properties, and distribution;

3) Release mechanism and rates;

4) Fate and transport processes;

5) Current and potential receptors;

6) Potential remedial options; and

7) Other available site characterization data.

1.3 Design Considerations

The design and installation of monitoring wells should consider 1) permanence, 2) installation methodology, and 3) well construction requirements. Many factors

must be considered when evaluating each of these three components, utilizing only the most reliable data and information. Monitoring requirements and project timeline and objectives will, in part, determine the need for temporary and/or permanent wells. Site conditions, geological and hydrological settings will influence the types of required drilling method, installation procedures and well construction characteristics. When designing monitoring wells, the U.S. Environmental Protection Agency (USEPA) document, *Environmental Investigations Standard Operating Procedure and Quality Assurance Manual*, Section 6, (2001), recommends the following considerations:

1) Short- and long-term objectives,

2) Purpose(s) of the well(s),

3) Probable duration of the monitoring program,

4) Contaminants likely to be monitored,

5) Types of well construction materials to be used,

6) Surface and subsurface geologic conditions,

7) Properties of the aquifer(s) to be monitored,

8) Well screen placement,

9) General site conditions, and

10) Potential site health and safety hazards.

A ground water monitoring and well installation plan can be developed from these data and information. The plan should address all phases of the installation and monitoring program, including site access, health and safety, drilling techniques, decontamination protocol, well installation, well development, well abandonment, sample collection, waste management, and site surveys.

2.0 Drilling Operations

A driller, water well contractor or water well consultant should ensure that all materials and equipment for drilling and installing any given well are available and onsite prior to commencing drilling activities. For long schedules, it should be ensured that the above-mentioned materials needed for at least 2 days of operation are onsite prior to drilling. Site-specific factors that preclude the availability of needed secure storage areas should be identified and resolved in a ground water monitoring plan.

2.1 Logistics

2.1.1 Permitting, Licenses and Registration

The driller, water well contractor, and/or water well consultant is responsible for identifying all applicable permits, licenses, professional registration, rights-of-entry, and applicable State and local regulatory procedures for drilling, well installation, and well abandonment (to include any requirements for the submission of well logs, samples, etc). Acquisition and submittal of these items to State or local authorities should be coordinated between the driller, contactor, and/or consultant, with the responsibilities of each specified in a ground water monitoring plan and subcontract agreements.

2.1.2 Access and Security

The need for any rights-of-entry should be specified in a ground water monitoring plan along with the organization(s) responsible for their acquisition. The driller or water well contractor shall comply with all security policies at a project site. The driller is responsible for securing his own equipment, and should prepare for any special situations identified in a ground water monitoring plan.

2.1.3 Site Safety

Safety precautions should be implemented for any drilling operation and in particular for activities related to the investigation and monitoring of hazardous and potentially hazardous materials sites. When appropriate, a site health and safety plan should be developed and followed during all drilling activities. The driller or designated safety person should be responsible for the safety of the drilling team during all drilling activities. All personnel involved with drilling activities should be qualified in proper drilling and safety procedures. Guidance related to drilling activities is available in Occupational Safety and Health Administration (OSHA) documents, particularly 29 CFR 1910.120 and 29, CFR 1926.

2.1.4 Site Preparation, Well Installation and Restoration

2.1.4.1 Site Reconnaissance

Site visits should be made prior to drilling activities to evaluate physical conditions and equipment and logistical requirements. Particular interests include site access, proximal utilities, barriers and hindrances to movement of equipment, potential hazards, and geographical locations of support facilities (i.e., drilling supplies, drilling water, sample shipment facilities, and emergency facilities). Site modifications and adaptations to drilling plans should be made accordingly and as is practical.

2.1.4.2 Utility Clearances

Prior to drilling or excavation activities, the driller, water well contractor, water well consultant, or appropriate person must coordinate with the appropriate utility locator services to identify and locate all underground utilities and other subsurface features that could obstruct or be damaged by such activities. Digging permits may be required and a locator service given notice to allow adequate time to locate and mark utilities prior to any onsite operations. Overhead utilities and structures should also be considered with respect to clearance space required by the drilling equipment.

As appropriate, boreholes should be advanced to a minimum of two to three feet below land surface (or more as required or needed) with a hand auger or post hole digger. The diameter of the manually advanced borehole should be at least as wide as the largest auger or other equipment to be placed within the borehole.

2.1.4.3 Equipment

The driller should arrive at the site with all the necessary personnel, supplies, and equipment to complete the specified tasks described in Chapter 3.0, Well Design and Material Specifications. All equipment must have been properly inspected, serviced, maintained, and tested prior to relocation to the site to ensure that it is in proper working condition, and to minimize the potential for delays. Sufficient replacement or repair equipment and supplies shall be kept on hand or readily available in the event of mechanical failures or malfunctions.

2.1.4.4 Borehole Requirements

The borehole shall be drilled and constructed so as to 1) allow for the proper construction of the monitoring well, 2) properly monitor the parameters of interest and 3) meet the objectives of the ground water monitoring program. Generally, monitored parameters occur in ground water as aqueous (those dissolved in the ground water) non-aqueous phase liquids (NAPLS) and particulate matter (colloid-sized particles that may be inert or biologically active. The borehole must

allow for the proper placement of the well screen so as to allow for monitoring of parameters based upon chemical and physical characteristics.

The borehole shall be drilled as close to vertical as possible. Slanted boreholes are not acceptable unless specified in the design. The depth and volume of the borehole, including any overdrilling if applicable, should be calculated such that appropriate quantities of materials are procured and installed during well construction. Table A-1 Appendix A, provides several typical volume calculations for use during boring and well installation. If the well boring is drilled too deeply, it should be backfilled to the desired installation depth with pure bentonite pellets (for fine-grained aquifers) or filter sand (for coarse-grained aquifers). If bentonite pellets are used, a minimum of 1 foot of filter sand should be placed above the bentonite prior to screen installation. This will protect the bottom of the well screen from bentonite intrusion.

The selected hollow-stem augers, temporary casing, or permanent surface casing should have an inside diameter (I.D.) sufficient to allow the installation of the prescribed diameter screen and well riser plus annular space for a tremie pipe through which to place the filter pack and annular sealants. It is advantageous that the I.D. of the drill casing or hollow-stem auger be at least 4 inches greater than the outside diameter (O.D.) of the centered well riser and screen. This increased borehole size will allow placement of a wider filter pack, annular seal, and annular grout. This will also allow the use of a 1.5-inch O.D. tremie pipe for emplacing well construction materials. However, larger diameter augers will also result in additional drilling time, increased cost of well installation, and increased production of investigations-derived waste (IDW), including drill cuttings and fluids removed from the borehole and monitoring well. Depending upon the project objectives and regulatory requirements, the advantages must be weighed against the disadvantages such that the project objectives are met with the minimum cost incurred.

When telescoping outer casings (one casing within another), the specified annulus may not be practical or functional. In this case, a lesser spacing allowing for proper grout placement may be acceptable, depending on site specifics and project objectives.

A separate pilot boring should be advanced if significant drilling beyond the desired screen interval(s) is required (as for defining stratigraphy or locating a zone of interest). Upon completion of the exploration, the pilot boring should be properly abandoned and a new boring advanced for the placement of a monitoring well. ASTM Standard D5299 provides guidance for abandonment of boreholes and ground water wells.

2.1.4.5 Well Installation Schedule

Ideally, well installation should begin immediately after boring completion. Once installation has begun, no breaks in the installation process should be made until the well has been grouted and temporary drill casing removed. This includes interruptions due to the end of the driller's work shift, weekend, or holiday. This does not include the time required for proper hydration of the bentonite seal.

Unscheduled delays may occur, including personal injury, equipment breakdowns, or sudden inclement weather. Scheduled delays may also occur such as the time required for downhole geophysical surveys. In such cases, the type of delay, beginning and ending times of the delay, and the delay interval should be noted on a well construction diagram (Section 3.2). In instances where a cased hole into bedrock is to be partially developed prior to well insertion, well installation should begin within 12 hours after this initial development.

Temporary casing and hollow-stem augers may be withdrawn from the boring prior to well installation if the potential for cross-contamination is not likely and if the borehole wall will not slough during the time required for well installation. This procedure is usually successful in firm clays and in bedrock that is not intensely fractured or highly weathered.

Any materials, especially soils, blocking the bottom of the drill casing or hollow-stem auger should be dislodged and removed from the casing prior to well insertion. The use of a bottom plug, dove-tail bit, or internal drill rods during drilling may be beneficial for reducing and/or eliminating soil blocking and heaving sands. If used, the composition of any disposable bottom plug (such as stainless steel or wooden plug) must be appropriate considering the analytical parameters of interest.

2.1.4.6 Restoration

All work areas around the wells and/or borings should be restored to a condition equivalent to that prior to installation. This includes the disposal of borehole cuttings and rut repair. IDW, i.e., borehole cuttings, discarded samples, drilling fluids, equipment cleaning residue, water removed from a well during installation, development, or aquifer testing, and personal protection equipment (PPE) must be disposed of in a manner consistent with a waste management plan and all applicable Federal, State, and local regulations and ordinances. Restoration, disposal procedures, and responsibilities should be discussed in detail in a ground water monitoring plan.

2.2 Oversight

A site geologist, engineer or geotechnical engineer, suitably qualified to conduct hydrogeologic investigations should be present at each operating drill rig. The site geologist, engineer or geotechnical engineer must be familiar with all State,

Federal, and local laws, regulations, and requirements pertaining to the geologist's, engineer's or geotechnical engineer's duties and responsibilities. The geologist, engineer or geotechnical engineer shall be responsible for logging, acquisition, and shipment of samples, boring logs and well construction diagrams, and recording the well installation and abandonment procedures. Ideally, each site geologist, engineer or geotechnical engineer should be responsible for only one operating rig. The geologist, engineer or geotechnical engineer should have onsite sufficient tools, forms, and professional equipment in operable condition to efficiently perform the duties as outlined in this manual or other relevant project documents.

2.3 Drilling Methodology

2.3.1 Objectives

The objectives of selecting a drilling method for monitoring well installation are to use that technique which:

1) Provides representative data and samples consistent with project objectives;

2) Eliminates or minimizes the potential for subsurface contamination and/or cross-contamination; and

3) Minimizes drilling costs.

2.3.2 Methods

There are several drilling methods that can be used for site characterization and to install acceptable monitoring wells. Additional information and details on the various drilling methods can be found in Driscoll (1986), U.S. Army Corp of Engineers (USCOE) (1998), National Ground Water Association (1998) and Section 6.3 of the EPA manual, as well as numerous other sources. In addition, ASTM International maintains standards, ASTM D6286 and ASTM D5092, for selection of drilling methods for site characterization and the design and installation of ground water monitoring wells, respectively, as well as method-specific standards for many drilling techniques. The following drilling methods are most typically used in the installation of monitoring wells:

1) Hollow-stem augers;

2) Solid-stem augers;

3) Water/mud rotary;

4) Air/pneumatic rotary;

5) Sonic;

6) Direct Push; and

7) Casing or cable

The drilling method must be specified and described in a ground water monitoring plan. The plan should also contain detailed rationale for the selection of the specified method including, but not limited to, how the anticipated drilling conditions are accounted for by the selected method and how cross-contamination would be minimized.

2.3.3 Concerns Related to Drilling Methodology

Dry methods: Dry methods advance a boring using purely mechanical means without the aid of an aqueous or pneumatic drilling "fluid" for cuttings removal, bit cooling, or borehole stabilization. In this way, the chemical interaction with the subsurface is minimized, though not eliminated. Local aeration and heating of the borehole wall, for example, may occur simply by the removal of compacted or confining soil or rock (USCOE, 1998).

Aqueous methods: Aqueous drilling methods use fluid, usually either approved water or water and bentonite slurry, for cuttings removal, bit cooling, and borehole stabilization (USCOE, 1998). For environmental work, the use of these materials increases the potential to add a new contaminant or suite of contaminants to the subsurface environment adjacent to the boring. Even the removal of one or more volumes of water equal to the volume lost during drilling will not remove all of the lost fluid. The level of effort to be expended upon well development is directly related to the amount of fluid lost during drilling: a minimum of five times the volume lost should be removed during development. Therefore, the less fluid loss, the less the development effort, time, and cost.

Air/Pneumatic Rotary methods: Air/pneumatic rotary methods involve the use of compressed air to evacuate cuttings. Potential problems with this method include the introduction of pollutants such as hydrocarbons into the subsurface from the compressed air source, volatilization/stripping of contaminants from the subsurface, and mobilization of dust and/or vapor phase components to create a potential breathing hazard. However, this method may be advantageous in materials where circulation of other fluids cannot be maintained. Appropriate dust collection/suppression equipment must be provided. Wells installed using this method must be developed until the water becomes clear and free of sediment.

Sonic methods: The fundamental difference between the sonic drilling method and other rotary-type methods is that it employs a combination of rotation and high-frequency vibration for drill bit penetration. This method is suitable for use

in either consolidated or unconsolidated materials. The advantages of this technology are rapid drilling rates and relatively minimal amounts of waste generated. Disadvantages include potential disturbance to samples collected for geotechnical analyses and volatilization of chemical samples.

Direct push Technologies: Direct push technologies (DPT) utilize equipment that push or drive steel rods into the ground. They allow cost-effective, rapid sampling and data collection from unconsolidated soils and sediments. A tremendous variety of equipment is available, particularly in the type of attachments used at the end of rods to collect samples and data. These attachments may collect soil, soil gas, or ground water samples; they may conduct *in situ* analysis of contaminants; or they may collect geophysical data that are continuously logged as the DPT rods are advanced. Continuous logs of subsurface conditions are particularly valuable because they help to develop a three-dimensional conceptual site model.

Tables 1 and 2 provide a brief description and comparison of some common drilling methods.

Table 1: Drilling Methods for Monitoring Wells

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Auger, Hollow-Stem and Solid-Stem ASTM D5784, ASTM D1452	Successive 5-foot (1.5m) flights of spiral-shaped drill stem are rotated into the ground to create a borehole. Cuttings are brought to the surface by the rotation of the auger flights	150 (45)	• May be inexpensive • Fairly simple, quick setup time and moderately fast operation • Rigs are highly mobile and can reach most drilling sites • No drilling fluid or lubricants used, eliminating contamination from additives • Can be used to avoid hole caving • Hollow-stem allows formation water to be sampled during drilling via screened auger or advancing a well point ahead of the augers • Small-diameter wells can be built inside hollow-stem flights • Hollow-stem allows the collection of split-spoon samples, continuous sampling possible • Natural gamma-ray logging can be done inside hollow-stem flights	• Limited to unconsolidated or semiconsolidated (weathered rock) materials Compact, gravelly materials may be hard to penetrate • Possible problems controlling heaving sands • Rips and smears borehole wall, creating problems with connecting to the aquifer during well development • Well points yields low rates of water • Small diameter well screen may be hard to develop. Screen may become clogged if thick clays are penetrated • May not be able to run a complete suite of geophysical logs

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Water/Mud Rotary (Hydraulic Rotary) ASTM D5783	Rotating bit breaks formation; cuttings are brought to the surface by a circulation fluid (mud). Mud (which should be contaminant-free water and bentonite without additives) is forced down the interior of the drill stem, out the bit, and up the annulus between the drill stem and borehole wall. Cuttings are removed by settling in a mud pit at the ground surface and the mud is circulated back down the drill stem.	5,000+ (1,500+)	• Drilling is fairly rapid in all types of geologic materials, unconsolidated and consolidated • Borehole may stay open from formation of a mud wall on the sides of borehole by the circulating mud • Geologic cores can be collected • A complete suite of geophysical logs can be obtained in the open borehole • Many options for well construction. Can use casing-advancement drilling method, or casing may not be required • Smaller rigs can reach most drilling sites • Borehole can be gravel packed and easily grouted	• May be expensive, requires experienced driller and a fair amount of peripheral equipment; overburden casing required • Drilling fluids mix with formation water, may contaminate and can be difficult to remove. • Completed well may be difficult to develop, especially small diameter wells, due to mud cake invading the formation and is difficult to remove • Geological logging by visual inspection is only fair, can miss strata and composition • Location of water-bearing zones during drilling may be difficult to detect • Drilling fluid circulation is often lost and difficult to maintain in fractured rock, and gravel or cavernous zones • Difficult drilling in boulder and cobble zones • Circulation of drilling mud through a contaminated zone can create a hazard a ground surface and cross-contaminate clean zones • Organic drilling fluids can interfere with bacterial and/or organic-related analyses and are not allowed; bentonitic fluids with metal analyses, but may be necessary.

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Reverse Rotary ASTM D5781	Similar to hydraulic rotary, except the drilling fluid is circulated down the borehole outside the drill stem and is pumped up the inside; the reverse of the usual rotary method. Water is used as the drilling fluid and the borehole is kept open by the hydrostatic pressure of the water standing in the borehole.	5,000+ (1,500+)	• Drilling is readily accomplished in most geologic materials, unconsolidated and consolidated • Drilling is relatively fast and can be used for drilling large diameter boreholes • Large borehole diameter facilitates ease of well installation • Geophysical logs can be run prior to installation of well • Creates a “clean” borehole, not contaminated by introduced fluids • Split-spoon sampling possible	• May be expensive, requires experienced driller and a fair amount of peripheral equipment; overburden casing required • May be difficult to drill in boulder, cobble or cavernous zones • The addition of drilling lubricants may be required: lubricants interfere with borehole wall composition and water chemistry • Cross-contamination from circulating water is likely • A large water supply is needed to maintain hydrostatic pressure in deep holes and when highly conductive formations are encountered • Geologic samples brought to surface are generally of poor quality; fine-grained materials are washed out
Air Rotary ASTM D5782	Similar to hydraulic rotary. Air is used as the primary drilling “fluid” as opposed to mud or water	5,000+ (1,500+)	• Can be used in all geologic formations; most successfully in highly fractured environments • Useful at almost any depth • Drilling rates are usually fast • Can use the casing-advancement method • Drilling mud or water is not required • Borehole is accessible to geophysical logging prior to well installation • Geologic sampling is excellent in hard, dry formations • First water zone easily detected • Well development is relatively easy	• Relatively expensive, requires experienced drill crew • Overburden casing usually required • Air mixes with borehole water and blown from the hole, creating potential for cross-contamination, surface contamination, health and environmental risks • Water flow between zones with different hydrostatic pressures will occur between the time that drilling is completed and the hole is properly cases and grouted • Compressor discharge to air may contain hydrocarbons • Organic foam additives to aid cuttings removals may cause cross contamination

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Air-Percussion Rotary or Down-the-Hole Hammer (DTH) ASTM D5781	Air rotary with a reciprocating hammer connecting to the bit used to fracture rock.	600 (2,00)	• Very fast drill rates • Useful in all geologic formations • Only small amounts of water need for dust and bit temperature control • Cross-contamination potential can be reduced by driving casing • Can use casing-advancement method • Well development relatively easy	• Relatively expensive • As with most hydraulic rotary methods, the rig is large, heavy and has limited accessibility • Overburden casing usually required • Vertical mixing of water and air craters cross contamination potential • Hazard posed to surface environment if toxic compounds are encountered • DTH hammer drilling can cause hydraulic fracturing of borehole wall • The DTH hammer required lubrication during drilling • Organic foam additives for cuttings removal may contaminate samples
Sonic (Vibratory) ASTM D6914	Uses high-frequency mechanical vibration to take continuous core samples of overburden soils and most hard rocks.	500 (150)	• Can obtain large diameter, continuous and relatively undisturbed cores of almost any soil material without the use of drilling fluids • Can drill through boulders, wood, concrete and other construction debris • Can drill and sample most softer rock with a high percentage of core recovery • Drill rates are faster than most other methods • Large reduction of investigation-derived wastes	• Relatively expensive • Equipment is not readily available • Rock drilling requires the addition of water or air or both to remove drill cuttings • Extraction of casing can smear borehole wall with clays and silts • Extraction of casing can damage well screen

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Direct Push ASTM D6724, ASTM D6725	Advances a sampling device into the subsurface by applying static pressure, impacts, or vibrations or any combination thereof to the above ground portion of the sampler extensions until the samples has been advanced its full length into the soil strata.	100 (30)	• Avoids use of drilling fluids and lubricants during drilling • Equipment is highly mobile • Disturbance of geochemical conditions during installation is minimized • Drilling and well screen installation is fast, considerably less labor intensive • Does not produce drill cuttings, reduction of investigation-derived wastes	• Limited to fairly soft materials such as clay, silt, sand and gravel • Compact, gravelly materials may be hard to penetrate • Small diameter well screen may be hard to develop. Screen may become clogged if thick clays are penetrated • The small diameter drive pipe generally precluded conventional borehole geophysical logging • The drive points yield relatively low rates of water
Cable-Tool (Percussion) ASTM D5875, ASTM D5872	Borehole is created by dropping a heavy "string" of drill tools into well bore, crushing materials at the bottom. Cuttings are removed occasionally by bailer. Generally, casing is driven just ahead of the bottom of the hole; a hole greater than 6 inches in diameter is usually made	1,000+ (300+)	• Can be used in consolidated and unconsolidated formations • Can drill boulder, cobble, fractured and cavernous zones • Fairly accurate logs can be made from cuttings if collected often enough • Core samples easily obtained • Driving casing ahead of hole minimizes cross-contamination via vertical leakage of formation waters, maintains borehole stability • Excellent method for drilling in soils and rock where loss of circulation fluids is problematic • Recovery of borehole fluid samples excellent • Excellent method for detecting thin water-bearing zones • Excellent for well development	• The potential for cross-contamination of samples is very high • Steel casing must be used • Heavy steel drive pipe and drilling "tools" can limit accessibility • Heavier wall, larger diameter casing than that used for other drilling methods normally used • Cannot run a complete suite of geophysical logs due to the presence of the drive pipe • Temporary casing can cause problems with placement of effective filter pack and grout seal • Usually a screen must be set before a water sample can be collected • Heaving of unconsolidated sediment into bottom of casing can be problematic

Adapted from U.S. Army Corps of Engineers, November 1998

Table 2: Comparison of Drilling Methods

Drilling Method	Shallow and Intermediate Boreholes	Deep Boreholes	Water Sampling	Soil Sampling	Well Installation	Boulders and other obstructions	Control of Hydrostatic Pressure	Downhole Geophysics
Hollow-Stem Auger	E	P	E	E	E	P	F	L
Solid-Stem Auger	E	P	NA	NA	F	P	P	NA
Water/ Mud Rotary	E	E	P	P	F	G	E	E
Reverse Rotary	E	E	P	P	F	P	E	E
Air Rotary	E	E	P	P	F	G	P	P
Sonic	E	G	E	E	E	E	E	E
Direct Push	E	F	E	E	G	L	E	L
Cable-Tool (Cased Boring)	E	F	E	E	E	G	E	L

Notes:
E = Excellent
G = Good
F = Fair
P = Poor
L = Limited application
NA = Not applicable

2.3.4 Special Concerns

2.3.4.1 Recirculation Tanks and Sumps

Portable recirculation tanks should be used for mud or water rotary operations and similar functions. The use of dug sumps or pits (lined or unlined) are expressly prohibited to minimize cross-contamination and to optimize both personal safety and work area restoration (USCOE, 1998).

2.3.4.2 Surface Runoff

Surface runoff, e.g., precipitation, wasted or spilled drilling fluid, and miscellaneous spills and leaks, should not enter any boring or well either during or after construction. To help avoid such entry, the use of temporary casing, recirculation tanks, berms around the borehole, or temporary surficial bentonite packs is recommended (USCOE, 1998).

2.3.4.2 Drilling Fluids

To the extent practical, the use of water during drilling, and any other water used during well installation and completion, should be held to a minimum. When use of water is deemed necessary, the source of any water used must be specified in the ground water monitoring plan and approved by the appropriate authority. The driller should have the responsibility to procure, transport, and store the approved water required for project needs in a manner that avoids the chemical contamination or degradation of the approved water once obtained.

If there is a suitable source of approved water onsite, the source should be used. If no onsite approved water is available, a potential source must be located and water quality evaluated and approved prior to the arrival of any drilling equipment onsite. It is important that the approved water be free of site-related analytes. It is advantageous that the drilling water be pretested (sampled and analyzed) for the contaminants of interest. Knowledge of the water chemistry is the most important factor for water quality approval. Surface water bodies must not be used as a water source.

Pure bentonite (no additives) is the only drilling fluid additive that is typically allowed under normal circumstances. This includes any form of bentonite (powders, granules, or pellets) intended for drilling mud or sealants. The use of any bentonite shall be adequately discussed in the ground water monitoring plan, including documentation of the manufacturer’s recommendations and product constituents. Bentonite shall only be used if absolutely necessary to ensure that the borehole will not collapse or to improve cuttings removal (USCOE, 1998).

2.4 Decontamination

ASTM Standard D5088 provides guidance for decontamination of field equipment. All drilling equipment that is utilized in drilling or sampling activities must be cleaned or washed with high pressure hot water and decontaminated prior to arriving at the site or at the designated decontamination area before entering the site. This includes drilling rigs, support vehicles, water tanks (inside and out), augers, drill casings, rods, samples, tools, and recirculation tanks. The initial cleaning must be adequate to remove all rust, soil, or other material that may have been transported from another site. Any downhole auguring, drilling, and sampling equipment with paint, rust, or scale that cannot be removed by pressure washing or steam cleaning must be sandblasted prior to arrival on site. All equipment shall be inspected prior to site entry to confirm that all seals and gaskets are intact; no fluids are leaking; and all oil, grease, and other fluids have been removed. No oils or grease may be used to lubricate drill rods or any other equipment being used above or in the borehole without specific approval from the site geologist, engineer or geotechnical engineer. Such approval must be recorded on the well construction form.

All drilling, sampling, and associated downhole equipment that contacts the sample medium shall be cleaned and decontaminated by the following procedures:

1) Clean with approved water, laboratory-grade, phosphate-free detergent, and brush to remove particulate matter and surface films. Steam cleaning or high pressure hot water washing may be used in lieu of, or in addition to, brushing. Equipment that is hollow or perforated to transmit water or drilling fluids must be cleaned inside and outside. The steam cleaner or high pressure hot water washer must be capable of generating a pressure of at least 2500 PSI and producing hot water or steam of at least 200 ° F;

2) Rinse thoroughly with approved water. Approved water may be applied with a pump sprayer. All other decontamination liquids must be applied with non-interfering containers made of glass, Teflon ®, or stainless steel. Rinsing operations will be inspected by the site geologist, engineer or geotechnical engineer prior to initiation of work;

3) Rinse thoroughly with approved decontamination water;

4) Unless otherwise specified, rinse twice with pesticide-grade isopropanol;

5) Rinse thoroughly with approved decontamination water and allow to air dry;

6) Any equipment that will be stored or transported must be wrapped in aluminum foil (or clean plastic if equipment has been air dried);

7) Any printing or writing on well casing, tremie pipe, etc., arriving on site must be removed with sandpaper or emery cloth prior to initial cleaning; and

8) Well casing, tremie pipe, or other materials constructed of plastic or polyvinyl chloride (PVC) must be solvent rinsed during the cleaning and decontamination process.

After the onsite cleaning, only the equipment used or soiled at a particular boring or well should need to be cleaned between each boring or well at a given project. Paint applied by the equipment manufacturer may not have to be removed from drilling equipment, depending upon the paint composition and its contact with the environment and contaminants of concern. All equipment must be decontaminated before it is removed from the project site. If drilling requires telescoping casing because of differing levels of contamination in subsurface strata, then decontamination may be necessary before setting each string of smaller casing and before drilling beyond any casing. To the extent practical, all cleaning should be performed in a single remote area that is surficially cross gradient or downgradient and downwind from the clean equipment drying area and from any sited to be sampled. Waste solids and water from the cleaning and decontamination process shall be properly collected and disposed, as discussed in Chapter 5.0, Management of Investigation-Derived Waste. This may require that cleaning be conducted on a concrete pad or other surface from which the waste materials may be collected.

2.5 Sampling and Coring

A sufficient number of soil or rock samples should be collected and evaluated by the site and/or project geologist. The purpose of this collection is to provide a sound basis for the design of the ground water monitoring system. A “sufficient number of samples” is dependent on project-specific objectives, and should be described in the ground water monitoring plan. Soil samples should be collected according to ASTM Standards D1452, D1586, D3550, or D1587, whichever is appropriate given the anticipated characteristics of the soil samples. Rock samples should be collected using ASTM Standard D2113. Additional guidance on both soil and rock sampling can be found in ASTM Standard D6169.

2.5.1 Soil Sampling

The primary purpose of collecting soil samples, other than for chemical analysis, is the characterization of the subsurface lithology and stratigraphy. Typically, intact soil samples for physical descriptions are collected every 5 feet (1.5

meters) or at each change of material, whichever occurs first. Alternate sampling plans, with supporting information, should be detailed in the ground water monitoring plan. Additionally, a sufficient number of representative samples of the intervals significant to well design and hydrogeologic characterization should be collected for physical analyses; these results should then be used to support well design. These samples should be representative of the geographic and geologic range of materials within the project area and should specifically include the screened interval of a representative number of wells. Samples should be obtained with driven (e.g., split spoon), pushed (e.g., thin-wall Shelby tube), or rotary (e.g., Dennison) type samplers. Borehole cuttings do not usually provide the desired information and, therefore, are not usually satisfactory. Sampling procedures should be detailed in the ground water monitoring plan. Lithological logging of samples should be recorded according to the procedures listed in Section 2.9. Disposition of samples should be in accordance with Chapter 5.0

2.5.2 Rock Coring

Bedrock should be cored unless the ground water monitoring plan specifies otherwise. Coring, using a diamond- or carbide-studded bit, produces a generally intact sample of the bedrock lithology, structure, and physical condition. The use of a gear-bit, tri-cone, etc., to penetrate bedrock should only be considered for the confirmation of the “top of rock” (where penetration is limited to a few feet), enlargement of a previously cored hole, or drilling of highly fractured intervals. Lithologic logging of the core should be conducted in accordance with Section 2.9, Documentation.

Rock cores should be retrieved and stored in such a way as to reflect natural conditions and relative stratigraphic position. Gaps in the core and intervals of lost core should be noted in the core sequence. Cores should be stored in covered core boxes to preserve their relative position by depth. Boxes should be marked on the cover (both inside and outside) and on the ends to provide project name, boring number, cored interval, and box number in cases of multiple boxes. Each box shall clearly denote the top and bottom of the rock core present in that box. Any core box known or suspected to contain contaminated core should be appropriately marked on the log and on the box cover, (inside and out), and on both ends. Storage of rock cores must be in accordance with the approved ground water monitoring plan, and disposition must be in accordance with Chapter 5.0.

If photographs of the core are taken, the core surface must be cleaned or peeled, as appropriate, and wetted. Photographs should be taken in color.

2.6 Drilling through Contaminated Zones

When drilling through contaminated strata to reach lower, possibly uncontaminated, strata, the potential for “drag down” of contamination should be minimized by drilling technique. In this procedure, an outer drill casing is set and sealed within an “impermeable” layer or at a level below which the underlying environment is thought to be “cleaner” than the overlying environment. The drill fluids used to reach this point are disposed of according to Chapter 5.0 and replaced by a fresh supply. This system can be repeated, resulting in telescopic drill casing through which the final well casing is placed. These situations should be specifically addressed in the ground water monitoring plan.

2.7 Drilling Fluid Loss and Removal

When a borehole, made with or without the use of drilling fluid, contains an excessively thick, particulate-laden fluid that would preclude or hinder the specified well installation, the borehole fluid should be removed. This removal should facilitate the proper placement of casing, screen, granular filter, and seal.

Note: Unless the borehole wall has been supported by casing, the wall is likely to partially or completely collapse during fluid removal. Therefore, when no casing is present the fluid must be removed with great caution and the condition of the borehole monitored. Fluid losses in this operation must be recorded on the well diagram or boring log and later on the well development record. Any fluid removal prior to well replacement should be contingent upon the site geologist, engineer or geotechnical engineer’s evaluation of hole stability (i.e. sufficient for the desired well and seal placement).

If large drilling fluid losses occur in bedrock, the drilling operator should remove some of this fluid loss prior to well insertion. The intent here is to allow the placement of a larger pump in the borehole than otherwise possible in the well casing, thereby reducing subsequent development time and removing the lost water closer to the time of the loss. Development of the completed well can then be reduced by a volume equal to that which was removed through the above procedure.

2.8 Abandonment

All soil borings not completed as wells must be abandoned in accordance with Chapter 7.0, Well and Boring Abandonment. In addition, wells that are deemed

to be unnecessary for continued site monitoring or remediation system performance or to be structurally unsound should be abandoned.

2.9 Documentation

2.9.1 General

Each boring log should fully describe the subsurface environment and the procedures used to gain that description. Unless otherwise specified in the ground water monitoring plan, a log shall be produced for every boring completed. The information in subsection 2.9.3, Routine Entries, is required on boring logs although not necessarily in the format illustrated. Example soil and rock parameters for logging are included in Tables B-1 and B-2, respectively.

2.9.2 Time of Recording

Boring logs should be recorded directly in the field without transcription from a field book or other document. This technique minimizes the chance of errors of manual copying and allows the completed document to be field-reviewed closer to the time of drilling.

2.9.3 Routine Entries

In addition to specific data required by the ground water monitoring plan, the following information should be routinely entered on the boring log:

1) Each boring and well (active and abandoned) should be uniquely numbered in accordance with an established well designation plan (discussed in Subsection 3.1.1);

2) Depths and heights (and reference to the appropriated datum) should be recorded in feet and decimal fractions (tenths of feet);

3) Field soil classification must be in accordance with the Unified Soil Classification System (USCS) or Standard D2487 and D2488, and shall be recorded in the field at the time of the sampling by the geologist. Such terms as “trace,” “some", “several,” must be consistent with the USCS or ASTM Standard D2488;

4) Each soil sample collected should be fully described on the log. Sample colors should be described using a Munsell soil and/or rock color chart. Samples should be described when wetted;

5) When used to supplement other sampling techniques, disturbed samples (e.g., wash samples, cuttings, and auger flight samples) should be described in terms of the appropriated soil/rock parameters

6) Rock cores should be fully described on the boring log. Sample colors should be described using a Munsell rock color chart. Samples should be described when wetted;

7) For rock core the log will include, denoting by depth, the location, orientation, and nature (natural or mechanical) of all core breaks. Also mark the breaks purposely made to fit the core into the core boxes. If fractures are too numerous to be individually shown, their location may be drawn as a zone and described on the log. Also note, by depth, the intervals of all lost core and hydrologically significant details. This sketch should be prepared at the time of core logging, concurrent with drilling;

8) All special problems and their resolution should be recorded in the field logbook, with appropriated entries on the log form. Examples of problems include, hole squeezing, recurring problems at a particular depth, sudden tool drops, excessive grout takes, drilling fluid losses, unrecovered tools in hole, and lost casings;

9) The dates and times for the start and completion of borings should be recorded on the log;

10) Each sequential boundary between the various soils and individual lithologies should be noted on the log by depth and elevation;

11) The depth of the first encountered free water should be indicated. Before proceeding, the first encountered water should be allowed to partially stabilize for a minimum of 5 to 10 minutes and recorded along with the time between measurements. It is important to note if the measured water level increases or decreases over time;

12) The purpose and interval by depth for each sample collected, classified, and/or retained should be noted on the log;

13) A record of the blow counts, hammer type and weight, and length of hammer fall for driven samplers should be made when standard penetration samplers are used. For thin-wall samplers, indicate whether the sampler was pushed or driven and the pressure/blow count per drive. Blow counts should be recorded in half-foot increments when standard penetrations samplers (1-⅜ inch I.D. X 2

inch O.D.) are used. For penetration less than a half-foot, annotate the count with the distance over which the count was taken. Blow counts, in addition to their engineering significance and classification purpose, may be useful for stratigraphic correlation;

14) When drilling fluid is used, a quantitative record in the field logbook should be maintained of fluid losses and/or gains and the interval over which they occur. Adjustment should be made for fluid losses due to spillage and intentional wasting (e.g., recirculation tank cleaning) to more closely estimate the amount of fluid lost to the subsurface environment. Losses should be noted by time and depth interval;

15) Record the total depth of drilling and sampling on the log;

16) Record significant color and viscosity changes in the drilling fluid return, even when intact soil samples or rock core are being obtained. Include the color/viscosity change, depth at which change occurred, and a lithologic description of the cuttings before and after the change;

17) Soil gas and breathing zone readings, if taken, should be recorded on the log. Each notation should include interval sampled and reading. When possible, a general note on the log should indicate meter manufacturer, model, serial number, and calibration material. If several meters are used, key the individual readings to the specific meter; and

18) Special abbreviations used on the log and/or well diagram should be defined where used.

2.9.4 Soil Boring Abandonment

For each soil boring, its final status (abandoned; converted to a monitoring well, etc.) should be recorded on the boring log form. If the boring is abandoned, the date(s) of abandonment and the abandonment method should be included. The boring abandonment procedures should comply with Chapter 7.0 of the manual.

2.9.5 Well Abandonment

For each abandoned monitoring well or piezometers, a record of the abandonment must be provided on the Well Abandonment Form. An example of this form is included in Appendix B. Well abandonment procedures should comply with Chapter 7.0 of the manual.

3.0 Well Design and Material Specifications

3.1 Well Design Specifications

This section describes the design specifications for the various monitoring well components. Figure 1, Single-Cased Monitoring Well Schematic Diagram, illustrates typical single-cased well components described in the following subsections. Well construction specifications for monitoring wells installed with conventional drill rigs are outlined in Sections 6.4 through 6.6 of the USEPA guidance document (USEPA, 2001) and for direct-push micro wells in the ASTM Standard 6725. Variations from standard practices should be based upon site, geologic, and hydraulic conditions and must be approved prior to installation by the appropriate regulatory authorities and must follow appropriate regulatory procedures. Persons with authority to address and grant variances should be identified in the ground water monitoring plan. Circumstances and factors leading to variances must be properly documented.

3.1.1 Well Designation

Each well at a site should have a unique label that distinguishes it from all other wells located at the installation. Prior to assigning a well label, all wells at the site should be checked to ensure no duplication. An example of a naming convention is given below:

Site:	Johnson Bulk Tank Farm No. 2
Well Number (Name):	JBTF-N2-MW01;
Where:	JBTF = Johnson Bulk Tank Farm N2 = Farm No. 2 MW01 = monitoring well 01

It is preferred that wells be labeled with an identification tag. A metal tag containing the well designation should be attached to the protective casing of each monitoring well. Figure 2 presents a diagram of a well identification tag. The following specification can be applied to the use and installation of well tags:

Specifications:

4”X4”X0.032” stainless steel or aluminum
3/16” lettering
1/8” diameter mounting holes
black printed or stamped lettering

Printing:

A printing press can be used to complete as much information as possible before mobilizing to the site. Required information to be included in on a tag is shown in Figure 2. Information that is not available at the time of printing must be hand stamped in the field.

Figure 1: Typical Monitor Well Construction, Single-Cased Monitor Well

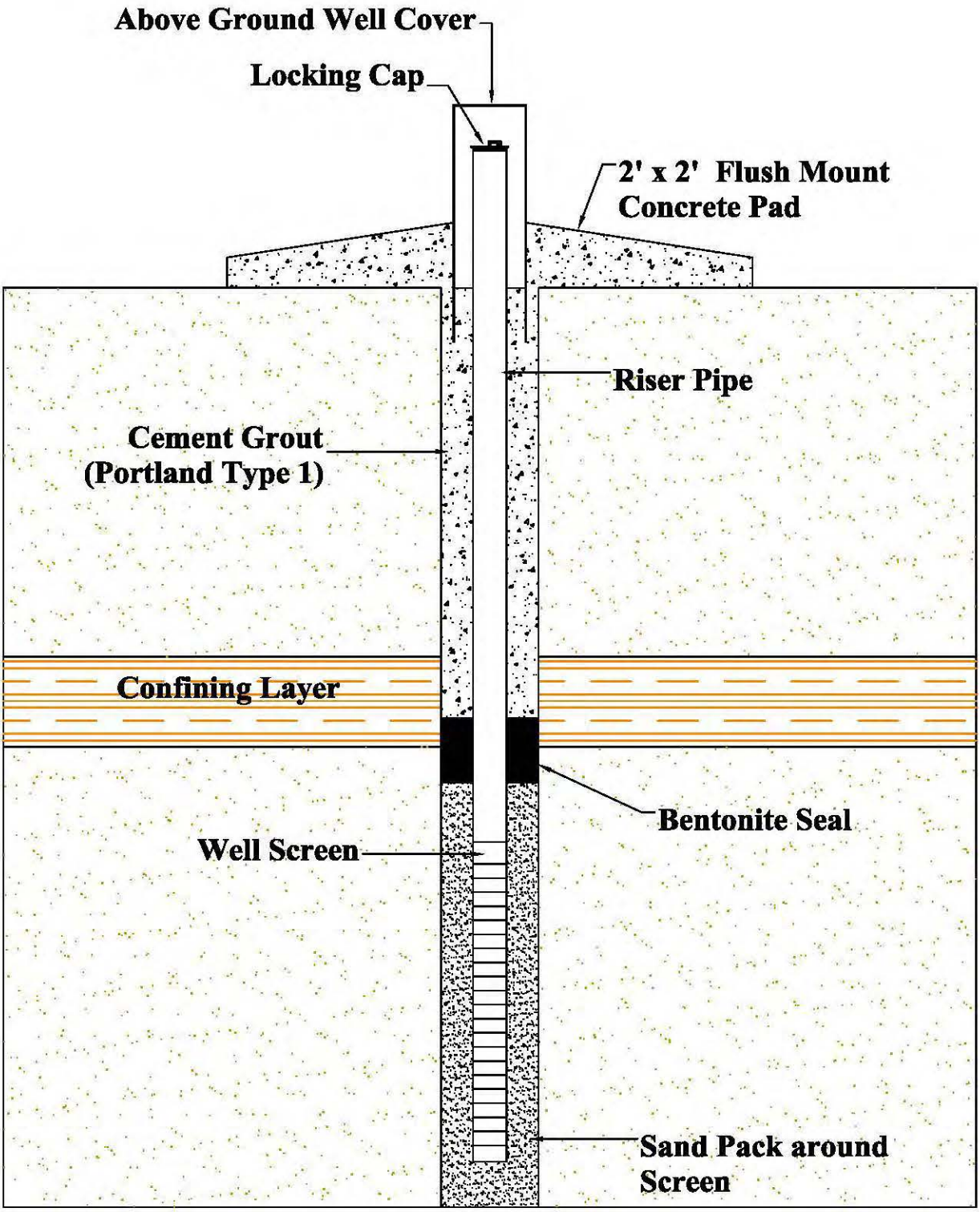


Figure 2: Monitoring Well Identification Tag

3.1.1.1 The Florida Unique Well Identification Program

The Florida Unique Well Identification (FLUWID) program provides a means to simplify the identification and exchange of water well information between state agencies and other interested parties. Under the program, water wells are assigned a unique alphanumeric code called the FLUWID identification number (example: AAA0000). The alphanumeric code is printed on a weather resistant adhesive tag/label and attached to a wellhead or pump house for identification. The FLUWID identification number serves as the primary water well identification number which enables different state agency water well databases to be cross referenced and queried. The FLUWID identification number is meant to be used in conjunction with any other numbering identification scheme such as the permit numbering system for water well construction and identification water well samples.

The naming convention in subsection 3.1.1 can still be used; however the FLUWID number can either replace the well number or be used in conjunction with the well number. For example a FLUWID number, AAB2123, queried from the database would show that this FLUWID number is associated to the original site name JBT-N2-MW01, and the FLUWID number would associate any sample identifications related to JBT-N2-MW01, as well as any other related data and information associated with that well.

The FLUWID Coordinator maintains the FLUWID Program Database (database). The database records the agency that is issued FLUWID tags, the date of issuance, differential global positioning system (DGPS) coordinates and other well information. The primary function of the database is to simplify water well

data inquires by directing all request to the party issued the FLUWID tags. The database is not a repository for water well historical data.

The FLUWID Program is not mandated by law, but implemented voluntarily to facilitate water well data collection The FLUWID Program only works if all parties participate and report data associated to the FLUWID ID numbers that are issued to said parties. It is most important that all data be returned to the FLUWID coordinator in a timely fashion in order to maintain an up-to-date and accurate database.

3.1.2 Well Material Specifications

The selected well construction materials should be chosen based on site and hydrogeological conditions and the physical and chemical monitoring objectives. The prime concern when selecting well materials is that these materials will not contribute foreign constituents to the ground water quality sample or alter the surrounding environment, either by leaching or sorption. The introduction of foreign matter or alteration of ground water quality may compromise the integrity of the well and of any analytical data. Also, well materials must not absorb any of the contaminants of interest that may be present in the ground water. An additional concern is that all well materials must be durable enough to withstand installation and well development and endure for the entire designed monitoring period. ASTM Standard D5092 presents an excellent discussion of material terminology and definitions. Deviations from acceptable well material specifications should be specified the ground water monitoring plan and approved prior to installation.

PVC and stainless steel are the most commonly used monitoring well screen and riser materials. However, in some situations, other materials, such as Teflon®, or carbon steel (for riser pipe) may meet project objectives. Typically, the riser is constructed of the same material as the well screen. However, depending upon the project objectives, PVC or carbon steel riser pipe material may be used to reduce the material cost when stainless steel well screens are specified. Where a different riser material is used to produce a “hybrid” well, the materials anticipated to be in contact with the ground water must be consistent with the material of the well screen. Table A-2, Appendix A, provides a comparison of stainless steel and PVC material characteristics. Table A-3, Appendix A, provides a comparison of the relative compatibility of miscellaneous well materials to potentially reactive substances.

All PVC screens, casings, and fittings are typically Schedule 40 or 80 and shall conform to National Sanitation Foundation (NSF) Standard 14 for approved water usage or ASTM Standards F480 or D1785. If the driller uses a screen and/or casing manufacturer or supplier who removes or does not apply this logo, a written statement from the manufacturer/supplier that the screens and/or casing

have been appropriately rated by NSF or ASTM should be included in the ground water monitoring plan.

Stainless steel well screen is typically Type 316 or 304. The stainless steel well screen must have flush threaded joints, sealing “O” rings of compatible material with the project objectives, and conform to ASTM Standard A312/A312M.

A Teflon® well screen must have flush threaded joins, sealing Teflon® “O” rings, and conform to ASTM Standard D4894 or D4895. Specific materials must be specified in the ground water monitoring plan. All materials should be as chemically inert as technically practical with respect to the site environment. Marking, writing, or paint strips are not allowed.

All monitoring well joints must be water tight. Couplings with the casing and between the casing and screen must be compatibly threaded. Thermal- or solvent-welded couplings on PVC pipe shall not be used. This restriction also applies to threaded or to slip-joint couplings thermally welded to the casing by the manufacturer or in the field. Gaskets, pop rivets, or screws are not normally used on monitoring wells. Exceptions are: 1) manufactured flush-joint casing requiring an o-ring to seal the joint and 2) stainless steel screws required to attach a bottom cap to a nonstandard length of screen material where the normal joint structure is missing. Exceptions should be approved prior to installation and must be recorded in the well completion report. All screen bottoms must be securely fitted with a cap or plug of the same composition as the screen. Solvents or glues are not permitted in the construction of a monitoring well.

All well screens and well casings must be free of foreign matter (e.g., adhesive tape, labels, soil, grease, etc.). Typically, well casing and screen materials are prepared, wrapped, and boxed by the manufacturer with a certificate of being “clean”. If the cleanliness of the well materials is in doubt, the casing and screen must be decontaminated using an approved protocol. Cleaned materials must be stored in appropriate containers until just prior to installation. Pipe nomenclature stamped or stenciled directly on the well screen and/or blank casing within and below the bentonite seal must be removed by means of sanding, unless removable with approved water. Solvents, except approved water, must not be used for removal of markings.

3.1.3 Well Screen Usage

Each well should be constructed with new, machine-slotted or continuously-wound screen section. The end plug should be composed of the same material as the well screen. The screen assembly must be able to withstand installation and development pressures without collapsing or rupturing.

Although many wells set into bedrock could be installed as open-hole installations, the extra cost and effort for screen installation can be more than

offset by the assurance of an unobstructed opening to the required depth during repeated usage. Well integrity and consistent access to the original sample interval during prolonged monitoring is thereby maintained.

3.1.4 Well Screen Length

Well screen lengths should be selected based on the purpose of the well. Some wells are designed to determine the presence or absence of contaminants. Others are designed to monitor a discrete zone for a particular contaminant type. Design of screen length must take into account hydrostratigraphy, temporal considerations, environmental setting, analytes of concern, fate and transport of contaminants, and/or regulatory requirements.

In most situations, monitoring wells are designed to double as ground-water quality sampling points and as piezometers to monitor water levels or hydraulic head at that particular location and depth. In order to satisfy these dual roles, monitoring well screen lengths may range from as short as 2 feet to greater than 20 feet. Typically, though, well screen lengths are 5 or 10 feet, and rarely exceeding 20 feet. It is important that well screen lengths be specified in the ground water monitoring plan.

3.1.5 Well Screen Diameter

The inside diameter (I.D.) of the well screen should be chosen based on anticipated use of the well. Generally, a 2-inch I.D. well is sufficient to allow sampling with most types of sampling devices such as bailers or low-flow samplers. If the well may be used as part of a remedial system, a greater I.D. may be considered (e.g., 4-inch or 6 inch), however, the advantages of this increased diameter should be evaluated with respect to cost increases in drilling, material, and disposal of waste material.

The actual inside diameter of a nominally sized well is a function of screen construction and the wall thickness/schedule of the screen, casing, and joints. In the case of continuously-wound steel screens, their interior supporting rods may reduce the full inside diameter. Additionally, the welded couplings on 2-inch I.D. stainless steel well pipe frequently reduces the inside diameter to slightly less than 2 inches. This consideration is critical when sizing pumps, bailers, surge devices, etc.

All well screens must be commercially fabricated, slotted or continuously wound, and have an I.D. equal to or greater than the I.D. of the well casing. An exception may be warranted in the case of continuously-wound screens. No fitting should restrict the I.D. of the joined casing and/or screen.

3.1.6 Well Screen Slot Size

The grain size distribution of the screened formation and the filter pack gradation are the primary parameters that should be used when selecting a slot size for the well screen. Therefore, the grain size of the aquifer material should be the determining factor in selecting well screen slot size.

The largest practical slot size that is compatible with the aquifer and available filter material should be used. This will allow maximum intake volume per unit screen length. The slot size should retain at least 90 percent (preferably 99 percent) of the filter pack material. The method for determining the appropriate gradation of filter pack material is described in paragraph 3.1.11.2, Primary Filter Pack.

3.1.7 Well Screen Placement

The screen shall be place such that the parameters of concern can be properly monitored. Chemical constituents with a specific gravity greater than water tend to sink and may accumulate as a dense non-aqueous phase liquid (DNAPL). If the well screen is to be installed in a location known or suspected to be impacted by DNAPLs, then the borehole must not be overdrilled and the screen must be placed at the bottom of the borehole. The screen must be placed with no filter pack beneath the base of the screen as this construction may provide a sediment trap and the DNAPLs may sink and not be detected. DNAPLs may exhibit an overall vertical migration, even with a predominant horizontal ground water flow. Therefore, screens need to be place at the bottom of a saturated zone or just above a confining layer. Screen lengths should be as short as possible, at the most 10 feet and preferably 5 feet (or less), to decrease the likelihood of cross contamination of deeper portions of an aquifer.

Overdrilling of a borehole is sometimes performed for such activities as definition of stratigraphy, location of a confining unit or to creation of a sediment trap. It is preferred that exploratory activities (i.e., stratigraphic definition and strata location) are conducted in a pilot hole and then the borehole be properly abandoned. A separate borehole should be advanced for the monitoring well.

Overdrilling to create sediment traps is not encouraged. If, however, overdrilling is performed to create a sediment trap, the bottom of a well screen may be placed at a minimum of 6 inches, but no more than 3 feet above the bottom of the borehole. If bentonite pellets are used to seal the bottom of the borehole, a minimum of one foot of filter sand must be placed above the bentonite prior to screen placement. Overdrilling must be appropriate for site conditions and the monitoring parameters of concern. The use and style of sediment traps must be discussed in the ground water monitoring plan.

3.1.8 Well Riser

The I.D. of the riser should be chosen based on the anticipated use of the well. Usually a minimum of 2-inch I.D. riser is required to allow use of most sampling devices and water level indicators. In most cases, the well riser will be fabricated of the same material and be the same I.D. as the selected well screen. Couplings within casing segments and between the casing and screen must be compatibly threaded.

Each riser section should be installed as straight and level as possible. For deep installations (greater than 40 feet) centralizers should be used to ensure a constant annular spacing between the borehole and well materials. The top of the uppermost riser pipe, i.e., the top of the well, must be level. A point on the top of the well should be marked such that survey and water level measurements are collected from the same location. Traditionally, this mark is placed on the north side of the riser.

3.1.9 Surface Casing

Outer well casing used as a permanent part of the installation when multi-cased wells are installed must be composed of new material. The casing must be free of interior and exterior protective coatings and must be steam cleaned or washed with a high-pressure water device (if appropriate for the selected material) using approved water immediately before installation. The type of material and wall thickness of the casing must be adequate to withstand the installation process. Surface casing must consist of steel meeting ASTM Standard A53/A53M-06 or Schedule 40 or 80 PVC, and shall have a minimum wall thickness of 0.25 inch, unless otherwise specified. The ends of each casing section should be either flush-threaded or beveled for welding.

At sites where multiple aquifers may be penetrated or where a confined or semi-confined aquifer must remain isolated from potential surface water infiltration, surface casing is required to prevent cross-contamination between the separate zones. When used to seal a confining layer or bedrock surface, well casing is typically installed 3 feet to 5 feet into the top of the unit. This should provide a sufficient isolation of the aquifer to be protected. For thin confining layers or thin saprolite horizons, a shallower penetration depth may be appropriate.

Different casing sizes may be required depending on the types of geologic materials encountered at the drilling site and the anticipated purpose of the well. The site geologist, engineer or geotechnical engineer should anticipate these conditions and design the monitoring wells accordingly. Casing diameters for filter-packed wells should be selected so that a minimum annular space of 2 inches is maintained radially between the inside diameter of the surface casing and outside diameter of the monitoring well riser. Also, the diameter of all casings in multi-cased wells should be sized so that a minimum of 2 inches of

annular space is maintained between the surface casing and the borehole. For example, a 2-inch diameter well screen will require a 6-inch diameter casing inside a 10-inch diameter boring.

3.1.10 Granular Filter Packs

3.1.10.1 Filter Pack Materials

All granular filters should be discussed in a ground water monitoring plan, including composition, source, placement, and gradation. If the actual gradation is to be determined during drilling, then more than one filter pack gradation should be available so that well installation will not be unnecessarily delayed. A 1-pint representative sample should be collected for possible future analysis.

Granular filter packs must be at least 98 percent pure silica sand, visually clean (as seen through a 10-power hand lens), free of materials that would pass through a No. 200 U.S. Standard sieve, inert, composed of rounded grains, and of appropriated size for the well screen and host environment. The filter material should be packaged in bags by the suppliers and therein delivered to the site.

Filter packs are placed in the borehole and around the well screen to prevent natural formation material from entering the well screen. The use of a tremie pipe for filter pack placement is recommended; especially when the boring contains thick drilling fluid or mud or is sufficiently deep such that bridging is likely. Exceptions to the use of a tremie pipe for filter pack placement may include vadose zone wells or surficial well with less than approximately 10 feet of standing water.

The final depth to the top of the granular filter should be directly measured (by fiberglass or stainless steel tape measure or rod) and recorded on a well construction form. Final depths must not be estimated based on volumetric measurements of placed filter sand.

When installing a monitoring well in karst or highly fractured bedrock, the borehole configuration of void spaces within the formation surrounding the borehole is often unknown. Therefore, the installation of a filter pack becomes difficult and may not be feasible.

3.1.10.2 Primary Filter Pack

The primary filter pack consists of granular, siliceous material or glass beads. These materials should be clean and free of materials that would compromise the integrity of the representative ground water quality.

The filter pack shall extend from the bottom of the boring to a minimum of 3 feet above the top of the screen unless otherwise specified in the work plan. As mentioned in Subsection 2.1.4.4, Borehole Requirements, the filter pack is not

placed beneath the screen when potential contaminants with a specific gravity greater than that of water (i.e. DNAPLs) are suspected. Once the filter pack material is in place the well should be surged to break bridged filter pack materials in the borehole and to consolidate those materials around the screened interval.

As appropriate, up to 5 feet of filter pack can be placed above the top of the screen. This additional filter pack thickness will allow for settling from infiltration and compaction of the filter pack during development and repeated sampling events. The additional filter also helps to maintain a separation between the bentonite seal and well screen. The selected filter pack material should be uniformly graded and composed of siliceous particles that have been appropriately washed and screened. The filter pack grain-size is based on the smallest natural formation material. The following table presents a comparison of typical filter pack mesh sizes and appropriate screen size openings:

Table 3: Comparison of Screen Slot Size and Filter Pack

Screen Size Opening (Inches)	Screen Size Slot Number	Typical Sand Pack Mesh Size (U.S. Standard Sieve Number)
0.005	5	100
0.010	10	20 to 40
0.020	20	10 to 20
0.030	30	10 to 20

3.1.10.3 Secondary Filter Pack

As appropriate and as borehole depth and hydrogeologic conditions allow, a minimum 1- to 2-foot thick secondary filter pack should be used during well installation. A fine-grained sand (i.e. 30/65) may be used as a secondary filter pack.

The objective of a secondary filter pack is to prevent intrusion of the bentonite seal into the primary filter pack. Additionally, a secondary filter pack can also be used between the bentonite seal and the grout backfill to prevent intrusion of the grout into the bentonite seal. Finally, for wells completed with the seal located above the static ground water level, a secondary filter pack should be installed to replace the bentonite seal.

3.1.11 Annular Seal

The objective of an annular seal is to prevent intrusion of the annular grout into the primary and/or secondary filter pack. An annular seal of fine-grained,

washed silica sand is recommended in situations where monitor well screen sections are designed to intercept the water table. In situations where the annular seal is assured to remain below the water table and saturated, a bentonite seal is appropriate. Bentonite has the ability to expand when completely hydrated to form a dense clay mass with very low in-place permeability, thereby providing an effective barrier to water migration. However, bentonite is not effective when 1) improperly hydrated, 2) allowed to desiccate in place or 3) placed in high or low pH environments. To allow for adequate hydration and avoid desiccation bentonite seals must be placed at a depth below the lowest anticipated static ground water level in the well.

Because bentonite has a high cation exchange capacity and high pH, it may adversely affect water-quality samples that come in contact with, or have migrated through or past the bentonite seal. Additional concerns include the use of bentonite in ground water that exhibits high total dissolved solids or high chloride content, or may contain chemicals reactive to the bentonite's cation exchange capacity and pH. For these reasons, the rationale and design specifications for bentonite seals should be detailed in a work plan. If selected for use during the design process, the bentonite seal should have a minimum 2-foot thickness.

Bentonite used in drilling slurries and as annular sealant shall be powdered, granular, chipped or pelletized. Pelletized or chipped bentonite should be used for bentonite seals, whereas powdered or granular bentonite should be used when required in preparing slurries and grout. The materials must be a 100 percent pure sodium bentonite (montmorillonite) supplied in sacks or plastic buckets. The bentonite must be free of any additives or other material that may negatively affect water quality in the resulting monitoring well. The diameter of the bentonite pellets used should be less than one fifth the width of the annular space into which they are placed. This will help reduce the possibility of the material bridging in the annular space.

The preferred method of placing bentonite pellets or chips is by positive displacement or by use of a tremie pipe. Use of the tremie method minimizes the risk of pellets or chips bridging in the borehole, but time and care must be taken to prevent plugging of the tremie pipe. Pouring of the pellets is acceptable in shallow boreholes (less than 40 feet). In order to provide accurate measurement of bentonite pellet thickness in the well boring, the pellet seal should be tamped during measurement. Bentonite pellet/chips seals should be measured during and immediately after placement, without allowance for swelling. Granular or chip bentonite may be used if the seal is set in a dry condition.

If the proposed seal location is above the anticipated static ground water level, a bentonite seal should not be used. In this case, a 1- to 2-foot layer of fine-grained sand (secondary filter pack) placed atop the primary filter pack will enhance resistance to downward grout migration.

Slurry seals should be used only as a last resort, as when the seal location is too far below water to allow for pellet or chips or containerized-bentonite placement or within a narrow well-borehole annulus. Typically, the specific gravity of cement grout placed atop the slurry seal will be greater than that of the slurry. Therefore, the intent to use a slurry seal should be detailed in the ground water monitoring plan, and details should include a discussion of how the grout will be precluded from migrating through the slurry. An option includes a secondary filter pack of fine-grained sand and the use of a side discharging tremie pipe. Slurry seals should have a thick, batter-like (high viscosity) consistency with a placement thickness of 3 feet to 5 feet.

The final depth of the top of the bentonite seal should be directly measured (by tape or rod) and recorded. Final depths should not be estimated based on volumetric measurements of placed bentonite.

In a well designed to monitor competent bedrock, the bottom of the bentonite seal should be located at 3 feet below the top of firm bedrock, as determined by drilling. “Competent bedrock” refers to that portion of solid or relative solid, moderately weathered to unweathered bedrock where the frequency of loose and fractured rock is markedly less than in the overlying, highly weathered bedrock. Special designs will be needed to monitor fractured bedrock.

3.1.12 Annular Grout

Grout used in monitoring well construction and borehole/well abandonment should be one of the five Portland cement types specified in ASTM Standard C150. Type I Portland cement is most commonly used for monitoring well construction. Bentonite-based grouts (30 percent solids) can be used when the grout needs to remain somewhat flexible. The cement-based grout should be composed of Type I Portland cement , 100 percent pure sodium bentonite (10 percent dry bentonite per 94-lb. sack of dry cement), and shall not exceed 6 gallons of water per 94 pounds of Portland cement. The amount of approved water used should be kept at a minimum. Use of 10 percent bentonite, by weight, added to a cement–based grout is advantageous when lower shrinkage, better workability, and reduced weight are important. The considerations of using bentonite include reduced set strength, increased set time, and potential incompatibility with some ground water chemistry conditions

When a sulfate-resistant grout is needed, Types II or V cement should be used instead of Type I. Quick-setting cements containing additives must not be used for monitoring well installation. These additives may leach from the cement and adversely affect the chemistry of the water samples collected from the resulting monitoring well. Generally, the use of air-entrained cements should be avoided to negate potential analytical interference in ground water samples by the

entraining additives. Neither additives nor borehole cuttings shall be mixed with the grout.

3.1.13 Surface Completion

Protective casing should be installed around each monitoring well the same day as the initial grout placement. Any annulus formed between the outside of the protective casing and the borehole or between the monitoring well and protective casing should be filled to the ground surface with grout as part of the overall grouting procedure. Specific details of well protection should be detailed in the ground water monitoring plan. Details and specific elements of well protection should be included in well completion diagrams. Figures 3 and 4 present schematic diagrams for flush-mounted and stick-up protective casing, respectively. ASTM Standard D5787 provides guidance for monitoring well protection.

All protective casing should be steamed or hot-water-pressure cleaned prior to placement; free of extraneous openings; and devoid of any asphaltic, bituminous, encrusted, and/or coating materials, except the paint or primer applied by the manufacturer.

As specified in Subsection 3.1.1, Well Designation, a metal identification tag containing the well designation should be attached to the protective casing of each monitoring well or placed square on the protective concrete pad, centered on the northern or northwestern side of the pad, with the top of the tag toward the well head. For new pads, the tag shall be placed and pinned during pad construction. For existing pads, the tag should be epoxy grouted and cement screwed.

The material type of the surface completion casing should be adequate to protect the completed monitoring well. The surface completion materials need to be selected such that they provide adequate protection against physical destruction, tampering, natural degradation, and the environment.

Unless otherwise specified, surface completion materials should conform to the following specifications:

1) Locking 16-gauge steel or aluminum protective well cover, round or square and 5-feet in length, or flush-mounted 22-gauge steel, water resistant, welded box with 3/8-inch steel lid;

2) Cement consisting of one of the five Portland cement types that are specified in Standard C 150 as discussed in Paragraph 3.1.12, Annular Grout;

3) Brass, corrosion resistant, keyed-alike padlock;

4) Protective bumper posts constructed of 4-inch diameter and minimum 5-foot long steel or aluminum pipe (four per well). Each post must be set into concrete outside the corners of the concrete pad and filled with concrete;

5) Paint that matches existing monitoring wells at the installation. Where no wells exist, it is recommended to use high visibility yellow epoxy paint;

6) A well identification tag as detailed in Subsection 3.1.1, Well Designation; and

7) Cement consisting of one of the five Portland cement types that are specified in Standard C 150 as discussed in Paragraph 3.1.12, Annular Grout.

The primary purpose of a properly designed surface completion is to maintain the integrity of the well for the designed monitoring period. After the well is installed, it shall be completed at the ground surface in one of two ways:

1) Construct around the protective casing a 2-foot by 2-foot, 4-inch thick concrete pad, sloping from the casing to the perimeter such that water will drain away from the well. The bottom of the concrete pad should be installed partially or completely below grade to protect against undermining. Bentonite grout should then be placed in the annular space below ground level within the protective casing. Pea gravel should then be placed in the annular space above the bentonite to about 6 inches from the top of the well riser.

2) Where monitoring well protection must be flush-mounted with the ground, a locking security internal cap must be on top of the riser within the steel manhole or vault. This cap must be leak proof so that if the vault or manhole should fill with water, the water will not enter the well casing. A bolt-down manhole cover should be required for security. The manhole cover should be installed into a 6-inch thick, 2-foot square, concrete pad, sloped (1 inch per foot) to provide water drainage away from the well, and finished flush to existing grade. Ideally the manhole cover should also be leak-proof.

If the well is completed above ground the protective casing should extend from slightly above the well casing to below ground with a minimum of 2.5 feet below grade. The protective casing should be waterproof and held firmly in lean concrete placed around the outside of the protective casing. The casing should be placed in alignment with the well riser pipe.

Figure 3: Flush-Mounted Protective Casing

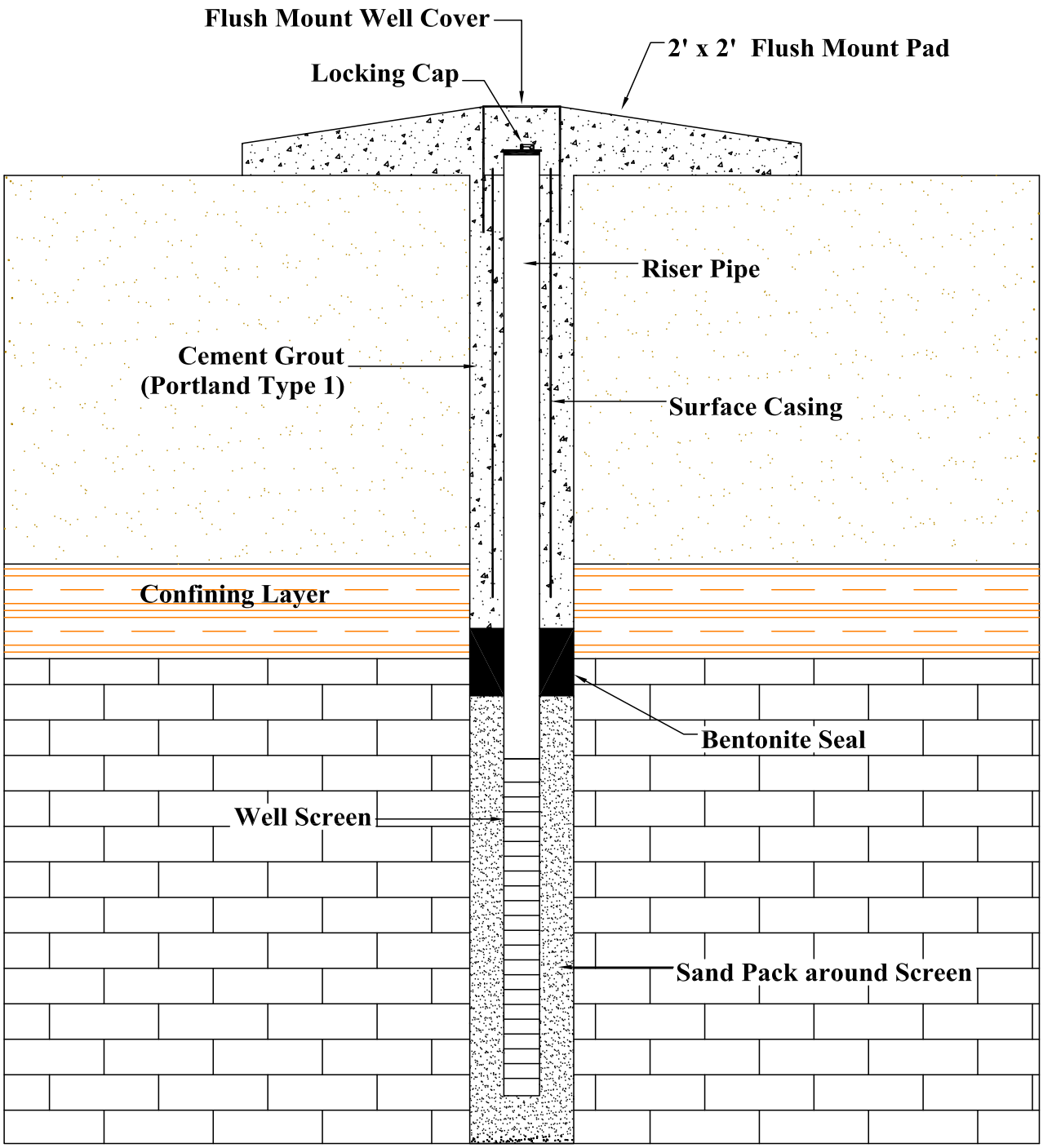
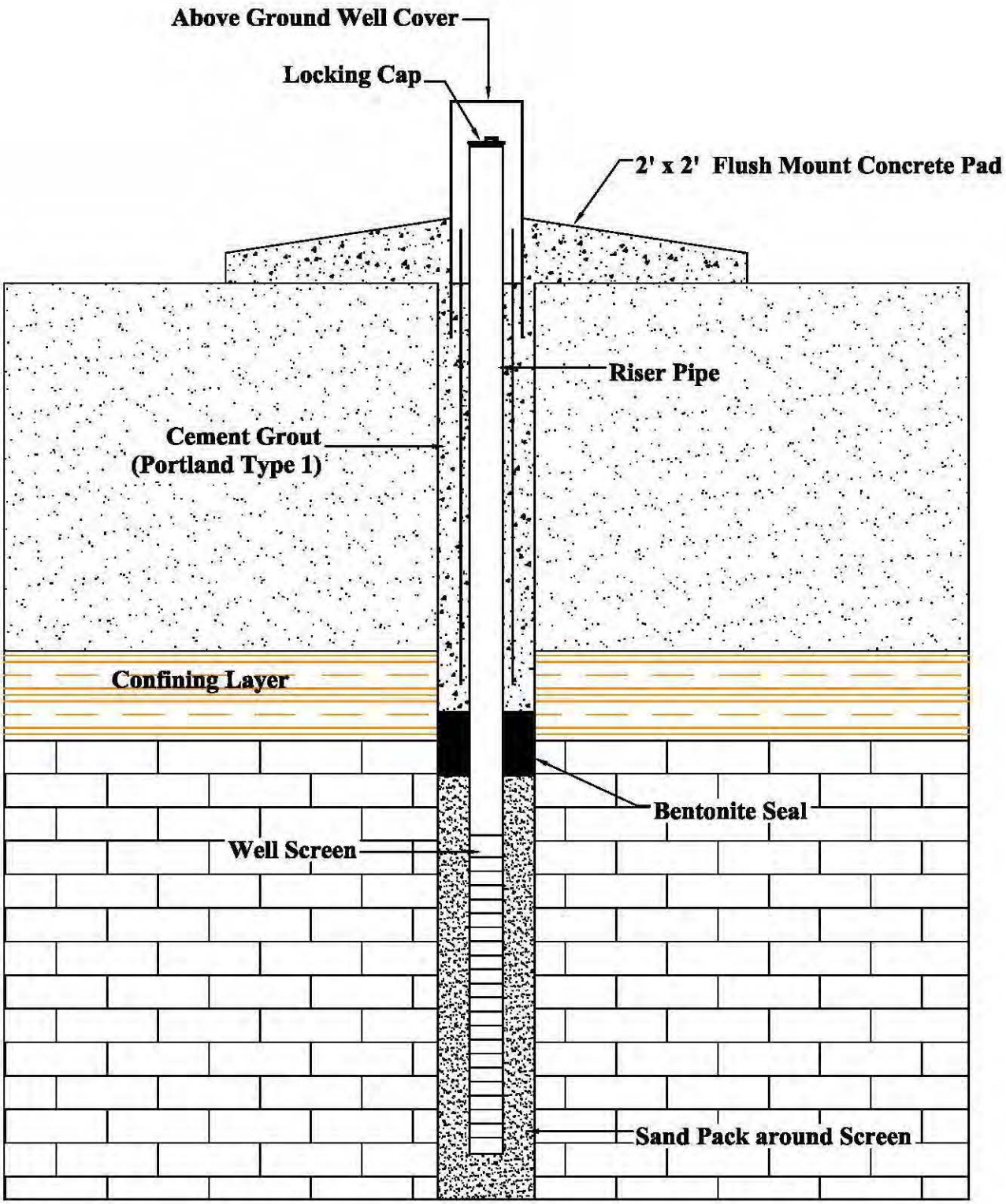


Figure 4: Above-Ground Protective Casing



Prior to protective casing installation, a ⅛-inch diameter vent hole should be drilled or slotted in the well riser approximately 6 inches below the cap to allow the well to vent. A second ¼-inch diameter hole (or weep hole), should be drilled in the surface casing immediately above the concrete pad to allow water to drain from the inside of the protective casing. Vent holes should not be used for flush-mounted well completions. Enough clearance, usually 6 inches, should be left between the lid of the protective casing and the tip of the riser to allow the introduction of sampling equipment and/or pumps. All materials chosen shall be documented.

Monitoring wells located in high traffic areas should be flush mounted whenever possible. If a well can not be flush-mounted in high traffic areas or areas where heavy equipment is operated, the well should be protected with four steel bumper posts. This type of protection may not be necessary at all monitoring well locations**.**

Additional design details for a typical aboveground protective casing include the following:

1) A 5-foot minimum length of steel or aluminum protective casing shall extend approximately 2.5 feet above ground surface and set into the protective apron (aluminum should be used in coastal environments due to its corrosion resistant characteristics);

2) The protective casing inside diameter shall be at least 4 inches greater than the nominal diameter of the well riser;

3) An aluminum-hinged cover or loose-fitting telescopic slip-joint-type cap should be used to keep precipitation and cap runoff out of the casing;

4) All protective casing covers/caps shall be secured to the protective casing by means of a padlock at the time the protective casing is installed;

5) If practical, all padlocks at a given site should be keyed alike;

6) No more than a 2-inch clearance should be left between the top of the protective casing and the top of the well riser. This spacing may be required for installation of monitoring and/or pumping devices. If, however, acoustical equipment will be used for water-level determinations, a smaller spacing (2 inches or less) may be necessary;

7) Only the outside of the protective casing, hinges (if present), and covers/caps must be prepainted or painted with a paintbrush (no aerosol can). Paint shall dry prior to initially sampling that well;

8) A metal identification tag should be placed on the outside of the protective casing; and

9) In high traffic areas, install four steel or aluminum bumper posts. Each post should be radially located 4 feet from the well (immediately outside each corner of the concrete pad) and placed a minimum 2 feet below ground surface, having a minimum of 3 feet above ground surface. The posts should be set into and filled with concrete. Flagging or signposts in areas of high vegetation may be helpful. The bumper posts should be prepainted or painted using a brush.

3.1.14 Quality Assurance Sampling

Certain well construction materials used during installation should be collected for quality assurance (QA) purposes. It is not always necessary to perform chemical analyses on collected materials. However, with the exception of the approved water, the materials should be archived until the chemical results are received from the environmental samples at that location in case that the results appear to be anomalous. In this case, it may be desirable to analyze some or all of the well construction materials. Such materials include drilling fluids (approved water and any additives, if used), annular filter pack, bentonite, and cement.

3.2 Documentation

Unless otherwise specified in the ground water monitoring plan, a well construction diagram and a certificate of conformance must be produced for every monitoring well constructed.

3.2.1 Well Construction Diagram

Each diagram must be attached to, or placed on the original boring log and maintained by the site geologist, engineer or geotechnical engineer until completion of the field effort. Figure 3-1 presents an example of a completed well construction diagram included on a soil boring log. The original diagram and boring log should be retained for later reference, as needed. Special abbreviations used on the well completion diagram must be defined on the diagram.

The following information should be attached to the original boring log and graphically denote, by the depth from ground surface:

1) The bottom of the boring (that part of the boring most deeply penetrated by drilling and/or sampling) and boring diameter(s);

2) Screen type and interval;

3) Joint type and depths;

4) Granular filter pack type and depth interval;

5) Seal type and depth interval;

6) Grout type and depth interval;

7) Cave-in, if any;

8) Centralizer locations;

9) Height of riser (stickup) without cap/plug above ground surface;

10) The following protective casing details; and
    a. Height of protective casing, without cap/cover, above ground surface;
    b. Base of protective casing below ground;
    c. Weep hole location and size;
    d. Concrete pad thickness, height, and extent, and;
    e. Protective post configuration.

11) Water level immediately after completion and 24 hours after completion with date and time of measurement.

In addition to the graphical presentation discussed above, the following items should be described on each diagram:

1) The actual quantity and composition of the grout, bentonite seal, and granular filter pack used for each well;

2) The screen slot-size in inches, slot configuration type, total open area per foot of screen, outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer;

3) The material between the bottom of the boring and the bottom of the screen;

4) The outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer of the well casing;

5) The joint design and composition;

6) Centralizer design and composition;

7) Depth and description of any permanent pump or sampling device. For pumps, include the voltage, phase requirements, and electrical plug configuration;

8) Protective casing composition, length, and nominal inside diameter;

9) Special problems and their solutions; e.g., grout in well, lost casing and/or screens, bridging, casing repairs and adjustments, etc.; and

10) Dates and times for the start and completion of well installation.

3.3 Special Concerns

3.3.1 Shallow Wells

During shallow well construction (i.e., less than approximately 15 feet) sufficient depth may not be available to install the desired thickness of typical well components (filter pack, bentonite seal, grout, etc.). Tailored well designs and deviations from standard well construction requirements should be detailed in a ground water monitoring plan. The design, if modified, should minimize the potential infiltrations of surface water.

3.3.2 Well Clusters

Unless otherwise specified in an approved work plan, each well in a cluster shall be installed in a separate boring rather than co-located within one large-diameter boring. Each monitoring well is a mechanism through which to obtain a ground water sample representative of the aquifer zone monitored and, if so designed, to measure the potentiometric surface in that well. To ensure this representation, each well in a cluster must be constructed and installed in a separate boring. Multiple well placements in a singe boring are too difficult for effective execution and evaluation to warrant single hole usage. One exception includes the intentional design and installation of well clusters such as bundled piezometers for DNAPL characterization. Such exemptions must be detailed in a ground water monitoring plan.

4.0 Well Development

4.1 General

Borehole drilling activities may retard the ability of an aquifer to transmit water to a monitoring well. Obstructions can be caused by physical alteration of the aquifer material, or by formation damage as a result of the introduction of drilling fluids or solids in the aquifer, causing reduced permeability adjacent to the borehole. Well development is necessary to correct this damage and improve hydraulic conductivity in the immediate vicinity of the monitoring well. The objective of well development is to remove all or as much as possible of the introduced drilling fluids, mud, cuttings, mobile particulates, and entrapped gases from within and adjacent to a newly installed well, thus providing an improved connection between the well screened interval and the aquifer. The resulting inflow to the well should be physically and chemically representative of that portion of the aquifer adjacent to the screened interval. The appropriate development method or procedure to use will vary according to the hydrologic characteristics of the aquifer, the drilling method used, and the type of well completion.

4.2 Development Methods

The method most appropriate for monitoring well development is dependent upon the construction material and size of the well screen and casing, design of the filter pack, characteristics of the formation material, disposal considerations of development fluids, borehole drilling method used, impact of development method on aquifer chemistry, well depth, and cost. ASTM Standard D5521 provides guidance for the development of monitoring wells in granular aquifers.

The following are some of the most commonly used methods:

<u>Mechanical Surging</u> This method involves use of a swedge (surge) block that is moved up and down the well screen and casing. Water is alternately forced in and out of the screen to loosen sediment bridges and draw fine-grained material into the well, which is then pumped out. This is the preferred method of well development. Fine-grained materials can become trapped between the swedge and the inner wall of the screen and well casing causing the swedge to freeze in the well as well as scouring the well materials.

<u>Overpumping</u> The well is pumped at a higher rate than when it will be purged and sampled. Theoretically, the high flow rates dislodge fine-grained materials, opening the flow paths between the well and the aquifer. This method is subject to sediment bridging, requires large pumps that may be difficult to fit into small

diameter wells, generates large volumes of water that must be disposed, and results in poor development of wells with long screen intervals.

Rawhiding In this method, the well is alternately pumped and stopped at intervals that draw water into the well and back out, developing the filter pack by fluid surging. The technique can cause a high rate of wear on the pump and in certain situations may not produce a sufficient surge action for development.

Jetting This method uses high velocity streams of water to loosen fine-grained material and drilling fluids from the formation. The material that enters the wells is then pumped out. This method requires an external water supply and high velocity streams can damage the well screen. Jetting may be appropriate for redevelopment of wells that have become fouled with silt and clay or other fine matter.

Air Lift Air Lift involves forcing air out through the screen and into the monitoring well to clean debris from the well. This method alters the chemistry of the aquifer, may introduce contaminants to the aquifer via the air supply, may release contaminants to the air via mists from the well, and may damage the screen and filter pack.

4.3 Timing and Record Submittal

The development of monitoring wells should not be initiated sooner than 12 hours after or longer than 7 days beyond placement of grout. Well development should be appropriately documented on a monitoring well development record and included with the boring log.

4.4 Oversight

The development of a monitoring well should be overseen and recorded by a site geologist, engineer or geotechnical engineer.

4.5 Development Criteria

Well development should continue until representative water; free of drilling fluids, cuttings, or other materials introduced during well construction is obtained. In other words, the well should be developed until the water is non-turbid. Well discharge water should be metered in the field until it can be established that development has attenuated and stabilized turbidity to the maximum degree possible. All turbidity sampling times and measurements should be recorded on a well completion form.

Suggested minimum volumes to be withdrawn from a well are:

1) For those wells where the boring was made without the use of drilling fluid, but approved water was added to the well installation, remove five times the amount of any water unrecovered from the well during installation (in addition to five times the standing volume).

2) For those wells where the boring was made or enlarged (totally or partially) with the use of drilling fluid, remove five times the measured, or estimated, amount of total fluids lost while drilling, plus five times that used for well installation (in addition to the five times the standing volume). Exceptions may be warranted during the drilling of deep well borings where significant water was lost in a previous hydrologic zone.

Note: Developing a well for too short a period is a common and major cause for poor well performance. Also, water should not be added to a well as part of the development once the initial bentonite seal atop the filter pack is placed.

If any of the following circumstances occur, the site geologist, engineer or geotechnical engineer should document the event in writing and use an alternate plan of action:

1) After extensive development, a non-turbid sample cannot be collected due to a significant fraction of fine-grained material in the surrounding aquifer;

2) Persistent water discolorations remain after the required volumetric development; and

3) Excessive sediment remains after the required volumetric removal.

4.6 Development – Sampling Break

Well development must be completed at least 24 hours before well sampling. The intent of this hiatus is to provide time for the newly installed well and backfill materials to sufficiently equilibrate to their new environment and for that environment to re-stabilize after disturbance of drilling. Applicable Federal, State, and local regulations may require up to 14 days before well sampling can begin.

4.7 Pump/Bailer Movement

During development, water should be removed throughout the entire water column in the well by periodically lowering and raising the pump intake (or bailer stopping point).

4.8 Well Washing

Well development should include the washing of the entire well cap and the interior of the well riser above the water table using only water from that well. The result of this operation will be a well casing free of extraneous materials (grout, bentonite, sand, etc.) inside the well cap and casing, between the top of the well and the water table. The washing should be conducted before and/or during development, and not after development.

4.9 Well Development Record

The following data shall be recorded on a monitoring well development record during development:

1) Name of the responsible site geologist, engineer or geotechnical engineer;

2) Well designation and location;

3) Site name and location;

4) Date(s) of well installation;

5) Date(s) and time of well development;

6) Description of surge/development technique;

7) Type, size, capacity, and pumping rate of pump and/or bailer used;

8) Depth from top of well casing to bottom of well;

9) Well and casing inside diameter;

10) Static water level (equilibrium) from top of well casing before and after development;

11) Field measurements of pH, specific conductance, temperature, and turbidity before, at least twice during, and after development;

12) Screen length and interval;

13) Physical character of removed water, to include changes during development in clarity, color, particulates, and any noted incidental odor;

14) Cumulative water volume or pumping rate;

15) Quantity of fluids/water removed and time interval for removal (present both incremental and total values); and

16) Drilling company.

4.10 Determination of Hydraulic Conductivity from Specific Capacity

Immediately following well development, estimates of hydraulic conductivity can be obtained by conducting specific capacity tests. Specific capacity of a well is the well yield per unit drop of water level in the well. Immediately after monitoring well development, the specific capacity can be measured and used to provide an estimate of the hydraulic conductivity. If the well does not sustain pumping rates of at least 0.5 gallons per minute without excessive drawdown, other aquifer tests, such as slug tests, should be conducted.

Inherent in the calculation of hydraulic conductivity from specific capacity data are certain assumptions, therefore the responsible site geologist, engineer or geotechnical engineer should account for the following potential sources of error when calculating the hydraulic conductivity from specific capacity data:

1) Effects of variable discharge;

2) Effects of partial penetration of the well;

3) Calculation of well losses;

4) Appearance of delayed yield in the aquifer; and

5) Estimates of aquifer storativity.

Appendix C presents details on the performance of specific capacity tests.

5.0 Management of Investigation-Derived Waste

Investigation-Derived Waste (IDW) is defined as waste materials generated during environmental field activities. IDW may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from sample collection; residues such as ash, spent carbon, well development purge water for testing of treatment technologies; contaminated PPE; and solution used to decontaminate equipment and non-disposable PPE. An IDW management plan should be developed as part of a ground water monitoring plan.

5.1 IDW Management Requirements

The fundamental purpose of IDW management is to choose options that are:

1) Protective of human health and the environment; and

2) In compliance with regulations and applicable or relevant and appropriate requirements (ARARs).

5.2 General Objectives for IDW Management

General objectives that site managers should consider include:

1) Protectiveness;

2) Minimization of IDW generation; and

3) Management of IDW consistent with the final remedy for the site.

To the extent that the objectives can be achieved is highly dependent on site-specific conditions.

5.2.1 Protectiveness

Factors that should be considered in determining if a specific management or disposal option is protective include the following:

1) The contaminants, their concentrations, and total volume of IDW;

2) Potentially affected media under management options;

3) Location of the nearest population(s) and likelihood or degree of site access;

4) Potential exposure to workers; and

5) Potential for environmental impacts.

Generally, best professional judgment will be required to make this determination.

5.2.2 IDW Management

Site managers should attempt to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information during the site inspection. The potential problems of managing IDW should be a factor in choosing an investigation method.

5.2.3 Consistency with Final Remedy

Most IDW generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements. Because early planning for IDW can prevent unnecessary costs and the use of treatment and disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated or disposed of immediately or addressed with the final remedy. In addition, when IDW is stored on site, it should be managed as part of the first remedial action that addresses the affected media.

5.3 Selection of IDW Disposal Options

The manner of waste disposal must be consistent with applicable Federal, State, and local regulations. Actual disposal and/or treatment techniques for contaminated materials are the same as those for any hazardous substance, that is, incineration, deposition in a landfill, treatment, etc. Protocols and the parties responsible for the handling and disposal of IDW should be included in the ground water work plan.

Disposal option selection should be based on the previously discussed factors:

1) The type and quantity of IDW generated;

2) Risk posed by managing the IDW on site;

3) Compliance to regulations, standards, and ARARs;

4) IDW minimization; and

5) Whether the final remedy is anticipated to be an off site or and onsite remedy.

6.0 Topographic Survey

6.1 Licensing

When practical or if site circumstances require, topographic survey efforts should be conducted by a Florida-licensed surveyor. Exceptions may include low resolution surveys, temporary point locations, and relative location surveys performed by personnel familiar with land surveying but not state certified.

6.2 Horizontal Control

Each boring and/or well installation should be topographically surveyed to determine its location referenced to either a Universal Transverse Mercator (UTM) grid or the State Plane Coordinate System (SPCS). These surveys should be connected to the UTM or SPCS by third order, Class II control surveys in accordance with the Standards and Specifications for Geodetic Control Networks (Federal Geodetic Control Committee, 1984). If the project is an area remote from UTM or SPCS benchmarks and such horizontal control is not warranted, then locations measured from an alternate system depicted on project plans may be acceptable. An accuracy of +/- 0.10 foot is expected for monitoring well locations. Under typical conditions, all borings, temporary wells, temporary and/or permanent markers should also have an accuracy of +/- 1.0.

6.3 Vertical Control

Elevations for a designated point (marked measuring point) on the rim of the uncapped well casing (not the protective casing) for each bore/well site should be surveyed to within +/- 0.010 foot and referenced to the National Geodetic Vertical Datum (NGVD) of 1988. If elevations for the natural ground surface at the bore/well site (not the top of the concrete pad) are required, the survey should be within +/- 0.10 foot and referenced to the NGVD 1988. These surveys should be connected by third order leveling to the NGVD in accordance with the Standards and Specification for Geodetic Control Networks. If the project is in an area remote to NGVD benchmarks and such vertical control is not warranted, then elevations measured from a project datum may suffice, at least on a temporary basis.

6.4 Benchmark Placement

Temporary benchmarks may be installed to perform survey work. Temporary benchmarks typically consist of one or more of the following:

1) Iron pin (#4 rebar minimum, 24 inches in length);

2) Railroad spike in utility pole or tree;

3) Masonry nail driven in pavement;

4) Chiseled square on a concrete structure; and

5) Painted portion of a fixed object, such as a specific part of a fire hydrant.

Permanent benchmarks may be required to provide future control at a site. Permanent benchmarks will consist of a concrete monument a minimum of 5 inches square and two feet in depth with an iron pin imbedded full depth of the concrete and set flush with the top of the concrete, or a brass marker set in a five inches square, two-foot deep concrete monument.

6.5 Field Data

The topographic survey should be completed as near to the time of the last well completion as possible. Survey field data (as corrected), should include loop closures and other statistical data in accordance with the Standards and Specifications. Closure should be within the horizontal and vertical limits referenced above. These data shall be clearly listed in tabular form; the coordinates (and system) and elevation (ground surface and top of riser) for all borings, wells, and reference marks. All permanent and semi permanent reference marks used for horizontal and vertical control (benchmarks, caps, plates, chiseled cuts, rail spikes, etc.) should be described in terms of their name, character, physical location, and reference value. These field data should become part of the project records maintained by the site geologist, engineer, geotechnical engineer, project manager, or other appropriate person.

6.6 Survey Reports

The survey report should include the following:

1) A map showing the locations of the monitoring wells, reference points, and benchmarks. Elevations must be included for all wells (ground surface and top of well riser) and benchmarks;

2) A copy of all checked field notes taken during the field work; and

3) A copy of all coordinates and elevations for the monitoring wells, soil borings, surface water/sediment locations, etc., and temporary control points (baseline and traverse points).

6.7 Geographic Positioning System

As an alternative to conventional land surveying, a Geographic Positioning System (GPS) may be used to determine the horizontal and vertical location of points in the field. GPS may provide greater convenience, reduce equipment and personnel demands, and reduce the time required to conduct a survey as opposed to more traditional methods. GPS is particularly suited for point positioning in remote locations away from established benchmarks. Adequate GPS units must be employed, though, as typical well location and elevation determinations require high resolution surveying.

7.0 Well and Boring Abandonment

7.1 General

Abandonment procedures are designed to permanently close a boring or monitoring well. As such they are designed to preclude current or subsequent fluid media from entering or migrating within the subsurface environment along the borehole vertical axis. It is therefore important that a borehole be sealed in such a manner that it cannot act as a conduit for migration of contaminants from the ground surface to the water table or between aquifers.

All soil borings not completed as monitoring wells must be abandoned in accordance with the following procedures and must be documented on the boring log as such. The date(s) of abandonment and the abandonment method must be included on the boring log.

7.2 Methodology

Each boring to be abandoned should be sealed by grouting from the bottom of the boring/well to ground surface. This should be done by placing a tremie pipe to the bottom for the boring (i.e., to the maximum depth drilled) and pumping grout through the pipe until undiluted grout flows from the boring at ground surface. The ground sealant must consist of high-solids, 100 percent-pure sodium bentonite grout. The amount of approved water used should be kept to a minimum. Neither additives nor borehole cuttings should be mixed with the grout. No borehole shall be backfilled with cuttings.

After 24 hours, the driller, site geologist, engineer, geotechnical engineer, or other field representative, should check the abandoned site for grout settlement. Any settlement depression should be immediately filled even with the ground surface and rechecked 24 hours later. Additional grout should be added using a tremie pipe inserted to the top of the firm grout, unless the depth of the unfilled portion of the hole is less than 5 feet and that portion is dry. The process should be repeated until firm grout remains at the ground surface. It may be necessary to grout the boring to a depth of 2 feet below grade and complete the backfill with lean concrete or asphalt, depending upon the composition of the original surface.

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ASTM, D1452, “Standard Practice for Soil Investigation and Sampling by Auger Borings,” ASTM International

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ASTM D2113 Historical Standard, “Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation,” ASTM International

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ASTM D4894, “Standard Specification of Polytetraflurorethylene (PTFE) Granular Molding and Ram Extrusion Materials,” ASTM International

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ASTM D5782, “Standard Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5783, “Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

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ASTM D5872, “Standard Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5875, “Standard Guide for Use of Cable-Tool Drilling and Sampling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D6169, “Standard Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations,” ASTM International

ASTM D6286, “Standard Guide for Selection of Drilling Methods for Environmental Site Characterization,” ASTM International

ASTM D6724, “Standard Guide for Installation of Direct Push Ground Water Monitoring Wells”, ASTM International

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ASTM F480, “Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80, ASTM International

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USCOE, ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive (HTRW) and Ordnance and Explosive Waste (OEW) Activities

U. S. Environmental Protection Agency, Environmental Investigations Standard Operating Procedure and Quality Assurance Manual, Section 6: Design and Installation of Monitoring Wells, November 2001

Other Suggested References

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ASTM D 5978, “Standard Guide for Maintenance and Rehabilitation of Ground-Water Monitoring Wells,” ASTM International

ASTM D 5979, “Standard Guide for Conceptualization and Characterization of Ground-Water Systems,” ASTM International

U.S. Environmental Protection Agency, Nonaqueous Phase Liquids Compatibility with Materials Used in Well Construction, Sampling, and Remediation, (EPA/540/S-95/503, July, 1995) http://www.epa.gov/ada/download/issue/napl.pdf

Appendix A – Tables

- Table 4: Typical Borehole and Annulus Volume Calculations
- Table 5: Comparison of Stainless Steel, PVC, and Teflon® for Monitoring Well Construction
- Table 6: Relative Compatibility of Rigid Well Casing Material (Percent)

Table 4: Typical Borehole and Annulus Volume Calculations

Inside Diameter of Borehole (inches)	Outside Diameter of Casing Within Borehole (inches)	Cubic Feet per Foot of Depth	U.S. Gallons per Foot of Depth
1.0	NA	0.005	0.04
1.5	NA	0.012	0.09
2.0	NA	0.022	0.16
2.5	NA	0.034	0.25
3.0	NA	0.049	0.37
3.5	NA	0.067	0.50
4.0	NA	0.087	0.65
4.0	2.5	0.053	0.40
4.5	NA	0.110	0.83
5.0	NA	0.136	1.02
5.5	NA	0.165	1.23
6.0	NA	0.196	1.47
6.0	2.5	0.162	1.21
6.0	4.5	0.086	0.64
6.5	NA	0.230	1.72
7.0	NA	0.267	2.00
8.0	NA	0.349	2.61
8.0	2.5	0.315	2.36
8.0	4.5	0.239	1.78
8.0	6.5	0.119	0.89
9.0	NA	0.442	3.30
10.0	NA	0.545	4.08
10.0	2.5	0.511	3.82
10.0	4.5	0.435	3.25
10.0	6.5	0.315	2.36
11.0	NA	0.660	4.94
12.0	NA	0.785	5.87
12.0	2.5	0.751	5.62
12.0	4.5	0.675	5.05
12.0	6.5	0.555	4.15
14.0	NA	1.069	8.00
14.0	4.5	0.959	7.17
14.0	6.5	0.839	6.27
16.0	NA	1.396	10.44
16.0	4.5	1.286	9.62
16.0	6.5	1.186	8.72

Table 5: Comparison of Stainless Steel, PVC, and Teflon® for Monitoring Well Construction

Characteristic	Stainless Steel	Schedule 40 PVC	Teflon
Strength	Use in deep wells to prevent compression and closing of screen and/or riser	Use when shear and compression strength are not critical	Low-strength capabilities limit deep-well construction
Weight	Relatively heavier	Light-weight	Relatively light
Cost	Relatively expensive	Relatively inexpensive	Expensive
Corrosivity	Deteriorates more rapidly in corrosive water, particularly when exposed to $H_2SO_4$4	Non-corrosive – may deteriorate in presence of high concentrations of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons	Nearly totally resistant to chemical and biological attack, oxidation, weathering and ultraviolet radiation
Ease of Use	Difficult to adjust size or length in the field	Easy to handle and work with in the field	Fairly easy to handle and work with in the field
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled	Never use glue fillings – pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells is not certified clean	Should be steam cleaned if not wrapped by manufacturer and if organics will be subsequently sampled
Interaction with contaminants	May sorb organic or inorganic substances when oxidized	May sorb or release organic substances	Almost completely chemically inert; may react to halogenated compounds, and sorption of some organic compounds, (Reynolds and Gillham, 1985). Except in the case of very low yield wells which preclude purging prior to sampling, these reactions are unlikely to cause significant sample bias.

Table 6: Relative Compatibility of Rigid Well Casing Material (Percent)

Potentially-Reactive Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-Carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon®*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/High Solids Content	100	48	57	60	80	82	100
Aqueous/ Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

<u>Preliminary Ranking of Rigid Materials</u>:

1. Teflon®*
2. Stainless Steel 316
3. Stainless Steel 304
4. PVC
5. Lo-Carbon Steel
6. Galvanized Steel
7. Carbon Steel

*Teflon is a registered product of DuPont

Appendix B – Forms

- Form 1: Soil Parameters for Logging
- Form 2: Rock Parameters for Logging
- Form 3: Monitoring Well Completion Report
- Form 4: Application to Construct, Repair, Modify or Abandon a Well

Form 1: Soil Parameters for Logging

Parameter	**Example**
Classification	
Depositional Environment and formation, if known	
ASTM D 2488 Group Symbol	
Secondary Components and estimated percentages	
Color: *Give both narrative and numerical description and what chart was used – Munsell Soil and/or GSA Rock Color*	
Plasticity	
Consistency (cohesive soil)	
Density (non-cohesive soil)	
Moisture content (use relative terms)	
Structure and orientation	
Grain angularity	

Source: U.S. COE, 1988

Form 2: Rock Parameters for Logging

Parameter	**Example**
Rock Type	
Formation	
Modifier denoting variety	
Bedding/banding characteristics	
Color: *Give both narrative and numerical description and what chart was used – Munsell Soil and/or GSA Rock Color*	
Hardness	
Degree of cementation	
Texture	
Structure and orientation	
Degree of Weathering	
Solution or Void Conditions	
Primary and secondary permeability, including estimates and rationale	
Rock quality designation	

Source: U.S. COE, 1988

Form 3: Monitoring Well Completion Report

DEP Form #	62-520.900(3)
Form Title	MONITORING WELL COMPLETION REPORT
Effective Date	
DEP Application No.	(Filled in by DEP)

Florida Department of Environmental Protection

Bob Martinez Center, 2600 Blair Stone Road Tallahassee, Florida 32399-2400

MONITORING WELL COMPLETION REPORT

PART I: GENERAL INFORMATION

Well ID:	Site Name:		Well Install Date
Facility ID	Alternate ID	FLUWID #	WMD Permit #
Well Purpose ☐ Background ☐ Intermediate ☐ Compliance ☐ Other (explain)			
Latitude (to nearest 0.1 seconds)		Longitude (to nearest 0.1 seconds)	
Latitude and Longitude collection method: ☐ DGPS ☐ AGPS ☐ MAP ☐ ZIPCODE ☐ DPHO ☐ UNKNOWN ☐ OTHER			

PART II: WELL CONSTRUCTION DETAILS

Water Well Contractor Name					Contractor License #
Company Name					
Construction Method: ☐ Hollow Stem Auger ☐ Solid Stem Auger ☐ Water/Mud Rotary ☐ Air Rotary ☐ Cable Tool ☐ Direct Push ☐ Sonic ☐ Other (describe)					Aquifer Monitored
Top of Casing Elevation (NVGD or NAVD)			Ground Surface Elevation (NVGD or NAVD)		
Casing					
Material	Inside Diameter	Outside Diameter	Depth (ft.) From	Depth (ft.) To	
Screen					
Material	Inside Diameter	Outside Diameter	Depth (ft.) From	Depth (ft.) To	Slot Size
Annulus					
Material including additives for sealant	Size of Material	Amount (# of bags)	Depth (ft.) From	Depth (ft.) To	Installation Method

PART III: WELL DEVELOPMENT DETAILS

Well Development Date	Well Development Method: ☐ Surge/Pump ☐ Pump ☐ Compressed Air ☐ Other (explain)		
Development Duration			
Pumping Rate	Maximum Drawdown	Well Purged Dry ☐ yes ☐ no	Pumping Condition ☐ continuous ☐ intermittent

Turbidity (if Measured):		Stabilized Water Level (BLS)
Start:	End:	

Water appearance (color and odor) at start of development:
Water appearance (color and odor) at end of development:

Report Prepared By:	Date
Title/Company	License #

PLEASE ATTACH BORING LOG

Remarks

Form 4: Application to Construct, Repair, Modify or Abandon a Well

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☐ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK OF PERMIT FORM.

THIS FORM MUST BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. _____
Florida Unique I.D. _____
Permit Stipulations Required (See attached)
62-524 well ☐
CUP/WUP Application No. _____

ABOVE THIS LINE FOR OFFICIAL USE ONLY

Fold at this line in order that address is visible through envelope window

1. _____
Owner, Legal Name of Entity if Corporation | Address | City | Zip | Telephone Number

2. _____
Well Location — Address, Road Name or Number, City

3. _____
Well Drilling Contractor | License No. | Telephone No.

_____
Address

_____
City | State | Zip

4. _____ (smallest) 1/4 of _____ (biggest) 1/4 of Section _____
(Indicate Well on Chart)

5. Township _____ Range _____

NW NE SW SE

6. _____ County | _____ Subdivision Name | _____ Lot | _____ Block | _____ Unit

7. **Number of proposed wells** _____ **Check the use of well:** (See back of permit for additional choices) _____ Domestic Monitor (type) _____
_____ Irrigation (type) (See Back) Public Water Supply (type) _____ (See Back) List Other _____
Distance from septic system _____ ft. **Description of facility** _____ **Estimated start of construction date** _____

8. **Application for:** _____ New Construction _____ Repair/Modify _____ Abandonment _____
(Reason for Abandonment)

Date Stamp

9. **Estimated:** Well Depth _____ Casing Depth _____ Screen Interval from _____ to _____
Casing Material: Blk-Steel / Gal / PVC Casing Diameter _____ Seal Material _____

10. **If applicable: Proposed Grouting Interval** From _____ to _____ Seal Material _____
From _____ to _____ Seal Material _____
From _____ to _____ Seal Material _____

Draw a map of well location and indicate well site with an "X". Identify known roads and landmarks; provide distances between well and landmarks.

North
N
West
East
South

11. **Telescope Casing** _____ **or Liner** _____ (check one) Diameter _____
Blk-Steel / Galvanized / PVC Other (specify: _____

12. **Method of Construction:** _____ Rotary _____ Cable Tool _____ Combination
_____ Auger _____ Other (specify:) _____)

13. **Indicate total No. of wells on site** _____. **List number of unused wells on site** _____.

14. **Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application?** ___No ___Yes
(If yes, complete the following) CUP/WUP No. _____
District well I.D. No. _____
Latitude _____ Longitude _____
Data obtained from GPS ____ or map ____ or survey ____ (*map datum NAD 27*___ *NAD 83*___)

15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

_____ Signature of Contractor | License No.

_____ Owner's or Agent's Signature | Date

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: _____ Issue Date: _____ Hydrologist Approval _____ Initials

Owner Number: _____ Fee Received: $ _____ Receipt No.: _____ Check No.: _____

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. ***This permit is valid for 90 days from date of issue.***

WHITE: ORIGINAL FILE
YELLOW: DRILLING CONTRACTOR
PINK: OWNER

SRWMD FORM 40B-3-1 REV. 12/95

Appendix C- Specific Capacity Testing

The purpose of specific capacity testing can be multi-fold, and depends on project demands. Specifically, some of the objectives of specific capacity testing include:

1) Determine the maximum pumping rate for a given well;

2) Obtain data to calculate first estimate of hydraulic conductivity and storativity; and

3) Obtain data to determine well efficiency.

Specific capacity tests can be conducted during or following development, or during purging for sampling. Specific capacity testing should be considered if the well is capable of sustaining a measurable yield, and if the test well pump is capable of sustaining a constant rate discharge. Specific capacity is defined as yield divided by drawdown, and is normally expressed as gallons per minute/feet of drawdown. Both pumping rate and drawdown are measured simultaneously in the tested well after a given amount of time has elapsed. Dividing the yield rate by the stabilized drawdown, gives the specific capacity. Specific capacity can vary with pumping duration, with specific capacity decreasing as pumping time increases. Additionally, specific capacity also generally decreases as discharge rate increases. Both of these responses are due to the dewatering of the aquifer within the domain of the cone of depression; for a given amount of drawdown, the yield progressively becomes less as the saturated thickness of the aquifer is reduced. Specific capacity may also vary with yield as function of the system efficiency, including the pump, well, discharge piping, well efficiency, etc., which all add an element of friction to the process.

The analysis of specific capacity test data is relatively straightforward, and based on equations presented in Jacob (1946) and Lohman (1972). Bradbury and Rothschild (1985) compiled a computer program to accept specific capacity data and output aquifer transmissivity. This program accounts for well loss and partial penetration, and is easily compiled from the reference. The treatment of partial penetration in the program is straightforward, and is treated mathematically in the reference. Well loss is less apparent, and is discussed further.

Well loss in an important factor in the analysis of specific capacity data when yield rate is substantially high. Well loss, or head loss due to well inefficiency, is due to turbulent flow of water through the well bore, into the well, and into the pump. Well loss is expressed as a percentage, or as a coefficient.

The equation representing general well loss (Walton, 1987) is expressed as:

Equation 1 $$S_\omega = CQ^2$$

Where:

S_ω = drawdown component due to well loss, in feet
C = well coefficient, in sec^2/ft^5
Q = production well discharge rate, in cubic feet per second (cfs) (1 cfs = 449 gallons per minute [gpm])

Values of the well loss coefficient as used in the Bradbury and Rothschild program for production wells are generally less than 10 and are more often than not less than 2 (Walton, 1987). Typically, well loss is calculated using step drawdown test data. During a step drawdown test, yield rate and drawdown are measured synoptically while the pump is operated at successive stages at some fraction of full capacity. Using a step test data, the well loss coefficient may be estimated by the following equation (Walton, 1987):

Equation 2 $$C = \frac{(\Delta S_n/\Delta Q_n) - (\Delta S_{n-1}/\Delta Q_{n-1})}{(\Delta Q_{n-1} + \Delta Q_n)}$$

The following example illustrates a typical well loss coefficient calculation: A step drawdown test was performed. The pumping rates and times are shown below:

Start Time	End Time	Pumping Rate (gpm)
10:30	12:40	13.3
12:40	14:00	25.0
14.00	14.20	42.0

During the pumping periods, the water levels in the pumping well were recorded using an electronic water/level indicator. Data required to calculate the well loss coefficient are shown below:

Step # (n)	Q (gpm)	Q (cfs)	ΔQ (cfs)	s (ft)	Δ s (ft)
1	13.3	0.0296	0.0296	5.6	5/.6
2	25.0	0.0557	0.0261	11.6	6.0
3	42.0	0.0935	0.0378	21.2	9.6

Where:

Q = Actual discharge for the time step
ΔQ = Increase in discharge for the time step
S = Drawdown at the time step pumping rate
ΔQ = Increase in drawdown from the previous time step

Using Equation 2, the well loss coefficients are:

C 1.2 = 730.7 sec^2 / ft^5
C 2.3 = 377.1 sec^2 / ft^5

Therefore, the average well loss coefficient is 553.9 sec^2 / ft^5. Using Equation 1, the well loss at 42 gpm is theoretically calculated to be 4.8 feet.

The importance of determining the well loss coefficient will depend on the yield rate of the test. Because of the association with turbulent flow, calculation of the well loss coefficient may be impractical and unnecessary for a yield rate of a few gallons per minute or less.

The procedure for conducting a specific capacity test is quite simple, and consists of the following general steps:

1) Open the well to vent;

2) Measure the static water level;

3) Insert pump into well and allow to equilibrate;

4) Remeasure water level to ensure equilibration following pump insertion;

5) Initiate pumping;

6) Measure yield rate and drawdown synoptically at regular and frequent intervals, and record on the specific capacity test form;

7) Pump until drawdown stabilized (subjective determination; generally measurements within 0.03 feet over a ten minute interval can be considered stable);

8) Terminate pumping; and

9) Measure water levels at frequent intervals during recovery to ensure original static water level is reached; the water level measured when residual drawdown stabilized should be used as the static water level.

RULES OF THE NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
CHAPTER 40A-3, FLORIDA ADMINISTRATIVE CODE

REGULATION OF WELLS

Effective March 1, 2000

Regulatory Guidelines #2000-2

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
CHAPTER 40A-3, FLORIDA ADMINISTRATIVE CODE
REGULATION OF WELLS
(Revised March 1, 2000)

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REGULATION OF WELLS

40A-3.011 POLICY AND PURPOSE.

(1) The purpose of Chapter 40A-3, Florida Administrative Code, is to implement the duties and responsibilities of the District under Part III, Chapter 373, Florida Statutes, and those responsibilities and duties delegated to the District by the Department of Environmental Protection relative to regulating the location, construction, repair, or abandonment of wells, and the licensing of water well contractors. It is the policy of the Board that these rules are a reasonable necessity to insure the protection and management of water resources and the health, safety, and general welfare of the people of this District.

(2) The rules in this Chapter implement the regulation of wells and licensing of water well contractors through the following parts:

(a) Part I of this Chapter establishes a permitting system for the location, construction, repair or abandonment of wells.

(b) Part II of this Chapter establishes the minimum standards for the construction, repair, or abandonment of wells.

(c) Part IV of this Chapter provides for suspension and revocation of water well contractor licenses.

(d) Part V of this Chapter provides for enforcement and penalties.

(e) Rules relating to water well contractor licensing are found in Chapter 62-531, Florida Administrative Code, adopted by reference in Section 40A-3.037 of these rules.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.333, 373.337, FS.
Law Implemented: 373.306, 373.308, 373.309, 373.313, 373.316, 373.323(2), 373.324, 373.326, 373.329, 373.333, 373.342, FS.
History–New 4-14-80; Amended 4-13-81, 2-1-82, 10-1-84, 1-9-86, 8-1-89; Formerly 16G-3.01.

40A-3.021 DEFINITIONS.

The following words and phrases, when used in these rules, shall have the following meanings, except where the context clearly indicates a different meaning:

(1) ***"Abandonment"*** means the act, whether intentional or unintentional, of allowing a well to attain the condition of an abandoned well.

(2) ***"Abandoned Well"*** means a well the use of which has been permanently discontinued. Any well shall be deemed abandoned which is in such a state of disrepair, as determined by a representative of the District, that continued use for the purpose of obtaining ground water or disposing of water or liquid wastes is impracticable.

(3) ***"Aesthetic Use"*** means the use of water for fountains, waterfalls, and landscape lakes and ponds where such uses are ornamental and decorative.

(4) ***"Agricultural Irrigation Use"*** means the use of water for the commercial production of crops or the growing of farm products, including vegetables, citrus, pasture, nursery stock, turf grass, and sod.

(5) ***"Annulus"*** or ***"Annular Space"*** means any artificially created void existing between a well casing or liner pipe and a borehole wall.

(6) ***"Aquacultural Use"*** includes the use of water for spawning, cultivating, harvesting, or marketing of fin-fish, shellfish, crustaceans, frogs, turtles, and other aquatic organisms that have a sport or other economic value.

(7) ***"Aquifer"*** means a subsurface geologic unit capable of yielding significant quantities of water to wells and springs.

(8) ***"Aquifer Restoration Well"*** means a well used for the withdrawal of water for the purpose of recovering contaminant(s) to restore or improve the quality of the water within an aquifer.

(9) ***"Artificial Recharge"*** means the intentional introduction of water into any underground formation by means of a recharge or injection well.

(10) ***"Artificial Recharge Facility"*** means any facility constructed for the intentional introduction of water into any underground formation.

(11) ***"Board"*** means the Governing Board of the Northwest Florida Water Management District.

(12) ***"Certified Receipt"*** means the date and time an application for a permit is stamped as received in the District office.

(13) ***"Commercial Use"*** includes small businesses and facilities in which water is the prime ingredient of the service rendered, such as a car wash and laundromat.

(14) ***"Contractor"*** means any person licensed in accordance with Chapter 62-531, Florida Administrative Code, and engaged in the business of construction, repair, or abandonment of wells.

(15) ***"Construction of Wells"*** means all parts and acts necessary to obtain ground water by wells, including the location and excavation of the wells, but excluding the installation of pumps and pumping equipment.

(16) ***"Department"*** means the Department of Environmental Protection (DEP) or its successor agency or agencies.

(17) ***"Domestic Self Supply Use"*** means the use of water for household purposes such as drinking, bathing, cooking, sanitation, or cleaning, which occurs in a private residence, and includes no more than one rental residence or no more than four nonrental residences served by one well.

(18) ***"Dewatering Use"*** means the removal of water from a specific area to facilitate mining or construction.

(19) ***"District"*** means the Northwest Florida Water Management District operating under the authority of Chapter 373, Florida Statutes.

(20) ***"Diversion and Impoundment into Non-District Facilities Use"*** means the diversion or extraction of water into non-District impoundments and delivery systems designed for such purposes as maintaining structural integrity, providing agricultural water

and other non-recreational, non-aesthetic use.

(21) ***"Drive Shoe"*** means any device specifically designed, fabricated, and installed to protect the bottom end of a water well casing or liner pipe from collapse or other damage while the casing or liner pipe is being driven into place in a well.

(22) ***"Essential Use"*** includes the use of water strictly for fire-fighting purposes, health and medical purposes, and the use of water to satisfy federal, state, or local public health and safety requirements.

(23) ***"Freeze Protection"*** includes the periodic and infrequent use of water to protect agricultural and nursery crops from permanent damage due to low temperatures.

(24) ***"Golf Course Irrigation Use"*** is the use of water to irrigate golf courses.

(25) ***"Grout"*** means a mixture consisting of water and Portland cement (American Concrete Institute type I or American Concrete Institute type III), sand and Portland cement mixed at three parts sand to one part cement by weight, or other approved types of cement and acceptable amounts of those additives approved by the District for use in cement grouts. The use of alternative methods or materials shall not cause degradation of the water resource. Grout composition shall not exceed six (6) gallons of water per cubic foot or sack of cement.

(26) ***"Heating or Cooling Use"*** means the use of water for heating, air-conditioning, or other cooling uses.

(27) ***"Industrial Use"*** includes those many uses wherein the water serves the purposes of manufacturing, commerce, trade or industry.

(28) ***"Injection Well"*** means a well for the express purpose of introducing under pressure any water into underground formations. This includes return wells for air conditioning systems and injection of water under pressure into underground formations for the possible purpose of storage and later recovery.

(29) ***"Landscape Irrigation Use"*** is the outside watering of plants, shrubs, grass, trees, and other such flora in landscapes surrounding homes, non-commercial house-hold gardens, industrial buildings, parks, recreational areas, cemeteries, public right-of ways, and medians.

(30) ***"Livestock and Other Animals Use"*** includes water for drinking by or washing of livestock, including zoo animals.

(31) ***"Mining Use"*** includes use wherein the water is applied for the extraction, transportation, or processing of minerals.

(32) ***"Navigation Use"*** means water discharged from ground or surface sources either to tide water or to downstream lakes or reaches of rivers or canals for the purpose of permitting or protecting boating activity.

(33) ***"Nursery Irrigation Use"*** (Non agricultural) is the use of water on premises on or in which nursery stock is held for sale, distribution or is sold or reshipped. This term does not apply to

water used for production of nursery stock.

(34) ***"Other Outside Use"*** means the use of water outdoors for dust control, maintenance, cleaning, and washing of structures and mobile equipment, including automobiles and the washing of streets, driveways, sidewalks, and similar areas.

(35) ***"Limited Use Public Supply"*** means the use of water in public water systems not covered under the definitions of Domestic Self Supply Use or Public Water Supply Use of this section, and which is further defined as either:

(a) ***"Limited Use Commercial Public Water Systems Use"*** means the use of water by one or more nonresidential establishments; or

(b) ***"Limited Use Community Public Water System Use"*** means the use of water by five or more private residences or two or more rental residences.

(36) ***"Perishable Food Processing Use"*** includes industrial uses involving the processing of perishable food.

(37) ***"Power Production Use"*** includes use for steam or co-generation and the use of water for cooling and for replenishment of cooling reservoirs.

(38) ***"Public Water Supply Use"*** is the use of water as defined by the Florida Safe Drinking Water Act, and means the use of water by a Public Water System.

(39) ***"Public Water System"*** means a system for supplying water for human consumption, if such system has at least 15 service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A Community Water System is a public water system which has at least 15 service connections used by year-round residents or which regularly serves at least 25 year-round residents. A Non-Community Water System is a public water system which serves at least 25 individuals daily at least 60 days out of the year but the individuals served are not year-round residents and may be transients.

(40) ***"Recharge Well"*** means a well for the express purpose of introducing any waters into any underground formation. This definition shall include drainage or connector wells.

(a) ***"Drainage Well"*** generally describes a well for the express purpose of disposing of excess surface waters by gravity flow into any underground formation.

(b) ***"Connector Well"*** is a well for the express purpose of draining one aquifer and allowing this water to recharge another aquifer (interaquifer transfer).

(41) ***"Recreation Area Irrigation Use"*** is the use of water to irrigate recreational areas such as soccer, baseball, and football fields or playgrounds.

(42) ***"Repair"*** means any action which involves the physical alteration or replacement of any part of a well, but does not include the alteration or replacement of any portion of a well which is above ground surface.

(43) ***"Sanitation Use"*** includes supplying water for toilet facilities, and for cleaning, when the use is in a non-residence. This use does not include drinking water or water used in cooking.

(44) ***"Soil Flooding Use"*** means the use of water for raising of water levels on agricultural lands for purposes not directly related to such purposes as crop growth, soil preservation, crop harvesting, and pest control.

(45) ***"Test Well"*** or ***"Test Hole"*** is a well constructed for temporary use, designed to allow specific geological or groundwater parameters to be examined prior to the construction of a permanent well.

(46) ***"Water-Based Recreation Use"*** is the use of water for public or private swimming and wading pools and other water-oriented recreation such as fishing, boating, and swimming, and including water slides.

(47) ***"Well"*** means any excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed when the intended use of such excavation is for the location, acquisition, development, or artificial recharge of ground water, but such term does not include any well for the purpose of obtaining or for prospecting for oil, natural gas, minerals, or products of mining or quarrying, for inserting media to dispose of oil brines or to repressure oil or natural gas-bearing formations, or for storing petroleum, natural gas, or other products; or for temporary dewatering of subsurface formations for mining, quarrying, or construction purposes.

(48) ***"Well Completion"*** means a well that meets all construction standards specified in Part II.

(49) ***"Well Seal"*** means an arrangement or device that prevents contaminants from entering the well at the upper terminal and that is approved by the District as satisfying the requirements of Section 40A-3.521 of this rule.

(50) ***"Onsite Sewage Disposal System (OSDS)"*** means a sewage treatment and disposal facility, which may contain a standard subsurface, filled, or mound drainfield system, an aerobic treatment unit, a graywater system tank, a laundry wastewater system tank, a septic tank, a grease interceptor, a dosing tank, a solids or an effluent pump, alternative system or experimental system.

(51) ***"Sanitary Hazard"*** means a physical condition which involves or affects any part of a drinking water system or the raw water source, and that creates an imminent or potentially serious risk to the health of any person who consumes water from that system.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS.
Law Implemented: 373.303, 373.306, 373.308, 373.309, 373.313, 373.316, 373.319, 373.323(2), FS.
History–New 4-14-80; Amended 2-1-82, 3-29-84, 10-1-84, 1-9-86, 4-5-88, 8-1-89, 12-1-90, 11-1-92, 11-1-93, 11-1-95, Amended 7-1-98; Formerly 16G-3.02.

40A-3.031 IMPLEMENTATION.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.103(1), 373.306, 373.308, 373.309, 373.313, 373.314, 373.316, 373.319, 373.323(2), 373.326, 373.329, 373.333, 373.342, FS.
History–New 4-14-80; Amended 2-1-82; 10-7-82; 1-9-86; Formerly 16G-3.03; Repealed 7-1-98.

40A-3.032 DELEGATION.

Specific Authority: 373.044, 373.113, 373.171, FS.
Law Implemented: 373.308, 373.309(2), 373.342, FS.
History–New 1-9-86, Repealed 7-1-98.

40A-3.037 WATER WELL CONTRACTOR LICENSING.

(1) Chapter 62-531, Florida Administrative Code, which requires the licensing of water well contractors, is hereby adopted by reference and made part of this rule. The licensing program shall be administered and enforced by the District under the authority delegated to it by the Department of Environmental Protection by Order dated July 11, 1984.

(2) Unlicensed persons violating the provisions of Chapter 373, Florida Statutes, or these rules, or orders of the District are subject to the disciplinary procedures prescribed in Section 373.323, Florida Statutes.

Specific Authority: 373.044, 373.113, 373.323, 373.337, FS.
Law Implemented: 373.323, FS.
History–New 10-1-84; Amended 8-1-89.

40A-3.038 VIOLATIONS OF LICENSING REQUIREMENTS.

(1) Actions, omissions, or conduct by any contractor licensed by this District which may be considered as violations for the purposes of Chapter 62-531, Florida Administrative Code, shall include the following:

(a) Practicing with a revoked, suspended, or inactive license.

(b) Attempting to obtain, obtaining, or renewing a license under this part by bribery or fraudulent misrepresentation.

(c) Being convicted or found guilty, regardless of adjudication, of fraud or deceit or of gross negligence, incompetency, or misconduct in the performance of work, or of a crime in any jurisdiction which directly relates to the practice of water well contracting or the ability to practice water well contracting.

(d) Failure to display the contractor license number in a conspicuous place on both sides of each piece of drilling equipment owned, leased, or operated by the contractor.

(e) Failure to notify the District in writing within 15 days of any change in official address.

(f) Having had administrative or disciplinary action relating to water well construction, repair, or abandonment taken by any municipality or county or any state agency. These actions shall be reviewed by the District before it takes any disciplinary action of its own.

(g) Constructing, repairing, or abandoning a water well without first obtaining all applicable permits.

(h) Allowing any other person to use the license.

(i) Violating or refusing to comply with any provision of Chapter 373, Florida Statutes, or rule adopted by the District, or any order of the District previously entered in a disciplinary hearing.

(j) A licensed water well contractor shall not allow an unlicensed

individual to construct, repair or abandon wells under the licensed well contractor's license unless: (a) the unlicensed individual is employed and supervised by the licensed contractor or (b) the licensed well contractor has a contractual agreement with the unlicensed subcontractor in which the licensed contractor obtains all well permits, supervises all well work and accepts full responsibility for the subcontractors well drilling activity.

(2) Actions which may be taken by the District upon determination that a violation has occurred are outlined in Chapter 62-531, Florida Administrative Code, adopted by reference and made a part of this rule.

Specific Authority: 373.044, 373.113, 373.171, 373.323, 373.337, FS. Law Implemented: 373.323, 373.333, 373.336, FS. History–New 1-9-86; Amended 8-1-89, 12-1-90, 11-1-92.

PART I - PERMITTING OF WELLS

40A-3.040 SCOPE OF PART I.

Specific Authority: 373.044, 373.113, 373.171, FS. Law Implemented: 373.303, 373.308, 373.309, 373.316, 373.326, 373.342, FS. History–New 1-9-86, Repealed 7-1-98.

40A-3.041 PERMITS REQUIRED.

(1) Unless expressly exempted by Statute or District rule, a permit must be obtained from the District prior to construction, repair, or abandonment of a well and the well must be constructed, repaired, or abandoned by a licensed water well contractor. Any potable water well proposed within an area of ground water contamination, as delineated by the Department, will be permitted pursuant to Chapter 62-524, Florida Administrative Code.

(2) A permit to construct, repair, modify or abandon any water well meeting the provisions of Chapter 373, Part III, Florida Statutes, and Chapter 40A-3, Florida Administrative Code, will be issued by the Executive Director. However, if a permit request is considered for denial or a written objection is filed to the issuance of a permit, or the application is for the construction of an artificial recharge facility, then the application shall be processed in accordance with the applicable provisions of 40A-1.203, Florida Administrative Code, and acted upon by the District's Governing Board.

(3) Permit applications shall be filed with the District on NWFWMD Form No. 10, revised 11/1/95, hereby incorporated by reference. The required fee shall be submitted with the permit application. Applications to construct an artificial recharge facility shall be accompanied by a completed copy of the appropriate artificial recharge application required pursuant to 62-528, Florida Administrative Code.

(4) Permits for water use must be obtained under the provisions of Chapter 40A-2, Florida Administrative Code. A well shall not be constructed until an Individual water use permit is granted, if a water use permit is required.

(5) Additional information may be required such as: geophysical logs, geologic samples and logs, a list of proposed construction methods, a description of proposed pump tests, a list of well

specifications, a description of the proposed water quality monitoring systems, and a description of the proposed total monitoring system.

(6) Receipt of the permit will constitute permission to begin well construction, repair, or abandonment.

(7) The District permit for a public water supply well does not constitute approval of the public water system. A separate application must be submitted to the Department in accordance with Subsection 62-555.102(2), Florida Administrative Code, to obtain a permit to construct or alter a public water supply system.

(8) The permit shall be available at the site of the well during construction, repair, or abandonment.

(9) Any permittee who desires to change the location of a well or otherwise amend a permit shall apply to the District for an amendment. No charge shall be made to amend the permit. As a condition to approving any amendment, the District may require remedial action to bring any work accomplished under the original permit into compliance with provisions of this Chapter.

(10) A repair permit is not necessary if remedial work is performed on a well before the expiration date of the construction permit; however, an updated completion report should be filed with the District if the well depth or casing depth is increased.

(11) Permits will not be granted after a water well has been constructed, repaired, or abandoned, except in the case of subsection (12) below. As a condition to the enforcement action taken, a contractor will be required to submit a permit application and completion report for the District's records.

(12) A permit to abandon is required for any well which was constructed and found unsuitable for use. If the contractor is in the drilling process and needs to abandon, he may perform the work prior to obtaining a permit; however, the permit must be obtained by telephone or in person no later than 24 hours following the well abandonment. The hole must be properly abandoned (plugged) according to the standards of Subsection 40A-3.531(4), Florida Administrative Code.

(13) If a well unsuitable for use is abandoned (plugged), and the contractor plans to construct a new well, he may use the construction permit granted for the first well, provided that it has not expired.

(14) Receipt of a permit from the District does not alleviate the responsibility of the applicant to obtain other permits that may be necessary from local, state, or federal agencies. If more stringent rules concerning construction standards for water wells are promulgated by local permitting authorities, those standards shall apply.

(15) A permit to abandon a test well or test hole is required to be obtained by the property owner, through a licensed water well contractor, within six (6) months from the date of well construction permit issuance. However, if the test well or test hole was constructed to permanent well standards and meets all applicable setback

requirements, the well may be converted to permanent well status by obtaining an additional construction permit for the new permanent well type. A new permit application fee must also be submitted in accordance with the proposed permanent well type.

Specific Authority: 373.044, 373.113, 373.171, 373.337, FS. Law Implemented: 373.106, 373.109, 373.306, 373.308, 373.309, 373.313, 373.314, 373.316, 373.342, FS. History–New 4-14-80: Amended 4-13-81, 2-1-82, 10-7-82, 3-29-84, 1-9-86, 8-1-89, 12-1-90, 2-14-91, 11-1-95, 7-1-98; Formerly 16G-3.04, 16G-3.11.

40A-3.051 EXEMPTIONS.

(1) A permit is not required prior to the construction, repair, or abandonment of any well exempted by Subsection 373.303(7) and Section 373.326, Florida Statutes (any well for the purpose of obtaining or prospecting for oil, natural gas, minerals, or products of mining or quarrying; wells for inserting media to dispose of oil brines, or to repressure oil or natural gas-bearing formations; wells for storing petroleum or natural gas or other products; or wells used for temporary dewatering for construction purposes).

(2) When the District finds that compliance with all requirements of this Chapter would result in undue hardship, supported by information which demonstrates that the intent and purpose of the rule will not be impaired, an exemption from any one or more such requirements shall be granted by the District to the extent necessary to ameliorate such undue hardship. Such information may include water quality sampling or other reasonable information or action deemed necessary to assure the well will not adversely impact the water resource. The request for an exemption must be submitted in writing and detail the reasons why compliance with the requirements of this Chapter will create a hardship.

(3) A water well contractor license is not required for a homeowner when he plans to construct a well two (2) inches or less inside diameter on his own or leased property, intended for use only at a single family house which is his residence or intended for use only for farming purposes on his farm, and when the waters to be produced are not intended for use by the public or any residence other than his own. However, the well construction must meet all applicable standards of Part II of these rules, and the requirements for a Consumptive Use Permit.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.303, 373.306, 373.308, 373.309, 373.313, 373.316, 373.326, FS. History–New 4-14-80: Amended 2-1-82, 5-17-83, 3-29-84, 1-9-86, 8-1-89, 12-1-90, 11-1-92, 7-1-98; Formerly 16G-3.05, 16G-3.12.

40A-3.201 PERMIT APPLICATION FEES.

(1) There shall be an application fee according to the following schedule, unless the well is a potable well within a delineated area as established by the Department, pursuant to Chapter 62-524, Florida Administrative Code:

OUTSIDE DIAMETER OF CASING

	OUTSIDE DIAMETER OF CASING	FEE *
Public Supply Wells, Construction and Repair	All Diameters	$250.00
Limited Use Public Supply Wells, Construction and Repair	All Diameters	$200.00
All Other Wells, Construction and Repair, Not Listed Above	6 Inches and larger Diameter	$100.00
All Other Wells, Construction and Repair, Not Listed Above	4 Inch Diameter, but less than 6 Inch Diameter	$50.00
All Other Wells, Construction and Repair, Not Listed Above	Less than 4 Inch Diameter	$35.00
Monitor Wells	All Diameters	$30.00
Well Abandonment	All Diameters	$10.00
Emergency Telephone Authorization – Added to Regular Permit Fee	All Diameters	$25.00
Exemption (Variance) - Added to Regular Permit Fee	6 Inches and Larger Less Than 6 Inches	$150.00 $50.00

(2) There shall be an application fee according to the following schedule, for those potable wells constructed within an area of groundwater contamination, as delineated by the Department pursuant to Chapter 62-524, Florida Administrative Code:

OUTSIDE DIAMETER OF CASING

	OUTSIDE DIAMETER OF CASING	FEE *
Public and Limited Use Public Supply Wells	All Diameters	$500.00
Potable Wells Serving Single Family Residences	All Diameters	$100.00
Exemption (variance) - Added to Regular Permit Fee	6 Inches and Larger Less Than 6 Inches	$150.00 $50.00

* All permit application fees shall be non-refundable.

Note: The Emergency Telephone Authorization Fee and Exemption Fee are in addition to the standard permit fees listed above, and shall accompany applications for permits.

Specific Authority: 373.044, 373.109, 373.113, 373.171, 373.337, FS.
Law Implemented: 373.109, 373.309, FS.
History–New 4-14-80; Amended 6-11-80, 4-13-81, 2-1-82, 5-17-83, 1-9-86, 8-1-89, 1-1-90, 12-1-90, 2-14-91 11-1-93; Formerly 16G-3.20, 16G-3.13.

40A-3.301 CONDITIONS FOR ISSUANCE OF PERMITS.

(1) The District shall complete action upon any permit application within fourteen (14) days after receipt of a complete application, except in the case of water wells constructed for public water supply systems as defined in Section 62-555.200, and wells constructed for the artificial recharge of water, wells requiring an Individual Water Use Permit under provisions of Chapter 40A-2, Florida Administrative Code, in which case permit action shall be completed within 90 days of receipt of a complete application for the construction of an artificial recharge well or Chapter 40A-2 Florida Administrative Code application.

(2) The issuance of a permit is dependent upon:

(a) The application being accompanied by the required fee, and containing the information required on NWFWMD Form No. 10. An application will be deemed incomplete if any portion of the application form is left blank or if the required sketch is illegible, does not provide the means to locate the proposed well, or is not consistent with the land coordinates provided in the application.

(b) The proposed construction, repair, or abandonment being in accordance with applicable law, rules, and orders.

(c) The work being done for a purpose and in a manner which is consistent with generally accepted engineering,

hydrologic, and hydrogeologic practices.

(d) Whether the construction of the well will adversely affect the ground water resources.

(e) Whether the proposed well's proximity to an area of ground water contamination delineated under the provisions of Chapter 62-524, Florida Administrative Code, may adversely affect the ground water resources or present a threat to the health, safety, and welfare of individuals who, through ingestion, inhalation, or dermal absorption may be exposed to ground water contamination.

(f) Whether the Governing Board has approved the issuance of an Individual Water Use permit or the construction of an artificial recharge well, if applicable.

(3) A permit may be granted with certain conditions or restrictions, such as:

(a) Geologic samples required;

(b) Geophysical logs required;

(c) Pumping test required;

(d) Borehole diameter restricted;

(e) Total depth restricted;

(f) Length of casing specified;

(g) Capacity of pump restricted;

(h) Water use permit required;

(i) Grouting inspection required;

(j) Grout specified;

(k) Water quality sampling required;

(l) Water Treatment Systems (including filters);

(m) In areas delineated under the provisions of Chapter 62-524, Florida Administrative Code, a water well construction permit shall not be issued unless the well is constructed to criteria intended to protect the water resources from further contamination and the health, safety, and welfare of individuals who, through ingestion, inhalation, or dermal absorption may be exposed to ground water contamination. This criteria shall include stipulations on any of the following items: casing depth, construction method, well depth, water quality sampling, grout specifications, the installation of a water treatment system such as a filter and setback distance from a specific known source of contamination;

(n) Other such reasonable conditions as are necessary to assure that the well will comply with the requirements of Chapter 373, Florida Statutes, and will not adversely impact the water resources of the District.

(4) If the permit is obtained by the owner, the permit will be granted with the condition that the permit document be signed by the licensed water well contractor who will perform the work and return the permit to the District prior to construction, repair, or abandonment.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS.
Law Implemented: 373.109, 373.306, 373.308, 373.309, 373.313, 373.323, FS.

History–New 4-14-80; Amended 2-1-82, 10-7-82, 5-17-83, 3-29-84, 1-9-86, 8-1-89, 2-14-91, 11-1-92, 11-1-95, 7-1-98; Formerly 16G-3.30, 16G-3.14.

40A-3.321 DURATION OF PERMITS.

All permits shall be valid for a period of ninety (90) days. If construction, repair, or abandonment is not completed within that time, the District shall extend the permit for a period not to exceed ninety (90) days provided the conditions of the original permit application have not changed. Public water supply well permits may be renewed for a period of up to one (1) year from the date of permit issuance (in increments of ninety days per renewal request only). The District must receive a written request for an extension from the permittee or permittee's agent before the original permit expires.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.308, 373.309, FS. History–New 1-9-86; Amended 8-10-87, 8-1-89, 12-1-90, 11-1-95; Formerly 40A-3.041.

40A-3.341 DISAPPROVAL OF WELLS.

(1) The District may disapprove any water well or abandoned well if the District finds, after inspection, that the well does not comply with the provisions of this Chapter.

(2) The District may disapprove any well if the well is determined not to be suitable for the intended use identified in the application submitted to the District or if the well represents a threat to the water resources, or if the well is determined by the Department of Environmental Protection or the Department of Health and Rehabilitative Services to pose a threat to the health, safety, or welfare of the user.

(3) No well which has been disapproved may be used until it has been brought into compliance with this Chapter. A well that cannot be brought into compliance with the District's rules shall be abandoned as required by Subsection 40A-3.531(4), Florida Administrative Code.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS.
Law Implemented: 373.306, 373.308, 373.309, 373.319, FS.
History–New 4-14-80; Amended 4-13-81, 2-1-82, 10-1-84, 8-1-89, 7-1-98; Formerly 16-3.34, 16G-3.18.

40A-3.342 PERMIT DENIAL.

(1) The District shall issue a notice of Intent to Deny whenever it determines that an application for a permit under 40A-3.041 fails to meet the requirements of Chapter 373, Florida Statutes, or 40A-3, Florida Administrative Code, or any rule, order, or standard adopted pursuant thereto.

(2) The Notice of Intent to Deny shall:

(a) State the grounds for denial;

(b) Give the date of the Governing Board meeting at which the recommendation for denial shall be presented according to the procedures set forth in Subsection 40A-3.342(3); and

(c) Be served in writing upon the contractor and owner at their last known addresses by registered or certified mail.

(3) The Governing Board shall be presented with a recommendation for denial of a permit application at the first regularly scheduled Board meeting following the determination that an application for a permit under 40A-3.041 fails to meet the requirements of Chapter 373, Florida Statutes, or 40A-3, Florida Administrative Code, or any rule, order, or standard adopted pursuant thereto. At

that time pertinent facts concerning the basis for denial shall be presented, and the contractor and owner will have an opportunity to present pertinent information. The Governing Board shall then decide to:

(a) Grant a permit to construct, repair, or abandon a water well as specified in the application;

(b) Grant a permit as in (a) above except that certain conditions or restrictions authorized by law are imposed; or,

(c) Deny a permit, stating the reason for such denial.

(4) The District shall notify the contractor and owner of final Board action described in 40A-3.342(3) within fourteen (14) days after the action. The Notice of Denial shall:

(a) State the grounds for denial; and

(b) Be served in writing upon the contractor and owner at their last known addresses by registered or certified mail.

(5) Any person receiving a denial may request a hearing by filing a written petition with the District within 21 days of the mailing of the notice.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.306, 373.313, FS.
History–New 4-14-80; Amended 2-1-82, 1-9-86, 4-5-88, 11-1-92, 7-1-98; Formerly 16G-3.17, 16G-3.31.

40A-3.411 COMPLETION REPORTS.

(1) Within thirty (30) days after the expiration of a permit, a well completion report shall be filed with the District on the forms provided by the District and in accordance with the instructions provided thereon.

(2) If no work is performed or if the well is not completed, a report shall be filed within thirty (30) days of the expiration of the permit stating that no well construction was performed under the permit or outlining the status of the incomplete well.

(3) NWFWMD Form 114 shall be used to report the completion of construction, repair, or abandonment of any well within District jurisdiction.

(4) The water well contractor shall provide the well owner a copy of the well completion report.

(5) The information filed as a part of the completion report shall be truthful and accurate in providing the specifications and characteristics of the constructed well.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS.
Law Implemented: 373.308, 373.309, 373.313, FS.
History–New 4-14-80; Amended 5-17-83, 1-9-86, 8-1-89, 11-1-95; Formerly 16G-3.41, 16G-3.15.

40A-3.451 EMERGENCY AUTHORIZATION.

(1) Permission to begin construction, repair, or abandonment of any well may be applied for by telephone when conditions exist which would justify such a request. The District may grant such permits at its discretion. However, a serious set of unforeseen circumstances must exist to create an emergency. Mere carelessness,

lack of planning on the part of the applicant (the owner or the contractor for the owner) or a desire to expedite the required work shall not be sufficient grounds to warrant the granting of an emergency authorization.

(2) Emergency permits shall be obtained from the District Headquarters only.

(3) Emergency permit applications shall be accompanied by a $25.00 fee in addition to the standard fee.

(4) The recipient of an emergency authorization shall submit an application in writing in accordance with the provision of 40A-3.041, Permits Required. Permit applications shall be postmarked within 24 hours of the time the emergency authorization was granted by the District; the application shall also be accompanied by a handwritten note stating the nature of the emergency. All other provisions of these rules shall remain in force.

(5) Failure to fulfill the guidelines for obtaining emergency permits may result in the issuance of a Notice of Violation under the provisions of Rules 40A-3.041, 40A-3.301, and 40A-3.451, Florida Administrative Code.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.109, 373.308, 373.309, 373.313, 373.326, 373.333, 373.342, FS. History–New 4-14-80; Amended 1-9-86; Formerly 16G-3.45, 16G-3.16.

40A-3.461 INSPECTIONS.

(1) The District is authorized to inspect any water well or abandoned water well within its area of responsibility. The District may cause to be made such inspections as it deems necessary to insure conformity with applicable standards of this rule chapter. Duly authorized representatives of the District may, at reasonable times, enter upon and shall be given access to any premises for the purpose of such inspection.

(2) If, upon the basis of such inspections, the District finds the standards of this rule chapter have not been met, the District shall give the owner and contractor written notice stating which rules have been violated and shall order that necessary corrective action be taken within a reasonable time to be prescribed in such order. Failure to act in accordance with the order of the District after receipt of written notice shall be grounds for disapproval of the well.

(3) A site inspection must be completed by an authorized representative of the District or the Department prior to issuing a permit for construction of a public water supply well.

(4) The District shall be notified at least 24 hours in advance of placement of grout in the annular space of any public supply water well; failure to notify the District sufficiently in advance may result in delay of completion of the well. A District representative will be on site to observe the grouting. If the District is properly notified and an inspector is not at the site at the appointed time, the grouting may be accomplished in his absence.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.119, 373.308, 373.309, 373.319, 373.333, FS. History–New 4-14-80; Amended 2-1-82, 1-9-86, 7-1-98, 3-1-00; Formerly 16G-3.22.

40A-3.492 VIOLATIONS OF PERMITS.

(1) Actions, omissions, or conduct which shall be considered as violations for the purposes of Part I, Permitting, shall include the following:

(a) Failure to obtain a permit where required under Section 40A-3.041.

(b) Failure to provide accurate information in the application for a permit.

(c) Failure to fulfill the guidelines for obtaining an emergency permit.

(d) Failure to comply with any or all permit conditions.

(e) Failure to submit a completion report within the time period specified in Section 40A-3.411.

(f) Failure to file an accurate completion report.

(g) Failure to report to the District within thirty (30) days of expiration of the permit when no work is performed or the well is not completed.

(h) Failure to notify the District 24 hours prior to the grouting of the annular space of any public supply well.

(i) Failure to fulfill any other applicable requirements of Chapter 373, Part III, Florida Statutes, or Chapter 40A-3, Florida Administrative Code.

(2) Actions which may be taken by District staff upon determination that a violation has occurred are outlined in Section 40A-3.980, of these rules.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, 373.319, FS. History–New 1-9-86; Amended 11-1-92, 11-1-95; Formerly 40A-3.953, FAC.

PART II - CONSTRUCTION, REPAIR, AND ABANDONMENT STANDARDS

40A-3.500 SCOPE OF PART II.

Specific Authority: 373.044, 373.113, 373.171, FS. Law Implemented: 373.308, 373.309, 373.313, FS. History–New 1-9-86, Repealed 7-1-98.

40A-3.502 CONSTRUCTION METHODS.

(1) Wells must be so constructed, cased, grouted, plugged, capped, or sealed as to prevent uncontrolled surface flow, uncontrolled movement of water from one aquifer or zone to another, contamination of ground water or surface water resources, or other adverse impacts. The foregoing shall apply to all construction, repair or abandonment of wells in the District except for public water supply wells, which shall be constructed, repaired, or abandoned in accordance with Chapter 62-555, Florida Administrative Code.

(2) The well construction regulations promulgated by the Department governing the construction of potable wells in delineated areas, as set forth in Chapter 62-524, Florida Administrative Code, are hereby adopted by reference and made a part of this rule, and shall apply to all potable wells constructed, altered, repaired, or abandoned in those delineated areas of the District.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, FS. History–New 1-9-86; Amended 12-1-90, 2-19-91, 11-1-95.

40A-3.504 LOCATION.

(1) Wells shall be located so as to not pose a threat of contamination to the District's water resources and to provide for the

protection of the health, safety, and welfare of the user.

(2) Minimum spacing between wells and sanitary hazards such as septic tanks, drainfields, ground water contamination areas, cesspools, etc. shall be as specified by Section 381.0065 and Chapter 373, Part III, Florida Statutes, and the respective rules of the Department of Health and Rehabilitative Services and the Florida Department of Environmental Protection.

(3) The following minimum distances shall apply, unless an exemption has been obtained. The following list is not inclusive or exhaustive, and further reference to Chapters 64E-6, 64E-8, 62-524, 62-550, 62-555 and 62-610, Florida Administrative Code, should be made.

(a) Landscape and recreational area irrigation wells shall be located a minimum of seventy-five (75) feet from a sanitary hazard.

(b) Landscape and recreational area irrigation wells shall be located outside ground water contamination areas delineated by the Department of Environmental Protection in Section 62-524.430, Florida Administrative Code.

(c) Domestic Self Supply water wells shall be located a minimum distance of twenty-five (25) feet from building foundations treated with pesticides.

(d) Domestic Self Supply water wells shall be located a minimum distance of seventy-five (75) feet from a sanitary hazard, such as an onsite sewage disposal system (OSDS).

(e) Domestic Self Supply water wells shall be located a minimum distance of one hundred and seventy-five (175) feet from storage and treatment facilities of livestock farms.

(f) Domestic Self Supply water wells within ground water contamination areas delineated by the Department of Environmental Protection shall be located as specified in Section 62-524.500, Florida Administrative Code. The delineated areas are found in Section 62-524.430, Florida Administrative Code.

(g) Limited Use Public Supply wells, constructed under the provisions of Chapter 64E-8, Florida Administrative Code, shall be located a minimum distance of one hundred (100) feet from a sanitary hazard, such as an onsite sewage disposal system (OSDS), if the sewage flow is less than 2,000 gallons per day or 200 feet from an OSDS with sewage flows of 2,000 gallons per day or more.

(h) Limited Use Public Supply Wells, constructed under the provisions of Chapter 64E-8, Florida Administrative Code, within ground water contamination areas delineated by the Department of Environmental Protection shall be located as specified in Section 62-524.500, Florida Administrative Code. The delineated areas are found in Section 62-524.430, Florida Administrative Code.

(i) Public water supply wells constructed under provisions of Chapter 62-555, Florida Administrative Code, DEP Public Supply Wells, must be located

a minimum distance of two hundred (200) feet from a sanitary hazard, such as an onsite sewage disposal system (OSDS).

(j) Public water supply wells shall be located a minimum distance of one hundred (100) feet from other sanitary hazards as identified in Department of Environmental Protection Section 62-550.200, Florida Administrative Code.

(k) Public water supply wells shall be located a minimum distance of three hundred (300) feet from storage and treatment facilities of livestock farms.

(l) Public water supply wells shall be located a minimum distance of five hundred (500) feet from areas used for land application of reclaimed water.

(m) Public water supply wells within ground water contamination areas delineated by the Department of Environmental Protection shall be located as specified in Section 62-524.500, Florida Administrative Code. The delineated areas are found in Section 62-524.430, Florida Administrative Code.

(4) The District shall increase these distances if necessary to protect the health, safety, and welfare of individuals who may be exposed to ground water contamination through ingestion, inhalation, or dermal absorption.

(5) Exemptions to the above specified distances may be obtained from the District as provided by Section 40A-3.051, Florida Administrative Code. The exemption request will be evaluated on such criteria as gradient, well location, natural barriers, impermeable geological strata, water quality sampling, grouting, and the use of water treatment systems acceptable to the Department of Environmental Protection or the local health unit.

(6) In subdivisions platted after January 1, 1972, domestic self-supplied potable wells may be located on lots with onsite sewage disposal systems (OSDS), provided that each lot has a minimum area of at least one-half acre and either a minimum dimension of one hundred (100) feet or mean of at least one hundred (100) feet of the side bordering the street and the distance formed by a line parallel to the side bordering the street drawn between the two most distant points of the remainder of the lot, and providing the projected daily domestic sewage flow does not exceed an average of 1,500 gallons per acre per day.

Specific Authority: 373.026, 373.044, 373.103, 373.113, 373.171, 373.308, 373.309, 373.326, 373.337, FS.
Law Implemented: 373.306, 373.308, 373.309, 373.326, FS.
History–New 1-9-86; Amended 4-5-88, 8-1-89, 12-1-90, 2-19-91, 11-1-92, 11-1-93, 11-1-95.

40A-3.507 CASING AND LINER PIPE STANDARDS.

(1) Well casing and liner pipe shall be new or shall be pipe or casing in like-new condition. Such casing or pipe shall not be used unless free from leaks, breaks, corrosion, and dents; is straight and true; and is not out of round. Welded or seamless black or galvanized steel pipe or casing, or stainless steel pipe or casing, or approved types of nonmetallic pipe shall be used for well or liner pipe. All well casing shall meet and be clearly stamped with one of the following standards: (ASTM) A120-84, (ASTM)

A53-89A, (ASTM) A589-89A, (ASTM) A-252-89, A135-89A; or (API) 5L-6/91. Well casing that conforms to any of the aforementioned ASTM or API standards must also conform to (ANSI/ASME) B-36.10M-85. All well casing shall be stenciled with the applicable standard no later than January 1, 1994. All well casing or liner pipe proposed for potable use placed into service on or after January 1, 1994, shall conform to NSF Standard 61-1991, National Sanitation Foundation, Post Office Box 1468, Ann Arbor, Michigan, 48106, as certified by an entity approved by the American National Standards Institute (ANSI).

(2) For well casing or liner pipe installed by driving, the casing or pipe shall not butt together inside threaded couplings unless the joint is electrically welded so as to be completely watertight. A drive shoe is required for use on pipe installed by driving unless exempted by the District.

(3) Well casing installed by driving shall not have less than the dimensions and weights specified in Table 1, unless it can be shown the casing will maintain its integrity so as to prevent degradation of the water resource. The Department of Environmental Protection, under the provisions of Subsection 62-532.500(f), Florida Administrative Code, requires all alternative well casing, not listed in Table 1 to receive Department approval prior to use. Prior approval for the use of alternative materials shall also be obtained from the District.

TABLE 1
MINIMUM NOMINAL DIMENSIONS AND WEIGHTS FOR BLACK OR GALVANIZED STEEL CASING OR LINER PIPE INSTALLED BY DRIVING

Nominal Size (in.)	Outside Diameter (in.)	Wall Thickness (in.)	Plain End Weight (lb.ft.)
1.25	1.660	0.140	2.27
1.5	1.900	0.145	2.72
2	2.375	0.154	3.65
3	3.500	0.216	7.58
3.5	4.000	0.226	9.11
4	4.500	0.237	10.79
5	5.563	0.258	14.62
6	6.625	0.280	18.97
8	8.625	0.277	24.70
10	10.750	0.307	34.24
12	12.750	0.330	43.77
14 - 30		0.375	(standard wall Schedule 40)
Greater than 30		0.500	(standard wall Schedule 40)

Note: A 4 inch nominal size casing with a wall thickness of 0.188 and a plain end weight of 8.66 may be used if it conforms to standard API 5L-6/91, Grade B, 60 KSI tensile strength. For example A53-89a, Grade B, may also be substituted.

(4) Black or galvanized steel casing or liner pipe set into place without driving shall not have less than the dimensions and weights specified in Table 2.

TABLE 2
MINIMUM NOMINAL DIMENSIONS AND WEIGHTS FOR BLACK OR GALVANIZED STEEL CASING OR LINER PIPE SET INTO PLACE WITHOUT DRIVING

Nominal Size (in.)	Outside Diameter (in.)	Wall Thickness (in.)	Plain End Weight (lb.ft.)
1.25	1.660	0.140	2.27
1.5	1.900	0.145	2.72
2	2.375	0.154	3.65
2.5	2.875	0.203	5.79
3	3.500	0.188	6.65
3.5	4.000	0.188	7.65
4	4.500	0.188	8.66
5	5.500	0.188	10.79
6	6.625	0.188	12.92
8	8.625	0.188	16.94
10 – 16		0.250	
Greater than 16		0.375	

(5) Polyvinyl Chloride (PVC) pipe may be used for well casing or liner pipe. Any PVC pipe used to construct a water well shall have been marked by the manufacturer, under a method specified by the National Sanitation Foundation, Post Office Box 1468, Ann Arbor, Michigan, 48106, in ANSI-NSF Standard 14-1990, as suitable for use in potable water systems. Any PVC pipe used for well construction or repair shall, at a minimum, meet specifications for Standard Dimension Ratio (SDR 21) and have a working pressure rating of not less than 200 p.s.i. at 73 degrees F or shall be ASA Schedule 40. Other nonmetallic pipe shall not be used unless it can be shown the pipe will maintain its integrity so as to prevent degradation of the water resource. The Department of Environmental Protection, under the provisions of Paragraph 62-532.500(1)(f), Florida Administrative Code, requires all other nonmetallic well casing to receive Department approval prior to use. Prior approval for the use of alternative materials shall also be obtained from the District.

(6) Steel well casing and liner pipe shall be joined in a watertight manner by threaded couplings, electrical welding methods or other methods approved by the District. PVC pipe shall be joined by heat welding, solvent bonding, threaded couplings or other methods approved by the District, which shall meet the strength requirements of the casing as specified in (5) above.

(7) Nonmetallic and stainless steel well casing or liner pipe shall not be installed or seated by driving unless it can be shown the casing or pipe will maintain its integrity so as to prevent degradation of the water resource. The Department of Environmental Protection, under the provisions of Paragraph 62-532.500(1)(f), Florida Administrative Code, requires all alternative well casing, not listed in Table 1 to receive Department approval prior to use. Prior approval for the use of alternative materials shall also be obtained from the District.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.308, 373.309, FS.

History–New 1-9-86; Amended 4-5-88, 8-1-89, 12-1-90, 11-1-92. Formerly in 40A-3.701(1)(a), FAC.

40A-3.512 STANDARD WELL CONSTRUCTION METHODS.

(1) In the construction of a well, reasonable caution shall be taken to maintain the premises in sanitary condition and to minimize the entrance of contaminants into the water resource. Water and materials used in construction shall be reasonably free of contamination.

(2) For wells which penetrate multiple aquifers or zones, the well shall be completed so as to prevent cross-connections of different aquifers or zones and to prevent leakage of water from one aquifer or zone to another aquifer or zone. If a well cannot be properly completed to prevent such an interchange of water between water-bearing zones or to prevent a loss of artesian pressure, the well shall be abandoned and plugged in accordance with 40A-3.531 of these rules or other specifications provided by the District, as may be appropriate for the geological conditions encountered.

(3) For wells completed into unconsolidated aquifers, casing shall extend from land surface to the well screen. The well screen shall be attached to the casing with a watertight seal.

(4) For wells obtaining water from consolidated aquifers, a continuous casing shall extend from the land surface into the producing aquifer, and such casing must extend below the static water level of the aquifer intended to supply the water to the well unless it can be shown an alternative placement of the casing will prevent degradation of the water resource. All caving zones shall be cased or screened. Prior approval for the use of alternative methods shall be obtained from the District.

(5) Wells constructed to provide water for irrigation systems are required to have installed an anti-syphon device adequate to protect against contamination of the water supply, pursuant to the requirements of Section 487.064, Florida Statutes.

(6) All water wells intended to provide potable water shall be thoroughly cleaned of all foreign substances and obstructing material after the well has been constructed. The well shall be developed by pumping, surging, bailing, or other means which effectively remove sediment, well cuttings, and foreign material from in and around the well. Such wells shall be properly disinfected after construction in accordance with Section 11, Well Disinfection, American Water Works Association Standard for Water Wells, AWWA A100-84, dated June 10, 1984, which is hereby incorporated by reference.

(7) It is the intent that all wells shall be constructed to prevent caving and pumping of sand. In areas where the potential exists for sand to enter the well, a screen shall be used. If a screen is not used and the completed well pumps sand, the well will be determined not to be suitable for its intended use and the well will have to be repaired or abandoned.

(8) The well casing shall extend a minimum of twelve (12) inches above ground level and shall not be cut off below ground level unless prior approval is obtained from the District. Circumstances for which such approval shall be considered

include the practice of installing the well top, pump and pump control apparatus in a water tight below grade box specifically designed and installed for such purpose for a well whose location is not subject to flooding or inundation. Persons wishing to apply for approval shall submit their request to the District on NWFWMD Form No. 122, Request For Below Grade Well Casing Approval. The request will be reviewed in the same manner as exemption requests specified in Section 40A-3.051, Florida Administrative Code.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, FS. History–New 1-9-86; Amended 8-10-87, 4-5-88, 8-1-89, 12-1-90, 11-1-92. Formerly 40A-3.701(2), FAC.

40A-3.517 GROUTING AND SEALING.

Wells shall be grouted and sealed to protect the water resource from degradation caused by movement of waters along the well annulus either from the surface to the aquifer or between aquifers, and to prevent loss of artesian pressure in artesian aquifers. All wells shall be constructed and sealed using a method which insures that an open or unnaturally permeable annular space does not remain when a well is completed.

(1) Rotary wells located south of the grout line. Wells constructed by the rotary method and located south of the grout line established in Appendix I of these rules shall have an annular space between the casing and the borehole wall of not less than two inches and shall be sealed according to the following criteria:

(a) All diameter wells constructed by the rotary method and completed into a consolidated formation shall be sealed by filling the annular space with a two-inch thickness of grout from the bottom of the casing to the land surface.

(b) Wells constructed by the rotary method and completed into an unconsolidated formation shall be sealed by filling the annular space with a two-inch thickness of grout from a point above the top of the screen to the land surface if:

1. The well is a public water system as defined in Section 40A-3.021(35) of this rule;

2. The well is for Limited Use Public Supply Use as defined in Section 40A-3.021(31) of this rule;

3. The well has a diameter of six inches or larger;

4. The well penetrates a confining bed;

5. The well is to be located within one thousand (1,000) feet of any source of pollution, including plants processing hazardous or toxic substances, sanitary landfills (active or closed), sewage percolation ponds, sewage spray irrigation fields, toxic waste disposal systems of any kind including known ground water contamination areas, or other such sources of pollution; or

6. The well, with an approved exemption from the District, is to be located within seventy-five (75) feet of an onsite sewage disposal system (OSDS).

(c) Wells constructed by the rotary method and completed into an unconsolidated formation, but which do not meet the conditions identified in subparagraph (1)(b), shall be sealed by filling the annular space with uncontaminated, well-compacted sand and sealing the top of the casing with grout that contains a minimum of one (1) cubic foot of cement.

(2) Rotary wells located north of the grout line. Wells constructed by the rotary method and located north of the grout line established in Appendix I of these rules shall have an annular space between the casing and the borehole wall of not less than two inches and shall be sealed according to the following criteria:

(a) Wells constructed by the rotary method and completed into a consolidated formation shall be sealed by filling the annular space with a two-inch thickness of grout from the bottom of the casing to the land surface if:

1. The well is a public water system as defined in Section 40A-3.021(35) of this rule;

2. The well is for Limited Use Public Supply Use as defined in Section 40A-3.021(31) of this rule;

3. The well has a diameter of six (6) inches or larger;

4. The well is to be located within one thousand (1,000) feet of any source of pollution, including plants processing hazardous or toxic substances, sanitary landfills (active or closed), sewage percolation ponds, sewage spray irrigation fields, toxic waste disposal systems of any kind including known ground water contamination areas, or other such sources of pollution; or

5. The well, with an approved exemption from the District, is to be located within seventy-five (75) feet of an onsite sewage disposal system (OSDS).

(b) Wells constructed by the rotary method and completed into a consolidated formation, but which do not meet the conditions identified in subparagraph (2)(a), shall be sealed by filling the annular space with a two-inch thickness of grout from the bottom of the casing up to a minimum distance of twenty (20) feet, or into the last confining bed encountered, whichever is greater. The remainder of the annular space shall be filled with uncontaminated, well compacted sand, clay, or other material that is appropriate for the specific geological conditions encountered and that will prevent degradation of the water resource. The top of the casing shall be sealed with grout that contains a minimum of one (1) cubic foot of cement. Prior approval for the use of alternative methods or materials shall be obtained from the District.

(c) Wells constructed by the rotary method and completed into an unconsolidated formation shall be sealed by filling the annular space with a two-inch thickness of grout

from a point above the top of the screen to the land surface if:

1. The well is a public water system as defined in Section 40A-3.021(35) of this rule;

2. The well is for Limited Use Public Supply Use as defined in Section 40A-3.021(31) of this rule;

3. The well has a diameter of six inches or larger;

4. The well penetrates a confining bed;

5. The well is to be located within one thousand (1,000) feet of any source of pollution, including plants processing hazardous or toxic substances, sanitary landfills (active or closed), sewage percolation ponds, sewage spray irrigation fields, toxic waste disposal systems of any kind including known ground water contamination areas, or other such sources of pollution; or

6. The well, with an approved exemption from the District, is to be located within seventy-five (75) feet of an onsite sewage disposal system (OSDS).

(d) Wells constructed by the rotary method and completed into an unconsolidated formation, but which do not meet the conditions identified in subparagraph (2)(c), shall be sealed by filling the annular space with uncontaminated, well-compacted sand and sealing the top of the casing with grout that contains a minimum of one (1) cubic foot of cement.

(3) Driven wells located north or south of the grout line. Wells with casing which is driven starting at the land surface and thence to its final depth in a borehole that is equal to or smaller in diameter than the outside diameter of the casing, or which is driven starting at the land surface and thence to its final depth ahead of the drill bit, shall be sealed with grout if:

(a) Any part of the well is constructed by setting the casing in a previously constructed borehole which is larger in diameter than the outside diameter of the final casing, or, for any other reason, a space is created between the borehole and the casing. Such a well shall be sealed by filling the annular space with grout from bottom to top.

(b) The well is a public water system as defined in Section 40A-3.021(35) of this rule or is for Limited Use Public Supply Use as defined in Section 40A-3.021(31) and the well is constructed by driving casing into a consolidated formation. Such a well shall be sealed by under-cutting or under-reaming the last five (5) feet of the hole before seating the casing. A minimum of one (1) foot of the enlarged hole must be in the consolidated formation in which the casing will be seated. The entire enlarged portion of the hole shall be filled with grout and the casing driven through the grout to refusal. The upper twenty (20) feet of the well shall have an annulus not less than two inches, and shall be sealed

by filling the annular space with grout.

(4) Grouting and sealing of water wells shall be accomplished in the following manner unless an exemption is granted by the District for the use of alternative methods or materials that are appropriate for the specific geological conditions encountered and that prevent degradation of the water resource.

(a) Composition of neat cement grout shall not exceed six (6) gallons of water per cubic foot or 94-pound sack of Portland cement.

(b) The casing shall be centered in the borehole prior to grouting and sealing.

(c) In all cases, neat cement grout will be introduced into the annular space from bottom to top.

(d) The minimum set time for grouting of casing before drilling operations may continue will be as specified in Table 3 below.

TABLE 3
GROUT SETTING REQUIREMENTS

TYPE OF WELL	STEEL CASING	PVC CASING
Public Supply Well	MINIMUM OF 72 HOURS	MINIMUM OF 72 HOURS
Limited Use Public Supply Well	MINIMUM OF 12 HOURS	MINIMUM OF 12 HOURS
Other Wells: 4 Inches and Smaller in Diameter	Driven into a consolidated formation with drive shoe MINIMUM OF 2 HOURS	Constructed into a consolidated formation utilizing a shell packer MINIMUM OF 4 HOURS
	Not driven into a consolidated formation but utilizing a shell packer MINIMUM OF 4 HOURS	Constructed into a consolidated formation not utilizing a shell packer MINIMUM OF 12 HOURS
	Sand-and-gravel wells which penetrate a confining bed and which do not utilize a shell packer MINIMUM OF 12 HOURS	Sand-and-gravel wells which penetrate a confining bed and which do not utilize a shell packer MINIMUM OF 12 HOURS
Larger than 4 Inches in Diameter	MINIMUM OF 12 HOURS	MINIMUM OF 12 HOURS

(5) Other approved methods and materials may be used if they are appropriate for the specific geological conditions encountered and if they prevent degradation of the water resource. Prior approval for the use of alternative methods or materials shall be obtained from the District.

(6) In those cases where, during grouting operations, circulation of the neat cement grout is lost so that the annular space being grouted cannot be filled in one continuous operation, a tremie pipe shall be installed in the annular space to a point immediately above the zone of lost circulation; and the annulus shall be bridged at that point by sand or other suitable material introduced through the pipe until a level is reached at which grouting can be continued.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, FS. History–New 1-9-86; Amended 8-10-87, 4-5-88, 8-1-89, 12-1-90, 11-1-92, 11-1-93. Formerly 40A-3.701(2)(e), FAC.

40A-3.521 WELL SEALS.

(1) Temporary Well Seals. Whenever there is a temporary interruption in work on the well during construction, repair, or abandonment, the well opening shall be sealed with a substantial watertight cover. Except for those areas of the District with the concurrence of the Department, any well in which pumping equipment is installed seasonally or periodically shall, whenever pumping equipment is not installed, be capped with a watertight cap or valve.

(2) Permanent Well Seals. Wells located on ground subject to flooding shall be properly sealed to prevent the movement of contaminants and surface water into the well. The upper end of the well casing shall include a watertight seal with any vent above the 100-year flood level. Pumping equipment and any necessary pipe or electrical connections shall be so installed as to prevent inadvertent introduction of contaminants into the well. Pumping equipment and any necessary piping or electrical connections installed within the casing shall be installed through a well seal. An unobstructed inspection port equipped with a removable plug shall be provided and be accessible at the wellhead.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, FS. History–New 1-9-86.

40A-3.525 EXPLOSIVES.

The use of explosives in well construction or development is prohibited unless it can be shown their use will not cause degradation of the water resource and will not endanger the health, safety, or welfare of the people. The use of explosives must be specifically approved by the District.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, FS. History–New 1-9-86, Amended 4-5-88.

40A-3.529 FLOWING WELLS.

If the well flows at land surface, a valve shall be provided and maintained for controlling the discharge from the well. For newly constructed wells, the responsibility for controlling the discharge from the well becomes the owner's upon the water well contractor's submission of a well completion report to the District.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.206, 373.209, 373.306, 373.308, 373.309, FS. History–New 1-9-86, Formerly 40A-3.701(4).

40A-3.531 ABANDONED WELL PLUGGING.

(1) All abandoned wells shall be plugged.

(2) It shall be the responsibility of:

(a) The water well contractor to plug any well drilled under his license which is not completed or is not

suitable for its intended use when work is completed. Wells which are not completed by the contractor shall be plugged prior to the well drilling rig being removed from the site. A well which is determined to be unsuitable for its intended use shall be plugged within fourteen (14) days of notification from the District.

(b) The property owner to have properly plugged any existing abandoned well on his property, or any well on his property which, following construction, attains the state of an abandoned well as defined in 40A-3.021(1) of these rules.

(3) Any well which was not constructed in accordance with the standards of Part II of these rules and fails to be corrected within a time certain may be deemed an abandoned well.

(4) Abandoned wells shall be plugged by filling them from bottom to top with grout, unless otherwise provided by the District. The use of alternative methods or materials shall not cause degradation of the water resource.

(5) Abandoned wells shall be plugged only by a licensed water well contractor.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.206, 373.207, 373.209, 373.306, 373.308, 373.309, FS. History–New 1-9-86; Amended 4-5-88, 8-1-89; Formerly 40A-3.701(5).

40A-3.550 VIOLATIONS OF CONSTRUCTION STANDARDS.

(1) Acts or omissions which constitute violations of Part II of these rules governing well construction standards, shall include:

(a) Failure to meet the location requirements of Section 40A-3.504.

(b) Failure to meet the casing specifications provided in Section 40A-3.507.

(c) Failure to provide an antisyphon device on wells for irrigation systems.

(d) Failure to disinfect a well constructed for potable use.

(e) Failure to provide a nominal two-inch annulus in rotary constructed wells.

(f) Failure to properly seal the annular space of any well.

(g) Failure to plug an abandoned well.

(h) Failure to comply with any order for corrective work.

(i) Failure to fulfill any other applicable requirements of Chapter 373, Part III, Florida Statutes, or Chapter 40A-3, Florida Administrative Code.

(2) Actions which may be taken by the District staff upon determination that a violation has occurred are outlined in Section 40A-3.980 of these rules.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.306, 373.308, 373.309, 373.319, FS. History–New 1-9-86; Amended 11-1-92.

40A-3.701 CONSTRUCTION STANDARDS.

Specific Authority: 373.044, 403.812, 403.861(8), (9), 373.309, FS, 17-1.04(8), FAC. Law Implemented: 373.313, 373.316, FS, 17-21, FAC. History–New 4-14-80; Amended 10-27-80, 4-13-81, 2-1-82, 3-29-84; Repealed 1-9-86. Formerly 16G-3.70, 16G-3.21.

PART III - DRILLER REGISTRATION

40A-3.721 DRILLER REGISTRATION.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.308, 373.323, 373.326, FS.
History–New 10-1-84; Amended 1-9-86; Repealed 8-1-89.

40A-3.725 RESPONSIBILITY OF CONTRACTOR.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.308, 373.323, 373.326, FS.
History–New 10-1-84; Repealed 8-1-89.

40A-3.727 TYPE OF REGISTRATION.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.308, 373.323, 373.326, FS.
History–New 10-1-84; Repealed 8-1-89.

40A-3.733 EXEMPTIONS.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.308, 373.323, 373.326, FS.
History–New 10-1-84; Repealed 1-9-86.

40A-3.751 ENFORCEMENT AND PENALTIES.

Specific Authority: 373.044, FS, 17-21, FAC.
Law Implemented: 373.126, 373.333, FS.
History–New 4-14-80;
Transferred to 40A-3.980. Formerly 16G-3.75, 16G-3.76, 16G-3.31, 16G-3.32.

40A-3.752 REFUSAL, SUSPENSION, OR REVOCATION OF REGISTRATION.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.308, 373.323, 373.326, FS.
History–New 10-1-84; Amended 1-9-86; Repealed 8-1-89.

40A-3.763 EXAMINATIONS.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.308, 373.323, 373.326, FS.
History–New 10-1-84; Repealed 8-1-89.

40A-3.901 FORMS AND INSTRUCTIONS.

The following District forms are used in the implementation of this Chapter and are hereby incorporated by reference into this rule.

(1) NWFWMD Form 10; Application to Construct, Repair, or Abandon a Well (Effective: 11-1-95).

(2) NWFWMD Form 114; Well Completion Report (Effective 11/1/95).

(3) NWFWMD Form No. 88; Application for Water Well Contractor License, (Effective 6-22-89);

(4) NWFWMD Form 122; Request For Below Grade Well Casing Approval (Effective 11-1-92).

Necessary forms may be obtained from: District Headquarters, 152 Water Management Drive, Havana, FL 32333-9700, (850) 539-5999; Marianna Field Office, 4765 Pelt Street, Marianna, FL 32446, (850) 482-9522; Pensacola Field Office, 2261 W. Nine Mile Road, Pensacola, FL 32534-9416, (850) 484-5125.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337 FS, 62-532, FAC. Law Implemented: 373.306, 373.308, 373.309, FS. History–New 4-14-80; Amended 10-27-80, 2-1-82, 1-9-86, 8-1-89, 12-1-90, 2-14-91, 11-1-92, 11-1-93, 11-1-95.
Formerly 16G-3.90.

PART IV - SUSPENSION AND REVOCATION OF WATER WELL CONTRACTOR LICENSES

40A-3.951 INTRODUCTION.

The purpose of this part is to implement the delegation of Section 373.333, Florida Statutes, under provisions of Subsection 62-101.040(10), Florida Administrative Code, by the Department of Environmental Protection to the Northwest Florida Water Management District. This delegation provides authority to the District to suspend or revoke the license issued pursuant to Section 373.333, Florida Statutes, of any holder of such license who has violated any provision of Part III, Chapter 373, Florida Statutes, or any rule or regulation adopted pursuant to this part.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.333(6), FS.
History–New 2-1-82; Amended 1-9-86, 11-1-93.

40A-3.952 VIOLATIONS.

(1) Violations for purposes of this Part IV shall mean the failure of any licensee or his agents or employees to comply with the provisions of Chapter 373, Florida Statutes, Chapter 40A-3, Florida Administrative Code, Chapter 62-531, Florida Administrative Code, Chapter 62-532, Florida Administrative Code, or Chapter 62-555, Florida Administrative Code.

(2) A licensee will be notified of any violation according to the procedures specified in Chapter 62-531, herein adopted by reference.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.323, FS.
History–New 2-1-82; Amended 1-9-86, 8-1-89.

40A-3.953 PROCEDURE.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.323, FS.
History–New 2-1-82; Repealed 8-1-89.

40A-3.954 REPORTING OF DRILLERS NOT REQUIRED TO BE LICENSED.

Specific Authority: 17-1.04(8), FAC.
Law Implemented: 373.323(3), (6), FS.
History–New 2-1-82; Repealed 1-9-86.

40A-3.955 SUSPENSION; SUSPENSION WITH CONDITIONS.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.323, FS.
History–New 2-1-82; Repealed 8-1-89.

40A-3.956 REVOCATION.

Specific Authority: 373.044, 373.113, FS.
Law Implemented: 373.323, FS.
History–New 2-1-82; Repealed 8-1-89.

PART V - ENFORCEMENT AND PENALTIES

40A-3.980 ENFORCEMENT AND PENALTIES.

(1) Enforcement of these rules shall be as provided by Chapter 373, Florida Statutes and Chapter 62-531, Florida Administrative Code, adopted herein by reference.

(2) Penalties for violation of these rules shall be as provided by Chapter 373, Florida Statutes and Chapter 62-531, Florida Administrative Code, herein adopted by reference.

Specific Authority: 373.044, 373.113, 373.171, 373.309, 373.337, FS. Law Implemented: 373.333, 373.336, FS.
History–New 4-14-80; Amended 10-1-84, 8-1-89; Formerly 16G-3.75, 16G-3.76, 16G-3.31, 16G-3.32, 40A-3.751, FAC.

APPENDIX I

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301

BOB GRAHAM
GOVERNOR

JACOB D. VARN
SECRETARY

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

September 10, 1980

SEP 15 1980

Mr. J. William McCartney
Executive Director
Northwest Florida Water Management
District
Route 1, Box 3100
Havana, Florida 32333

Dear Bill:

This is in response to your letters of August 1, 1980 and August 15, 1980, and the meetings between our staffs relative to your District's request for an exemption under the provisions of Section 17-21.10, Florida Administrative Code.

Under provisions of Section 373.326, Florida Statutes, the Department concurs with your request and the following exemptions from the water well construction standards contained in Section 17-21.10(2)(d), Florida Administrative Code, are granted.

The attachment to this letter contains the description of a line extending across the area of the Northwest Florida Water Management District. Within the area to the north of the line, private water wells with a casing diameter less than four and one-half inches (4½") inside diameter constructed with the casing installed in a borehole larger than the outside diameter of the casing may be exempt from the full grouting requirements of Section 17-21.10(2)(d), Florida Administrative Code, under the following conditions:

a) The borehole shall be nominally four inches (4") larger than the outside diameter of the casing.

b) The annular space between the well and the borehole shall be filled from the bottom of the casing up to at least twenty feet (20') or twenty feet (20') into the fast confining bed encountered, whichever is greater. The remainder of the annular space shall be filled with clean, well-compacted sand, clay, or other approved material. The top of the annular space shall be sealed with at least one cubic foot (1 ft^3) of grout.

recycled/recyclable paper

c) The well is located more than one thousand feet (1,000') from any plant processing hazardous or toxic substances, any hazardous waste disposal sites, sanitary landfills, whether these sites are active or closed, sewage percolation ponds or spray irrigation fields, and any other such sources of pollution which could endanger the health or welfare of the inhabitants of the area.

d) The well is located more than seventy-five feet (75') from an individual domestic septic tank drain field.

e) The well is constructed in an unconsolidated formation, does not penetrate any competent and continuous confining beds, and is finished with a well screen. In such cases, any annular space will be filled with well-compacted, clean sand with a seal at the top of the casing of not less than one cubic foot (1 ft^3) of grout.

Thank you for the opportunity to be of assistance.

Sincerely,

Jake

Jacob D. Varn
Secretary

JDV/mm
Attachment

cc: Sanford Young
Robert V. Krieyel
Rodney DeHan

BOUNDARIES OF THE NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT GROUT LINE

JEFFERSON COUNTY:

Beginning at the S/E corner of Section 18, Township 4 South, Range 4 East, continue west on a tangent across the south line of Sections 13, 14, 15, 16, and 17, to the S/W corner of Section 18, adjoining the Eastern Wakulla County line.

WAKULLA COUNTY:

Beginning at the S/E corner of Section 13, Township 4 South, Range 2 East, continue on a tangent across the south line of Sections 14, 15, 16, 17, to the S/W corner of Section 18. Beginning at the S/E corner of Section 13, Township 4 South, Range 1 East, continue on a tangent across the south line of Section 13 to the St. Marks River in Section 14; thence N/W for a distance of approximately 1 mile across river to the S/E corner of R.S. 9, Township 4 South, Range 1 East of the Hartsfield Survey; thence south and west along the south line of Hartsfield Survey, Sections 2, 9, 13, 100, 99, 98, 97, 96, 95, 94, 93, and 92 to the N/W corner of Section 101 of the Hartsfield Survey; thence south on the East line of Sections 1 and 12 to the S/E corner of Section 13, Township 5 south, Range 2 West; thence west along the south line of Sections 13, 14, 15, 16, 17, and 18; thence west along the south line of Section 13, Township 5 South, Range 3 West across 14 and to the S/W corner of Section 15, thence south along the west line of Sections 22, 27, and 34 to the Ochlockonee River, all lying and being in Wakulla County, Florida.

FRANKLIN COUNTY:

Beginning at the S/E corner of Section 28, across Ochlockonee River, Township 5 South, Range 3 West, continue south along the east line of Section 33, to S/E corner of Section 33; thence east across Crooked River to the N/E corner of Section 4, Township 6 South, Range 3 West; thence south along the east line of Sections 4, 9, 16, and 21, to the S/E corner of Section 28; thence west along the south line of Section 28, to the S/W corner of Section 29; thence south to the S/E corner of Section 31; thence West along the south line of Section 31 to the S/W corner of Section 36, Township 6 South, Range 4 West; thence south along the east line of Section 2, to the S/E corner; thence west along the south line of Section 2, to the S/W corner of Section 3; thence south along the east line of Section 9 to the S/E corner; thence west along the south line of Section 9 to the S/W corner of Section 8; thence south 2640 feet along the east line of Section 7, to the S/E corner; thence west across Crooked River on the south line of Section 7 to the S/W corner of Section 12, Township 7 South, Range 5 West; thence south along the east line of Section 14, to the S/E corner; thence west along the south line of Sections 14, 15, 16, 17, and 18; thence continue west across Section 13, Township 7 South, Range 6 West, 14, 15, 16, and 17 to the S/W corner of Section 18; thence north along the east line of Sections 13 and 12 to the N/E corner of Section 1; thence west along the north line of Sections 1, 2, 3, 4, and 5 to the N/W corner of Section 6, Township 7 south, Range 7 West; thence west along the north line of Section 1 to the west bank of the Apalachicola River, Township 7 South, Range 8 West; thence north and east along the west bank of the Apalachicola River 1320 feet; thence west along a line crossing the northernmost head of Smokehouse Creek, continuing west

across Bearman Creek on Forbes Island to the west bank of Brothers River, all lying and being in Franklin County, Florida.

GULF COUNTY:

Beginning at the west bank of the Brothers River along the south line of Section 33, Township 6 South, Range 8 West, continue west across Sections 32 and 31 to the S/E corner of Section 36, Township 6 South, Range 9 West; thence west along the south line of Sections 36, 35, 34, 33, 32, and 31 to the S/W corner of Section 36, Township 6 South, Range 10 West; thence west across the south line of Section 35 to the S/W corner of Section 34; thence north along the east line of Sections 33 and 28 to the N/E corner of Section 21; thence west along the south line of Sections 16 and 17 to the S/W corner of Section 18; thence north along the east line of Sections 13 and 12 to the N/E corner of Section 1, Township 5 South, Range 11 West; thence west along the south line of Section 36 to the S/W corner of Section 35; thence north along the east line of Section 34, on a tangent line of Wetappo Creek, continuing the east line of Section 27 to the N/E corner of Section 22; thence west along the south line of Sections 15, 16, 17, and 18 to the Bay County line, all lying and being in Gulf County, Florida.

BAY COUNTY:

Beginning at the S/E corner of Section 13, Township 5 South, Range 12 West, continue north along the Gulf County line to the S/E corner of Section 36, Township 4 South, Range 12 West; thence west along the south line of Sections 36 and 35 to the S/W corner of Section 34; thence north along the east line of Sections 33 and 28 to the N/E corner of Section 21; thence west along the south line of Sections 16 and 17 to the S/W corner of Section 18, Township 4 South, Range 12 West; thence west along the south line of Sections 13, 14, 15, 16, and 17 to State Road 729 north; thence continue west along the North R/W line of State Road 729 west to the West R/W line of State Road 30A in Parker, Florida; thence north along the West R/W line of State Road 30A to the S/W corner of Section 6, Township 4 South, Range 14 West; thence west through Springfield, Florida, along the south line of Section 1, and continue onto the east shore of Watson Bayou at the S/W corner of Section 3; thence north along the west line of Section 3 to the N/W corner at the intersection of the south R/W line of U.S. 98, thence west along the south R/W line of U.S. 98 to the west R/W line of State Road 391, Township 3 South, Range 15 West, thence north along the west R/W line of State Road 391 to the S/E corner of Section 25; thence west along the south line of Section 25, across West Bay on the north side of Hathaway Bridge, and continuing west to the S/W corner of Section 30, Township 3 South, Range 16 West; thence north along the east line of Section 25 to the N/E corner of Section 24; thence West along the south line of Sections 13, 14, and 15 to the S/W corner of Section 16; thence north along the east line of Section 17 to the N/E corner of Section 8; thence west along the south line of Section 5 to the S/W corner of Section 6; thence continue west to the S/W corner of Section 1, Township 3 South, Range 17 West; thence north along the east line of Sections 2 and 35 to the N/E corner of Section 26; thence west on the south line of Sections 23, 22, 21, and 20 to the S/W corner of Section 19, Township 2 South, Range 17 West at the Walton County line, all lying and being in Bay County, Florida.

WALTON COUNTY:

Beginning at the S/E corner of Section 24, Township 3 South, Range 18 West, at the Bay County line, continue west along the south line of Section 24 to the S/W corner; thence north along the east line of Section 23 to the S/E corner of Section 14; thence west along the south line of Sections 14, 15, 16, and 17 to the S/W corner of Section 18, Township 3 South, Range 18 West; thence north along the east line of Sections 13, 12, and 1, Township 3 South, Range 19 West; thence north along the east line of Sections 36, 25, 24, 13, and 12, to the N/E corner of Section 1; thence west along the south line of Section 36 to the S/W corner of Section 35, Township 1 South, Range 19 West; thence north along the east line of Sections 34 and 27 to the N/E corner of Section 22; thence west along the north line of Sections 22 and 21 to the N/W corner of Section 20; thence north along the east line of Section 18, to the N/E corner; thence west along the south line of Section 7 to the S/E corner of Section 12, Township 1 South, Range 20 West; continue west along the south line of Sections 12, 11, 10, and 9 to the S/W corner of Section 8; thence south along the east line of Section 18 to the S/E corner; thence west along the south line of Section 18, Township 1 South, Range 21 West; continue west on the south line of Sections 13 and 14 to the S/W corner of Section 15; thence south along the east line of Section 21 to the S/E corner; thence west along the south line of Sections 21 and 20 to the S/W corner of Section 19, Township 1 South, Range 21 West at the Okaloosa County line, all lying and being in Walton County, Florida.

OKALOOSA COUNTY:

Beginning at the S/E corner of Section 24, Township 1 South, Range 22 West at the Walton County line, continue west along the south line of Section 24 to the S/W corner; thence north along the east line of Sections 23, 14, and 11 to the N/E corner of Section 2; thence west alongthe south line and the Tallahassee Base Line of Sections 35, 34, 33, and 32 to the S/E corner of Section 31, Township 1 North, Range 22 West; thence continue west along the south line of Section 36 to the S/W corner of Section 35, thence south along the east line of Sections 3 and 10 to the S/E corner of Section 15; thence west along the south line of Sections 15, 16, and 17 to the S/W corner of Section 18, Township 1 South, Range 23 West; thence continue west along the south line of Sections 13, 14, and 15 to the S/W corner of Section 16; thence south along the east line of Sections 20 and 29 to the S/E corner of Section 32; thence west along the south line of Section 32 and to the S/W corner of Section 31, Township 1 South, Range 24 West; thence continue along the south line of Sections 36, 35, 34, 33, and 32 to the S/W corner of Section 31, Township 1 South, Range 25 West at the Santa Rosa county line, all lying and being in Okaloosa County, Florida.

SANTA ROSA COUNTY:

Beginning at the S/E corner of Section 36, Township 1 South, Range 26 West at the Okaloosa County line, continue west along the south line of Sections 36 and 35 to the S/W corner of Section 34; thence north along the east line of Sections 33 and 28 to the N/E corner of Section 21; thence continue west along the south line of Sections 16 and 17 to the S/W corner of Section 18; thence continue north along the east line of Sections 13 and 12 to the N/E corner of Section 1 at the Tallahassee Base Line; thence continue north across said Base Line on the east line of Section 36, Township 1 North, Range 27 West, and continue north along the east line of

Sections 25, 24, 13, and 12 to the N/E corner of Section 1; thence west along the south line of Section 36, Township 2 North, Range 27 West; continue west along the south line of Sections 35, 34, 33 and 32 to the S/W corner of Section 31; thence north along the east line of Section 36, Township 2 North, Range 28 West, and continue north along the east line of Sections 25, 24, 13 and 12 to the N/E corner of Section 1; thence west along the south line of Section 36, Township 3 North, Range 28 West, and continue west along the south line of Sections 35, 34, 33, and 32, to the S/W corner of Section 31; thence north along the east line of Section 36, Township 3 North, Range 29 West and continue north along the east line of Sections 25, 24, 13, and 12 to the N/E corner of Section 1, thence continue north along the east line of Section 36, Township 4 North, Range 29 West, and continue north along the east line of Sections 25, 24, 13, and 12 to the N/E corner of Section 1; thence continue north along the east line of Section 38, Township 5 North, Range 29 West and north along the east line of Sections 27, 26, 15, and 14 to the N/E corner of Section 1; thence continue north along the east line of Section 38, Township 6 North, Range 29 West to the N/W corner of Section 25 at the Alabama State line, all lying and being in Santa Rosa County, Florida.

APPENDIX II

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☐ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK OF PERMIT FORM.

THIS FORM *MUST* BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. _____
Florida Unique I.D. _____
Permit Stipulations Required (See attached)
62-524 well ☐
CUP/WUP Application No. _____

ABOVE THIS LINE FOR OFFICIAL USE ONLY

Fold at this line in order that address is visible through envelope window

1. _____
Owner, Legal Name of Entity if Corporation — Address — City — Zip — Telephone Number

2. _____
Well Location — Address, Road Name or Number, City

3. _____
Well Drilling Contractor — License No. — Telephone No.

_____
Address

_____
City — State — Zip

4. _____ 1/4 of _____ 1/4 of Section _____
(smallest) (biggest)
(Indicate Well on Chart)

5. Township _____ Range _____

NW	NE
SW	SE

6. _____ | _____ | _____ | _____ | _____
County — Subdivision Name — Lot — Block — Unit

7. **Number of proposed wells** _____ **Check the use of well:** (See back of permit for additional choices) _____ Domestic Monitor (type) _____

_____ Irrigation (type) (See Back) Public Water Supply (type) _____ (See Back) List Other _____

Distance from septic system _____ ft. **Description of facility** _____ **Estimated start of construction date** _____

8. **Application for:** _____ New Construction _____ Repair/Modify _____ Abandonment _____
(Reason for Abandonment)

Date Stamp

9. **Estimated:** Well Depth _____ Casing Depth _____ Screen Interval from _____ to _____
Casing Material: Blk-Steel / Gal / PVC Casing Diameter _____ Seal Material _____

10. **If applicable: Proposed Grouting Interval** From _____ to _____ Seal Material _____
From _____ to _____ Seal Material _____
From _____ to _____ Seal Material _____

Draw a map of well location and indicate well site with an "X". Identify known roads and landmarks; provide distances between well and landmarks.

North
N
West
East
South

11. **Telescope Casing** _____ **or Liner** _____ (check one) Diameter _____
Blk-Steel / Galvanized / PVC Other (specify: _____

12. **Method of Construction:** _____ Rotary _____ Cable Tool _____ Combination
_____ Auger _____ Other (specify:) _____)

13. **Indicate total No. of wells on site** _____. **List number of unused wells on site** _____.

14. **Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application?** ___No ___Yes
(If yes, complete the following) CUP/WUP No. _____
District well I.D. No. _____
Latitude _____ Longitude _____
Data obtained from GPS ____ or map ____ or survey ____ (*map datum NAD 27*___ *NAD 83*___)

15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

_____ Signature of Contractor — License No.

_____ Owner's or Agent's Signature — Date

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: _____ Issue Date: _____ Hydrologist Approval _____ Initials

Owner Number: _____ Fee Received: $ _____ Receipt No.: _____ Check No.: _____

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. ***This permit is valid for 90 days from date of issue.***

WHITE: ORIGINAL FILE
YELLOW: DRILLING CONTRACTOR
PINK: OWNER

NWFWMD Form No. 10. Rev. 11/1/95

Southwest Florida Water Management District
2379 Broad Street, Brooksville, FL 34609-6899 Ph: (904) 796-7211 or 800-423-1476

Environmental Action Commission
P.O. Box 1000
Bradenton, FL 34206-1000

Sarasota County Health Department
P.O. Box 2658
Sarasota, FL 34233-2658

Northwest Florida Water Management District
Route 1, Box 3099, Havana, FL 32333-9700
(U.S. Highway 90, 10 miles west of Tallahassee) Ph: (904) 539-5999

St. Johns Water Management District
P.O. Box 1429, Palatka, FL 32078-1429 Ph: (407) 897-4349

South Florida Water Management District
P.O. Box 24680 3301 Gun Club Road
West Palm Beach, FL 33416-4680 Ph: (407) 686-8800

Suwannee River Water Management District
Route 3 Box 64, Live Oak, FL 32060 Ph: (904) 362-1001 or 800-226-1066

USE OF WELL – ADDITIONAL CHOICES:

Recovery	Landscape Irrigation	Recreation Area Irrigation (ball fields, playgrounds)	Aquaculture (fish ponds)
Public Water Supply (DEP) Community Non-Community	Agricultural Irrigation (crops, sod, orchards, nursery stock)	Golf Course Irrigation	Class I Injection Well Class V Injection
Limited Use Public Supply (HRS)	Nursery Irrigation (retail outlets only)	Heat Pump (AC Supply)	Test (temporary) WUP
Livestock	Pesticide Mixing & Loading	Heat Pump (AC Return)	Industrial

WELL SETBACK DISTANCES:

25 ft.	From a treated building slab.
75 ft.	Domestic – From on site septic system.
100 ft.	Public Supply and Limited Public Supply less than 2000 GPD Sewage Flow.
200 ft.	Public Supply and Limited Public Supply greater than 2000 GPD Sewage Flow

These are common setback distances. ***However they are not all-inclusive.*** Refer to other applicable rules for additional setbacks.

APPENDIX III

WELL COMPLETION REPORT (Please complete in black ink or type.)

PERMIT # _____ CUP/WUP # _____ DID # _____

If permit is for multiple wells indicate the number of wells drilled _____.

Indicate remaining wells to be cancelled _____

WATER WELL CONTRACTOR'S

SIGNATURE _____ License # _____

I certify that the information provided in this report is accurate and true.

Grout	No. of Bags	From (Ft.)	To (Ft.)
Neat Cement:			
Bentonite:			

WELL LOCATION: County _____

_____ 1/4 of ____ 1/4 of Section _____ Twp: _____ Rge: _____

Latitude _____ Longitude _____

DATE STAMP

Official Use Only

Sketch of well location on property ✓

Give distances from septic tank and house or other reference points

CHEMICAL ANALYSIS WHEN REQUIRED

Iron: ____ ppm Sulfate: ____ ppm

Chloride: _____ ppm

[ ] Lab Test [ ] Field Test Kit

Pump Type

[ ] Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

Horsepower _____ Capacity _____ G.P.M. _____

Pump Depth _____ Ft. Intake Depth _____ Ft.

NWFWMD Form 114. Rev. 11/1/95

OWNER'S NAME _____

COMPLETION DATE _____ Florida Unique I.D. _____

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ____

HRS Limited ____ 62-524 ____ Other _____

DRILL METHOD [ ] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [ ] Auger Other _____

Measured Static Water Level _____ Measured Pumping Water Level _____

After ____ Hours at ____ G.P.M. Measuring Pt. (Describe): _____

Which is ____ Ft. [ ] Above [ ] Below Land Surface

Casing: [ ] Black Steel [ ] Galv. [ ] PVC Other _____

[ ] Open Hole [ ] Screen Casing Diameter & Depth (Ft.)	Depth (Ft.) From	Depth (Ft.) To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. *Color* | *Grain Size* | *Type of Material*
Diameter ____			
From _____			
To _____			
Diameter ____			
From _____			
To _____			
Liner [ ] or			
Casing [ ]			
Diameter ____			
From _____			
To _____			

Driller's Name:
(print or type) _____

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Havana, FL 32333-9700
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Resolution Consultants

Utility Clearance

Procedure 3-01

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials.

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 The procedure applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities.

1.4 The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

1.5 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 utility clearance, those procedures should be added as an appendix to the project specific SAP.

1.6 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 Field and subcontractor personnel shall adhere to a site-specific health and safety plan (HASP).

3.0 Terms and Definitions

3.1 **Utility**

For the proposes of this SOP, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 **As-Built Plans**

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 **One-Call**

The Utility Notification Center is the one-call agency for nationwide call before you dig. The Utility Notification Center is open 24 hours a day, and accepts calls from anyone planning to dig. The phone number 811 is the designated call before you dig phone number that directly connects you to your local one-call center. Additional information can be found at www.call811.com.

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Calling before you dig ensures that any publicly owned underground lines will be marked so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines, but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a call is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address.
- What type or work is being done.
- Who the work is being done for.
- The county and city the work is taking place in.
- The address or the street where the work is taking place.
- Marking instructions, (specific instructions as to where the work is taking place).

Under normal circumstances it takes between 2 to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested.

3.4 **Toning**

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned.

4.0 Training and Qualifications

4.1 The **Contract Task Order (CTO) Manager** is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration.

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 utility locating activities are performed in accordance with this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Equipment and supplies necessary for locating subsurface utilities will be provided by the subcontractor; however, the project **Field Manager/Field Personnel** will provide any additional equipment and supplies as needed as well as maintain information regarding the utility clearance activities in the field logbook.

6.0 Procedure

Proceed wtih the following steps where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

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6.1 Prepare Preliminary Site Plan

- Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the project specific Sampling and Analysis Plan (SAP) or Work Plan. Include as many of the cultural and natural features as practical in this plan.

6.2 Review Background Information

- Search existing plan files to review the as-built plans to identify the known location of utilities at the site. Plot the locations of utilities identified onto a preliminary, scaled site plan. Inform the CTO Manager if utilities lie within close proximity to a proposed exploration or excavation location. The CTO Manager will determine if it is necessary to relocate proposed sampling or excavation locations.
- Include the utility location information gathered during previous investigations (e.g., remedial investigation or remedial site evaluation) in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected during implementation of a CTO can be shared with the subcontractor during implementation of a particular task order. In many instances, this will help to reduce the amount of additional geophysical surveying work the subcontractor may have to perform.
- Conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.
- During the pre-field work interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

6.3 Site Visit/Locate Utilities/Toning

- Prior to the initiation of field activities, the Field Task Manager or similarly qualified field personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.
- Following the initial site visit by the Field Task Manager, a trained utility locating subcontractor will locate, identify, and tone all utilities depicted on the preliminary site plan. The Field Task Manager or similarly qualified field personnel shall visit the site and identify the areas of subsurface disturbance with white spray paint, chalk, white pin flags or some other easily identifiable marking. The utility locator should utilize appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. At a minimum, the utility subcontractor should utilize a metal detector and/or magnetometer; however, it is important to consider the possibility that non-metallic utilities or tanks might be present at the site. Use other appropriate surface geophysical methods such as Ground Penetrating Radar, Radiodetection, etc. as appropriate. Clear proposed exploration areas of all utilities in the immediate area where subsurface exploration is proposed. Clearly tone all anomalous areas. Clearly identify all toned areas on the preliminary site plan. All utilities near the area of subsurface disturbance should also be marked out by the utility subcontractor using the universal colors for subsurface utilities (i.e., red – electric; blue – water; green – sewer; yellow – gas; etc.). After toning the site and plotting all known or suspected buried utilities on the preliminary site plan, the utility locator shall provide the Field Task Manager with a copy of the completed preliminary

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site plan. Alternatively, the Field Task Manager or designee shall document the results of the survey on the preliminary site plan.

- Report to the Field Task Manager anomalous areas detected and toned that are in close proximity to the exploration or excavation areas. The Field Task Manager shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate the proposed exploration or excavation areas. If this is required, the Field Task Manager or designee shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In some instances, such as in areas extremely congested with subsurface utilities, it may be necessary to dig by hand or use techniques such as air knife to determine the location of the utilities.

6.4 **Prepare Site Plan**

- Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the Navy Technical Representative (NTR), the CTO Manager, and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the NTR to verify its accuracy prior to initiating subsurface sampling activities.

7.0 Quality Control and Assurance

7.1 Utility locating must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

8.1 A bound field logbook will be kept detailing all activities conducted during the utility locating procedure.

8.2 The logbook will describe any changes and modifications made to the original exploration plan. The trained utility locator shall prepare a report and keep it in the project file. Also, a copy of the final site plan will be kept in the project file.

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.

Author	Reviewer	Revisions (Technical or Editorial)
Caryn DeJesus Senior Scientist	Bob Shoemaker Senior Scientist	Rev 0 – Initial Issue (June 2012)

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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

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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.

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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:

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- 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.

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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.

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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

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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

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Attachment 1
Chain-of-Custody Seal

CHAIN-OF-CUSTODY SEAL

<table>
<tr><td rowspan="3">[LABORATORY]</td><td>SAMPLE NO.</td><td>DATE</td><td>SEAL BROKEN BY</td></tr>
<tr><td colspan="2">SIGNATURE</td><td>DATE</td></tr>
<tr><td colspan="3">PRINT NAME AND TITLE (Inspector, Analyst or Technician</td></tr>
</table>

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

M601376

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client/Project Name:	Project Location:
Project Number:	Field Logbook No.:
Sampler: (Print Name) /Affiliation:	Chain of Custody Tape No.:
Signature:	Send Results/Report to:

Analysis Requested

Field Sample No./ Identification	Date	Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	Field Filtered								Lab I.D.	Remarks

Relinquished by: (Print Name) Signature:	Date: Time:	Received by: (Print Name) Signature:	Date: Time:	Analytical Laboratory (Destination):
Relinquished by: (Print Name) Signature:	Date: Time:	Received by: (Print Name) Signature:	Date: Time:	
Relinquished by: (Print Name) Signature:	Date: Time:	Received by: (Print Name) Signature:	Date: Time:	Serial No.

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Attachment 3
Sample Completed Chain-of-Custody

Chain-of-Custody

(11) Control Number: *96H0HC205*

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(1)
CTO/DO Manager: Joe Smith
CTO/DO Name: Former Navy Landfill
CTO/DO Number: CTO 0250
Deliver results to the address above or as stated in contract

(2)
Bill To: CLEAN/RAC Contractor
Company: company name
Address: Oahu, Hawaii

(3)
Sample Disposal: by lab
Shipment Method: Express Courier
Comments: PACDIV Level D, Measure Cooler Temperature at Lab

(4) Cooler No: 413
QC Level: PACDIV Level D
TAT: Normal - per contract

(5) container # (water): 1, 2, 2, 1, 2, 1, 2

Preservatives: HCL, HCL, HNO3

(6) Sample Data

(7) Matrix/QC

(8)

(12)

Sample ID (EPA ID)	Sample ID (Navy IRP Use Only)	Date Collected	Time Collected	Lab ID	Soil	Water	Other (drum, sludge, etc.)	Field Duplicate (MS/MSD)	TPH 8015B	CLP VOAs	CLP SVOAs	CLP Pesticides	CLP Metals	EPA 8080 (PCBs only)	EPA 8240	EPA 8270	Total Lead by EPA 6010					Extra Volume MS/MSD	HOLD	Total # of Containers
HC205		9/6/96	9:35		X				X	X	X	X	X	X										1
HC206		9/6/96	9:50		X				X	X	X	X	X	X										1
HC207		9/6/96	10:15		X				X	X	X	X	X	X										1
HC208		9/6/96	10:25		X				X	X	X	X	X	X										1
HC209		9/6/96	10:45		X				X	X	X	X	X	X										1
HC210		9/6/96	10:55			X		X		X														2
HC211		9/6/96	12:50			X			X	X	X	X	X	X										9
				TOTALS:					6	9	7	6	7	6										16

(9)

Samplers Signature	Date	Time
Relinquished By:	Date	Time
Received By:	Date	Time
Relinquished By:	Date	Time
Received By (LAB):	Date	Time

(13)

(10) For Lab Use

Lab No.:
Does COC match samples: Y or N
Broken container: Y or N
Received within holding time: Y or N
COC seal intact: Y or N
Any other problems: Y or N
If problems, Client contacted: Y or N
Date contacted: ___/___/___
Temperature (°C):

Original (white), Lab Copy (yellow), Field Copy (pink)

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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:
Dated Occurred:	Matrix
Parameter (Test Code):	Method:
Analyst:	Supervisor:

Samples Affected (List by Accession AND Sample No.)

1. Type of Event (Check all that apply)		2. Corrective Action (CA)* (Check all that apply)	
	Calibration Corr. Coefficient <0.995		Repeat calibration
	%RSD>20%		Made new standards
	Blank >MDL		Reran analysis
	Does not meet criteria:		Sample(s) redigested and rerun
	Spike		Sample(s) reextracted and rerun
	Duplicate		Recalculated
	LCS		Cleaned system
	Calibration Verification		Ran standard additions
	Standard Additions		Notified
	MS/MSD		Other (please explain)
	BS/BSD		
	Surrogate Recovery		
	Calculations Error		
	Holding Times Missed		
	Other (Please explain	Comments:	

3. Results of Corrective Action	
	Return to Control (indicated with)
	Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____.

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

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Direct Push Sampling Techniques

Procedure 3-17

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) provides guidance on the use of direct push techniques for the United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command, Atlantic (NAVFAC Atlantic).

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 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.

1.4 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 direct push sampling then those procedures may be added as an appendix to the project specific SAP.

2.0 Safety

2.1 Field personnel shall perform work in accordance with the site-specific health and safety plan (HASP). During monitoring well installation, subcontractors in direct contact with potentially contaminated media shall wear the proper personal protective equipment (PPE) as outlined in the site-specific health and safety plan. Failure to comply will result in disciplinary action.

2.2 If circumstances warrant, a real-time immediate response instrument, such as a Miniram Dust Monitor, organic vapor analyzer, HNu, Thermo, Draeger or Sensidyne tubes, or explosimeter, should be used to monitor the work area. When real/time instrument response exceeds the permissible exposure limit, personnel shall don the appropriate PPE and alternate control measures to ensure personnel safety. If safe control measures are not achievable, field activities shall be discontinued immediately. Company-specific HASPs offer guidelines on air surveillance and on selection of PPE. In addition, the site-specific HASP includes an air monitoring program and suggested PPE.

2.3 In addition to the aforementioned precautions and depending upon the type of contaminant expected, employ the following safe work practices:

Particulate or Metal Compounds

1. Avoid skin contact and/or incidental ingestion of soil.
2. Wear protective clothing, steel-toed boots, gloves, safety glasses, and hearing protection as warranted.

VOCs

1. Avoid breathing constituents venting from holes by approaching upwind, and/or by use of respiratory protection.

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2. Pre-survey the area with a flame ionization detector (FID) or photoionization detector (PID) prior to sampling.
3. If monitoring results indicate organic vapors that exceed action levels as specified in the site-specific HASP, sampling activities may need to be conducted in Level C protection. At a minimum, skin protection will be required by use of gloves and Tyvek or other media that is protective against the media being encountered.

Flammable or Explosive Conditions

1. Monitor explosive gases as continuously as possible using an explosimeter and oxygen meter.
2. Place all ignition sources upwind or crosswind of the borehole.
3. If explosive gases exceed the designated action levels as specified in the site-specific HASP, cease operations and evaluate conditions.

Physical Hazards Associated With Soil Sampling

1. To avoid possible back strain associated with sample collection, use the large muscles of the legs, not the back, when retrieving soil samplers.
2. Stay clear of all moving equipment, and avoid wearing loose fitting clothing.
3. To avoid slip/trip/fall hazards, be wary of open trenches, pits, or holes.
4. Be aware of restricted mobility due to PPE.
5. To avoid hand, wrist, arm, shoulder, and back trauma due to the use of slide hammers or hand augers, rotate sampling among field personnel

3.0 Terms and Definitions

3.1 Direct push techniques are methods for subsurface sampling or monitoring that involve the application of downward pressure (usually supplied through hydraulic means) without the benefit of cutting tool rotation to enter soil. A variety of systems are available under several trade names, such as GeoProbe®. Equipment may be skid-mounted, trailered, or mounted directly on the frame of a vehicle.

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 **CTO Manager** is responsible for ensuring that these standard direct push technique procedures are followed during projects conducted under the ER Program and that a qualified individual conducts or supervises the projects. A qualified individual for subsurface sampling or monitoring using direct push techniques is defined as a person with a degree in geology, hydrogeology, or geotechnical/civil engineering with at least 1 year of experience supervising soil boring construction using conventional drilling or direct push techniques. The CTO Manager

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or designee is responsible for ensuring that all personnel involved in direct push sampling techniques shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1c (DON 2007).

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 personnel follow these procedures.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

5.2.5 The Field Personnel and/or Field Manager is responsible for directly supervising the direct push 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

In addition to those materials provided by the subcontractor, the project **Field Manager/Field Personnel** will require:

- Boring Logs;
- Spoons or scoops;
- Sample kit (bottles, labels, custody records and tape, cooler, ice), if laboratory analysis is required;
- Sample collection pan;
- Folding rule or tape measure;
- Plastic sheeting;
- Utility knife;
- Equipment decontamination materials (as described in SOP 3-06, *Equipment Decontamination*);
- Health and safety equipment (as required by HASP); and
- Field project notebook/pen.

7.0 Procedure

Direct push techniques may be used as a cost-effective alternative to conventional drilling techniques for obtaining subsurface soil and groundwater samples and for monitoring subsurface conditions.

7.1 Method Selection

Base the decision to use direct push techniques on: (1) their ability to achieve the required information at the required level of quality control and (2) their cost-effectiveness compared to conventional drilling methods. Major limitations of direct push techniques are their inability to penetrate rock or cobbles and a shallow maximum depth of penetration. The capabilities of direct push systems vary significantly among vendors. Consider these differences in capabilities when evaluating the method for a subsurface exploration program.

Use direct push techniques to obtain groundwater samples for confirmatory analyses only if the screen placement method protects the screen from clogging during installation and allows the installation of a sand-pack around the exterior of the well screen.

7.2 Inspection of Equipment

Inspect direct push equipment prior to use for signs of fluid leakage, which could introduce contaminants to the soil. If, at any time during equipment operation, fluid is observed leaking from the rig, cease

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operations and immediately repair or contain the leak. Collect, containerize, and label soil and other materials affected by the leak for proper disposal (see SOP 3-05, *IDW Management*).

7.3 Preparation of Work Site

Inspect the work site prior to commencing operations to ensure that no overhead hazards exist that could impact the direct push equipment, and the work area should cleared and/or marked by the local underground utility locating service (e.g., DigSafe). In addition, clear locations planned for subsurface exploration using either geophysical methods and/or hand excavate locations to a depth of 2 to 3 feet prior to soil penetration, unless it is certain (by virtue of subsurface clearing activities) that no utilities or other hazardous obstructions will be encountered in the first 2 to 3 feet. Hand excavation may be waived when it is not practical.

Locate the direct push rig so that it is downslope from the penetration point, if the work is to be performed on a grade. Locate the rig downwind or crosswind of the penetration point, if possible. Cover the area surrounding, and in the vicinity of, the penetration point with plastic. Establish required exclusion zones using plastic tape or cones to designate the various areas.

7.4 Equipment Decontamination

To avoid cross-contamination, thoroughly decontaminate equipment used for direct push exploration and sampling as described in SOP 3-06, *Equipment Decontamination*. Decontaminate sampling tools and downhole equipment between each sampling event and between penetration points. At a minimum, steam clean or wash and rinse the equipment. Collect, containerize, and label all wash and rinse water for proper disposal. Clean equipment (e.g., drive rods and samplers) shall not come into contact with contaminated soils or other contaminated materials. Keep equipment on plastic or protect it in another suitable fashion. Store push rods and other equipment removed from a hole on plastic sheeting until properly decontaminated.

7.5 Soil Sampling

This SOP assumes that the subcontractor will perform sampling; therefore, detailed procedures regarding sample acquisition are not provided. Vendors of direct push equipment offer a variety of sampling systems designed specifically for their equipment. Both continuous and discreet soil samples may be obtained using sampling equipment similar to that described in Procedure 3-21, *Surface and Subsurface Soil Sampling*. The preferred methods for soil sampling using direct push techniques use brass or stainless steel split-tube samplers that are driven through the horizon to be sampled. Use plastic sample tubes (e.g., Macro-Core Samplers) only for screening purposes or, in the case of confirmatory sampling, if samples will not be analyzed for volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs).

7.6 Groundwater Sampling

Direct push vendors offer numerous methods for obtaining groundwater samples. Key differences among methods involve: (1) the maximum well diameter achievable; (2) the ability to protect the well screen from exposure to contaminated overburden soils during installation; (3) the ability to install packing around the screen; (4) flexibility in the size, materials of construction, and design of well screens; and (5) the ability to convert sampling points into permanent monitoring wells. The limitations and abilities of a given system must be thoroughly understood and matched to the needs of the project before committing to the collection of groundwater samples using direct push techniques.

Use direct push techniques only to collect screening samples unless it is confirmed that the system:

1. Effectively protects the well screen from exposure to contaminated overburden soils during installation
2. Allows the installation of effective packing around the well screen

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3. Allows the well screen to be effectively sealed against the downward infiltration of overlying groundwater or surface precipitation
4. Is constructed of materials compatible with the intended sampling and analysis goals of the project
5. Allows the use of a well screen properly sized and slotted for the needs of the project

Additional information on the collection of groundwater samples can be found in SOP 3-14 Monitoring Well Sampling.

It is the responsibility of the **CTO Manager** to evaluate and determine the appropriateness of direct push systems prior to committing to their use on any project involving groundwater sampling. As part of this evaluation, it is recommended to obtain concurrence from regulatory authorities in advance for the method selection.

7.7 Borehole Abandonment

Methods for abandoning boreholes created with direct push systems will vary among vendors. Coordinate the desired method for abandonment with the vendor in the planning stages of the project to ensure proper abandonment.

Some direct push boreholes will close naturally as the drive rods and sampling tools are withdrawn. This may occur in loose, unconsolidated soils, such as sands. Close all boreholes using one of the procedures described in this procedure, unless natural caving precludes such closure.

The three methods for closing direct push boreholes are:

1. Add granulated or pelletized bentonite and hydrate in layers, proceeding from the bottom of the hole to the surface.
2. Pour premixed cement/water (or cement/water/bentonite) mixture into the hole.
3. Fill the entire hole with granular or pelletized bentonite and hydrate by means of a previously emplaced water tube that is gradually withdrawn as water is supplied to the bentonite.

The second method is recommended. For shallow holes less than 10 feet in depth, pour a cement/water/bentonite mix directly into the opening using a funnel. For deeper holes, use a conductor (tremie) pipe to carry the grout mix to the far reaches of the borehole. Lower the conductor pipe to within 2 inches of the bottom and gradually withdraw it as grout is added, keeping the lower end of the pipe submerged in grout at all times.

The recommended grout mixture for well abandonment is 7 to 9 gallons of water per 94-pound bag of Portland cement, with 3 percent to 5 percent by weight of powdered bentonite added to the mixture. Commercial products, such as Volcay are acceptable with pre-approval of the **CTO Manager**.

Seal boreholes to within 0.5 to 2.0 feet of the surface. Inspect the abandoned borehole after 24 hours to ensure that grout shrinkage does not occur. If significant shrinkage has occurred, re-grout the borehole. Fill the remaining portion of the hole with local topsoil or appropriate paving materials.

8.0 Quality Control and Assurance

8.1 Collection of representative samples will be ensured through adherence to the procedures in this SOP and the sampling strategy outlined in the SAP. The field quality control samples identified in the SAP must be collected. These samples may include field duplicates, equipment rinsate blanks, trip blanks, and matrix spike/matrix spike duplicates

9.0 Records, Data Analysis, Calculations

9.1 Various forms are required to ensure that adequate documentation is made of the sample collection activities. These forms may include:

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- Boring logs;
- Field logbook;
- Sample collection records;
- Chain-of-custody forms; and
- Shipping labels.

9.2 Boring logs (Attachment 1) will provide visual and descriptive information for samples collected at each soil boring and are often the most critical form of documentation generated during a soil sampling program.

9.3 The field logbook is kept as a general log of activities and should not be used in place of the boring log.

9.4 Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes.

9.5 Shipping labels are required is sample coolers are to be transported to a laboratory by a third party (courier service).

10.0 Attachments or References

10.1 Attachment 1 – Boring Log

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

10.3 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.

10.4 Department of the Navy (DON). 2007. *Navy Environmental and Natural Resources Program Manual*. OPNAV Instruction 5090.1c. October.

10.5 SOP 3-05, *IDW Management.*

10.6 SOP 3-06, *Equipment Decontamination.*

10.7 SOP 3-21, *Surface and Subsurface Soil Sampling.*

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

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Attachment 1
Boring Log

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Boring ID:

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Project Name:	Drilling Company:	Type of Surface Material:
Project Number:	Drilling Method:	Patching Material:
Date Started Drilling:	Rig Type:	Drilling Water Level:
Date Finished Drilling:	Core Size:	Boring Total Depth (bgs):
Physical Location:		Logged By:

(Note: bgs = below ground surface)

Depth Range	Re covery ft./ft	PID (ppm)	Moisture Content	GA Class.	USCS	GA Class: Garfield Avenue Sites classification & Modified Unified Soil Clasiffication System	
						Ground Surface Cover and Thickness:	Sample name & #)
0-1							
1-2							
2-3							
3-4							
4-5							
5-6							
6-7							
7-8							
8-9							
9-10							
10-11							
11-12							
12-13							
13-14							
14-15							
15-16							
16-17							
17-18							
18-19							
19-20							

Stratigraphic Unit Intervals:		Comments:
1.)	5.)	
2.)	6.)	
5.)	6.)	

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Headspace Screening for Total VOCs

Procedure 3-19

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the basic techniques for using headspace analysis to screen for volatile organics in contaminated soils using a portable Photo Ionization Detector (PID) or Flame Ionization Detector (FID).

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 The health and safety considerations for the work associated with this SOP 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)**. Note that headspace screening usually requires Level D personal protection unless there is a potential for airborne exposure to site contaminants. Under circumstances where potential airborne exposure is possible respiratory protective equipment may be required based on personal air monitoring results. Upgrades to Level C will be coordinated with the Site Safety Officer (SSO) or **CTO Manager**.

2.2 Health and safety hazards and corresponding precautions include, but are not limited to, the following:

2.2.1 Dermal contact with contaminated soil. Personnel should treat all soil as potentially contaminated and wear chemically impervious gloves. Minimize skin contact with soil by using sampling instruments such as stainless steel spades or spoons. Do not touch any exposed skin with contaminated gloves.

2.2.2 Inhalation hazards. Appropriate air monitoring should be conducted to ensure that organic vapor concentrations in the breathing zone do not exceed action levels as specified in the Site-Specific HASP. When ambient temperatures are low enough to require warming samples using the vehicle heater, the vehicle's windows should be opened enough to prevent the build-up of any organic vapors. Use the PID or FID to verify the airborne concentrations in the vehicle remain below applicable action levels. Note that many volatile organic compounds (VOCs) are flammable and all precautions must be observed to eliminate any potential ignition sources.

2.2.3 Shipping limitations. Follow applicable regulations when shipping FID/PID equipment. When shipping an FID by air, the hydrogen tank must be bled dry. Calibration gas canisters are considered dangerous goods and must be shipped according to IATA and DOT regulations. Consult your EHS Coordinator and check with your shipping company to determine the correct shipping procedures

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

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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 collection of headspace readings comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the collection of headspace readings 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 headspace readings are conducted according to this procedure as well as verifying that the PID/FID is in proper operating condition prior to use and for implementing the calibration.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

6.1 The following materials must be on hand in good operating condition and/or in sufficient quantity to ensure that proper field analysis procedures may be followed:

- Calibrated PID/FID instrument;
- Top-sealing "Zip-Loc" type plastic bags – or – 16 ounces of soil or "mason-" type glass jars and aluminum foil;
- Project field book and/or boring logs;
- Personal Protective Equipment (PPE) as specified in the project HASP; and
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants.

7.0 Procedure

7.1 Preparation

Review available project information to determine the types of organic vapors that will likely be encountered to select the right instrument. The two basic types of instruments are FIDs and PIDs.

FIDs work well with organic compounds that have relatively lightweight molecules, but may have problems detecting halogenated compounds or heavier organic compounds; FIDs can detect methane for example. Since the FID uses a flame to measure organic compounds, ensure that work is conducted in an atmosphere, which is free of combustible vapors. If ambient temperatures are below 40°F, the flame of the FID may be difficult to light.

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When using a PID, select an instrument that can measure the ionization potential of the anticipated contaminants of concern. PIDs work well with a range of organic compounds and can detect some halogenated hydrocarbons; PIDs cannot detect methane. The correct ultraviolet (UV) light bulb must be selected according to the types of organic vapors that will likely be encountered. The energy of the UV light must equal or exceed the ionization potential of the organic molecules that the PID will measure. The NIOSH Pocket Guide to Chemical Hazards is one source for determining ionization potentials for different chemicals. Bulbs available for PIDs include 9.4 eV, 10.6 (or 10.2) eV, and 11.7 eV bulbs. The 10.6 eV bulb is most commonly used as it detects a fairly large range of organic molecules and does not burn out as easily as the 11.7 eV bulb. The 9.4 eV bulb is the most rugged, but detects only a limited range of compounds. Under very humid or very cold ambient conditions, the window covering the UV light may fog up, causing inaccurate readings. Ask the **SSO** about correction factors when high humidity conditions exist.

After selecting the correct instrument, calibrate the PID/FID according to the manufacturer's instructions. Record background/ambient levels of organic vapors measured on the PID/FID after calibration and make sure to subtract the background concentration (if any) from your readings. Check the PID/FID readings against the calibration standard every 20 readings or at any time when readings are suspected to be inaccurate, and recalibrate, if necessary. Be aware that, after measuring highly contaminated soil samples, the PID/FID may give artificially high readings for a time.

7.2 Top-Sealing Plastic Bag

Place a quantity of soil in a top-sealing plastic bag and seal the bag immediately. The volume of soil to be used should be determined by the **CTO Manager** or **Field Manager**. The volume of soil may vary between projects but should be consistent for all samples collected for one project. Ideally, the bag should be at least 1/10th-filled with soil and no more than half-filled with soil. Once the bag is sealed, shake the bag to distribute the soil evenly. If the soil is hard or clumpy, use your fingers to gently work the soil (through the bag) to break up the clumps. Do not use a sampling instrument or a rock hammer since this may create small holes in the plastic bag and allow organic vapors to escape. Alternatively, the sample may be broken up before it is placed in the bag. Use a permanent marker to record the following information on the outside of the bag:

- Site identification information (i.e., borehole number);
- Depth interval; and
- Time the sample was collected. For example: "SS-12, 2-4 ft, @1425".

Headspace should be allowed to develop before organic vapors are measured with a PID/FID. The amount of time required for sufficient headspace development will be determined by the project-specific sampling plan and the ambient temperature. Equilibration time should be the same for all samples to allow an accurate comparison of organic vapor levels between samples. However, adjustments to equilibration times may be necessary when there are large variations in ambient temperature from day to day. When ambient temperatures are below 32°F, headspace development should be within a heated building or vehicle. When heating samples, be sure there is adequate ventilation to prevent the build-up or organic vapors above action levels.

Following headspace development, open a small opening in the seal of the plastic bag. Insert the probe of a PID/FID and seal the bag back up around the probe as tightly as possible. Alternatively, the probe can be inserted through the bag to avoid loss of volatiles. Since PIDs and FIDs are sensitive to moisture, avoid touching the probe to the soil or any condensation that has accumulated inside of the bag. Since the PID/FID consumes organic vapors, gently agitate the soil sample during the reading to release fresh organic vapors from the sample. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted. Record the highest reading on the field form or in the field notebook as described in Section 9.

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7.3 **Jar and Aluminum Foil (Alternate Method)**

Half-fill a clean glass jar with the soil sample to be screened. Quickly cover the jar's opening with one to two sheets of clean aluminum foil and apply the screw cap to tightly seal the jar. Allow headspace development for at least ten minutes. Vigorously shake the jar for 15 seconds, both at the beginning and at the end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated area. When heating samples, be sure there is adequate ventilation to prevent the build-up of organic vapors above action levels.

Subsequent to headspace development, remove the jar lid and expose the foil seal. Quickly puncture the foil seal with the instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates. As an alternative, use a syringe to withdraw a headspace sample, and then inject the sample into the instrument probe or septum-fitted inlet. This method is acceptable contingent upon verification of methodology accuracy using a test gas standard. Following probe insertion through the foil seal or sample injection to probe, record the highest meter response on the field form or in the field notebook. Using foil seal/probe insertion method, maximum response should occur between two and five seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted.

8.0 Quality Control and Assurance

Quality Assurance/Quality Control (QA/QC) will include the collection of duplicate samples. In general, one duplicate will be collected per 20 samples. Organic vapor concentrations measured in the primary and duplicate samples should be similar within plus or minus 20 percent. The frequency of headspace duplicate collection will be determined by the project manager/task manager. The PID/FID instrument must be calibrated according to the manufacturer's instructions before beginning screening, and checked or recalibrated every 20 analyses or when readings are suspected to be inaccurate. Record ambient organic vapor levels in the field notebook and on the field form. Periodically check ambient organic vapor levels. If ambient levels have changed more than 20 percent, recalibrate the PID/FID. Make sure readings are not collected near a vehicle exhaust or downwind of a drill rig exhaust. If grossly contaminated soil is encountered, decontaminate sampling instruments between samples and/or change contaminated gloves to avoid cross contaminating less contaminated samples.

9.0 Records, Data Analysis, Calculations

9.1 All data generated (results and duplicate comparisons) will be recorded in the field notebook and/or on the field form. Any deviation from the outlined procedure will also be noted. Field conditions (ambient temperature, wind, etc.) should also be recorded in the field notebook.

9.2 Readings may be recorded in a field notebook, on a boring log, or on an appropriate form specific to the project. The form should include the following information:

- When the PID/FID was calibrated (date/time) and calibration standard used;
- Background/ambient concentrations measured after PID/FID calibration;
- Location of sample (i.e., bore-hole number);
- Depth interval of sample measured;
- Lithology of material measured; and
- PID/FID reading and units of measure.

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9.3 Note that if PID/FID measurements are recorded on a boring log, it is not necessary to duplicate information in the column where the PID/FID readings are recorded (e.g., borehole number, depth interval, lithology type).

9.4 All documentation will be stored in the project files and retained following completion of the project.

10.0 Attachments or References

SOP 3-20 Operation and Calibration of a Photoionization Detector

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

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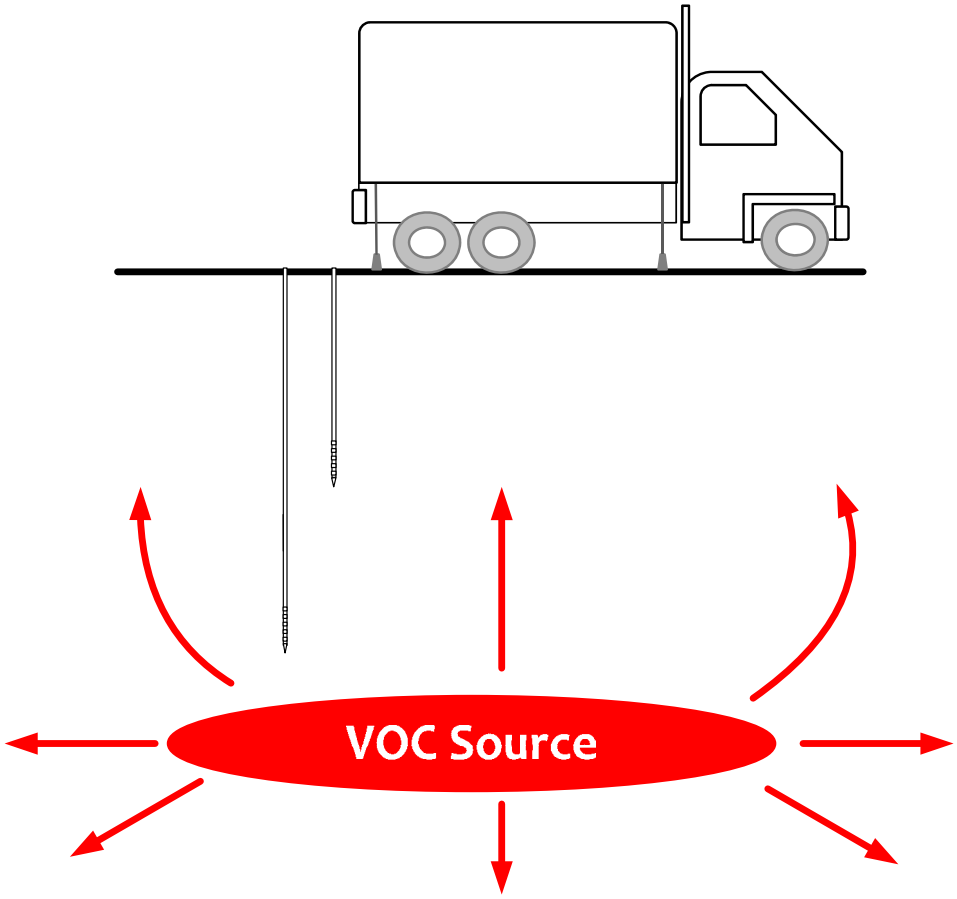
ADVISORY
ACTIVE SOIL GAS INVESTIGATIONS



California Environmental Protection Agency
Department of Toxic Substances Control
Los Angeles Regional Water Quality Control Board
San Francisco Regional Water Quality Control Board

April 2012

FOREWORD

In a coordinated effort, the Department of Toxic Substances Control, the Los Angeles Regional Water Quality Control Board, and the San Francisco Regional Water Quality Control Board have jointly developed the *Advisory – Active Soil Gas Investigations*. This document attempts to ensure that high quality data used for regulatory decision making are collected during active soil gas investigations using consistent methodologies. The document was reviewed by other government organizations and the regulated community. Their comments were considered and the Advisory changed in response to those comments. The Advisory also addresses recent developments in the field of soil gas collection. As additional information and experience are obtained, this Advisory may be modified as appropriate.

The information in the Advisory should not be considered as regulations. Mention of trade names or commercial products does not constitute the agency endorsement or recommendation.

If you have any questions or comments regarding this document, please contact Theodore Johnson of DTSC at via email at tjohnson@dtsc.ca.gov.

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The committee would like to acknowledge the contribution from soil gas practitioners that provided extensive and valuable comments, improving the overall quality of this document. More than 440 public comments on the Draft Advisory were received. Every comment was considered and the Advisory was changed in response to those comments. The Advisory was also revised to address recent developments in the field of soil gas collection. The Soil Gas Workgroup thanks all contributors for their efforts which improved the Advisory through their thoughtful observations.

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[1] Currently with United States Environmental Protection Agency Region X.
[2] Currently with California Air Resources Board.

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ACRONYMS

AGSI	Active Soil Gas Investigation
AST	Aboveground Storage Tank
ASTM	American Society of Testing and Materials
BFB	Bromofluorobenzene
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
CHHSLs	California Human Health Screening Levels
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
ECD	Electron Capture Detector
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
ETBE	Ethyl Tertiary Butyl Ether
FID	Flame Ionization Detector
Freon 11	Trichlorofluoromethane
Freon 12	Dichlorodifluoromethane
Freon 113	1,1,2-Trichloro-1,2,2-Trifluoroethane
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
CRWQCB	California Regional Water Quality Control Board
GEM	Gas Emission Monitor
ITRC	Interstate Technology and Regulatory Council
LARWQCB	Los Angeles Regional Water Quality Control Board
LCS	Laboratory Control Samples
L-D PE	Low Density Polyethylene
μg/L	Microgram per Liter
$\mu g/m^3$	Microgram per Cubic Meter
MS	Mass Spectrometer
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTBE	Methyl Tertiary Butyl Ether
mL/min	Milliliters per Minute
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standard and Technology
PAHs	Polycyclic Aromatic Hydrocarbons
PEEK	Polyetheretherketone
ppmv	Parts per Million by Volume
ppbv	Parts per Billion by Volume
PID	Photoionization Detector
PRT	Post-Run Tubing
RL	Reporting Limit
%RPD	Percent Relative Percent Difference
%RSD	Percent Relative Standard Deviation
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control

ACRONYMS (continued)

QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SIM	Selected Ion Monitoring
SOP	Standard Operating Procedure
SVOCs	Semi-Volatile Organic Compounds
SW-846	Solid Waste-846; USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TAME	Tertiary Amyl Methyl Ether
TBA	Tertiary Butyl Alcohol
TCE	Trichloroethylene or Trichloroethene
TICs	Tentatively Identified Compounds
TO-15	Toxic Organic-15 Analytical Method (USEPA, Compendium Method TO-15 for the Determination of Toxic Organic Compounds in Ambient Air)
TO-17	Toxic Organic-17 Analytical Method (USEPA, Compendium Method TO-17 for the Determination of Toxic Organic Compounds in Ambient Air)
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

The Advisory – Active Soil Gas Investigations (ASGI or Advisory) provides technically defensible and consistent approaches for collecting and analyzing soil gas samples. The Advisory is not a regulation. It does not impose any requirements or obligations on the regulated community. Rather, it provides a technical framework and reference for addressing soil gas sample collection and analysis. It is not intended to determine the need for soil gas samples, but rather to serve as a guide once a decision has been made to collect soil gas samples. Other technically equivalent procedures may exist. This Advisory is not intended to exclude alternative approaches or methodologies. The Advisory is a compilation of available information, knowledge, experience and best practices regarding soil gas sampling. The mention of trade names or commercial products in this Advisory is for illustrative purposes only, and does not constitute an endorsement or exclusive recommendation by the contributing government agencies.

Active soil gas sampling and analysis refers to the methods utilized to collect vapor phase data at sites potentially affected by volatile organic compounds (VOCs), chlorinated solvents, petroleum hydrocarbons, methane, hydrogen sulfide and semi-volatile organic compounds (SVOCs). The data obtained from a soil gas investigation can be used to identify the source and spatial distribution of contamination at a site or to estimate contaminant indoor air concentrations for risk assessment purposes. For guidance on evaluating the risk associated with vapor intrusion to indoor air, including sub-slab sampling, consult the DTSC Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (October 2011), hereafter referred to as the Vapor Intrusion Guidance.

Within the subsurface, contaminants may exist in the following phases:

1) Solid phase by adsorbing onto the organic fraction of soil;
2) Aqueous phase by dissolving in groundwater and pore water;
3) Non-aqueous phase liquid (NAPL); and/or
4) Gaseous phase, by accumulating in the interstitial space of soil particulates as soil gas.

Thus, soil matrix and groundwater sampling and analysis should be considered for site characterization in addition to soil gas sampling to ensure that all potential phases of VOCs are evaluated and their associated exposure pathways. Soil gas sampling is practical and preferred for many geologic materials, and, with care, can be successful in fine-grained soils.

This document supersedes the 2003 *Advisory – Active Soil Gas Investigations* (Cal/EPA, 2003) and 1997 LARWQCB *Interim Guidance for Active Soil Gas Investigations* (CRWQCB, 1997). It is the opinion of Cal/EPA that active soil gas investigations should be performed in accordance with this document. However, as noted above, other technically equivalent procedures may exist, and this Advisory is not intended to exclude alternative approaches or methodologies.

2.0 INITIAL PROJECT PLANNING AND WORKPLAN DEVELOPMENT

2.1 STUDY PURPOSE AND DATA QUALITY OBJECTIVES

A soil gas investigation may be undertaken for a number of different reasons and a single investigation may have multiple objectives. The data quality objectives (DQOs) for each investigation will vary according to the overall goals of each specific investigation. Examples of different purposes for performing a soil gas investigation are provided below:

- Determining if discharges of contaminants have occurred which may impact indoor air, outdoor air and groundwater, such as leaks at aboveground storage tanks (AST), underground storage tanks (USTs) or other underground pollution sources;
- Determining the spatial patterns and extent of vapor phase soil contamination,
- Designing and monitoring the performance of a soil vapor extraction system;
- Mapping soil vapor plumes to select buildings for indoor air monitoring;
- Creating a stand-alone data set for performing a vapor intrusion risk assessment using either generic attenuation factors or a mathematical model to estimate indoor air concentrations from soil gas data;
- Remedy performance monitoring; and
- Providing data for no-further-action determinations at impacted sites.

The DQO process is a systematic planning tool based on the scientific method for establishing criteria for data quality and for developing data collection procedures. By using the DQO process to plan environmental data collection efforts, the effectiveness, efficiency and defensibility of decisions can be improved. DQOs should be established before an investigation is started. Example input parameters to the DQOs include past, current and future land uses, regulatory action levels for contaminated media, laboratory method reporting limits, and the appropriate sample collection method. The expected output is the most resource-effective design for the study. Information concerning DQOs is provided in USEPA (1994a, 1994b, 2000a). A critical step in developing site-specific DQOs is the generation of a conceptual site model (CSM), discussed below in Section 2.3.2.

2.2 TECHNICAL DOCUMENTS

Each soil gas investigation should have two technical documents: a workplan that describes the investigation in detail, and a report that describes the results of the investigation and the analysis of data. The workplan should incorporate the CSM and DQOs as a framework for the planned investigation. The CSM should be updated during the investigation as data gaps are addressed.

2.3 WORKPLAN

A workplan should be prepared and submitted to the regulating agency for review and approval according to the agreed upon schedule. Any variations or deviations from this Advisory should be specified in the workplan. The soil gas workplan may be incorporated as part of a comprehensive site investigation workplan or as a stand-alone

incorporated as part of a comprehensive site investigation workplan or as a stand-alone document, depending on site-specific circumstances. The workplan should include a CSM, sampling and analysis plan (SAP), and DQOs. The decision making criteria for step-out sampling should be included in the workplan.

The workplan should have contingences to address unexpected field conditions, such as larger than anticipated contaminant plumes, low flow or no flow conditions, and resampling when anomalous data are obtained. Anomalous data are defined as data which are inconsistent with the CSM. Additional points may be required to resolve anomalies.

The regulating agency should be informed of any problems, unforeseen site conditions or deviations from the approved workplan. If modifications to the approved workplan are going to be implemented, the regulating agency should be notified and provided an opportunity to review the changes prior to implementation. Changes made without prior agency approval should be clearly documented in subsequent reports, including justification for these changes.

The project proponent should notify the regulating agency 10 working days prior to implementation of field activities. All necessary permits and utility clearances should be obtained prior to conducting any investigations described in this Advisory.

2.3.1 Elements of the Workplan

Specific information that the regulating agencies will expect to see in a workplan include the following:

1) Site background;

2) CSM;

3) A SAP that contains the number, location and depth of sampling points and the rationale for this decision;

4) A statement of the investigation objectives relative to the site-specific DQOs;

5) A statement as to whether permanent or temporary soil gas wells are to be installed. See DTSC (2011) for guidance concerning the need for the installation of permanent soil gas wells;

6) A statement as to whether a mobile and/or stationary laboratory will be used, and the rationale for making this decision;

7) A schematic diagram of the well design;

8) A schematic diagram of the sampling train;

9) A geological cross-section of the site showing the major lithologic units and zones for vapor monitoring;

10) Procedures for soil gas sample collection and the analytical methods to be used along with their laboratory detection limits;

11) Contaminant analyte list;

12) Considerations for sampling frequency pursuant to the DQOs established for each site;

13) Procedures to properly decommission soil gas wells to effectively prevent cross-contamination in the subsurface;

14) A project-specific quality assurance project plan (QAPP) for the project if no existing approved QAPP is applicable;

15) Procedures for handling and disposing of investigation-derived waste in accordance with federal, state and local agency requirements; and

16) A site-specific Health and Safety Plan.

2.3.2 Conceptual Site Model

A CSM is an integral part of all site investigations. The purpose of a CSM is to provide a conceptual understanding of the potential for exposure to hazardous contaminants at a site based on:

- Sources of contamination;
- Release mechanisms;
- Transport media;
- Exposure pathways; and
- Potential receptors.

The CSM also aids in the justification for the number, location and frequency of samples. The CSM should consist of descriptive text and diagrammatic or schematic figures relating the sources of contamination to receptors and the environment. The CSM organizes and communicates information about the site characteristics and provides all interested parties with an understanding of the potential for exposure to chemicals of potential concern (COPCs) at a site. Additional resources regarding CSMs include: (1) DTSC, 2011; (2) ITRC, 2007; (3) DTSC, 1994; (4) USEPA, 1988; (5) USEPA, 1989; and (6) USEPA, 1994.

The basic components of a CSM are:

1) Type of contaminants, including VOCs, currently or previously stored or handled at the site, to develop a site-specific target analyte list;
2) Known concentrations of COPCs in media such as soil gas, soil and groundwater;
3) Identification of the primary and secondary sources of COPCs;

5) Primary release mechanism;
6) Exposure media such as surface soil, drinking water and air;
7) Potential human and ecological receptors and groundwater; and
8) Unique site features.

The CSM is a dynamic and iterative tool, and is updated as new information becomes available. Therefore, it should be reviewed after each stage of investigation and revised as appropriate.

The following information should be considered to identify contaminant sources, potential release mechanism(s) and pathway(s) for vapor migration:

- Soil types;
- Subsurface geology;
- Hydrogeology (local and regional), including depth to groundwater and groundwater flow direction;
- Subsurface heterogeneity;
- Preferential pathways, such as fractures, sand lenses, and utility corridors;
- Groundwater quality data;
- Regional groundwater flow direction;
- Well records;
- Boring logs;
- Building construction details; and
- Surficial features of the area, such as ground cover and surface water bodies.

A CSM should be supported by contaminant plume maps and geological cross sections. The narrative description should clearly describe known site conditions and state what assumptions were made to generate the CSM.

2.3.3 Sampling and Analysis Plan

The SAP should specify all procedures and techniques used for soil gas sample collection, shipment, analytical procedures and chain of custody documentation. Field personnel should follow the SAP while collecting and analyzing soil gas samples.

The SAP should identify proposed sampling points, known or inferred extent of contamination, potential or known areas of concern and pertinent features such as existing or former sumps, trenches, utility corridors, drains, sewer lines, clarifiers, septic systems, piping, ASTs, USTs and waste management units. Generally, the SAP should contain:

- Sampling objectives;
- Sample location and frequency;
- Pre-sampling activities;
- Sample equipment and collection procedures;
- Sample handling and analyses;
- Chain of custody control and records management;
- Analytical procedures;

- Field instrument and laboratory detection limits;
- Field and laboratory quality assurance/quality control (QA/QC); and
- Evaluation of data quality.

The SAP should also contain a quality assurance project plan describing the policy, organization, activities and protocols necessary to achieve the data quality objectives dictated by the intended use of the data. The QAPP should include the following applicable information:

- Project description, management/organization and responsibilities;
- Quality assurance objectives;
- Sampling, calibration and analytical procedures;
- Data acquisition, reduction, validation and reporting;
- Documentation;
- Internal quality control;
- Performance and systems audits;
- Preventative maintenance;
- Data assessment procedures;
- Corrective actions; and
- Quality assurance reports.

Project tasks and time lines, including dates anticipated for initiating and completing sampling activities should also be included in the SAP.

2.4 SOIL GAS INVESTIGATION REPORTS

A soil gas investigation report should be submitted to the regulating agency at the conclusion of the investigation. Electronic data files should be submitted in accordance with the electronic data format requirements of the oversight agency.

Reports should include the following information:

- Description of field operations (including purge testing and leak check compounds);
- Analytical methods used;
- Analytical results;
- Analysis and revision of the CSM based on data obtained from the soil gas investigation;
- Deviations from the approved workplan;
- Data inconsistencies;
- Data gaps identified based on the revised CSM; and
- Conclusions and recommendations.

Additionally, the following tables and diagrams should be included in the Report:

1) Site plan and sample location maps;

2) Plume maps and geologic cross sections with isoconcentration contours displaying the limits of contamination. Data from previous investigations may be included provided the data are presented in a way that distinguishes them from the current investigation;

3) Boring logs;

4) Construction and as-built diagrams for soil gas wells;

5) Summary tables for analytical data;

6) Legible copies of field and laboratory notes or logs;

7) All analytical results and QA/QC information including tables and explanation of procedures, results, corrective actions and effect on the data;

8) All raw data including chromatograms and calibration data if specifically requested by the regulating agency; and

9) Electronic data deliverables submitted in the format specified by the regulating agency.

All engineering or geologic work should be performed or supervised by a California Registered Professional in accordance with the Business and Professions Code, chapters 7 and 12.5, and the California Code of Regulations, title 16, chapters 5 and 29.

3.0 SOIL GAS INVESTIGATION DESIGN

The number, location and depth of soil gas samples should be based on the CSM and the project-specific DQOs, as well as the following general guidelines.

3.1 LOCATION, SPACING AND DEPTH

Subsurface contamination should be delineated three-dimensionally. Vertical soil gas delineation is achieved by collecting soil gas samples at varying depths in a single location, or by using closely spaced soil gas wells installed at varying depths.

3.1.1 Lithology

Locations and depths for soil gas monitoring wells should be based on site-specific lithologic information. If on-site lithologic information is not available prior to conducting the soil gas investigation, one or more continuously cored boring(s) should be installed at the first location to the proposed greatest depth of the soil gas investigation. If the soil gas data are to be used for human health risk assessment, geotechnical data may be needed. Geotechnical information needed for vapor intrusion risk assessment purposes can be found in DTSC's Vapor Intrusion Guidance (DTSC, 2011).

Lithologic logs should be prepared for all borings, including soil matrix and geotechnical borings. Information gathered from the continuously cored borings may include lithologic descriptions, geotechnical data and contaminant data. Information collected from borings should be used to update the CSM. All boring logs generated during the soil gas survey should be provided to the regulating agency.

3.1.2 Sample Spacing

Sample spacing may be based on historical site use or known or potential release sources. Initial spacing can be grid-based such as samples spaced on a 50- by 50-foot grid. Alternatively, initial sampling can be based on historical or suspected site use. When areas of contamination are identified, a more focused grid spacing or biased sampling approach may be employed. Use a close interval grid or radial or step-out sampling pattern such as 10- to 20-foot grid pattern and multi-level sampling at 5-, 10-, 15-feet vertically to delineate identified contaminant areas. If historical information for the area is unknown, a screening grid pattern, such as 100- by 100-foot may be used.

3.1.3 Sample Depth

All available information such as boring logs and field instrument readings from soil cuttings or cores should be used to select the correct depths to collect soil gas samples. Probes should be installed at depths with elevated vapor readings and/or slightly above fine-grained soils. If vertical characterization to groundwater is needed, the deepest soil gas sample should be collected near the top of the capillary fringe. Soil gas wells or probes[3] should not be installed within or below the capillary fringe. Nested soil gas wells

[3] The term "soil gas monitoring well", "soil gas well", "soil vapor well", and "soil vapor probe" are considered equivalent and used interchangeably within the Advisory.

may be installed in the annular space of groundwater monitoring wells to serve as a dual-purpose well if both vapor and groundwater monitoring are required.

Soil gas sample depths should be chosen to minimize the effects of changes in barometric pressure and temperature, breakthrough of ambient air from the surface, and to ensure that representative samples are collected. Soil gas samples collected at less than 5 feet below ground surface (bgs) may be subject to barometric pressure effects and prone to breakthrough of ambient air through the soil column. Consideration should be given to source location, types of chemicals of concern and the lithology encountered. Variation of sample depths and the need for deeper sample locations should be evaluated based on site-specific characteristics and DQOs.

When evaluating vapor intrusion, sampling soil gas immediately adjacent to a building's foundation may be a viable option if the samples are collected near the contaminant source. Soil gas samples collected immediately above the source of contamination are more likely to be representative of what may be in contact with the building's foundation (Hers et al., 2006 and DiGiulio and Cody, 2006). Likewise, the numerical modeling conducted by Abreu and Johnson (2005) and Abreu and others (2006) also suggests this relationship. Hence, risk estimates may be biased low if quantified with shallow soil gas measurements (five feet below grade) using the Johnson and Ettinger (1991) model. Accordingly, collecting soil gas samples near contaminant sources is recommended for vapor intrusion modeling. Vertical soil gas sampling should be conducted to determine the source of subsurface contamination. Ideally, numerous vertical profiles of soil gas should be developed at the site to accurately locate subsurface sources. Once located, soil gas collection can be targeted at these depths site-wide. Typically, contaminant sources are adjacent to the areas of highest subsurface concentration.

3.2 INSTALLATION PROCEDURES

Soil gas well installation procedures are described below. Soil gas well construction should ensure a good seal between the formation and sampling assembly, and minimize ambient air breakthrough. Additional standards may be required by local oversight agencies.

3.2.1 Installation Methods and Design

Soil gas wells may be installed using a variety of drilling methods such as direct push, hollow stem auger or hand auger. Certain drilling methods that significantly disrupt soil gas equilibrium, such as air rotary and rotosonic, may be employed if longer equilibration times are used prior to sampling. The mud rotary drilling method is not acceptable for soil gas probe emplacement under any circumstances. Following is a step-by-step guide to soil gas well (probe) installation after the borehole has been drilled:

1) Install a sand pack to minimize disruption of airflow to the sampling tip. A tremie pipe should be used for soil gas wells deeper than 15 feet to avoid bridging or segregation during placement of the sand pack and bentonite seal. The sand

pack should be a minimum of six inches thick. Place the probe tip midway in the sand pack, as shown on Figure 1;

2) Emplace at least six inches of dry granular bentonite on top of each sand pack, as shown on Figure 1. Following the dry bentonite, fill the borehole to the surface with hydrated bentonite. The bentonite should be hydrated in a container at the surface and then slowly poured into the borehole. The purpose of the dry granular bentonite between the sand pack and the hydrated bentonite is to prevent hydrated bentonite from infiltrating the sand pack. Follow a similar procedure for deep well construction with multiple probe depths, in that one foot of dry granular bentonite should be emplaced on top of the sand pack encasing each probe, followed by hydrated bentonite. The hydrated bentonite should continue until the next sand pack, as shown on Figure 1. A cement/bentonite mixture may also be used above the dry bentonite layer to seal the borehole annulus, consistent with California Department of Water Resources Bulletin 74-90 (California Well Standards) (DWR 1991). Dry and hydrated bentonite layer thicknesses may be adjusted based on probe use (such as sub-slab probes).

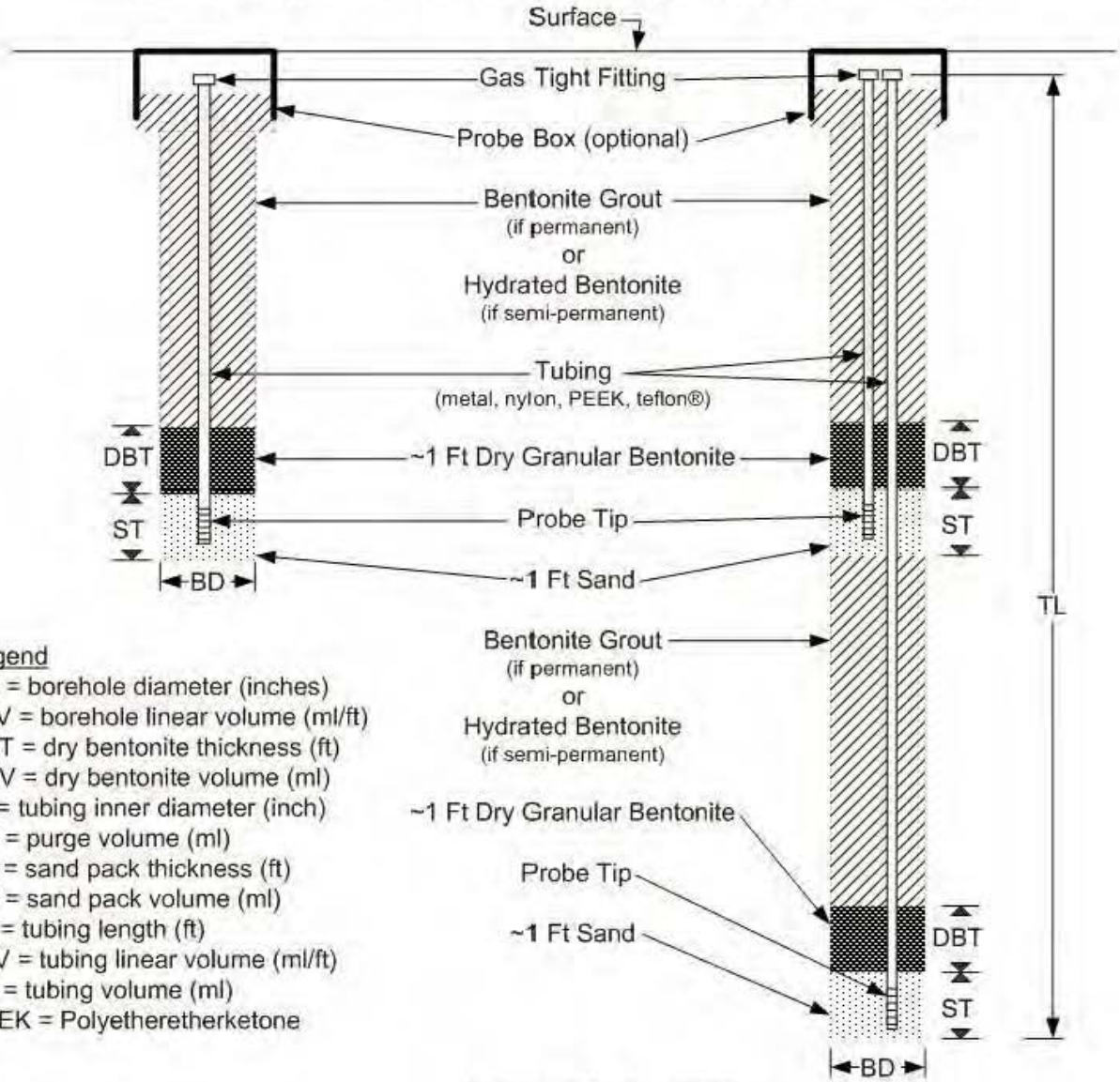
3) A down-hole rod should be used to support the well tubing in the borehole. The support rod ensures that the probe tip is placed at the proper depth. The support rod should be constructed to avoid possible cross contamination or ambient air intrusion. Alternative probe support designs with accompanying descriptions may be proposed in the project workplan. Justification should be included in the project workplan if the project proponent chooses not to use probe support for deep soil gas wells.

3.2.2 Temporary and Permanent Wells

Permanent or temporary soil gas wells may be used for collecting samples. Permanent sampling points are installed so that repeated sampling can be conducted, as necessary, to evaluate seasonal or temporal variations. Temporary sampling points are typically used for one or two sampling events and then decommissioned in accordance with Section 3.4 of this Advisory.

Figure 1

Typical Single and Nested Soil Gas Probe Design & Purge Volume Calculation



Legend
BD = borehole diameter (inches)
BLV = borehole linear volume (ml/ft)
DBT = dry bentonite thickness (ft)
DBV = dry bentonite volume (ml)
ID = tubing inner diameter (inch)
PV = purge volume (ml)
ST = sand pack thickness (ft)
SV = sand pack volume (ml)
TL = tubing length (ft)
TLV = tubing linear volume (ml/ft)
TV = tubing volume (ml)
PEEK = Polyetheretherketone

(1) TV = TL x TLV = (TL) _____ X 6 if tubing ID = 3/16" = X 16 if tubing ID = 5/16" = X __ if tubing ID = ____" = _____ ml

(2) DBV = DBT x BLV = (DBT) _____ X 350 if BD = 2 1/8" = X 820 if BD = 3 ¼" = X ___ if BD = _____" = _____ ml

(3) SV = ST x BLV = (ST) _____ X 280 if BD = 2 1/8" = X 660 if BD = 3 ¼" = X ___ if BD = _____" = _____ ml

Note: porosity of 50% used for dry bentonite and 40% used for #3 sand pack to calculate BLV.

1 PV = (1)TV + (2) DBV + (3) SV = _____ ml

3.2.3 Sampling Tubing

To minimize purge volume, use small diameter (1/8 to 1/4 inch) sampling tubing from the vapor probe tip to the ground surface, made of material which will not react or interact with site contaminants. The probe tip, probe and probe connectors should all have the same diameter to provide a good seal between the formation and the sampling assembly. The following steps will help ensure a good-quality soil gas sample.

1) Clean, dry tubing should be used at all times. If any moisture or unknown material is present in the tubing prior to insertion, decontaminate or replace the tubing;

2) The bottom-end of the tubing should be attached to a soil gas probe tip. Downhole equipment (probe screens, tie wires, etc.) or drive heads should be free of cutting oils and other contaminants;

3) Metal tubes should not be used to collect hydrogen sulfide samples. Nylaflow®, polyetheretherketone (PEEK), and Teflon® are recommended for soil vapor sampling. Low-density polyethylene (L-D PE) should not be used due to decreased performance relative to other tubing types in both off-gassing of VOCs inherent in the tubing structure (contribution to background) and for decreased contaminant recovery (reactivity). Reduced recovery of naphthalene was observed when using Nylaflow® tubing with small sample sizes. For additional information, see Appendix B;

4) Prior to sampling, an assembled soil gas probe, tip and tubing should be blank tested at a frequency of one analysis per new batch of tubing or material used.

3.2.4 Drive Point Method

Post-run tubing (PRT) and drive point methods[4] used to create temporary soil gas wells may be used to rapidly acquire soil gas samples when carefully installed. Contractors should ensure that installation includes regularly checking and cleaning of the PRT tip threads and its seat and changing the O-rings on a daily basis. Contractors should use stiff tubing to couple the PRT tip to the connective hose and use ¼ inch outer diameter, thick-wall tubing to ensure sufficient torque is available to screw the tip tightly into the seat. If the O-ring is not seated properly into the drill rod, ambient air from inside the rod could enter into the sampling system, introducing ambient air into the soil gas sample. The integrity of the seal of the O-ring cannot be readily evaluated with a leak check compound.

Representative soil gas samples may be difficult to obtain with PRT and drive point methods in certain lithologies. Drive point probes may be deflected by consolidated lithologies and strata containing cobbles or boulders, which can create gaps between

[4] Drive point methods may be appropriate for certain site conditions or circumstances depending on DQOs. The use of post-run tubing should be discussed with the regulating agency prior to inclusion in the workplan.

the outer wall of the drive rod and the subsurface that are difficult to observe and equally difficult to seal. A hydrated bentonite plug at ground surface does not stop communication along the annular space. Samples collected under these circumstances will potentially draw soil gas primarily from the most permeable layer above the probe tip which may introduce a significant bias. Moreover, this condition is difficult to identify by a leak check compound applied at or near ground surface. Collecting representative soil gas samples in these conditions may require alternative sampling methods such as passive soil gas sampling or the installation of permanent sampling wells.

3.3 SOIL GAS WELL COMPLETION

Soil gas wells should be secured, capped and completed to prevent infiltration of water or ambient air into the subsurface, and to prevent accidental damage or vandalism. Mark the tubing at the surface to identify the probe location and depth. For surface completions, the following components may be installed:

- Gas-tight valve or fitting for capping the sampling tube;
- Utility vault or meter box with ventilation holes and lock;
- Surface seal; and
- Guard posts.

3.4 DECOMMISSIONING

When sample collection ceases at a vapor well, properly remove or decommission wells with concurrence from the regulating agency. The decommissioning process should prevent the well and associated borehole from becoming a conduit for the preferential migration of contamination. The decommissioning procedures within the California Well Standards (Bulletin 74-90) should be followed along with any local requirements.

When decommissioning vapor wells with tubing, the following decommissioning steps should be followed:

1) Squeeze sealant, such as grout, cement or silicone caulk, into the exposed tubing until the entire tubing is filled with material;
2) Cut the well tubing as far below grade as possible;
3) Fill the open hole with hydrated bentonite to within one foot of the surface grade;
4) Fill the last foot of the hole with compacted native material; and,
5) Restore pavement and vegetation to original conditions, if needed.

When overdrilling vapor wells with ridged casing, a casing guide should be used to prevent the drill bit from drifting during the decommissioning. A casing guide will allow the drill bit to remain aligned on the top of the well casing, allowing for effective removal of the well material. Once the well material is removed, the borehole should be filled with bentonite grout. If vapor wells penetrate clay units, consideration should be given to overdrilling rather than abandonment in place in order to prevent preferential contaminant migration.

3.5 DECONTAMINATION

Decontaminate all reusable equipment to prevent cross contamination. Tubing is not reusable and should not be decontaminated. Instead, use new or unused sampling tubing for each probe location.

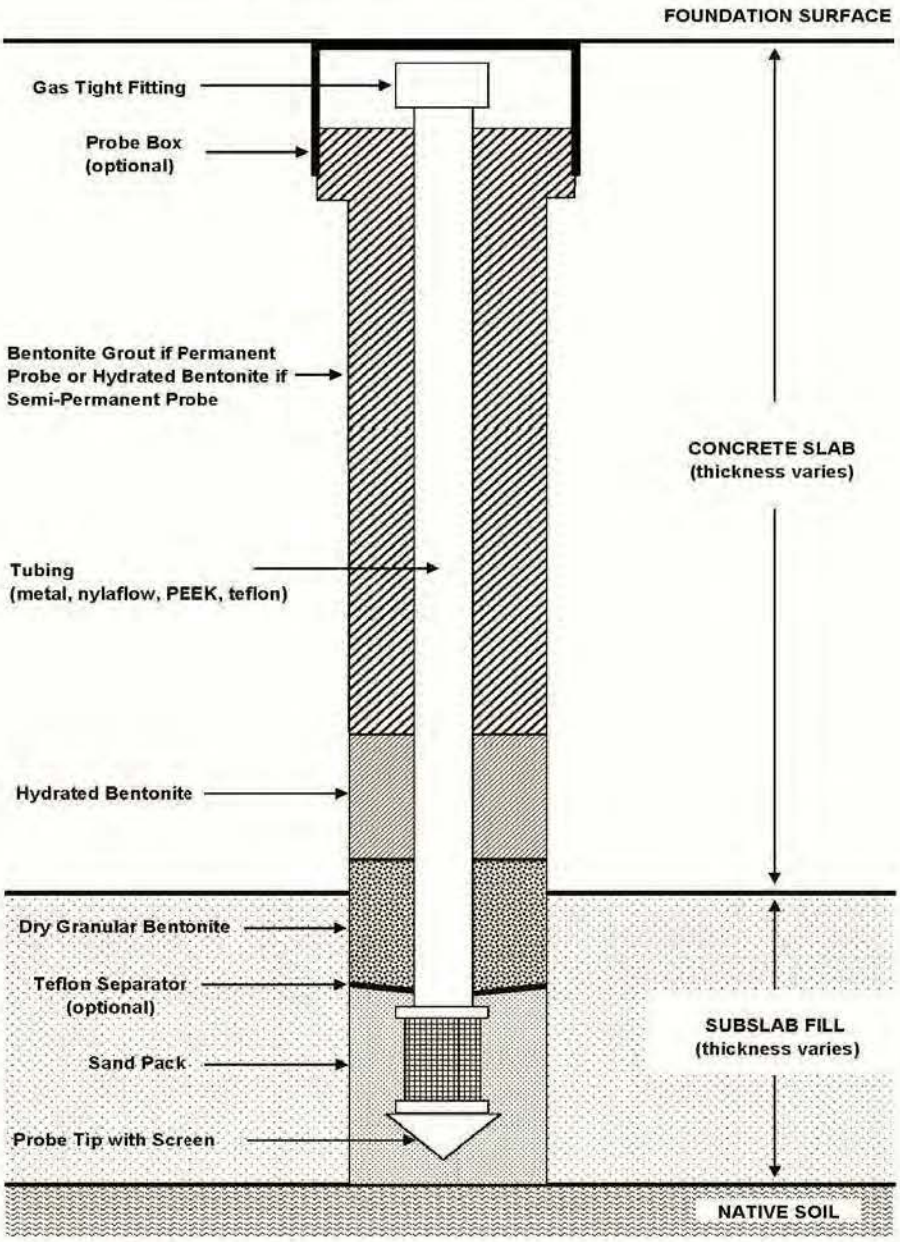
Decontamination may consist of steam cleaning or a three-stage decontamination process consisting of a wash with a non-phosphate detergent, a rinse with tap water and a final rinse with distilled water. Collect one equipment blank at the beginning of sampling and at least one each day after decontamination. Equipment should be air-dried before reuse.

3.6 SUB-SLAB INVESTIGATION METHODS

The procedures for collecting sub-slab soil gas samples are the same as for collecting subsurface soil gas samples except that small sampling canisters should be used to minimize ambient air breakthrough into samples. USEPA (2006) recommends that the sampling canisters should be one liter or less. Methods for installing sub-slab vapor probes can be found in the DTSC Vapor Intrusion Guidance (DTSC, 2011, Appendix G). A typical sub-slab probe design is included in this document as Figure 2. The probe tubing should extend to the bottom of the foundation slab to effectively bypass any cracks within the slabs at the probe location. It is critical to seal off the probe to ambient air to obtain high quality data.

FIGURE 2

Sub-Slab Vapor Probe Typical Diagram



NOT TO SCALE

4.0 SOIL GAS SAMPLE COLLECTION

4.1 EQUILIBRATION TIME

Subsurface conditions are disturbed during drilling and probe placement. To allow for the subsurface to equilibrate back to representative conditions, the following equilibration times are recommended before proceeding with soil gas sampling:

1) For soil gas wells installed with the direct push method, do not conduct the purge volume test, leak test and soil gas sampling for at least two hours following vapor probe installation;

2) For soil gas wells installed with hollow stem or hand auger drilling methods, do not conduct the purge volume test, leak test and soil gas sampling for at least 48 hours after soil gas probe installation;

3) For soil gas wells installed with a combination of hand auger drilling or hollow stem auger and direct push methods, do not conduct the purge volume test, leak test and soil gas sampling for at least two hours following vapor probe installation provided that at least five feet of the borehole was drilled by direct push technology. The five feet of direct push borehole should be drilled after the completion of hand augering or hollow stem augering. The well screen should be located below this five-foot interval. If the well screen is located above the five-foot interval, do not conduct the purge volume test, leak test and soil gas sampling for at least 48 hours after soil gas probe installation; and

4) For soil gas wells installed with the rotosonic or air rotary method, do not conduct the purge volume test, leak test, and soil gas sampling until it can be empirically demonstrated that the subsurface equilibrium time is sufficient to collect representative samples. Due to site-specific conditions, the re-establishment of equilibrium could vary from a few days to a few weeks.

Note: The best option to verify that equilibrium has re-established is to collect time-series data. Soil gas samples, along with oxygen and carbon dioxide measurements, should be collected shortly after installation, and then at a frequency that will demonstrate the time needed to attain representative samples. A field instrument may be used to analyze the soil gas samples to evaluate representativeness. Assuming similar lithology, one monitoring point could serve as a surrogate for all others when installing multiple sampling probes. For differing lithologies, see Additional Purge Volume Tests section below.

Soil gas well installation method and equilibration time should be recorded in the field log book or field form.

4.2 SOIL GAS ASSEMBLY TESTS

Complete shut-in, leak, and purge volume tests before collecting soil gas samples after the soil gas well has equilibrated.

4.2.1 Shut-In Test

Prior to purging or sampling, a shut-in test should be conducted to check for leaks in the above-ground sampling system. To conduct a shut-in test, assemble the above-ground valves, lines and fittings downstream from the top of the probe. Evacuate the system to a minimum measured vacuum of about 100 inches of water using a purge pump. The test is conducted while the sampling canister, if used, is attached with its valve in the closed position. Observe the vacuum gauge connected to the system with a “T”-fitting for at least one minute or longer. If there is any observable loss of vacuum, the fittings are adjusted until the vacuum in the sample train does not noticeably dissipate. After the shut-in test is validated, the sampling train should not be altered. The vacuum gauge should be calibrated and sensitive enough to indicate a water pressure change of 0.5 inches. A shut-in test is not a replacement for a leak test.

4.2.2 Leak Test

A leak test is used to evaluate whether ambient air is introduced into the soil gas sample during the collection process. Atmospheric leakage occurs in three ways:

1) Advection through voids in the probe packing material and along the borehole sidewall;
2) Advection directly through the soil column; and
3) Through the fittings in the sampling train at the surface (Banikowski et al, 2009).

A leak test should be conducted at every soil gas well each time a soil gas sample is collected to evaluate the integrity of the sample. Introducing ambient air may result in an underestimation of actual site contaminant concentrations or, alternatively, may introduce external contaminants into samples from ambient air.

The two types of leak check compounds available for use when soil gas sampling are liquid compounds and gaseous compounds. Both types have their advantages and disadvantages, and practitioners should select a leak check compound based on their project’s DQOs. See Appendix C for quantitative leak testing.

4.2.2.1 LEAK CHECK COMPOUNDS (LIQUID)

Liquid tracer compounds, such as hexane, pentane, diflouroethane and isopropanol, can be used to evaluate sample integrity. Other compounds not listed here may also be appropriate. Typically, liquid tracer compounds are applied to towels or clean rags and placed around all connections in the sampling train in order to evaluate potential leaks of ambient air into the sampling train. The liquid tracer should not be directly sprayed or poured onto a fitting, but rather applied to a cloth which should be placed near the connection. Towels or rags with the liquid tracer should also be placed on the ground adjacent to the probe to evaluate soil column and probe construction breakthrough. The leak check compound selected should not be a suspected site-specific contaminant. Seal integrity is confirmed by analyzing the soil gas sample for the tracer compound. Alternatively, each connection can be individually checked by placing the tracer cloth in a plastic bag and then using the bag to enclose individual connections. Instruments can

be used in the field to evaluate whether leakage is occurring rather than waiting for the mobile or stationary laboratory results. Liquid leak check compounds should be included in the laboratory analyte list. The laboratory reports should quantify and annotate all detections of the leak check compound at the reporting limit of the target analytes. If the concentration of the leak check compound is greater than or equal to 10 times the reporting limit for the target analyte(s), then corrective action is necessary as discussed below.

4.2.2.2 LEAK CHECK COMPOUNDS (GASEOUS)

Gaseous tracer compounds, such as helium and sulfur hexafluoride, can be used along with a shroud or tent placed over the sampling equipment. Other compounds not listed here may also be appropriate. Procedures for conducting a quantitative leak test are described in Appendix C. An ambient air leak up to 5 percent is acceptable if quantitative tracer testing is performed by shrouding.

4.2.2.3 LEAK CHECK CONSIDERATIONS

A soil gas well should be decommissioned if the leak cannot be corrected. Replacement soil gas wells should be installed at least five feet from the location where the original soil gas well was decommissioned due to a confirmed leak. The leak check compound concentrations detected in the soil gas samples should be included in the laboratory report and the ambient air breakthrough should be discussed in the site characterization report.

The intent of the leak check compound is to enhance the integrity of the soil gas sample by demonstrating that minimal or no ambient air breakthrough during sampling is occurring. Although it is preferable not to have any tracer gas breakthrough, minor amounts of breakthrough may be acceptable if the breakthrough is appropriate for the site's DQOs. Detecting leak check compounds indicate potential field problems. Some potential sources of leaks in sampling trains are poor quality fittings, stripped, over tightened, dirty or worn threads, and excessive sampling train connections. Regardless of the cause of the leak, a data adjustment factor based upon the concentration of the leak check compound to compensate for the inability to collect representative samples is inappropriate.

Note that if a passivated stainless steel canister is used to collect a sample that is later analyzed at a stationary laboratory and there is a significant leak, it will typically not be identified until after demobilization of the field crew. Therefore, field screening prior to laboratory analysis is recommended.

Commercially available leak check compounds, both liquid and gaseous, may contain unanticipated impurities. Therefore, laboratories should analyze the leak check compound to aid in the interpretation of the data.

When designing a field study, the tracer compound should be carefully selected. The following items should be considered when choosing a tracer compound.

- Excessive concentrations of the tracer can elevate analytical detection limits;

- Tracer compounds can cause interference with target analytes;
- Field detectors may produce biased results in the presence of water vapor or other compounds;
- The tracer compound may be naturally occurring;
- Field detectors may not be routinely calibrated; and
- Pressurized canisters of tracer gas may be dangerous to transport.

4.2.3 Purge Volume Test

The purpose of a purge volume test is to ensure that stagnant air is removed from the sampling system and to ensure that samples are representative of subsurface conditions. The purge volume test should be completed after the shut-in and leak test. The test well should be located near the contaminant source zone and in a lithologic unit where soil gas concentrations are anticipated to be elevated. The purge volume test is conducted by collecting and analyzing a sample for target compounds after removing one, three and 10 purge volumes. The purge volume test samples should be analyzed with the same analytical method as the constituents of concern.

One purge volume includes the following volumes:

- The internal volume of tubing;
- The void space of the sand pack around the probe tip; and
- The void space of the dry bentonite in the annular space.

For permanent probes subject to frequent sampling, the purge volume can be reduced to one tubing volume if sufficient time, typically two weeks, has transpired between sampling events to allow the filter pack to come into equilibrium with the surrounding soil and the probe has remained sealed to ambient air. Sample containers are not included in the purge volume calculation except when non-evacuated glass bulbs are used. In those instances, the volume of the non-evacuated glass bulbs should be added to the purge volume to account for mixing and dilution of gasses inside the glass bulb.

Conduct the purge test at the same flow rate and applied vacuum as will be used to collect the soil gas samples. If the pump is battery-operated, the batteries should be checked before and during the operation to insure that a proper charge is maintained. As batteries lose charge the flow rate is lowered, effectively changing the purge rate. Select the appropriate purge volume based on the highest concentration of the compound(s) of concern detected during the purge volume test.

To avoid extensive purging for soil gas samples collected at less than five feet bgs, a default of three purge volumes should be extracted prior to sampling. If VOCs are not detected in any of the step purge tests, a default of three purge volumes should be used.

Include the purge test data in the report to support the purge volume selection. The data set should include the purge volume test as well as the flow rate, vacuum exerted on the formation, and duration of each purge step. Additionally, dependent on the objectives of the characterization activities, collecting pneumatic data during the purge

volume testing may be warranted to determine the air permeability of the subsurface (see Appendix D for more information).

4.2.4 Additional Purge Volume Tests

Additional purge volume tests may be warranted by site-specific situations. Under the following conditions, additional purge volume tests should be conducted:

- A previously unknown lithology is encountered;
- Variable flow conditions are unexpectedly encountered; or
- If the default purge volume of three is used and a VOC of concern not previously detected is subsequently detected.

If a new purge volume is selected, then 10 percent of the previously completed soil gas wells should be re-sampled using the new purge volume. Re-sampling may be necessary for all previously sampled soil gas wells depending on results of the re-sample. The soil gas investigation may then be continued with the revised purge volume in the remaining areas.

4.3 PURGE/SAMPLE FLOW RATE AND APPLIED VACUUM

Flow rates between 100 to 200 milliliters per minute (mL/min) and vacuums less than 100 inches of water should be maintained during purging and sampling to minimize stripping (partitioning of vapors from pore water to soil gas), to prevent ambient air from diluting the soil gas samples, and to reduce variability between contractors. Maintaining these flow rates and vacuums will increase the likelihood that representative samples will be collected. A flow rate greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100 inches of water or less must be maintained during sampling whenever a higher flow rate is used. The pressure gauge used to measure vacuum should be calibrated and in good working order.

A vacuum gauge should be used between the soil gas sample tubing and the soil gas purging device to verify that 100 inches of water or less is maintained during sampling. Gas-tight syringes may also be used to qualitatively determine if a high vacuum soil condition is present. If a high vacuum condition is present due to low permeability soil, the sampling technician can feel the suction while the plunger on the syringe is being withdrawn. If low permeability conditions are encountered where 100 inches of water is exceeded, the well can be sampled using the techniques in Appendix D (Soil Gas Sampling in Low Permeability Soil).

4.3.1 Vacuum Pump

When a vacuum pump is used, collect samples on the intake side to prevent potential contamination from the internal parts of the pump. To collect the sample in a polymer gas sampling bag, a lung box[5] is required. Record the vacuum readings and

[5] A lung box is a small airtight chamber into which the polymer gas sampling bag is placed. The connective tubing to the bag protrudes out a hole in the chamber. The sealed chamber is evacuated by a pump, causing the bag to

corresponding flow rates on field data sheets for each sample. If the pump is battery-operated, the batteries should be checked before and during the operation to ensure that a proper charge is maintained. As batteries lose charge the flow rate is lowered, effectively changing the purge rate.

expand, drawing the soil gas from the probe into the bag.

5.0 SAMPLE HANDLING AND TRANSPORT

5.1 SAMPLE CONTAINERS

Collect samples in gas-tight containers and handle in a manner that will prevent photodegradation of the target analytes. Sample containers should not compromise the integrity of the samples.

5.1.1 Syringes

Syringes should be checked for leaks before each use by closing the exit valve and attempting to force ambient air through the needle. Gas-tight glass syringes with Teflon® seals are preferred. Glass syringes should be leak tested periodically to verify integrity with age.

Plastic syringes should not be used because of the potential interaction with some target analytes.

5.1.2 Passivated Stainless Steel Canisters

Passivated stainless steel canisters need a flow regulator and vacuum gauge when sampling soil gas. If the canister is not fitted with a permanent vacuum gauge, a field vacuum gauge should be attached between the flow regulator and the canister inlet during sampling. To prevent stripping, connections should be initially hand-tightened. To verify the integrity of the seal on the steel canisters during transit, pressure readings should be collected during the canister's journey. The stationary laboratory should record the pressure when the canisters leave the laboratory and record it again on receipt of the canisters. Likewise, the field crew should record the pressure upon start and completion of the sampling. Typically, canisters are returned to the stationary laboratory with a slight vacuum (two to four inches of mercury). These pressure measurements should be included in the laboratory's analytical report as a mechanism to verify the integrity of the sample.

Pressure measurements should be collected using a calibrated pressure gauge, using the same gauge at the laboratory and in the field. Field crews should only rely on canister-dedicated pressure gauges if the gauges are calibrated and working properly. Canister-dedicated gauges tend to be inaccurate due to overuse.

5.1.3 Polymer Gas Sampling Bags or Glass Bulbs

Samples in polymer gas sampling bags or glass bulbs should be analyzed within six hours after collection. Appendix B discusses the merits of collecting samples in polymer gas sampling bags.

Surrogates do not need to be added to polymer gas sampling bags because surrogate recovery levels cannot be precisely calculated since the volume of soil gas collected in a polymer gas sampling bag cannot be measured precisely. Thus, adding surrogates to polymer gas sampling bags is unnecessary.

Samples collected in glass bulbs should have surrogates added within 15 minutes of collection and the samples analyzed within six hours after collection.

5.1.4 Sorbent Tubes

Sorbent tubes are used with USEPA (1999) Compendium Method TO-17 (Method TO-17). Method TO-17 describes:

- Sorbent tube sampling procedures;
- Sorbent tube selection;
- Tube conditioning;
- Sampling apparatus;
- Sampling rates;
- Sample collection preparation;
- Flow rates; and
- Other sampling procedures.

Method TO-17 is used for VOCs and SVOCs including naphthalene (See Appendix E for additional details on collecting and analyzing for naphthalene in soil gas).

5.1.5 Alternate Sample Containers

Non-traditional sample containers are available for collecting soil gas samples. MiniCans, smaller versions of the passivated stainless steel canister, may be useful in many field applications. Evacuated glass bottles (e.g., Bottle Vac®) may also be used but their holding time should be limited to 48-hours. The use of non-traditional size or types of containers should be discussed in the workplan.

5.2 FIELD CONDITIONS

The regulating agency may request raw data at any time during the investigation. Hard copies of the complete raw laboratory data, including handwritten field and laboratory notes, should be provided to the regulating agency staff upon request. Adjustments or modifications to the sampling program may be required by the regulating agency to accommodate changes mandated by evaluation of the data set or unforeseen site conditions. Field conditions, such as rainfall, irrigation, low permeability lithology or drilling conditions may affect the ability to collect soil gas samples.

5.2.1 Rainfall and Barometric Pressure (See Appendix G)

Rainfall decreases the air-filled porosity of the shallow soil, thereby limiting diffusional transport of volatile contaminants. Also, soil gas contaminants may partition into the clean infiltrating rainwater, both of which may potentially bias soil gas sampling results. Hence, soil gas sampling should not occur during a significant rain event and should only occur after five days without a significant rain event. A significant rain event is defined as 1/2 inch or greater of rainfall during a 24-hour period. The waiting period is based upon soil drainage curves. Appendix G provides additional information. Irrigation or watering of soil should stop at least five days prior to the soil gas sampling event. Likewise, areas subject to soil gas sampling should be free of standing or ponded water

for at least five days prior to sampling. Do not perform soil gas sampling in swales or depressions where water might have accumulated. However, soil gas sampling after rainfall can proceed where infiltration has not occurred, such as under buildings or beneath high-integrity pavement.

Barometric pressure fluctuations associated with the passage of frontal systems can introduce atmospheric air into the shallow vadose zone. Therefore, soil gas sampling should be delayed until frontal systems have passed the area.

5.2.2 Wet Conditions

If no flow or low flow conditions are encountered where water is drawn into the sampling system due to wet soils caused by rain or irrigation, cease soil gas sampling and wait five days for the soils to drain.

5.2.3 Soil Gas Sampling in Low-Permeability Soil

Soil gas sampling in silt and clay-rich soils is feasible by following the sampling protocols described in Appendix D. Low flow or no flow conditions correspond to conditions where the minimum flow rate of 100 mL/min cannot be sustained at the maximum applied vacuum of 100 inches of water. High quality data can be produced by implementing the following field practices:

- Good annular seals;
- Careful monitoring of flow rate and vacuum during purging; and
- Use of tracer gas for leak-testing.

If the soil gas permeability is too low to allow sustainable purging at appreciable flow rates without applying excessive vacuum, follow the protocols described in Appendix D by using an alternative sample collection method or re-drilling and constructing a soil gas well in a non-traditional manner.

If low flow or no flow conditions are encountered, a new soil gas well in a coarser lithology at a different depth or lateral location may be installed. The following should be considered if low-flow conditions persist:

1) Evaluate site lithologic logs and adjust sample depth and location;
2) Collect new continuous soil core samples;
3) Use alternate low-flow sampling methods (see Appendix D);
4) Use passive soil gas methods (see Appendix A); and
5) Collect soil matrix VOC samples using 5035/8260 (DTSC, 2004).

If moisture or unknown material is observed in the sample container, cease soil gas sampling until the cause of the problem is determined and corrected. Moisture detected in either the sampling train or the sample container may indicate saturated conditions in the subsurface. Vapor phase compounds may partition into the dissolved phase, affecting the recovery of target analytes and causing analytical results to be biased low.

5.2.4 Drilling Refusal

If refusal occurs during drilling, soil gas samples should be collected as follows:

1) Install a replacement borehole at least five feet laterally from the original boring location. If refusal still occurs after three tries, collect a soil gas sample at the depth of refusal or use an alternate drilling method; and

2) If refusal occurs at depths less than five feet, collect the soil gas sample following the precautions in Appendix D. Sealing off the probe to ambient air is critical to obtaining high quality data.

5.3 SAMPLE CONTAINER HANDLING

Sample handling procedures cited in the analytical methods should be followed. However, since most methods are not designed for soil gas, additional safeguards should be implemented to maintain the integrity of the samples. If samples need to be shipped to a stationary laboratory, then follow the container-specific handling procedures below.

5.3.1 Syringes and Glass Bulbs

Samples in syringes and glass bulbs should be analyzed as soon as possible after collection in a mobile laboratory and should never be transported. Samples in syringes and glass bulbs should be kept in a cool dark location at all times, protected from exposure to light, until the samples are analyzed. A cooler without ice works well for syringe and glass bulb sample storage.

Do not subject syringe and glass bulb samples to extreme temperatures. Heat can cause compound degradation and leakage from the syringe or glass bulb. Cold can cause moisture condensation, which can affect the recovery of target analytes. If condensation is observed, the sample should be discarded and a new sample should be collected.

5.3.2 Sorbent Tubes

Samples collected in sorbent tubes may be shipped for analysis at a stationary laboratory. Samples tubes should be capped with Swagelok®-type caps and combined Teflon (PTFE) ferrules, rewrapped in aluminum foil, and placed in the storage container immediately after sampling.

Sorbent tubes should be stored at 4°C or less and analyzed within 30 days after collection. For compounds likely to undergo chemical degradation, such as bis-chloromethyl ether and sulfur or nitrogen-containing volatiles, analysis should be done within one week (USEPA, 1999; Compendium Method TO-17, Section 10.10).

Samples collected on tubes containing multiple sorbent beds should be analyzed as soon as possible after collection unless it can be verified that storage will not affect analyte recovery (USEPA, 1999; Compendium Method TO-17, Section 10.10).

5.3.3 Polymer Gas Sampling Bags

These procedures should be followed when transporting samples in polymer gas sampling bags:

1) Do not expose soil gas samples in polymer gas sampling bags to light or extreme temperatures. Photodegradation of target analytes is possible with light exposure. Heat can cause expansion of the bag and possibly result in leakage. Cold can cause moisture condensation in the bags;

2) Do not ship polymer gas sampling bags by air because changes in ambient pressure can adversely affect the integrity of the bags. Increases in pressure may collapse the bag and decreases in pressure may expand the bag. These changes in pressures, coupled with possible flaws in the bag, may cause sample loss; and

3) Do not ship polymer gas sampling bags by vehicle where changes in elevation, such as over mountain passes, will result in ambient pressure changes.

5.3.4 Passivated Stainless Steel Canisters

Samples collected in passivated stainless steel canisters may be shipped for analysis at a stationary laboratory. Passivated stainless steel canisters have minimal problems associated with their handling. Therefore, no additional precautions or safeguards are needed.

5.4 SAMPLE CONTAINER CLEANLINESS AND DECONTAMINATION

New containers should be shown to be free of contaminants by providing data from either the supplier or the analytical laboratory. After each use, reusable sample containers should be decontaminated as follows:

1) Glass syringes and bulbs may be decontaminated by disassembling and heating them. Some components of the syringes and glass bulbs, such as the syringe barrel and bulb stopcock, cannot be heated and should be decontaminated by other methods such as rinsing with methanol and/or expunging with nitrogen or clean air. If a syringe is reused, it should be blank tested, and tested for adsorptive losses via spike testing;

2) Passivated stainless steel canisters should be decontaminated as specified in USEPA Method TO-15, either batch or individually certified, according to project DQOs;

3) Polymer gas sampling bags should not be reused; and

4) Equipment blanks should be analyzed to verify and evaluate the effectiveness of decontamination procedures for recycled or reused containers, except for certified containers. At a minimum, one equipment blank should be run per 20 sample containers cleaned, or at least one per day.

5.5 CHAIN OF CUSTODY RECORDS

The chain of custody documents the identity and integrity of the sample from the time of collection through receipt at the laboratory.

A chain of custody form should be completed in the field and include any relevant problems encountered during sample collection. The starting and ending pressures for passivated stainless steel canisters should be recorded on the chain of custody form. USEPA provides a complete description of chain of custody protocols and records management (USEPA, 1998, 2000b). To avoid loss or damage, the chain of custody forms should be placed into a sealable bag and attached to the inside of the shipping container.

6.0 ANALYSIS OF SOIL GAS SAMPLES

The sections below summarize analytical methods, QA/QC, holding times, reporting and laboratory certification. Additional details are provided in Appendices F and H.

6.1 TARGET COMPOUNDS

Target compounds are chemicals believed to be present, used, or released at the site. Common target compounds are listed below. Compounds may be added or excluded from the list below based on site history and DQOs. A vapor intrusion-specific list can be found in DTSC's Vapor Intrusion Guidance (DTSC, 2011).

6.1.1 Common Organic Compounds

Halogenated

1) Bromochloromethane
2) Bromodichloromethane
3) Bromomethane
4) Carbon tetrachloride
5) Chloroethane
6) Chloroform
7) 1,1-Dichloroethane
8) 1,2-Dichloroethane
9) 1,1-Dichloroethylene
10) cis-1,2-Dichloroethylene
11) trans-1,2-Dichloroethylene
12) Dichlorodifluoromethane (Freon 12)
13) Dichloromethane(Methylene chloride)
14) Tetrachloroethylene
15) 1,1,1,2-Tetrachloroethane
16) 1,1,2,2-Tetrachloroethane
17) 1,1,1-Trichloroethane
18) 1,1,2-Trichloroethane
19) Trichloroethylene (TCE)
20) Trichlorofluoromethane (Freon 11)
21) 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
22) Vinyl chloride

Aromatics and Oxygenates

23) Benzene
24) n-Butylbenzene
25) sec-Butylbenzene
26) tert-Butylbenzene
27) 1,4-Dichlorobenzene
28) Di-isopropyl ether (DIPE)
29) Ethylbenzene
30) Ethyl tertiary butyl ether

31) Isopropylbenzene
32) p-Isopropyltoluene
33) Methyl tertiary butyl ether (MTBE)
34) Naphthalene
35) n-Propylbenzene
36) Tertiary amyl methyl ether
37) Tertiary butyl alcohol
38) Toluene
39) 1,2,4-Trichlorobenzene
40) 1,2,4-Trimethylbenzene
41) 1,3,5-Trimethylbenzene
42) Xylenes

Others

43) Acetone
44) Carbon disulfide
45) 2-Hexanone
46) Styrene
47) Methyl ethyl ketone
48) Methyl isobutyl ketone
49) Ethylene dibromide

6.2 REPORTING LIMITS FOR TARGET COMPOUNDS

Reporting limits (RLs) should be based on the DQOs of the investigation. Corresponding analytical methods should be selected to achieve RLs that are below regulatory or risk-based screening levels. The RLs for the leak check compound should be reported at the RL of the target analytes.

When RLs are elevated due to sample dilution, the laboratory should provide a written explanation of why the project-specific RLs were not achieved. In some instances, sample dilution is necessary because of high concentrations of non-target compounds (background). It may be necessary to collect new samples for reanalysis to achieve appropriate RLs pursuant to the project's DQOs. A higher RL as a result of sample dilution is acceptable for the compound(s) whose concentration in an undiluted sample exceeds the upper level of an initial calibration range. Non-detected results for all target compounds shall be reported at the lowest dilution(s) concentration or no dilution concentration.

6.3 QUALITY ASSURANCE/QUALITY CONTROL

This section primarily focuses on field laboratory QA/QC and not stationary laboratory QA/QC. For a detailed discussion on stationary laboratory QA/QC, refer to Appendix F.

Laboratories should comply with the project QAPP, USEPA Methods, and the criteria in this Advisory. The analytical data should be consistent with the DQOs established for the project.

The regulating agency may inspect the field and/or stationary laboratory QA/QC procedures. Copies of the QA/QC plan and laboratory calibration data should be presented upon request.

All calibration and QA/QC standards, traceable to a source, should be documented by the laboratory. Continuing calibration and QC standards should be from a second source or a different lot from the same supplier. Vapor phase standards should be used to calibrate laboratory instruments.

The following items should be included when using USEPA Methods:

- Initial calibration;
- Daily calibration/continuing calibration;
- Laboratory control spike;
- Internal standards;
- Surrogates;
- Method blank; and
- Field blank.

All surrogate recovery data should comply with laboratory-derived control limits. Control limits should be listed in the laboratory reports for reference.

Surrogate recovery limits should be approximately 70 percent to 130 percent (30 percent deviation). The laboratory-derived recovery limits may be wider or narrower than the 30 percent figure depending on sample introduction technique and compound used. If a compound-specific recovery limit is not selected, an explanation should be provided to justify the recovery limit used. See Appendix F for surrogate introduction techniques.

6.3.1 Sample Blanks

- Method Blanks: Method blanks should be used to verify the effectiveness of decontamination procedures in the laboratory, and to detect any possible interference from ambient air;

- Trip Blanks for Off-site Shipments: Trip blanks should be included in the shipping containers when collecting USEPA TO-17 samples;

- Material Blanks: Prior to soil gas sampling, an assembled soil gas probe, tip and tubing should be blank tested at a frequency of one analysis per new batch of tubing or material used; and

- Equipment Blanks: Equipment blanks should be collected from decontaminated equipment before reuse at a frequency specified in the workplan. One equipment blank should be collected and analyzed for each batch of 20 samples, or at least one per day, whichever is more often.

6.3.2 Field Duplicate/Replicate Samples

Duplicate samples are collected simultaneously, whereas replicate samples are collected sequentially. At least one duplicate/replicate sample should be collected and analyzed per 20 samples or per batch, whichever is more often.

Duplicate/replicate samples should be collected from contaminated areas at a frequency based on the project DQOs. The workplan should state the duplicate/replicate collection frequency.

Duplicate/replicate samples should be collected in separate sample containers at the same location and depth. Replicate samples can be collected immediately after the original sample, or a duplicate sample can be collected simultaneously by use of a T-splitter at the point of collection to divide the sample stream into two separate sample containers.

The field replicate mentioned in this section should not be confused with the laboratory replicate (see Table 2 in Section 6.5, and the QA/QC Section of Appendix F).

When comparing the results from field duplicate/replicate samples, a wider allowance should be given for the differences (e.g., 50 percent Relative Percent Difference [RPD]) because of the inherent variability associated with soil gas samples. The specific guideline for the RPD should be based on DQOs and be specified in the QAPP.

6.3.3 Laboratory Control Samples

Laboratory Control Samples (LCS) are optional as described in Appendix F.

6.3.4 Split Samples

The regulating agency may request split samples be collected and analyzed by a separate laboratory.

6.4 HOLDING TIMES

Holding times for soil gas samples should be specified in the workplan. All soil gas samples should be analyzed pursuant to container-specific holding times, as follows:

TABLE 1
Soil Gas Sample Holding Time

Container	Holding Time	Comments
Glass syringes	30 minutes	
Polymer gas sampling bags	6 hours	
Glass bulbs	24 hours	Must have surrogate added within 15 minutes of collection
Passivated stainless steel canisters	30 days	
Sorbent Tubes	30 days	Sulfur and nitrogen compounds and bis-chloromethyl ether should be analyzed with one week.
Hydrogen sulfide	See Section 7.1	

Note that for passivated stainless steel canisters, storage pressure and humidity in a canister are also important factors that determine analyte recovery. Additionally, mercaptans, dimethyl acetal and bis-[chloromomethyl] ether at low concentrations are not suitable for collection in passivated canisters pursuant to a study by Brymer and others (1996).

6.5 ANALYTICAL METHODS

There are no approved USEPA methods specifically designed to analyze soil gas samples. Consequently, modified versions of existing USEPA methods were adopted.

Numerous modifications of USEPA methods are being used for soil gas analysis. Each modification has advantages and disadvantages. Soil gas analysis should be performed in accordance with the protocols noted in the respective USEPA method(s) concurrently with the specific recommended practices for soil gas samples outlined in Table 2. Methods/Parameters not included in Table 2 should be followed as stated in the original USEPA method.

For a more detailed discussion on the various types of modifications and other applications, consult Appendix F.

TABLE 2
Preferred Analytical Methods and Modifications*

Method/ Parameter	GC/MS Methods			GC Methods	COMMENTS
	Modified USEPA 8260	Modified USEPA TO-15	Modified USEPA TO-17	Modified USEPA 8015 and Modified USEPA 8021	
Applicability/Analytes	Most VOCs: confirmation sampling for naphthalene should be performed by USEPA TO-17.	Most VOCs: confirmation sampling for naphthalene should be performed by USEPA TO-17.	Most VOCs: approximate concentrations should be known prior to sampling.	Limited number of VOCs: gasoline/TPH most VOCs: confirmation sampling for naphthalene should be performed by USEPA TO-17.	See Appendix F of this guidance for discussion.
Sample Introduction Technique	Modified Purge-and-trap (USEPA 5030).	Samples collected in passivated canisters: VOCs are concentrated on sorbent trap.	Samples pulled through sorbent pack, thermally desorbed into GC.	Modified purge-and-trap (USEPA 5030).	See Appendix F of this guidance for discussion.
Sample Size	Purge-and-trap: 5 to 250 mL (cc) (See Appendix F for discussion).	To be determined by sample delivery technique and sample concentration; typically 1 to 6 liters.	To be determined by a combination of factors: sorbent selected, tube length, humidity, temperature; 50 to 250 ml of sample suggested.	Purge-and-trap: 5 to 250 mL (cc) (See Appendix F for discussion).	See Appendix F of this guidance for discussion. Dilution may be needed if high concentration is suspected.
Method Validation (1)	As per Section 8.4 of USEPA 8000B.	As per Section 8.4 of USEPA 8000B.	As per Section 8.4 of USEPA 8000B.	As per Section 8.4 of USEPA 8000B.	
Initial Calibration	Minimum of 5 levels, lowest at reporting level. Use method acceptance criteria.	Minimum of 5 levels, lowest at reporting level. Use method acceptance criteria.	Minimum of 5 levels, lowest at reporting level. Use method acceptance criteria. Preloaded certified standard tubes may be used for calibration.	Minimum of 5 levels, lowest at reporting level. Use method acceptance criteria.	Vapor-phase standards are preferred. Liquid standards may be used for USEPA Methods 8260, 8015, 8021 and TO-17 provided calibration curve is validated. See Appendix F of this guidance.
Continuing Calibration	Mid-level calibration standard run every 12 hours. Use method acceptance criteria.	Mid-level calibration standard run every 24 hours. Use method acceptance criteria.	Mid-level calibration standard every 10 sample batch (Section 12 of USEPA TO-17).	Mid-level calibration standard run every 12 hours. Use method acceptance criteria.	
Calibration Validation	At minimum, vapor-phase validation check standard (2) analyzed and evaluated for each new calibration curve (% difference ≤ 20%).	Not Applicable.	No vapor-phase standard validation needed for liquid standards.	At minimum, vapor-phase validation check standard (2) analyzed and evaluated for each new calibration curve (% difference ≤ 20%).	Validation not needed if calibration curve is prepared with vapor-phase standards.

TABLE 2 (continued)
Preferred Analytical Methods and Modifications*

Method/ Parameter	GC/MS Methods			GC Methods	COMMENTS
	Modified USEPA 8260	Modified USEPA TO-15	Modified USEPA TO-17	Modified USEPA 8015 and Modified USEPA 8021	
End of Run Calibration Check	Optional.	Optional.	Optional.	Mid-level calibration standard run for each 20 sample batch or at end of run, whichever is more often.	See Appendix F of this guidance for discussion.
Surrogates	Surrogates needed for glass bulbs but not for syringes or polymer sampling bags.	Optional.	Optional.	**8015:** To be determined by lab. (3) **8021:** Surrogates needed for glass bulbs but not for syringes or polymer sampling bags.	Recovery acceptance limits to be determined by lab. Default=70-130%.
Internal Standards	As per Section 5.10 of USEPA 8260.	As per Section 9.2.2.3 of USEPA TO-15.	As per Sections 6.12.2 and 9.4 of USEPA TO-17.	**8015:** To be determined by lab. (3) **8021:** As per Section 5.9 of USEPA 8021.	
Accuracy/Precision Matrix Spike/Matrix Spike Duplicate	See Appendix F of this guidance.	Optional.	Optional.	See Appendix F of this guidance.	See Appendix F of this guidance for discussion. Recovery acceptance limits to be determined by lab. Default=70-130% and %RPD=25%.
Duplicates	One per 20 samples or batch, whichever is more often.	One per 20 samples or batch, whichever is more often.	One per 20 samples or batch, whichever is more often.	One per 20 samples or batch, whichever is more often.	See Appendix F of this guidance for discussion. %RPD=25%.
Replicates	One per 20 samples or batch, whichever is more often.	One per 20 samples or batch, whichever is more often.	One per 20 samples or batch, whichever is more often.	One per 20 samples or batch, whichever is more often.	See Appendix F of this guidance for discussion. %RPD=25%.
Laboratory Control Samples (LCS)	Optional.	Not Required.	Not Required.	Optional.	See Appendix F of this guidance for discussion.
Method Detection Limit/Reporting Limit	See Appendix F of this guidance.	See Appendix F of this guidance.	See Appendix F of this guidance.	See Appendix F of this guidance.	See Appendix F of this guidance.
Reporting Limit Verification	One per batch of samples. (4)	One per batch of samples. (4)	One per batch of samples. (4)	One per batch of samples. (4)	See Appendix F of this guidance for discussion.
Method Blanks	Method blank using humidified lab grade ultra-pure air as sample and per Section 8.4.1 of USEPA 8260.	Analyze at least once in a 24-hour analytical sequence.	At least two are required per monitoring exercise.	**8015:** Method blank using humidified lab grade ultra-pure air as sample and per Section 9.5 of USEPA 8015C. **8021:** Per Section 8.4 of USEPA 8021.	

TABLE 2 (continued)
Preferred Analytical Methods and Modifications*

Method/ Parameter	GC/MS Methods			GC Methods	COMMENTS
	Modified USEPA 8260	Modified USEPA TO-15	Modified USEPA TO-17	Modified USEPA 8015 and Modified USEPA 8021	
Container Blank	One sample container per 20 samples or per batch, whichever is more often.	One sample container per 20 samples or per batch, whichever is more often.	One sorbent tube blank per 20 samples or per batch, whichever is more often.	One sample container per 20 samples or per batch, whichever is more often.	Monitor other components (i.e., fittings/ valves) of sampling system if needed.
Holding Time	Analyze syringes within 30 minutes of collection; analyze glass bulbs within 24 hours following surrogate addition; analyze passivated stainless steel canisters within 30 days; analyze polymer gas sampling bags within 6 hours.	Analyze passivated stainless canisters within 30 days; sulfur and nitrogen compounds and bis-chloromethyl ether should be analyzed within one week.	Up to 30 days refrigerated. Exceptions as noted in Section 10.10 of USEPA TO-17.	Analyze syringes within 30 minutes of collection; analyze glass bulbs within 24 hours following surrogate addition; analyze passivated stainless steel canisters within 30 days; analyze polymer gas sampling bags within 6 hours.	
Other Requirements	Tuning: 50 ng Bromofluorobenzene (BFB) initially and every 12 hours. Meet acceptance criteria as per Table 4 of USEPA 8260.	1. Tuning: 50 ng BFB initially and every 24 hours. Meet acceptance criteria as per Table 3 of USEPA TO-15. 2. Must meet equipment specifications in Section 7.2 of USEPA TO-15 or report results as modified TO-15.	1. Analytical protocol as per USEPA TO-15. 2. Condition freshly packed (new) sorbent tubes. 3. Collect and analyze "Distributed Volume Pairs" for uncharacterized sites as per Section 10.7 of USEPA TO-17. 4. Determine/ validate "Safe Sampling Volume" (SSV) if needed as per Sections 10.8 and 13.1.2 of USEPA TO-17; analyze as per USEPA TO-15 and Section 11.2 of USEPA TO-17. 5. Analytical precision test as per Section 11.3.2.2 of USEPA TO-17. 6. Performance criteria as per Section 14 of USEPA TO-17.	Use only for routine monitoring at well-characterized sites. Other than TPH, identification of new compounds must be confirmed either by second column or different detector, and then 10% of those samples must be confirmed with a GC/MS method.	

* Adapted from "Guide to Environmental Analytical Methods" 5th edition, Edited by Roy-Keith Smith, Ph.D., Genium Publishing Corp., 2003.
(1) Initial, one-time demonstration of ability to generate acceptable accuracy and precision. Procedure may need to be repeated if changes in instrument, methodology or personnel occur. USEPA Method 8000B (Determinative Chromatographic Separations), Revision 2, December 1996 (SW-846 Manual).
(2) Mid-level NIST (National Institute of Standard and Technology) traceable (where available or equivalent) vapor-phase standard.
(3) No internal standards and surrogates were suggested by the method. The compounds are to be selected by the laboratory analyst and they must be similar in analytical behavior to the compounds of interest. The analyst needs to demonstrate the internal standards are not affected by method or matrix interferences.
(4) There is no limit on the number of samples per batch for Reporting Limit Verification. If the RL is set at the lowest calibration point, then this verification is not needed.

6.6 SOIL GAS SAMPLE ANALYSIS AND LABORATORY REPORTING

6.6.1 Analytical Methods

At sites that are not fully characterized, soil gas samples should be analyzed using only USEPA modified analytical methods 8260B, TO-15, TO-17, or equivalent. At well-characterized sites, alternative methods may be used for monitoring contamination where VOCs are known to be present and confirmed based on previous gas chromatograph/ mass spectrometer (GC/MS) analyses. Non-specific portable organic vapor analyzers and/or GC-based hand-held detectors can provide useful information for selecting samples for laboratory analysis and verifying the integrity of collected samples. However, these instruments are not acceptable substitutes for compound-specific analysis due to a lack of QA/QC protocols. The various available VOC analytical methods are discussed in detail in Appendix F. Additional discussion is provided in Appendix E specific to soil gas containing naphthalene.

If new VOC(s) are detected by a non-GC/MS method during routine monitoring, then at least 10 percent of the samples for each newly identified VOC should be confirmed by a GC/MS method. Thereafter, routine monitoring can resume with the non-GC/MS method, including the newly identified analyte(s).

6.6.2 Contaminant Reporting

Laboratory reports should contain the analytical results for all identified quantifiable contaminants, along with all tentatively identified compounds (TICs) with an estimated concentration. The site's QAPP should specify that TICs will be identified and reported.

6.6.3 Leak Check Compounds

Liquid and gaseous leak check compounds should be included in the laboratory analyte list. The laboratory reports should quantify and annotate all detections of the leak check compound the target analyte reporting limits. For additional information on leak check compounds, refer to Section 4.2.

6.6.4 Auto Samplers

Using an autosampler with modified USEPA Method 8260B/C for soil gas analysis is not reliable. Sample loss may occur from the vials during the sample transfer and sample run. In addition, the vials may sit in the autosampler for an extended period of time which may compromise the sample through leakage at the vial seal (See Appendix F, GC/MS Methods Section for additional information).

7.0 METHANE AND HYDROGEN SULFIDE SAMPLING PROGRAMS

7.1 METHANE

There are several analytical methods appropriate for methane, including:

- USEPA Methods 8015B modified;
- TO-3, 3C;
- ASTM Method D1945; or
- ASTM Method D1946.

Methane may also be measured with a hand held gas emissions monitor or analyzer. The RLs for methane analysis should be determined by project-specific DQOs.

7.1.1 Methane Field Collection

The following procedures should be followed when collecting samples for methane analysis:

- Methane should be collected in gas-tight sample containers such as passivated stainless steel canisters or polymer gas sampling bags.

- Fixed and biogenic gases such as oxygen, carbon dioxide, methane and ethylene should be analyzed to determine whether methanogenesis is occurring. The RL for oxygen and carbon dioxide should be one percent or less.

- Prior to sampling, tubing or probe pressure should be recorded in the field logs and reported along with the methane concentration to determine if the area is pressurized.

7.1.2 Methane Laboratory Analysis

GC calibration curves for analytes such as methane should be recorded and reported. Hand-held instruments should be calibrated in accordance with the manufacturer's specifications. At least 10 percent of all positive detections with concentrations more than 5,000 parts per million by volume (ppmv) should be confirmed by another hand-held instrument (either different unit or a different brand) or by a GC method when a hand-held instrument is used.

7.2 HYDROGEN SULFIDE

Hydrogen sulfide may be analyzed using:

- South Coast Air Quality Management District Method 307-91;
- ASTM D5504;
- USEPA Method 16;
- Draeger™ tubes; or
- Other equivalent methods.

Hand held multi-gas monitors equipped with a hydrogen sulfide sensor may also be used. The RL should be equal to or less than 0.5 ppmv, be at least one microgram per liter or sensitive enough to allow for a modeled ambient air concentration at the soil surface.

7.2.1 Sample Containers

The following sample containers are recommended for hydrogen sulfide:

- Black polymer gas sampling bags fitted with polypropylene valves or equivalent. Clear polymer gas sampling bags can be used, stored and/or transported provided they are protected from light;
- 100 mL gas-tight glass syringe or gas-tight glass bulb fitted with an inert valve and wrapped in aluminum foil; and
- Passivated stainless steel canister. Note that recovery of hydrogen sulfide in passivated stainless steel canisters will deteriorate naturally with time with repeated hydrogen sulfide sampling.

7.2.2 Hydrogen Sulfide Field Collection

Hydrogen sulfide samples should be analyzed by a hand-held instrument within 30 minutes of collection to minimize sample degradation from reaction with the container surfaces. If a hand-held instrument is not used, hydrogen sulfide samples should be analyzed as follows:

1) Within 30 minutes of collection using GC procedures;

2) Within 24 hours of collection if duplicate samples are collected and analyzed; or

3) Within 24 hours of collection in polymer gas sampling bag using ASTM D5504 with no surrogate addition needed.

7.2.3 Precautions Particular to Hydrogen Sulfide

1) Contact with oxygen and moisture should be avoided because hydrogen sulfide is extremely unstable;

2) Due to the high reactivity of hydrogen sulfide gas, avoid contact of hydrogen sulfide samples with metallic or other active surfaces during sample collection, storage, and analysis;

3) Ensure GC components do not react with the sample. Typically, glass-lined injection ports, thick-film capillary columns and silcosteel® lined tubing are used to avoid loss of hydrogen sulfide during analysis;

4) Exposure of samples to light should be minimized to prevent photodegradation; and

5) USEPA Method 16 should be used with caution because it is a source-testing method which has limitations, including non-linear detector response, high reporting limits and susceptibility to hydrocarbon interference.

8.0 LABORATORY CERTIFICATION

The California Department of Public Health, Environmental Laboratory Accreditation Program (ELAP), offers certification for soil gas analysis. Laboratories utilizing USEPA Methods 8015B, 8021B, 8260B, TO-15 and TO-17 for analyses of soil gas samples should obtain ELAP certifications for these methods. Accreditation under National Environmental Laboratory Accreditation Program (NELAP) for USEPA Methods TO-13A, TO-15 and TO-17 for ambient air testing is acceptable as certification for soil gas testing.

As of the date of this document, the development of a laboratory certification program for soil gas is in progress in California. Once a certification program is available by the California Department of Public Health, laboratories should apply to be certified. Further information concerning laboratory certification is provided in Appendix F.

Any laboratory analyzing soil gas samples may be subject to inspection by regulatory agency staff.

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APPENDIX A PASSIVE SOIL GAS METHOD

Passive soil gas sampling consists of burying an adsorbent material into the subsurface soil and subsequently retrieving and measuring organic vapors passively amassed onto the absorbent material. Unlike active soil gas sampling, passive soil gas sampling does not force soil gas into the sampling vessel through pumping or vacuum. Instead, as the vapors disperse from a subsurface contaminant source, the sorbent acts as a sink for the VOCs and SVOCs found in soil gas.

Passive soil gas methods provide a quantified mass value for the absorbent material and a semi-quantitative soil gas result. In contrast to active soil gas samples, which yield concentration data in micrograms per cubic meter ($\mu g/m^3$) or micrograms per liter ($\mu g/L$), passive soil gas samples do not generate contaminant concentration data. For this reason, passive soil gas sampling and analysis is not applicable as a stand-alone method for determination of human exposure.

Potential uses of the passive soil gas method are as follows:

1) To delineate contaminant plumes, contaminant sources, and hot spots;

2) To identify potential preferential pathways where sewer and utility corridors provide vapor migration pathways into and around buildings. Passive methods can also identify preferential pathways resulting from lithologic variability;

3) To collect soil gas in areas where active soil gas samples are difficult to obtain. These areas include low-permeability lithology, high-moisture soils and shallow groundwater conditions. When the depth to groundwater is within five feet of the surface, the capillary fringe may prevent sample collection by active soil gas methods due to the high soil moisture content; and

4) To evaluate whether a release has occurred. Active soil gas data should be collected following the detection of subsurface contamination by the passive method.

Advantages of the passive soil gas methods are:

1) Provides a time-integrated measurement, which reduces uncertainty due to temporal variations;
2) Detects compounds with low vapor pressures not easily captured by active methods, such as naphthalene (see Appendix E);
3) Maintains subsurface equilibrium during sampling since there is no forced movement of soil gas into the sampling vessel with passive methods; and
4) Simple to design, install, and retrieve.

Passive Sampling Procedures

Analytical procedures, deployment depths, and sampling durations will depend on the manufacturer's recommended procedures. Some samplers currently available can be installed at any depth, and at the same sampling density as the active method. Typically, passive samplers are deployed in hand-drilled boreholes that are three to five feet deep and one-inch in diameter. The sampler is lowered into the borehole with a string and the surface is covered to prevent the introduction of ambient air. Deployment duration is usually 10 to 14 days. The samplers are retrieved by pulling the device from the borehole with its string. Analysis of the absorbent material is conducted by Methods 8260, 8270 or TO-17. Sample preparation prior to analysis can be very simple and may involve cutting the tip off the bottom of the sampler and transferring an exposed sorbent material to a thermal desorption tube.

Replicate samples, if collected, are retained for approximately two weeks after initial analysis. Two trip blanks should be collected and analyzed for passive soil gas sampling. One trip blank should accompany the passive samplers to the field and then be analyzed. The second trip blank should accompany the samples from the field to the laboratory.

APPENDIX B POLYMER GAS SAMPLING BAGS AND TUBING TYPES

Polymer Gas Sampling Bags

Polymer gas sampling bags require similar quality assurance/quality control as other sample containers, specifically container blanks, laboratory control samples and trip blanks. Additional information on quality assurance requirements is presented in Appendix F.

Polymer gas sampling bags should not be reused because contaminants may adhere to the surface of the bag. Also, the bags themselves may off-gas various organic compounds. Manufacture specifications of the bag material should be checked to verify site-specific COCs are compatible.

Relative humidity inside polymer gas sampling bags may affect recovery of polar compounds. Additionally, water may permeate into and out of polymer gas sampling bags during storage.

Advantages are:

- Inexpensive;
- Disposable;
- Easily handled and transported; and
- Recommended for reduced sulfur compounds such as hydrogen sulfide and the fixed gases such as O_2, N_2, CH_4, etc.

Disadvantages are:

- Potential bag material off gassing (toluene and ketones);
- Adsorption of some VOCs;
- Sample loss (mostly via hose valve assembly);
- Limited holding time;
- Vulnerable to puncture;
- Should not be used when moisture content of soil gas is high (condensation);
- Highly polar compounds adhere to the inner surface of the bag; and
- Low molecular weight compounds may permeate the bag.

Tubing Types

Nylaflow®, polyetheretherketone (PEEK), and Teflon® are recommended tubing materials for soil vapor sampling. Low-density polyethylene (L-D PE) should not be used due to decreased performance relative to other tubing types in both off-gassing of VOCs inherent in the tubing structure (contribution to background) and for decreased recovery (reactivity). Reduced recovery of naphthalene has been observed when using Nylaflow® tubing with small sample sizes.

Justification

Nylaflow®, PEEK, Teflon®, and L-D PE were evaluated for contribution to background. Of the four tubing types, L-D PE exhibited the highest frequency of VOCs and hydrocarbons in background samples and the poorest recovery for target analytes. Some off-gassing of toluene, and to a lesser extent, benzene, propylbenzene and methanol, were noted with the Nylaflow® tubing.

The following table summarizes the results of several studies:

TABLE B-1
Tubing Type Study Results

Tubing Type	Study		
	Ouellette (2004)	Hayes and others (2006)	Nicholson and others (2007)
L-D PE	Sorption of hexane and pentane	Sorption of numerous compounds	N/A
Tygon	Sorption of hexane and pentane	N/A	N/A
Nylaflow®	Acceptable	Sorption of naphthalene	Sorption of aromatics
Teflon®	Acceptable	Acceptable	N/A
Vinyl	Sorption of hexane and pentane	N/A	N/A
PEEK	N/A	Acceptable	N/A

References

Hayes, H., N. Khan, and D. Benton. 2006. *Impact of Sampling Media on Soil Gas Measurements.* In Proceedings; Air and Waste Management Association's Vapor Intrusion Symposium: The Next Great Environmental Challenge – An Update. September 13 – 15, 2006, Los Angeles, California. Pages 69 – 83.

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APPENDIX C QUANTITATIVE LEAK TESTING USING A TRACER GAS

Background

High quality soil gas data collection is driven by project-specific data quality objectives (DQOs) and can be enhanced by using a shroud and a gaseous tracer compound. This method of leak detection ensures that soil gas wells are properly constructed and the sample train components do not leak. Gaseous leak check compounds differ from liquid leak check compounds in that liquid leak check compounds can interfere with target analytes. Soil gas samples containing liquid tracers frequently require extensive sample dilution resulting in elevated reporting limits. These elevated reporting limits may not meet project DQOs. Most gaseous tracer compounds do not affect target analyte measurements nor does their detection require sample dilution. Also, gaseous leak tracer compounds allow a quantitative determination of a leak either in the sampling train or from ambient air intrusion down the borehole.

Shroud Design

The shroud should be designed to contain the entire sampling train and the soil gas well annulus. The size of the shroud depends on the sampling equipment used but should be designed to minimize the shroud volume and gaseous leak tracer compound used. It is easier to maintain initial gaseous leak tracer compound concentrations within the shroud if the shroud volume is kept small, the number of holes in the shroud is kept minimal, and the shroud has good contact with the ground surface. The sampling train should be constructed of material that does not react with the sample analytes and will not off gas or adsorb volatile compounds. The sampling equipment should be clean and shut-in tested prior to use.

Shrouds should be designed for ease of use during purging and sampling, minimizing disturbance of the shroud. The gaseous leak tracer compound concentration inside the shroud should be monitored frequently to verify initial concentrations (See Figure C-1). Shroud design should also take into account the need for duplicate or multi-depth sampling.

Tracer compound detectors provide measurements of tracer gas concentrations inside the shroud and in the purge stream. Several types of detectors are available for field use including hand held, diffusion cell type (inside shroud), and flow through detectors for measuring the purge stream. Alternatively, an external lung box/polymer gas sampling bag setup may be used to quantify tracer compound breakthrough prior to sampling. Detection of tracer compounds prior to sampling enables the samplers to correct the source of the leak(s) or relocate well(s) before taking a compromised soil gas sample.

Soil gas probes installed with good seals throughout the borehole annulus and the use of compression fittings provide assurance against ambient air leaks.

Field Use

A detailed illustrated Standard Operating Procedure should be submitted to the regulating agency for review prior to sampling. Field personnel should be familiar with the procedures and practices necessary to successfully collect soil gas samples using this equipment. If the shroud and sampling train will be reused, all components should be cleaned and shut-in tested prior to reuse.

USEPA Method TO-15 requires sample trains be tested by passing both spiked and clean dry air through the sampling trains to validate performance characteristics.

Purging and Sampling

The tracer compound concentration around the sample train and above the well annulus should be maintained at a minimum concentration. The shroud should be infused with the tracer compound at least five minutes prior to sample collection to allow the tracer compound time to equilibrate (See Figure C-2).

All methods of tracer compound detection should be capable of measuring the tracer compound in air to an accuracy and precision of 0.1 percent. Shroud concentrations should be two orders of magnitude higher than the reporting limit of the laboratory analytical method or the field meter used to analyze the sample. Tracer compound concentrations inside the shroud should be carefully monitored and maintained to correct variations in tracer compound concentration due to wind and uniformity of the ground surface. Additional tracer compound should be added to the shroud incrementally to maintain the desired concentration. Field personnel should record the measured tracer compound concentration in the shroud periodically during the sampling event.

The calculation of a leak is based on the ratio of tracer compound concentration in the shroud to that in the sample, assuming that the tracer compound is continuously infused during sampling. The tracer compound in the shroud should be kept within ± 10% of its target value, and if not achieved then its lowest measured value should be used for calculation purposes.

The soil gas probe and sampling train assembly can be field screened for leaks by drawing purge gas through the well and then through the tracer compound detector while the shroud is in position and filled with the initial tracer compound concentration. Detecting a significant leak in the probe or sampling train at the time of sampling provides the opportunity for the field crew to correct the leak early in the sampling process, thereby ensuring the samples analyzed by the laboratory meet the project-specific DQOs.

If the concentration of the tracer compound in the purge sample is greater than or equal to five percent of the tracer compound concentration in the shroud, corrective action is necessary to either remedy the leak or relocate the probe prior to collecting a soil gas

sample. Regardless of the cause of the leak, a data "adjustment factor" based upon the concentration of the leak check compound to compensate for the inability to collect representative samples is inappropriate.

FIGURE C-1

Shroud Components

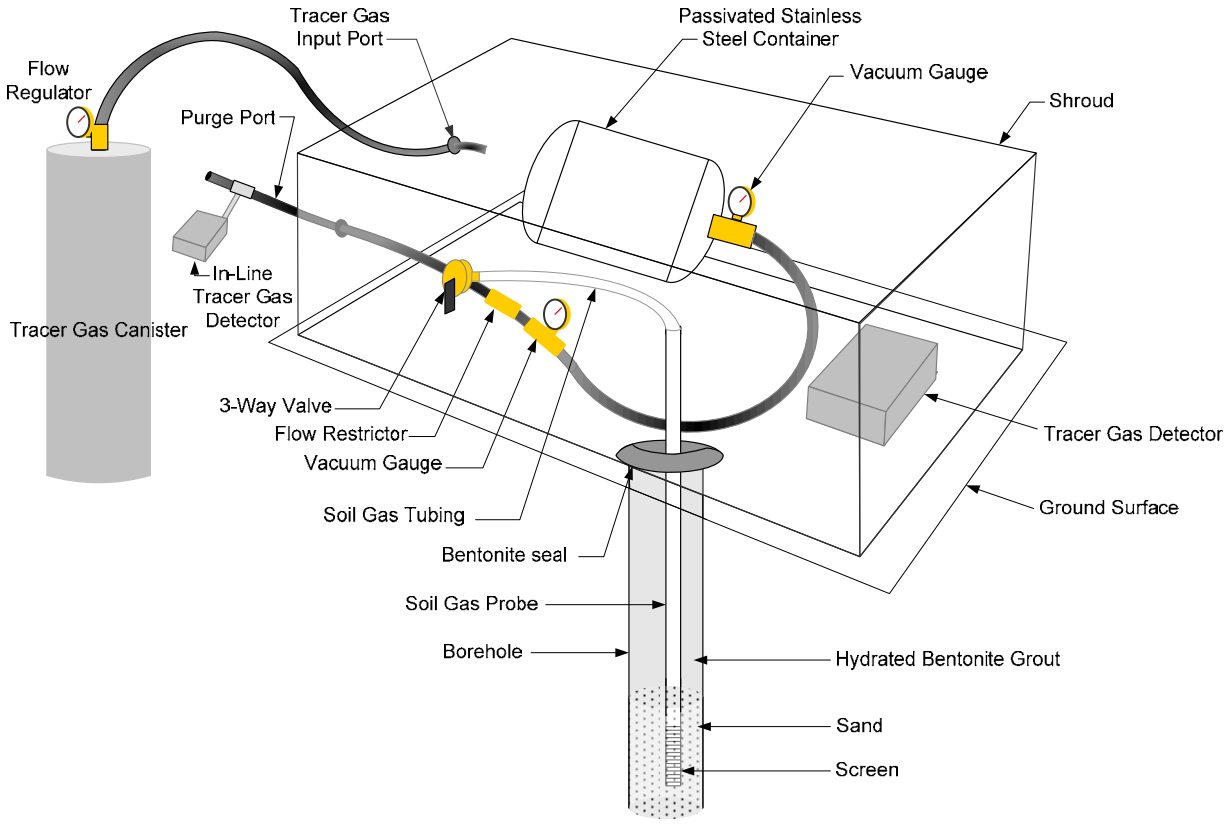
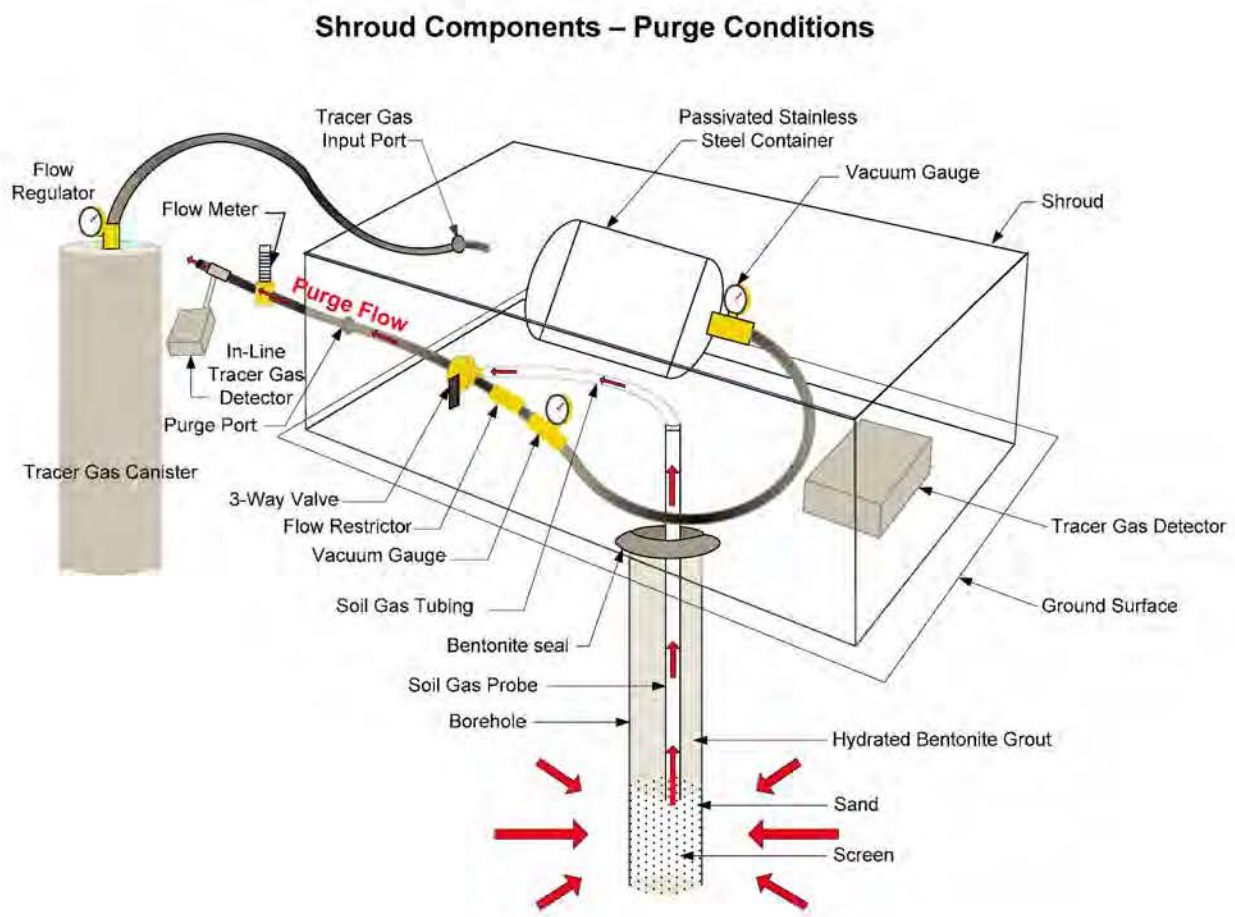


FIGURE C-2


Shroud Components – Purge Conditions
Tracer Gas Input Port
Passivated Stainless Steel Container
Vacuum Gauge
Shroud
Flow Regulator
Flow Meter
Purge Flow
In-Line Tracer Gas Detector
Purge Port
Tracer Gas Canister
3-Way Valve
Flow Restrictor
Vacuum Gauge
Soil Gas Tubing
Bentonite seal
Soil Gas Probe
Borehole
Tracer Gas Detector
Ground Surface
Hydrated Bentonite Grout
Sand
Screen

APPENDIX D SOIL GAS SAMPLING IN LOW PERMEABILITY SOIL

Representative soil gas samples can be collected from low permeability soil by utilizing specialized field procedures in addition to the protocols described in the main text of this Advisory. Hence, the procedures described in this Appendix do not replace the recommended procedures in the main text but rather supplement the procedures.

When low flow, high vacuum conditions are encountered during soil gas sample collection, two options are available for field technicians. Sampling can continue at the probe with an alternative sample collection method or the probe can be re-drilled and constructed in a non-traditional manner. Typically, low flow conditions are defined as the inability to maintain an appreciable flow rate (100 mL/min or greater) without applying excessive vacuum (any vacuum greater than about 100 inches of water). In the field, the determination of low flow, high vacuum conditions can be done quantitatively or qualitatively. The probe in question should be subject to applied vacuum for three minutes prior to rendering a decision about flow conditions.

In low permeability soil, it is helpful to initially perform passive soil gas sampling to determine whether active soil gas samples are required at low permeability sites. The passive soil gas samples are used to screen areas for contamination with follow-up active soil gas sampling for risk assessment. Passive soil gas sampling is described in Appendix A.

ALTERNATIVE SAMPLING METHOD

A modified purging and sampling procedure can be used for low flow vapor probes. In a study conducted by McAlary and others (2009), several nested soil gas probes were installed in low-flow conditions, as defined above. About a third of a liter of soil gas was collected from each soil gas probe under an applied vacuum of 100 inches of water before the flow diminished to a negligible amount. Once this vacuum threshold was obtained and it was determined that a flow rate of 100 mL/min was not sustainable, the probe valve was closed to allow the vacuum to dissipate and to allow soil gas to slowly enter the sand pack and tubing from the surrounding soils. When the vacuum dissipated, the probe valve was reopened, and another aliquot of sample was collected. This procedure was repeated until the soil gas probe was adequately purged and sampled. In this manner, probes can be appropriately purged and enough sample volume can be collected for analysis.

If this procedure is used, the rate of vacuum dissipation should be monitored with a dedicated vacuum gauge. The sampling crew may proceed with other nearby activities during the pressure rebound cycle. Additional pressure gauges, fittings, and a flow meter will be needed to implement this procedure in the field. Prior to purging and sampling, the sampling system should be shut-in tested to ensure that vacuum rebound is attributable to subsurface processes and not system leakage. Likewise, leak check compounds should be used during the entire sampling process to confirm the integrity of the sample.

REINSTALLATION METHOD

This approach requires the reinstallation of a vapor probe with a sand pack larger than traditional size. A large sand pack assures the availability of subsurface air for sampling. For this method, the sand pack should have an interstitial void volume of approximately 3 liters, which implies the use of approximately 10 liters of sand for the sand pack. To accommodate this large volume of sand, both the length and the radius of the sand pack must be larger than sand packs typically installed with direct push technology. Approximately ten liters of sand equates to a sand pack length of two feet for a six-inch borehole and a sand pack length of four feet for a four-inch borehole. A study by Neznal and Neznal (2005) indicates that measured radon concentrations in soil gas are not dependent on the subsurface well geometry when the soil is homogeneous and of low permeability.

When using this method, the following should be considered:

- The length of the sand pack should not be longer than the zone of interest;
- The vapor probe tip should be located in the center of the sand pack;
- The top of the sand pack should be at least five feet below surface grade;
- Excessively long sand packs (greater than five feet) should be avoided;
- The diameter of the vapor probe should be small to reduce purge volumes (less than or equal to ¼-inch); and
- The bentonite above the sand pack should be fully hydrated to ensure a high integrity annular seal.

The vapor probe should only be sampled after the sand pack has reached equilibrium with the native material. The establishment of equilibrium can be expected to take approximately two weeks. Purge volume testing should be conducted on the probe to determine optimal purging with one purge volume equating to one tubing volume. Probe tubing size should be selected so that the purge volume does not exceed 200 milliliters. Purging 200 milliliters should not induce any significant vacuum in the probe given the void volume in the sand pack. Excessive vacuum during sample collection can be avoided if the sample collection vessel is small. To avoid excessive vacuum, sample size should be no more than one liter. Vacuum within the vapor probe should be measured to ensure that 100 inches of water is not exceeded during the purging and sampling.

AIR PERMEABILITY TESTING

Air permeability is determined by measuring the gas pressure in a vapor probe as a metered flow of air is passed through the probe. These in-situ tests should only be conducted after soil gas sampling due to potential disruption of subsurface conditions by the movement of air. In-situ testing should continue until steady-state conditions occur. The occurrence of steady-state conditions is defined as less than a 130 Pascal pressure change within 30 minutes. The air permeability is calculated using the data obtained during steady-state conditions. The method also requires the measurement of the soil gas air temperature along with ambient air pressure. See DTSC'S Vapor Intrusion

Guidance for more information (Appendix J).

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Neznal, M., and M. Neznal. 2005. *Determination of Soil-Gas Radon Concentration in Low Permeability Soil.* Radioactivity in the Environment, v. 7, p. 722 – 725.

APPENDIX E NAPHTHALENE SOIL GAS COLLECTION

Soil gas sampling for naphthalene is more complex than traditional soil gas sampling procedures. Naphthalene analysis by USEPA Method TO-15 presents several challenges, such as contaminant carryover and variability in recovery (Hayes et al., 2005). Likewise, naphthalene readily sorbs onto traditional soil gas sample tubing such as polyethylene and nylaflow (Hayes et al., 2006). USEPA Method TO-15 defines target analytes as having vapor pressures greater than 0.1 millimeter (mm) of mercury (Hg) at standard conditions, and is suitable for organic compounds with carbon content ranging from C3 to C10. However, naphthalene with vapor pressure of 0.087 mm Hg falls just below this threshold and hence is not listed as an analyte for TO-15. USEPA Method TO-17 allows greater flexibility in targeting lower vapor pressure compounds, and hydrophobic sorbents can trap organic compounds ranging from C7 to C20. Nonetheless, naphthalene samples can be analyzed by both USEPA Methods TO-15 and TO-17 provided the appropriate protocols described below are followed. Table E1 is a comparison of the two methods, and can be used to assist practitioners in the selection process in conjunction with the project's data quality objectives (DQOs).

To collect a naphthalene sample, the entire sampling system should be composed of Teflon®, polyetheretherketones (PEEK) or other tubing types with demonstrated inertness (Hayes et al., 2006). Using proper materials in the sampling system will ensure that soil gas samples are representative of subsurface conditions. Soil gas sampling workplans should describe how the field investigation will meet all the recommendations within this appendix as well as those noted in the USEPA TO methods. Both passive and active soil gas samples may need to be collected in order to provide multiple lines of evidence to evaluate vapor intrusion exposure to naphthalene.

Naphthalene Sample Collection by TO-15 (USEPA, 1999a)

Many stationary laboratories are capable of obtaining naphthalene data of acceptable quality using TO-15. If TO-15 is used for naphthalene sampling, then the laboratory conducting the analysis should utilize certain procedures, as follows:

1) **Naphthalene Recovery:** Naphthalene may condense onto the interior surface of sampling canisters. Therefore, storage stability tests with prepared naphthalene vapor standards should be performed for the duration of expected holding times. These storage stability tests should be conducted in the laboratory using certified clean canisters. Acceptable recovery of naphthalene should be demonstrated using a gas standard at a concentration of 32 $\mu g/m^3$ or less prepared in a passivated canister of the same make and approximate age as those used for sampling. The recovery testing information should be provided in the laboratory reports.

2) **Naphthalene Carryover**: Laboratory blanks should be used to check for instrument carryover. The blank should be run after the introduction of the highest naphthalene standard used to generate the instrument's calibration curve. Likewise, blanks should be run after the analysis of soil gas samples with

high naphthalene concentrations. Any instrument carryover of naphthalene from the blank sample should be substantially lower than the reporting limit to assure that the analyses are not compromised. The laboratory blank information should be provided in the laboratory reports.

3) **Canister Cleanliness:** Canisters used for naphthalene analysis should be certified clean before and after use, and the certification sheets provided in the laboratory reports. The canisters can be either batched or individually certified dependent upon the project's data quality objectives.

4) **Canister Age:** Laboratories should consider utilizing newer canisters for naphthalene sample collection. In older canisters, the passivated interior surface degrades over time, allowing greater surface area for the sorption of naphthalene. The age of the sampling canisters should be provided in the laboratory reports.

5) **Matrix Spikes (MS) and Matrix Spike Duplicates (MSD):** As stated in Table 2 in the Advisory and repeated in Appendix F, MS and MSD are impractical and not required when using TO-15.

If TO-15 is used for naphthalene sampling, TO-17 should be used to confirm TO-15 sampling results at a frequency of five to ten percent of the field samples. The number of confirmatory samples should be a function of the data quality objectives for the site. Confirmation sampling is especially prudent when using data for risk assessment purposes or when verifying cleanup objectives.

Naphthalene Sample Collection by TO-17

Soil gas samples for analysis by TO-17 are collected in sampling tubes packed with an appropriate sorbent material. USEPA (1999b) contains lists of chemicals amenable to TO-17 analysis along with guidelines for sorbent selection. For naphthalene, the sorbent material is usually Tenax® GR or Tenax® TA, but others may be appropriate. Practitioners should reference Table I in the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (USEPA 1999b). The air flow rate through the tubes is monitored during sample collection and a vacuum of less than 100 inches of water should be maintained during sampling. Shut-in tests should be conducted and leak check compounds should be used to evaluate sample integrity.

Items to consider when soil gas sampling pursuant to TO-17 are as follows:

1) Practitioner's Unfamiliarity: Practitioner's unfamiliarity with sampling by TO-17 may lead to field errors, potentially reducing the integrity of the sampling data.

2) Perceived Limitations with Sorbent Tubes: Other concerns and perceived limitations with use of the sorbent tube include lack of repeat analysis for samples collected by TO-17, breakthrough of target analytes during sampling and potential mass spectrometer overload from high concentration samples. To

address these concerns, practitioners should consider pre-screening all soil gas samples subject to TO-17 procedures. By estimating the anticipated concentration range of the sample prior to sorbent tube sampling, practitioners can determine optimal sampling durations to avoid breakthrough and provide notification to the stationary laboratory about possible instrumentation overload. Field equipment capable of measuring in the microgram per cubic meter range may be warranted.

3) Breakthrough Volumes: The sampling air volume is calculated from the anticipated subsurface concentration, sampling tube sorption capacity and sorbent tube temperature. Equations for breakthrough are typically provided by either the sorbent tube manufacturer or the analytical laboratory. Calculations for breakthrough should include an adequate safety factor to ensure that breakthrough does not transpire during sampling. If breakthrough volumes cannot be determined due to unknown conditions, sorbent tubes should be arranged in series and all tubes should be submitted to the laboratory for analysis.

4) Pump Placement: The sorbent tube should be upstream of the sampling pump.

5) Sample Collection Flow Rate: Flow rates for sample collection are typically less than 50 milliliters per minute, and the flow rate should not vary by more than 10 percent during sample collection.

6) Sorbent Tube Orientation: Tube orientation is usually annotated on the tube by the sorbent manufacturer or laboratory. For thermal desorption methods, the sorbent tube must be oriented during sample collection in the direction indicated on the tube. Multiple tubes may be placed in series in the sampling train if analytes other than naphthalene are required or if duplicate samples are necessary.

7) Field Documentation: Data sheets should be completed in the field and submitted to the analytical laboratory. The sheets should contain the sampling flow rates and sampling volumes required to quantify contaminant concentrations. These field data sheets should be included within the characterization report.

8) Leak Check Compounds: Leak test compounds should be used to verify sample integrity when sampling pursuant to TO-17, but it should be noted that most sorbent tubes will not retain many typical leak check compounds. For example, compounds smaller than C7 are not captured by Tenax® GR or Tenax® TA. In these situations, practitioners cannot depend upon the analysis of sampling tube for quantification of the leak check compound. Instead, additional sampling and analytical procedures may be warranted. Leakage can be readily measured and quantified on-site with a field meter, or by a stationary laboratory after the soil gas sample is collected. If a leak test compound with a carbon range of greater than C7 is used, the additional mass absorbed onto the sorbent tube may elevate the reporting limit or even overload the mass

spectrometer upon analysis. Additionally, a shut-in test of the above-ground apparatus downstream from the probe should be performed prior to sampling.

9) Collection Tube Composition: Sorbent tubes composed of metal should be used due to potential photochemical reactions. However, if only glass sampling tubes are available, the tubes should be wrapped entirely in aluminum foil during and after sample collection to avoid photodegradation.

10) Duplicate Samples: Duplicate sorbent tube samples should be collected at a predetermined frequency, usually at a rate of 10 percent of the number of samples.

11) Trip Blanks: Each shipping cooler should contain a trip blank. The trip blank should be a sealed tube filled with the same sorbent used during the field procedures.

Other Analytical Methods for Naphthalene Sample Collection

1) **Method 8260:** Due to the potential for low data quality when collecting and analyzing naphthalene soil gas samples pursuant to Method 8260, sample results should not be used for risk assessment purposes. Similar to the concerns about naphthalene analysis by TO-15, Method 8260 presents issues concerning contaminant carryover, variability in recovery and sorption to sampling equipment, such as plastic and glass syringes, glass bulbs and Tedlar bags.

2) **TO-13A:** Naphthalene analysis by TO-13A is not recommended. While TO-13A procedures are similar to TO-17 in many respects, two fundamental differences exist. First, the sorbent material within the sampling tubes for TO-13A is composed of polyurethane foam, typically PUF® and XAD-2®. Second, the sorbent material is removed by solvent (soxhlet) extraction prior to introduction into the gas chromatography/mass spectrometry instrumentation rather than by thermal desorption as in TO-17. Both PUF® and XAD-2® are known to have marginal collection efficiency for vapor phase naphthalene. Additionally, there is a potential for substantial losses of naphthalene due to its tendency to sublimate and its relatively high vapor pressure during TO-13A soxhlet extraction and evaporative concentration (Fortune et al., 2010).

TABLE E-1
Comparison of Methodologies

Issues	TO-15	TO-17
Application to naphthalene	Naphthalene is not a listed constituent due to its low vapor pressure.	Method specifically designed for constituents with low vapor pressure.
Familiarity with method	Method is commonly used.	Method is not widely used. Some laboratories may not have the necessary analytical equipment.
Sample collection	Canisters are expensive, expensive to clean, and bulky to transport. Only one sampling canister is needed per sample if numerous constituents warrant analysis. Sample remains stored as a gas until analysis.	Sorbent tubes are inexpensive as compare to canisters, and are small and easy to transport. Numerous sampling tubes may be needed if numerous constituents warrant analysis. Samples are no longer in the gas phase once collected, and hence, less likely to interact or react until analysis.
Sample analysis	The GC/MS analysis is the same for both methods. The difference is how the sample is introduced into the GC.	The GC/MS analysis is the same for both methods. The difference is how the sample is introduced into the GC.
Sample recovery	Naphthalene may sorb into the interior surface of the sampling canister, biasing the sampling results.	Naphthalene readily desorbs from the sampling tube material.
Sampling rate	Canister sampling rate is controlled by a regulator which is pre-calibrated and usually provided by the laboratory.	Sampling rate is controlled by a purge pump in the field. Hence, the field crew is responsible for maintaining the flow rate and for determining the sample volume.
Subsurface concentration	Highly concentrated samples can be handled, but canisters need to be cleaned thoroughly afterward.	Constituent breakthrough can occur without realization, compromising the integrity of the sample.
Capacity for multiple runs	Multiple analyses can be performed on the canister air if needed.	Typically, only one analytical run is possible on a sorbent tube. Samples cannot be diluted in most cases.
Detection limits	Typically greater than 10 $\mu g/m^3$ for naphthalene.	Typically less than 10 $\mu g/m^3$ for naphthalene.
Water management	Both methods are effective in removing water. Sorbent trap in the concentrator allows for the passage of some water, and then a dry gas purge is performed prior to thermal desorption in the GS/MS.	Both methods are effective in removing water. Uses a combination of hydrophobic sorbents, and then a dry gas purge is performed prior to thermal desorption in the GS/MS.
QA/QC	Analytical QA/QC is same for both methods.	Analytical QA/QC is same for both methods. Relatively extensive QA/QC on the sorbent tubes before and during sampling.

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APPENDIX F SOIL GAS ANALYTICAL METHOD REVIEW

SOIL GAS ANALYSIS METHODS

There are two methods generally used in California for soil gas analysis. One is Gas Chromatography with Mass Spectrometer (GC/MS), which is able to confirm the identity of compounds. The second is GC with a single specific detector such as a Flame Ionization Detector (FID), Electron Capture Detector (ECD), Photoionization Detector (PID) or a series of these detectors. The GC/MS technique is preferred because of its specific compound identification ability.

There are no approved USEPA methods specifically designed to analyze volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in soil gas samples. Consequently, modified versions of existing USEPA methods are used to analyze soil gas samples.

The modifications made to accommodate soil gas samples include the sample introduction technique and the calibration approach. It is important for consultants, regulators and other stakeholders to evaluate the technique(s) being employed before work begins on a site. All of the modifications have advantages and disadvantages with some working better for certain compounds than others. Project data quality objectives should be the deciding factor on which technique is the best to use for each phase of work on a particular site. If possible, the parties involved should perform preliminary performance tests or trial runs using a selected number of techniques and determine the best method to use on the site.

PERFORMANCE-BASED MEASUREMENT SYSTEM

This appendix summarizes some common methods used to analyze soil vapor samples. Laboratories are not restricted to the methods described in this document. Modifications and other adjustments may be needed to accommodate matrix, background, or other analytical issues. These modified methods can be used provided they have been validated and it can be demonstrated that the modified methods are capable of meeting the project data quality objectives and established performance criteria. Innovations and creativity are encouraged.

Methods that do not follow the specifics of published written methods (such as USEPA Method TO-15) but have been validated and can be demonstrated to be effective are considered to be “performance-based measurement system” (PBMS) with stipulations.

USEPA published the PBMS in 1997. The intent of PBMS was to allow the regulated community to select any suitable analytical method for regulatory compliance, to improve data quality and to encourage development of better analytical techniques. PBMS conveys what needs to be accomplished, but does not prescriptively describe how to do it. PBMS are defined as a set of processes where the data needs of a program or project are specified, and serve as the criteria for selecting appropriate methods to meet data or project objectives.

Since there are no analytical methods specifically designed to analyze soil gas samples, laboratories may develop and implement PBMS for soil gas samples. PBMS can be used for soil gas samples provided the criteria stated above are met, specifically that:

- The process can be validated;
- It can be demonstrated that the process can meet project data quality objectives; and
- It can be demonstrated that the process can meet the specified method performance criteria.

Laboratories may independently validate their PBMS. All validation documentation, such as raw data, should be kept on file and available for review by parties that may have vested interests in a particular project.

The regulating agency should review all PBMS in detail before accepting the proposed modification. Data from projects where the proposed PBM will be used should be compared side-by-side with an existing method. The proposed PBMS should be scrutinized to make sure they are not simply short-cut methods disguised as performance-based measurement systems.

Project consultants and contractors should provide the necessary documentation to support the use of any proposed PBMS for a project. Documentation should substantiate that the proposed method is capable of meeting the project data quality objectives and meet performance criteria.

Laboratory results from a PBM should reference the method used as “Performance-Based” followed by the base method. For example, if the PBM is based on USEPA Method TO-15, then the method should be referenced as “Performance-Based USEPA Method TO-15.” In the report narrative, a short description of the modification and/or adjustment made to the established method should also be included.

HISTORICAL AND LATEST VERSIONS OF ANALYTICAL METHODS

Multiple versions of USEPA methods exist. Analytical methods are revised in order to add more analytes, update instrumentation and clarify requirements and recommendations. Most revisions do not involve substantial changes to the method technique. In general, laboratories should use the latest method revision in their work. However, before using a new revision, laboratories should carefully review and compare their existing method with the new revision to verify that there are no significant changes that can affect data quality and the data quality objectives of their clients. Likewise, laboratories using older revisions of methods, for historical or consistency reasons, should confirm that the older method version will serve the intended purpose. Laboratories should clearly indicate the exact revision of the method used in their laboratory reports to their clients.

Letter suffixes to a method such as “A”, “B”, etc. are used to identify the revision status of the method. The first version of a method (revision “0” [zero]) does not have a letter suffix.

Occasionally a revision or method may be declared obsolete by the USEPA and should therefore no longer be used by laboratories. For the current status of USEPA methods, refer to the Status Tables for SW-846, Third Edition.

Table F-1 displays the various versions of USEPA methods referenced in this advisory modified for soil gas testing:

TABLE F-1
USEPA Soil Gas Testing Methods

USEPA Method	Description	Revisions (Date)	Comments
8015	Nonhalogenated Organics by Gas Chromatography	0 (September 1986) A (July 1992) B (December 1996) C (February 2007) D (June 2003)	Revision D is the latest revision in spite of the later date for revision C. Revision C was introduced in 2000 as a draft update, but not finalized until 2007.
8021	Aromatic and Halogenated Volatiles by Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors	0 (July 1992) A (September 1994) B (December 1996)	Replaced methods 8010 and 8020.
8260	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	0 (July 1992) A (September 1994) B (December 1996) C (August 2006)	
TO-13A	Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)	First Edition (TO-13) (March 1989) Second Edition (January 1999)	“Edition” refers to the Compendium of Methods for the Determination of Toxic Organic Compound in Ambient Air, and not the revision of the method.
TO-15	Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS)	Second Edition (January 1999)	Method TO-15 was a new method added to the Second Edition of the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. TO-15 is based on Method TO-14A.
TO-17	Volatile Organic Compounds (VOCs) in Ambient Air Using Active Sampling Onto Sorbent Tubes	Second Edition (January 1999)	Method TO-17 was a new method added to the Second Edition of the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. It is an update of Methods TO-1 and TO-2 from the first compendium (1989).

MODIFIED GC/MS METHODS

USEPA Method 8260

USEPA Method 8260 (Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)) is designed to determine the concentration of VOCs in a variety of solid and liquid matrices (USEPA, 2000). There are two modifications made to this analytical method for soil gas sampling. In the first modification, a volume of soil gas sample is injected into the sparge vessel (sparger) containing water. Helium gas is then used to purge the VOCs out of the sparger and onto a sorbent trap. VOCs in the sorbent trap are thermally desorbed into the GC column for separation and analysis. This is equivalent to USEPA Method 5030 (Purge-and-Trap for Aqueous Samples). In the second modification, a small volume of the soil gas sample is directly injected into the GC.

Laboratories employing a modification of USEPA Method 8260 to analyze soil gas samples should adhere to all the analytical requirements of the original method including purge time, calibration and Quality Assurance/Quality Control (QA/QC). Modifications for soil gas samples are outlined in the following sections.

a) Sample Introduction

The original USEPA Method 8260 outlines five specific methods for sample introduction, none of which were designed for soil gas. Therefore, modifications of the introduction step are needed for soil gas samples. DTSC contacted several stationary and mobile laboratories that use Method 8260 for soil gas, and determined that soil gas samples are usually introduced by either purge-and-trap or direct injection, as described above. Each sample introduction technique has its own advantages and disadvantages. The advantages and disadvantages are summarized in Table F-2.

TABLE F-2
Advantages and Disadvantages of 8260 Sample Introduction Techniques for Soil Gas

Sample Introduction Technique	Advantages	Disadvantages	Comments
A volume of soil gas sample is injected into a purge-and-trap sparger containing water. Analytes are purged out of sparger into the sorbent trap using helium gas. Analytes in the trap are thermally desorbed into the GC column for separation.	• Larger volumes of soil gas sample may be forced into water to achieve lower reporting limits with limitations. • Surrogates, internal standards and spikes are added into the sparger before sample introduction and purging. • Soil gas volumes can be changed by using a smaller syringe or concentrated soil gas samples can be diluted in glass bulb before injecting into sparger.	• Analytes are forced into a water matrix and purged out into trap before entering into GC column. Loss of target analytes possible. • Depending on the type of sample container/vessel in which the sample is collected, sample may need to be transferred before injection into sparger –potential sample loss in transfer process. • Low recovery of polar/water soluble compounds. • Calibration curve not matrix-matched if liquid standards are used.	• Not recommended for polar/water soluble compounds. • Surrogates (liquid-phased) are used, but introduced separately into sparger. Does not actually provide true QA/QC information on soil gas. • Ideal for higher concentration samples. • Not recommended for low level (low concentration) samples. • Not recommended for oxygenates and chlorinated compounds due to poor purging efficiency.
Direct injection of soil gas sample into GC column for separation.	• Technique is quick with limited sample handling. • Holding time not an issue, provided samples are injected immediately after collection. • No transfer of analytes from one phase to another (i.e., gas to liquid to gas). • Can handle high level (concentrated) samples.	• Limited sample size; threshold limit on how much sample can be injected into GC column may result in elevated reporting limits • Elevated reporting limits may not meet the DQOs for risk assessment purposes. • Calibration not matrix-matched.	• Recommended for screening purposes (qualitative data) and routine monitoring of limited number of known compounds. • Calibration standards prepared by expansion of liquid standards in vials/bulb may not be amenable to all compounds.

b) Calibration for 8260

Analytical laboratories should use vapor-phase standards to calibrate their instruments when employing USEPA Method 8260B/C for soil gas analysis. Vapor-phase standards used for ambient air testing are readily available and can be used for soil gas analyses. Many laboratories use liquid-phase standards to prepare the calibration curve, for logistical and economic reasons, rather than using a vapor-

phase standard. This is problematic because the vapor pressure, solubility, and other properties of a compound may be different in a liquid-phase standard than in a vapor-phase standard, especially when it is subjected to being forced into an aqueous phase in the sparger and then forced out into a gaseous phase again during the purge. Therefore, the calibration curve should be matrix-matched by using a vapor-phase standard.

Some laboratories are essentially using a headspace technique modification that attempts to matrix-match a liquid-phase calibration standard to soil gas samples. The technique entails injecting the liquid standard into an empty volatile organic analysis (VOA) vial through the septum or into glass bulbs and allowing the standard to vaporize and equilibrate before taking an aliquot of the vapor and injecting it into the gas chromatograph. This technique may not be amenable to all VOCs since it is dependent on the vapor pressures of the target analytes and how well each compound will vaporize in the vial or bulb. The few laboratories that use this technique are analyzing a limited number of analytes. Laboratories using this approach should standardize their temperature range, time for equilibration, and other practices in preparing the calibration standards. Furthermore, laboratories using this technique should validate and verify the accuracy of their vaporized standards by comparing their calibration with vapor-phase standards (see next section).

c) Calibration Validation for 8260

Calibration curves are validated by analyzing a mid-level National Institute of Standard and Technology (NIST) traceable vapor-phase validation check standard on a routine basis. The vapor-phase validation check standard, or equivalent, should be analyzed and evaluated every time a calibration curve is generated. Routinely, a vapor-phase check standard should be analyzed with each analytical batch to verify the validity of the liquid calibration curve. In addition, the vapor-phase validation check standard should include all the target analytes in the calibration curve. Because the purging characteristic of each compound is different, laboratories should establish their own acceptance criteria for each compound for the validation. The acceptance criteria should be based on experimental and/or historical data. This validation procedure is recommended, regardless of the sample introduction technique being used, to provide technically sound and defensible data.

For laboratories that calibrate their analytical system using the headspace technique, validation of the calibration curve should be conducted by injecting an aliquot of a vapor-phase NIST traceable or equivalent standard at a volume equal in concentration to the mid-point of the calibration curve to validate and to verify the accuracy of their standard preparation technique. The volume needs to be calculated based on the volume of the vaporized standard injected and the concentration of the standard. The frequency of the validation, percent differences of validation check and reportable data should be the same as for liquid standards.

If vapor-phase standards are used to prepare the calibration curve with USEPA Method 8260B, the validation referenced above is not necessary. However,

analytical laboratories should verify the accuracy of their vapor-phase standards periodically by comparing them to a secondary standard either from another source or to a different lot of standards from the same supplier.

d) Sample Volume for 8260

The sample volume is determined by the sample introduction technique in conjunction with the project reporting limits. If lower reporting limits are desired, then a larger volume of sample should be injected. The volume for the direct injection technique is limited since only a very small volume can be injected onto the GC, whereas a larger volume can be used with the sparger technique. Sample volumes of five to 250 milliliters (mL) are typically used, although some laboratories use up to 500 mL of sample.

Larger volume samples are introduced in aliquots into a sparger filled with water by forcing the water directly through the trap. The contact time with the water is minimal. More water-soluble compounds such as ketones and methyl tertiary butyl ether will preferentially stay in the water phase until purged out.

Laboratories should validate their injection technique by injecting aliquots of vapor-phase standards into the sparger and evaluating the recovery levels. The recommended recovery range is 70 to130 percent for most compounds.

e) Purge Time for 8260

USEPA Method 8260B specifies a purge time of 11 minutes. Laboratories should not deviate from this specification as the method is optimized for the recovery of all target analytes. If modifications are required, they should be documented and validated with vapor-phased standards.

f) Autosamplers for 8260

Using an autosampler with modified USEPA Method 8260B/C is not reliable. The soil gas sample is transferred for analysis from a soil gas collection vessel such as a syringe to another secondary container such as a VOA vial, resulting in sample loss. This technique is not capable of handling variable volumes of soil gas sample, especially larger sample volumes needed to adjust for the desired site-specific compound RLs. Furthermore, gases and the more water-soluble compounds have questionable recoveries.

g) Screening

When using a GC/MS, laboratories should screen samples before analysis with a GC/FID to avoid saturation of the mass spectrometer. This will also provide information on the proper dilution(s) needed for quantification.

h) Applicability of 8260

Modified Method 8260B works well for soil gas samples with VOC concentrations greater than 0.1 μg/L or 100 μg/m^3 and for most compounds.

i) Other Modifications

The project proponent should propose method modifications to the regulatory agencies prior to implementation, leaving an adequate time for regulatory review and comment. Standard operating procedures (SOP) for the modified sample preparation and analysis should be provided. The laboratory using the modification must validate the procedures before implementation and provide the data and report for review. Refer to the Performance-Based Measurement System Section above.

USEPA Method TO-15

Although TO-15 (USEPA, 1999) was designed for collecting and analyzing VOCs in ambient air samples, this method can successfully be used for soil gas analysis. A known volume of sample is collected into a passivated stainless steel canister, then concentrated onto a solid sorbent trap in the laboratory and refocused on a second trap before being thermally desorbed onto the GC column for separation.

There are two techniques for introducing whole air samples by TO-15 from the canister into the gas chromatograph. These are the multisorbent pack method and a cold trap method. The multisorbent pack method uses different types of solid sorbent traps with different retentive properties selectively concentrating VOCs depending on the analytes. The cold trap method concentrates VOCs by condensing them on a cold surface.

TO-15 was designed for ambient air where the analyte concentrations have a narrow concentration range. In contrast, soil gas samples have a wide range of concentrations. Therefore, soil gas samples should be pre-screened before analysis. Pre-screening provides for adjusting the operating parameters such as dilution and recalibration to avoid overloading the instrument and/or creating problems such as carryovers.

Of all the USEPA methods, Method TO-15 is best suited for soil gas analysis since it is designed for gas samples. Laboratories employing TO-15 to analyze soil gas samples should adhere to all the basic requirements of the method including calibration and QA/QC protocols.

Advantages and disadvantages of TO-15 modifications are described in Table 3. Since a soil gas sample is treated in the same manner as an ambient air sample, there should be no modification needed to analyze soil gas samples with this method.

TABLE F-3
Advantages and Disadvantages of Modifications to TO-15

Modification	Advantages	Disadvantages	Comments
Samples collected in polymer gas sampling bags	• Lower Cost; • Easily; transported • Selected compounds have been shown to be stable. [1]	• Potential background issues (bag off-gas); • Adsorption of some compounds; • Bags do not conform to TO-15 protocol; and • Limited holding time (6 hours).	
Samples injected into instrument by filling injection loop with syringe	• Good for highly concentrated samples.	• Limited volume can be analyzed (0.5 – 5 cc); and • Not suited for low concentration samples.	• May only be used for highly concentrated samples.
Use of portable GC/MS system (e.g., Hapsite®) [2]	• Ideal for field screening.	• May not be able to handle the various types of sampling media. Samples have to be transferred for analysis (e.g., canister to syringe or polymer gas sampling bag.	• Considered to be an automated gas chromatograph under Section 1.6 of method.

[1] Hartman (2006)
[2] DTSC Environmental Chemistry Laboratory should be consulted.

a) Quality Assurance/Quality Control for TO-15

The QA/QC requirements for Method TO-15 differ from USEPA Method 8260B/C. The calibration curve and tuning need to be checked every 24 hours for Method TO-15 compared to every 12 hours for Method 8260B/C. There are no requirements to verify the calibration curve with a second-source standard, to analyze matrix spike/matrix spike duplicate samples (MS/MSD), to run laboratory control samples (LCS) or to use surrogates for Method TO-15.

b) Use of Autosamplers for TO-15

Samples in passivated stainless steel canisters may be analyzed without any further sample transfer if the canisters are directly connected to an autosampler. Additional blank samples should be included in the sample sequence to evaluate possible carryover of highly contaminated samples.

Samples in polymer gas sampling bags may also be analyzed with an autosampler provided the sample container is connected in such a way to ensure there is no leakage. A vacuum pump is needed to pull the sample into the instrument. Additional blank samples should be included in the sample sequence to evaluate possible carryover of highly contaminated samples.

Polymer gas sampling bags are sometimes used for dilution of highly concentrated samples from canisters. The bags used for dilutions should be new and thoroughly cleaned.

c) Canister Certification for TO-15

Although canister certification may not be appropriate for all projects, certifying canisters as clean canisters decreases the level of uncertainty associated with the prior use of the canister. Certified canisters are leak tested and documented to be clean and free of any contaminants. The project DQOs dictate the certification level and certification frequency. The certification level is determined by the reporting limits. The certification frequency refers to the number or percent of canisters requiring certification. Canisters should be certified with the same data acquisition mode as the sample analysis.

Soil gas samples collected in canisters may be shipped since they are under vacuum. The Department of Transportation (DOT) in title 49 Code of Federal Regulations, Parts 100-185, requires that canister pressure must not exceed 400 pound-force per square inch gauge (psig). Consult with the federal code of regulations and the shipping agent on specific regulations pertaining to shipping and transporting various materials.

USEPA Method TO-17

Method TO-17 (USEPA, 1999) is primarily a sampling method coupled with the analytical approach used in USEPA Method TO-15. In TO-17, a known volume of soil gas is pulled through a sorbent tube to collect the VOCs followed by VOC desorption onto the GC column for separation and analysis by the mass spectrometer. Other detectors or combinations of detectors, such as the ECD/FID in series, can be used with this method provided that the criteria specified in Section 14 of the method are met.

Like TO-15, TO-17 was designed for collecting and analyzing VOCs in ambient air samples, but can successfully be used for soil gas sampling and analysis.

Since a soil gas sample is treated in the same manner as an ambient air sample, there should be no modification needed to analyze soil gas samples with this method.

a) Conditioning and Calibration for TO-17

Freshly packed or new sorbent tubes must be conditioned before use. Conditioning entails heating the tubes at specific temperatures with a set gas flow rate (See Table 2 of method). Tubes can be reused for multiple thermal desorption cycles until the safe sampling volume validation procedures fails (USEPA, 1999, Method TO-17, Section 13.1.2).

For calibration, either vapor-phase or liquid standards can be used. Liquid standards are directly injected into the sorbent tubes for calibration. No calibration validation with gas-phase standards is needed if liquid standards are used.

According to USEPA 1999, "Sample tubes awaiting analysis on an automated desorption system must be completely sealed before thermal desorption to prevent ingress of VOC contaminants from the laboratory air and to prevent losses of weakly retained analytes from the tube." (Method TO-17, Section 8.2.1.2)

b) Advantages and Disadvantages

The TO-17 method has some advantages over Methods TO-15 and 8260. One advantage is the ability to collect and concentrate a larger volume of sample, resulting in lower reporting limits because the entire volume of VOCs trapped on the sorbent tube is desorbed completely as a single aliquot of sample. In comparison, for TO-15, only a smaller sub-sample is usually analyzed at a time, resulting in elevated reporting limits. Another advantage of Method TO-17 is that this method can be used on low vapor pressure compounds such as naphthalene. Finally, the collection apparatus and sample tubes for Method TO-17 are compact and easily transportable.

However, there are disadvantages in using a sorbent tube as required by TO-17. Some of the primary disadvantages include:

- The inability to repeat an analysis on the same sample;
- Potential MS overload due to desorption of concentrated sample; and
- Column breakthrough.

The unfamiliarity of practitioners in handling and collecting soil gas samples onto sorbent tubes is another potential disadvantage, since in the United States, soil gas samples are mostly collected in canisters and syringes rather than onto sorbent tubes. Sorbent tubes, however, are used widely in Europe.

With Method TO-15, additional analysis on the same sample can be easily performed by withdrawing another sample aliquot from the sample canister. With Method TO-17, once all the compounds are desorbed from the sorbent tube the sample is completely used. Repeating a sample analysis is possible only if multiple (duplicate) sorbent tubes are collected. Multiple sorbent tubes can be collected concurrently if several sorbent tubes are manifolded in parallel during sampling. Moreover, recent advances in thermal desorption (TD) technology have made it possible to split sample into fractions for repeat runs from the same sorbent tube.

For quantification, the volume of air passing through the cartridge must be measured and documented. Moisture can be a problem with sorbent cartridges, but it can be managed by using alternative sorbents, sample splitting or dry purging (USEPA, 1999, Method TO-17, Section 7.2). The use of in-line water traps is not recommended since the traps may absorb target analytes. Other issues with TO-17

include interferences from sorbent artifacts (USEPA,1999, Method TO-17, Section 7.1). There is no single universal sorbent that can be used for all possible VOCs. The choice of sorbent depends on the target VOCs. However, multi-bed (sorbent) tubes are also available that can be used to sample for a wide range of target compounds.

Method TO-17 should not be used to analyze highly concentrated soil gas samples. Highly concentrated soil gas samples will saturate the MS if completely desorbed into the GC. Therefore, the approximate concentration of VOCs or SVOCs should be predetermined by field screening specific soil gas sampling locations using another analytical method such as USEPA 5035/8260 or USEPA 5030/8260, prior to deployment.

USEPA Method TO-13A

Although TO-13A (USEPA, 1999) was designed for collecting and analyzing PAHs in ambient air, this method can successfully be used for soil gas sampling and analysis.

Samples are collected/adsorbed onto a combination of filter and sorbent cartridges followed by solvent extraction, cleanup (if needed) and concentration before analysis by GC/MS. Since a soil gas sample is treated in the same manner as an ambient air sample, there should be no modification needed to analyze soil gas samples with this method. The following need to be evaluated prior to sampling:

- Volume needed to meet the required reporting limits; and
- Sampling flow rate relative to the capacity of the sampling tube.

Scan vs. SIM Mode

Scan and Selected Ion Monitoring (SIM) are two data acquisition modes with GC/MS methods. The most common mode is the Scan mode in which the detector scans from high to low across a range of masses continuously. In scan mode, compound identification is made by comparing the samples mass spectrum against a spectral library. In SIM mode, only a few selected ion fragments or masses are monitored. Because the detector concentrates its time only on selected masses, the sensitivity is maximized. Due to the increase in sensitivity, lower reporting limits are possible.

Although SIM can provide lower reporting limits, its utility is limited and should only be used for a site that is completely characterized. It should never be used for initial site characterization because the instrument is set to monitor only the selected target compounds. SIM may be used to overcome some background problems in soil and water matrices. However, there are inherent matrix effects with soil gas samples; therefore, SIM is not always the best choice to use with soil gas samples.

MODIFIED GC METHODS

Two primary GC methods associated with soil gas analysis are USEPA Methods 8015 and 8021. GC methods may be used for routine monitoring when the contaminants and their approximate concentrations are known. The GC method should not be used for initial characterization. When new, unknown compounds are detected, these should be confirmed by analysis with a GC/MS method. On a routine basis, at least 10 percent of positive results from GC analysis should be confirmed by analysis with a GC/MS method.

Various versions of each method exist in the SW-846 manual (USEPA 2000). Laboratories should use the most updated versions of the method and state in their analytical reports which version of the method was used.

USEPA Method 8015 (8015, 8015A, 8015B, 8015C and 8015D)

USEPA Method 8015 (Non-halogenated Organics by Gas Chromatography) is used to determine the concentration of volatile and semi-volatile nonhalogenated organic compounds, triethylamine and petroleum hydrocarbons (C5-C32) (USEPA 2000). Samples are introduced into the GC by one of the following methods:

- Purge-and-trap;
- Equilibrium headspace;
- Direct injection;
- Injection of azeotropic distillation concentrate;
- Injection of vacuum distillation concentrate; and
- Injection of solvent extraction concentrate.

A FID is used with all modifications of Method 8015. In order to apply this method to soil gas samples, the same types of modifications described for Method 8260B/C should be used. Samples are either injected into a purge-and-trap sparger filled with water and purged or directly injected into the GC.

USEPA Method 8021 (8021, 8021A and 8021B)

USEPA Method 8021B (Aromatic and Halogenated Volatiles by Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors) is used to determine the concentration of halogenated and aromatic volatile organic compounds (USEPA 2000). Samples are introduced into the GC by one of the following methods:

- Direct injection;
- Purge-and-trap;
- Headspace; and
- Injection of vacuum distillation concentrate.

Both a PID and a Hall electrolytic conductivity detector (HECD) are used with Method 8021 in either series or as a single detector. In order to apply Method 8021 to soil gas

samples, the same types of modifications described for Method 8260B/C should be used.

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

QA/QC requirements for soil gas testing should be outlined in the project-specific Quality Assurance Project Plan (QAPP) or the specific modified USEPA Method being employed. Soil gas analytical laboratories should comply with those QA/QC requirements and add additional checks as needed.

QA/QC for Soil Gas Testing

The following are the QA/QC protocols that should be included with soil gas testing. Most of these QA/QC protocols are required with USEPA methods as well as laboratory certification (see later):

a) Daily Tune

For GC/MS methods, laboratories should conduct the daily tune as specified in the respective method. The instrument must meet the tuning criteria before sample analysis.

b) Initial Calibration

The calibration curve should consist of a minimum of five points. The maximum percent relative standard deviation (%RSD) for each target compound should not exceed 30 percent. For USEPA Methods TO-15 and TO-17, two compounds are allowed up to 40 percent RSD.

c) Daily Calibration (Continuing Calibration)

The calibration curve for each compound of interest should be verified with each analytical batch, or once every 12 hours (24 hours for TO-15 and TO-17). Verification is conducted by analyzing the mid-point calibration standard. The results from the mid-point standard should be within 20 percent (30 percent for TO-15 and TO-17) of the initial calibration in order to assume the calibration curve is valid.

d) End of Run Calibration Check

A mid-level calibration standard should be run for each 20-sample batch or at the end of the run, whichever is more often. Verification is conducted by analyzing the mid-point calibration standard. The results from the mid-point standard should be within 20 percent of the initial calibration in order to ensure the calibration curve is still valid at the end of the batch run and the instrument sensitivity has not deteriorated. For USEPA 8260B/C, TO-15 and TO-17 methods, there is no requirement for this analysis. The instrument is monitored by internal standards which are added to every sample. The need for an end-of-the-run calibration check for GC/MS methods is at the discretion of the parties involved in the project and

should be based on DQOs. For those methods where there is no internal standard monitoring, the end of run calibration check may be needed to evaluate the instrument.

e) Method Blanks

Method blanks are used to evaluate contamination from the analytical process. This is a sample prepared by the analytical laboratory using an analyte-free matrix and carried through the entire sample preparation and analytical procedure. The analyte-free matrix for soil gas is humidified laboratory grade ultra-pure air or ultra-pure nitrogen.

f) Container Blanks

If sampling containers are reused or recycled then at least one decontaminated sample container per 20 samples or per batch, whichever is more often, should be analyzed as a container blank sample to verify the effectiveness of the decontamination procedures. Other components such as fittings and valves of the sampling stream that are subject to carryover/contamination should also be monitored. Note: This was previously referred to as the “Method Blank” in the 2003 Advisory – Active Soil Gas Investigations).

g) Trip Blanks

Trip blanks consist of humidified laboratory-grade ultra-pure air. Trip blanks evaluate whether shipping and handling procedures are introducing contaminants into the samples, and if cross-contamination in the form of VOC migration has occurred between the collected VOC samples. Trip blanks are only required if samples are collected in polymer gas sampling bags or sorbent tubes for TO-17 analysis. A minimum of one trip blank per shipping container should be collected and analyzed for target compounds whenever VOC samples are shipped offsite for analysis. The trip blank containers and media should be the same as the site samples. USEPA Method TO-15 does not have specific trip blank requirements. Therefore, trip blanks are not needed if samples are collected in passivated stainless steel canisters.

h) Duplicate Samples

Duplicate sample analysis evaluates the reproducibility (precision) of the sampling process. At least one duplicate sample per 20 samples or per batch, whichever is more often, should be collected and analyzed. Duplicate samples should be collected in separate containers at the same location and depth. A duplicate sample can be collected by using a T-splitter at the point of collection to divide the sample stream into two separate sample containers.

i) Replicate Samples

Replicate sample analysis evaluates the reproducibility (precision) of the laboratory’s analytical ability and is used to estimate sample variability. At least one replicate

sample per 20 samples or per batch, whichever is more often, should be reanalyzed by the laboratory to assess analytical precision.

j) Matrix Spike/Matrix Spike Duplicates (MS/MSD)

The requirement for MS/MSD with modified USEPA Method 8260B/C is discretionary. Although MS/MSD samples are required with the USEPA 8000 series methods, there is no practical approach to apply this requirement to soil gas samples. For true MS/MSD samples, spike compounds must be added to the sample during the collection process. With soil gas samples, this is not technically feasible. The addition of a spike into the sparger with modified USEPA Method 8260B/C does not duplicate the actual condition of the sample as it is collected, processed and analyzed.

There is also no requirement for MS/MSD with USEPA Method TO-15 as the analysis of MS/MSD with TO-15 is impractical. Spike compounds are added at the same time that the sample is transferred into the concentrator. Because this does not truly assess the impact of the matrix on the recovery of the target compounds, the need for MS/MSD with Method TO-15 is at the discretion of the parties involved in the project and should be based on the data quality objectives.

k) Laboratory Control Sample (LCS)

LCS is a sample made with an aliquot of a clean (control) matrix similar to the sample matrix spiked with compounds that are representative of the target analytes and is used to document laboratory performance. For soil gas analysis, this QA/QC sample is not necessary since the “clean” matrix is humidified laboratory grade ultra-pure air. When prepared as such, this is equivalent to the daily calibration (continuing calibration) sample. It would be redundant to analyze this QA/QC sample; therefore, LCS samples are optional depending on the requirement of the project QAPP. Methods TO-13, TO-15 and TO-17 do not have any requirements for LCS sample analysis.

l) Surrogates

The use of surrogates in soil gas analysis is dependent on the method and container used. USEPA Method 8260B/C requires surrogates whereas Method TO-15 does not. Introducing surrogates into soil gas samples can present some logistical challenges, depending on the type of container being used to collect the sample. Surrogates are designed to monitor recoveries of target analytes. Therefore, they should be introduced at the point of sample collection in order to fully assess the recovery process.

For most laboratories that use modified USEPA Method 8260B/C, the surrogates are usually added to the water in the sparger either before or after the soil gas sample has been forced into the water. Vapor-phase surrogates (which are available for air analysis) can be theoretically added into soil gas sample aliquot in a gas-tight syringe just before injecting into the sparger. However, few if any laboratories are

using this practice for various reasons.

For laboratories using USEPA Method TO-15 the surrogates are added to the sample loop at the same time the soil gas sample is being loaded onto the concentrator. In both instances the surrogates are added after the sample has already been collected. There is a gap between when the sample is collected and when the sample is analyzed where there are no surrogates to monitor the process.

Commercially prepared surrogates or standards should be used. Preparing vapor internal standards or surrogates with liquid standards in either polymer gas sampling bags or glass bulbs is not recommended because of the inherent difficulty in preparing the surrogates or standards. Some laboratories add vapor surrogates immediately after sampling to samples collected in glass bulbs. The vapor surrogates are actually liquid surrogates injected into a glass bulb and allowed to expand. Aliquots of the vapor surrogates are injected into the glass bulb with the soil gas sample. The internal standards or surrogates should be completely vaporized before aliquots are taken. Droplets of liquid standards or surrogates can adhere to the internal surface of the bags or bulbs. Due to variations with where and when the surrogates are added to the soil gas samples, laboratories are advised to note in their final analytical reports the exact step in the process where the surrogates (if used) are added so the results can be evaluated accordingly.

m) Reporting Limit Verification

The RL is the limit of quantification reported by the analyzing laboratory. The RL should not be lower than the lowest calibration point. The RL should be validated periodically (recommended with each batch of samples) by spiking a blank sample at the RL level. There is no limit on the number of samples per batch for RL verification. If the RL is set at the lowest calibration point then verification is not needed.

n) Acceptance Limits

Based on laboratory performance, laboratories should establish their own acceptance limits for their QA/QC parameters. QA/QC parameters include percent recoveries for surrogates, matrix spikes, laboratory control samples and percent relative difference for duplicates. The limits should be evaluated and updated periodically. For guidance on establishing acceptance limits consult USEPA Method 8000B (December 1996), Section 8.0 of SW-846 (USEPA 2000).

o) Standard Operating Procedures

Laboratories should have detailed written Standard Operating Procedures (SOP) for their soil gas sampling and testing procedures. Copies of the SOP should be available in the laboratory for review and reference. The SOP should be reviewed on an annual basis and updated as needed. Field procedures, including sampling procedures, can be written as a separate SOP from the laboratory analytical procedures.

DATA REVIEW

All soil gas data should be reviewed in detail to ensure all QA/QC parameters are within specified control limits.

Soil gas data should be reviewed and evaluated as described in the most current version of DTSC's *"Guidance for the Evaluation of Subsurface Vapor Intrusion to Indoor Air"*.

DETECTION LIMITS VERSUS REPORTING LIMITS

A detection limit is defined as the *"the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and is determined from analysis of a sample in a given matrix type containing the analyte"* (SW-846, Chapter One, Quality Control, Revision 1, July 1992). A RL is defined as the lowest concentration of an analyte that can be detected in a sample by the given analytical procedure taking into account sample matrix, interferences, dilution factor and the lowest point of the calibration curve. Laboratories should use the RL in their analytical reports since it is a more reliable indicator of the limit of detection.

Reporting Limits

Reporting limits should be selected prior to choosing analytical methods and be based on project DQOs. Sampling protocols, analytical method(s) used, list of target compounds, and other DQOs should be considered when selecting project RLs.
For risk assessments, the reporting limits should be lower than the California Human Health Screening Levels (CHHSLs) for soil gas. For compounds that are not on the CHHSL listing, the analytical method should be selected to achieve the reporting limits for risk-based decision making.

Table F-4 delineates the reporting limits of the common soil gas analytical techniques for select analytical methods. The ranges in this table are based on a survey of analytical laboratories conducted by the Soil Gas Advisory Workgroup. For the reporting limits of other methods/techniques, consult with the analytical laboratory.

TABLE F-4
Reporting Limits

Analytical Method/Technique	Reporting Limit Range*	Comments
Modified USEPA 8260B/C: Direct injection of soil gas into sparger with water.	20 – 5000 $\mu g/m^3$ (most compounds at 1000 $\mu g/m^3$ or lower)	Sample size dependent. Most samples are 5-250 cc (mL).
Modified USEPA 8260B/C: Direct injection of soil gas into GC column.	100 – 1000 $\mu g/m^3$	
Modified USEPA TO-15 (Conventional GC/MS system).	Scan Mode: 0.7 – 200 $\mu g/m^3$ SIM Mode: 0.004 – 0.20 $\mu g/m^3$	
Modified USEPA TO-15 (Using portable GC/MS system (e.g., Hapsite®).	4 – 100 $\mu g/m^3$	

Reporting Units

Analytical laboratories should report soil gas results in $\mu g/m^3$ rather than $\mu g/L$ or parts per billion by volume (ppbv). Although 1,000 $\mu g/m^3$ is equivalent to one $\mu g/L$, neither can be converted to ppbv by simply moving the decimal point. The ppbv conversion is a function of the molecular weight of the compound in question, as shown in the example below. Environmental practitioners should verify that soil gas sample results are calculated correctly and reported in the proper units.

Example: benzene in air/soil gas with molecular weight=78.11 is converted as follows:

1.0 μg /L Benzene = 1000 μg /m^3 Benzene = 315 ppbv Benzene*

*ppbv = [(μg/L) x (RT)] x 1000/(MW) x P **or** ppbv = [($\mu g/m^3$) x (RT)] /(MW) x P

where:
$\mu g/L$ = 1.0
$\mu g/m^3$ = 1000
R = 0.0825 L-atm/mole-°K (Ideal Gas Law Constant)
T = 298°K (Standard Temperature)
1000 = Conversion of 1 m^3 = 1000 L
MW = 78.11 (Molecular Weight of Benzene)
P = 1 atm (Standard Pressure)

Laboratories using TO methods generally report results in ppbv, and may continue to do so, but should also provide the conversion to $\mu g/m^3$.

VARIABILITY AND COMPARING RESULTS

Variability in soil gas results comes from differences in the laboratory instruments, sample introduction techniques, and the analyst's skill, experience and practices, as well as variability in field sample collection methods and in sample containers. Finally, there is also a variation in the sample matrix. A replicate sample collected immediately after the original sample may not be the same due to spatial and temporal differences.

To evaluate the comparability of results from two different methods, calculate the Relative Percent Difference (RPD) of the results. The RPD is calculated with the formula:

$$RPD = 100 \times (C_1 - C_2)/[(C_1 + C_2)/2]$$

where: C_1 = Result from the first method
C_2 = Result from the second method

In instances where soil gas results from the same source analyzed by two different methods differ by more than 50 percent RPD, the results should be validated. Validation involves reviewing the sampling procedures, collection containers, sample introduction technique and QA/QC data. Any differences should be evaluated and explained. All QA/QC results should be reviewed to make sure the parameters are within the established control limits and the calculations checked. The final analytical results from modified 8260B/C should be reported and calculated as $\mu g/m^3$ or $\mu g/L$ (see section above on reporting units).

Some compounds are better analyzed by one method than the other due to their physical nature. Some compounds have a better recovery if a liquid standard is used whereas, the vapor phase standard will purge poorly. Highly volatile VOCs are recovered well with modified 8260B/C compared to TO-15. Resampling and reanalyzing samples may be necessary if the recovery discrepancies cannot be explained after validation.

METHOD REFERENCES IN ANALYTICAL REPORTS

The analytical method used to test soil gas samples and any modifications to the analytical method should be described in the laboratory reports. Refer to the Performance-Based Measurement Systems Section above for information on referencing PBMS.

LABORATORY CERTIFICATION

All laboratories performing soil gas testing should be certified. According to the California Health and Safety Code Section 25356.1.5(e), exposure assessments shall include development of reasonable maximum estimates or exposure to VOCs that may enter existing or future structures on a site. Section 25358.4 requires that analysis of any material, that is required to show compliance with Chapter 6.8 of the Health and

Safety Code, shall be performed by a laboratory accredited by the Department of Public Health pursuant to Article 3 of Chapter 4 of Part 1 of Division 101.

Soil gas testing laboratories can obtain certification from the California Department of Public Health's Environmental Laboratory Accreditation Program (ELAP) for all analytical methods they are using for soil gas testing. Certification ensures that the laboratories have the requisite facilities, equipment and personnel to perform the testing, and have demonstrated competence and compliance with the methods being certified.

In addition, certification entails the validation of the analytical method as well as periodic checks with performance evaluation or blind samples (where available) to assess laboratory continued competence with the method.

Soil gas certification for USEPA Methods 8015, 8021, 8260, TO-13A, TO-15 and TO-17 is available from ELAP.

National Environmental Laboratory Accreditation Program (NELAP) accreditation for USEPA Methods TO-13A, TO-15 and TO-17 should be accepted in lieu of California ELAP certification for soil gas testing.

Laboratories that have either certification from ELAP or NELAP for USEPA Methods 8015, 8021 or 8260B for either soil or water matrices should obtain separate certification from ELAP for soil gas work with those methods.

ELAP will provide certification for PBMS as warranted. PBMS may be new techniques using available equipment, an entirely new method with novel techniques and equipment, or modifications of known published methods. PBMS must meet the criteria below:

- The process can be validated;
- It can be demonstrated that the process can meet project data quality objectives; and
- It can be demonstrated that the process can meet the specified method performance criteria.

REFERENCES

Hartman, B. 2006. How to Collect Reliable Soil-Gas Data for Risk-Based Applications-Specifically Vapor Intrusion; Part 4-Updates on Soil-Gas Collection and Analytical Procedures, LUSTLine Bulletin 53, September 2006.

USEPA. 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*: Methods TO-13, TO-15, TO-17, Second Edition, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, January 1999; EPA 600/625/R-96/010b.

USEPA. 2000. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA Publication SW-846, Third Edition,* November 1986, as amended by Updates I (Jul. 1992), II (Sep. 1994), IIA (August 1993), IIB (Jan. 1995), III (Dec. 1996), IIIA (Apr. 1998), IVA (Jan. 1998) and IVB (Nov. 2000).

APPENDIX G BAROMETRIC PRESSURE, RAINFALL, AND SOIL DRAINAGE

BAROMETRIC PRESSURE FLUCTUATIONS

Soil Gas

Massmann and Farrier (1992) evaluated the significance of barometric pressure fluctuations on the transport of atmospheric gas into the vadose zone. They examined situations in which barometric fluctuations will yield a significant effect on the vadose zone. Model calculations showed that fresh air may migrate several meters into a highly permeable subsurface during large barometric pressure cycles and the depth of penetration increases as the thickness and permeability of the vadose zone increases. Massmann and Farrier (1992) thus suggested that the concentration of volatile contaminants may be lower when barometric pressures are high and that soil gas measurements will show the largest fluctuations during times of rapidly rising or falling barometric pressures. During these large barometric pressure changes, as indicated by Figure 8 of their paper, soil gas at 1.5 meters (5 feet) may be diluted with atmospheric air by 30 to 50 percent.

Surface Flux

Clements and Wilkening (1974) demonstrated empirically that atmospheric pressure changes of one to two percent associated with the passage of frontal systems will produce changes in the flux of radon from the subsurface by 20 to 60 percent. The actual magnitude of the change in the radon flux depends upon the rate of change of the barometric pressure and its duration. The effect of pressure changes on VOC concentrations in soil gas is expected to be similar.

RAINFALL EVENTS

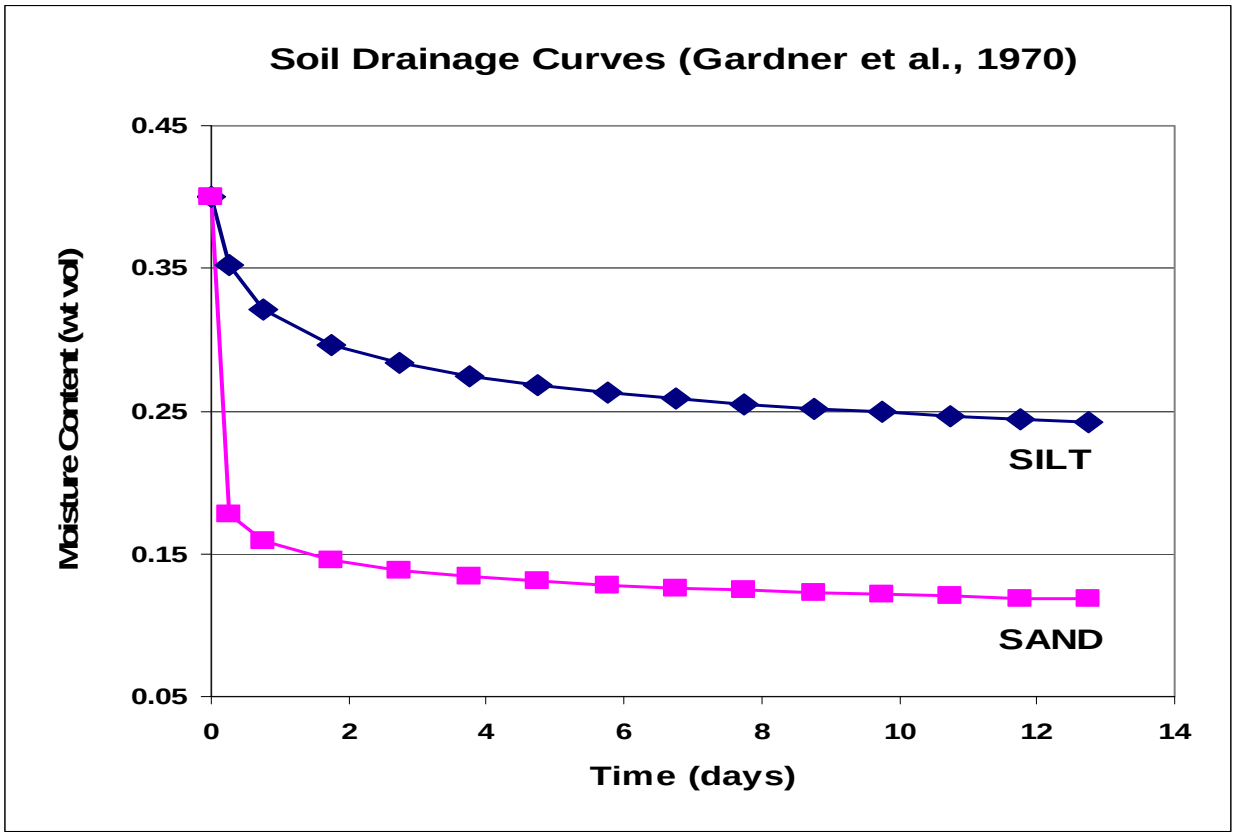
Surface flux

Kienbusch and Ranum (1986) evaluated the effects of rainfall on the collection of flux chamber measurements on open ground. In tests at a simulated landfill, water was added to dry soil cells to simulate rainfall. Trace precipitation (0.01 inches) had no effect on measured emission fluxes from the ground. Heavier rainfall (0.4 inches), however, did have an effect. The emission flux was decreased by 90 to 95 percent and the reduction in emissions lasted for over eight days. These results are consistent with other field observations (Radian Corporation, 1984; Eklund, 1992).

Soil Drainage

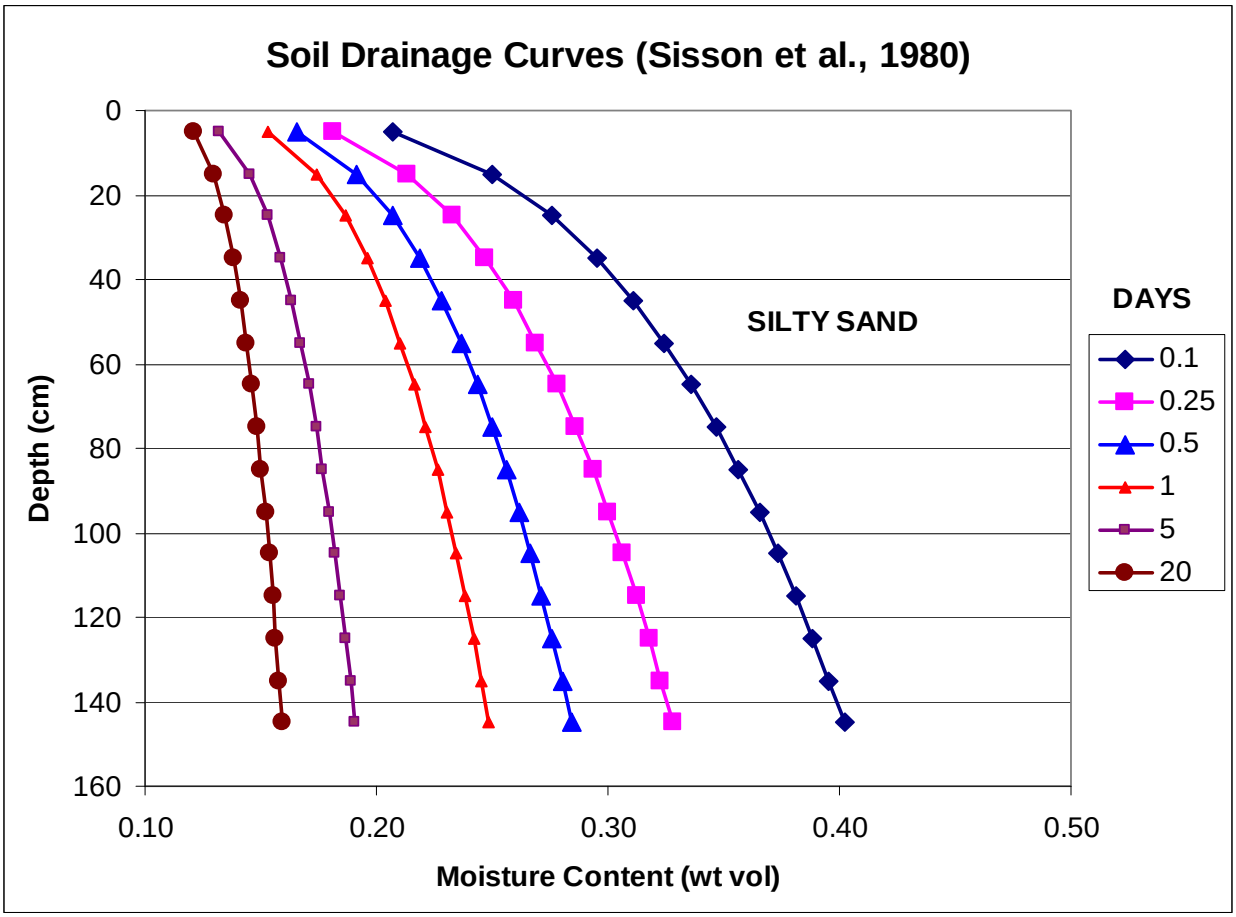
Gardner and others (1970) derived approximate solutions for unsaturated flow following irrigation. Their solutions can be used to evaluate the impact of rainfall on subsurface moisture conditions. The drainage of soil by gravity following infiltration of one centimeter of water for two soil types, sand and silt, is shown in Figure G-1. The initial unsaturated hydraulic conductivity within the infiltration zone for the silt and sand was assumed to be one centimeter per day and 1000 centimeters per day, respectively. An instantaneous infiltration of one centimeter was used in the evaluation. The figure demonstrates that drainage to approximately asymptotic moisture conditions occurred within about five days for these two soil types.

FIGURE G-1



Likewise, Sisson and others (1980) derived a one-dimensional unsaturated flow equation to evaluate water movement in the vadose zone. Soil drainage curves from Sisson and others (1980) where a unit gradient was assumed are shown in Figure G-2. The figure denotes a silty sand scenario where the initial unsaturated hydraulic conductivity was assumed to be 100 centimeters per day. The model assumed that the vadose was saturated to 0.40 and allowed to drain. Moisture profiles are shown for five different time intervals. The figure demonstrates that drainage to near ambient moisture conditions of 0.10 occurred within about five days, agreeing with the approximations by Gardner and others (1970).

FIGURE G-2



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Clements, W. E., and M. Wilkening. 1974. *Atmospheric Pressure Effects on 222Rn Transport Across the Earth-Air Interface*. Journal of Geophysical Research, v. 79, n. 33, p. 5025 - 5029.

Gardner, W. R., D. Hillel, and Y. Benyamini. 1970. *Post-Irrigation of Soil Water, 1. Redistribution.* Water Resources Research, v. 6, n. 3, p. 851 – 861.

Kienbusch, M., and D. Ranum. 1986. *Validation of Flux Chamber Emission Measurements on a Soil Surface.* Draft Report to EPA-EMSL, Las Vegas, Nevada, EPA Contract No. 68-02-3889, Work Assignment 69, June 1986.

Massmann, J., and D. F. Farrier. 1992. *Effects of Atmospheric Pressures on Gas Transport in the Vadose Zone.* Water Resources Research, v. 28, n. 3, p. 777 - 791.

Radian Corporation. 1984. *Soil Gas Sampling Techniques of Chemicals for Exposure Assessment – Data Volume.* Report to EPA-EMSL, Las Vegas, Nevada, EPA Contract No. 68 -02-3513, Work Assignment 32, March 1984.

Sisson, J. B., A. H. Ferguson, and T. Th. van Genuchten.1980. *Simple Method for Predicting Drainage from Field Plots.* Soil Science Society of America Journal, v. 44, p. 1147 – 1152.

APPENDIX H REPORTING FORMAT AND PARAMETERS

RECORDKEEPING IN THE MOBILE LABORATORY

The following records concerning calibration standards and QA/QC should be maintained as hard copies in the mobile laboratory:

a) Date of calibration standard receipt;
b) Name of calibration supplier;
c) Calibration lot number;
d) Date of preparation for intermediate standards (dilution from the stock or concentrated solution from supplier);
e) Calibration ID number or other identification data;
f) Name of technician who performed the dilution;
g) Volume of concentrated solution taken for dilution;
h) Final volume after dilution;
i) Calculated concentration after dilution;
j) The latest and current initial calibration data for each instrument used; and
k) The currently-used laboratory standard operating procedures.

REPORTING OF SOIL GAS SAMPLE RESULTS AND QA/QC DATA

1) Report all sample test results for all compounds in the analyte list and QA/QC data. Compounds may be listed by retention time or in alphabetical order. Report any unidentified or tentatively identified peaks. Submit all data in electronic format and raw data, including the chromatograms for samples and standards, as requested.

2) Report the following for all calibration standards, QA/QC standards, and soil gas samples:

   a) Site name;
   b) Laboratory name;
   c) Date of analysis;
   d) Initials of analyst;
   e) Instrument identification;
   f) Injection amount;
   g) Injection time;
   h) Concentrations of each analysis;
   i) Laboratory quality control limits;
   j) Calculated results; and
   k) Notes or explanation of any outliers

3) Provide additional information, as specified, for different types of analyses. Tabulate and present in a clear legible format all information according to the following grouping:

a) Initial calibration

i) Source of standard (STD Lot ID No.);
ii) Detector;
iii) Retention time (RT);
iv) Standard mass or concentration;
v) Peak area;
vi) Response factor (RF);
vii) Average response factor (RF_{Ave});
viii) Standard deviation (SD_{n-1}) of RF;
ix) Percent relative standard deviation (% RSD); and
x) Acceptable range of %RSD (ACC RGE).

b) Daily calibration check sample and Laboratory Control Sample (LCS)

i) Source of standard;
ii) Detector;
iii) Retention time (RT);
iv) Standard mass or concentration;
v) Peak area;
vi) Response factor (RF);
vii) Percent difference between RF and RF_{Ave} from initial calibration (% DIFF); and
viii) Acceptable range of %DIFF (ACC RGE).

c) Soil Gas Sample

i) Sample identification;
ii) Sampling depth;
iii) Purge volume;
iv) Vacuum pressure;
v) Sampling date and time;
vi) Injection date and time;
vii) Injection amount;
viii) Dilution factor (or concentration factor if trap is used);
ix) Detector;
x) Retention time (RT);
xi) Peak area;
xii) Concentration in either μg/L or $\mu g/m^3$. Specific reporting units should be specified in the QAPP;
xiii) Total number of peaks found by each detector;
xiv) Unidentified peaks and/or other analytical remarks;
xv) Surrogate results; and
xvi) Control limits.

APPENDIX D

ACCIDENT PREVENTION PLAN (INCLUDING SITE-SPECIFIC SAFETY AND HEALTH PLAN) (PROVIDED ELECTRONICALLY ONLY)

ACCIDENT PREVENTION PLAN

BASEWIDE
NAVAL AIR STATION WHITING FIELD (NASWF)
MILTON, FLORIDA

Revision 1

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PREFACE

This Accident Prevention Plan (APP) has been developed in accordance with ER 385-1-92, *Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste Activities.* The APP covers each of the applicable APP elements identified in Appendix A of Engineering Manual 385-1-1 (United States Army Corps of Engineers, 2008). An APP is a safety and health program and policy document.

This APP interfaces with Resolution Consultants overall safety and health program and policies, and is applicable basewide for all planned investigations at Naval Air Station Whiting Field located in Milton, Florida and includes outlying fields/facilities, as listed in Section 2.4. Site Safety and Health Plans (SSHPs) specific to Resolution Consultants activities and any Health and Safety Plan specific to activities to be performed by our subcontractor(s), if applicable, are included as Appendices H and I to this APP, respectively. Such plans cover elements, as outlined in Section 28.A.02 b of Engineering Manual 385-1-1

The purpose of this APP is to establish site-specific safety and health procedures, practices, and equipment to be implemented and used to protect personnel from the potential occupational safety and health hazards associated with the field investigation activities. The APP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise while operations are being conducted.

Project work will be performed in accordance with applicable federal, state, and local government safety and occupational health laws and regulations including Occupational Safety and Health Administration standards 29 Code of Federal Regulations 1910.120 and 1926.65. The content of the APP is subject to review and revision, as new information becomes available.

This APP has been developed based on known and anticipated potential hazards that may arise during performance of project tasks. At least one copy of the APP and applicable SSHP for the specific site, and the Resolution Consultants' United States Operations Safety, Health, and Environmental (SH&E) Manual, will be maintained in a readily accessible on-site location for review at all times during all field activities. The requirements established by this APP are mandatory and apply to all Resolution Consultants employees, subcontractors, and any other personnel entering designated work areas at the project sites during active field operations. Record keeping will be maintained in accordance with this APP and the applicable SH&E Program Standard Operating Procedures. In the event of a conflict between this APP, the SSHP, the Standard Operating Procedures, and/or federal, state, and local regulations, workers shall follow the most stringent/protective requirements.

CHANGES TO THE APPROVED APP

It is understood that this APP is a dynamic document and changes in the scope of work, field changes, or unanticipated site conditions may require APP modification and approval in order to retain field safety compliance with contract requirements, Engineering Manual 385-1-1 (United States Army Corps of Engineers, 2008), and the Occupational Safety and Health Administration regulations. All changes to the APP shall be prepared by the SH&E Manager, and approved by the Program Manager and Task Order Manager. All such modifications will be supplied to Naval Facilities Command for review and approval.

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List of Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CSP	Certified Safety Professional
DOT	Department of Transportation
EM	Engineering Manual
ERP	Emergency Response Plan
ERT	Emergency Response Team
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSI	Hazardous Substance Inventory
MSDS	Material Safety Data Sheet
NASWF	Naval Air Station Whiting Field
NAVFAC	Naval Facilities Command
OSHA	Occupational Safety and Health Administration
PHSP	Programmatic Health and Safety Plan
PPE	Personal Protective Equipment
SH&E	Safety, Health and Environmental
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SSHO	Site Safety and Health Officer
THA	Task Hazard Analysis
TLV	Threshold Limit Value
TOM	Task Order Manager

SIGNATURE SHEET

This Accident Prevention Plan (APP) was prepared for employees performing Basewide field activities at Naval Air Station Whiting Field (NASWF), Milton, Florida. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present at the project sites. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of the project, adherence to the safety and health program requirements of this APP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve this APP for the Basewide field activities at NASWF, Milton, Florida. This APP has been written for exclusive use by Resolution Consultants employees and its subcontractors. This APP was written for specified site conditions, and must be amended if these conditions change.

Plan Preparer:

_____ Date: 8/24/13

1.a. Bill Duffy
Safety, Health, & Environmental Representative - Resolution Consultants

Plan Review:

_____ Date: 8/24/13

1.B. Alexander Eddington
Task Order Manager - Resolution Consultants

Plan Concurrence:

_____ Date: August 26, 2013

1.c. Harold McDaniel, CSP
Safety, Health, & Environmental Representative - Resolution Consultants

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BACKGROUND INFORMATION

2.a. Contractor

Resolution Consultants, a joint venture between AECOM and EnSafe Inc., the prime contractor.

2.b. Contract Number

The project is being conducted under the Comprehensive, Long-term Environmental Action Navy contract number N62470-11-D-8013, Delivery Orders JM28, JM44 and JM57.

2.c. Project Name

This Accident Prevention Plan (APP) applies to projects executed by Resolution Consultants team members under Contract Number N62470-11-D-8013 as established by Naval Facilities Command (NAVFAC) Atlantic at Naval Air Station Whiting Field (NASWF) and outlying field/facilities. For the purposes of this APP, the term "Resolution Consultants employee" or similar phase means an employee of AECOM or EnSafe.

2.d. Project Description

Resolution Consultants will provide personnel, equipment, materials, facilities, and management to respond to multiple requests for environmental support at various sites at NASWF. These services may include actions such as, but not limited to:

- Performing geotechnical, hydrological, and engineering studies, including sampling for groundwater, waste water, soils, air, or other media;
- Conducting preliminary assessments/site investigations;
- Conducting environmental and/or risk assessments (both human health and ecological);
- Performing feasibility studies, as well as remedial or removal designs or actions;
- Development of plans and procedures, such as community relation plans;
- Performing expedited and emergency response actions at sites;
- Performing pilot and treatability studies;
- Providing facility operation, maintenance and instruction;
- Attending and/or presenting at various meetings, both public and team; and
- Various activities related to the Munitions Response Program (MRP), including unexploded ordnance (UXO) detection, clearance, and removal. Performing other related activities associated with returning sites to safe and acceptable levels of contamination.

2.e. Project Location

NASWF is depicted on Figure 2-1.

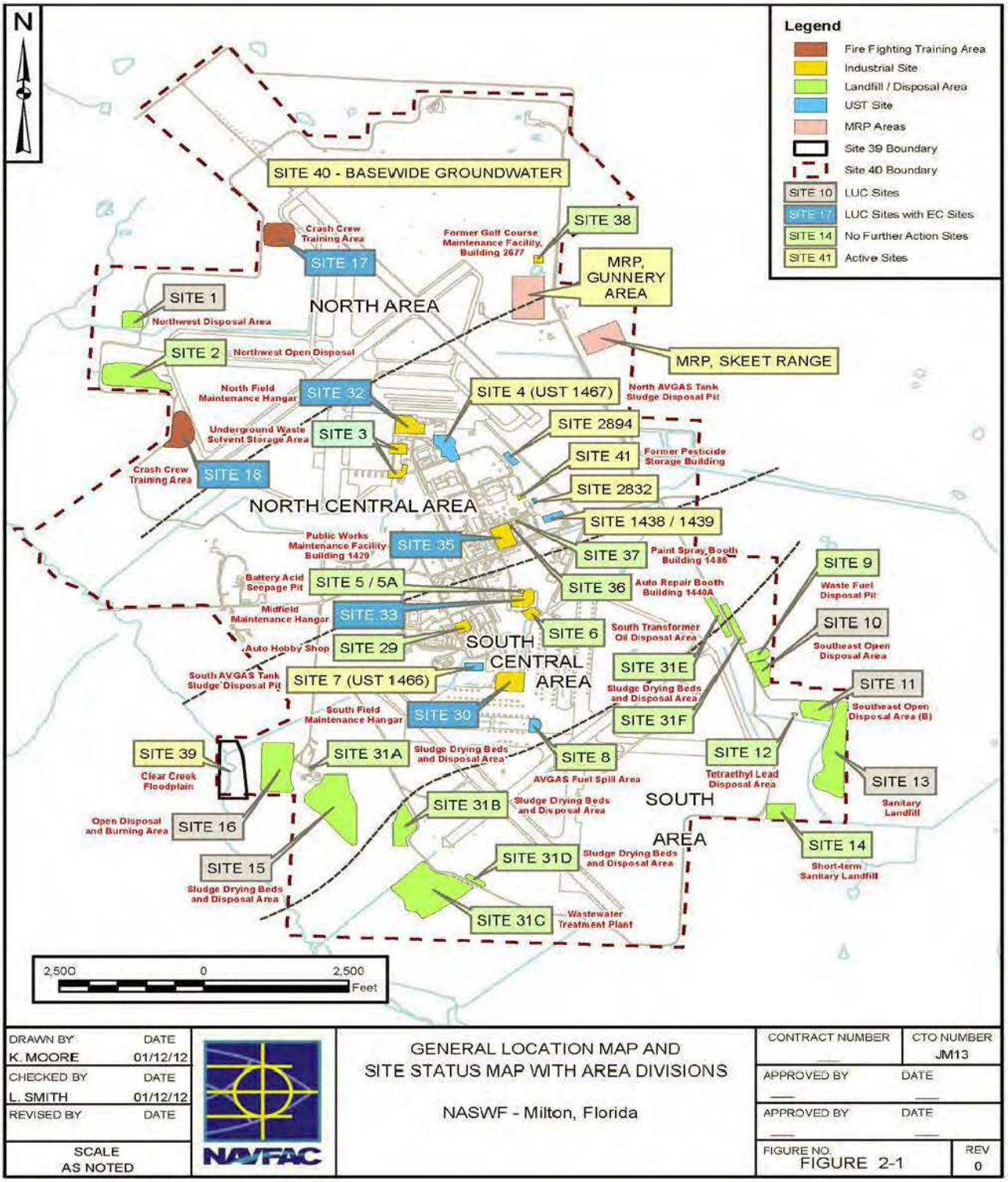
2.f. Contractor Accident Experience

A copy of the Occupational Safety and Health Administration (OSHA) 300 form is included in Appendix A.

2.g. Phases of Work and Hazardous Activities Requiring an Activity Hazard Analysis

Tasks planned as part of field operations that require an Activity Hazard Analysis (AHA) include oversight of visual inspection activities.

AHAs for each of the investigation tasks are included as part of the Site Safety and Health Plan (SSHP) discussed in Section 9.hh. of this APP. AHAs are also referred to and are synonymous with Task Hazard Analyses (THAs).



Source: Tetra Tech, 2012

Figure 2-1 General Location Map

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STATEMENT OF SAFETY AND HEALTH POLICY

Resolution Consultants believes that the safety and health of our employees and the responsible stewardship of the built and natural environment are critical elements to business growth and success. Resolution Consultants demonstrates commitment to this fundamental responsibility by embracing "Safety" as one of our Core Values. Resolution Consultants has developed and implemented a Safety, Health, and Environmental (SH&E) Programmatic Health and Safety Plan (PHSP) for United States operations, which establishes the framework to maintain effective SH&E management, monitoring, measurement, documentation, communication, and methods to promote continuous improvement.

3.a. SH&E Programmatic Health and Safety Plan Overview

The SH&E PHSP is based on proven management principles and practices. It consists of an organized framework that is continually monitored and periodically reviewed in response to changing internal and external factors. The system is designed to record SH&E actions, program performance, assist in communications, awareness, facilitates auditing, and management involvement and review. All Resolution Consultants employees are responsible for maintaining compliance with the PHSP, SH&E Policy, and Safe Operating Procedures. This SH&E Management System is based on the four-step problem solving process of "Plan-Do-Check-Act" methodology, which incorporates five major operational components:

- **Policy** — A clear SH&E Policy is the central focus of the PHSP. Resolution Consultants management and employees are fully committed to maintain compliance with this policy. Resolution Consultants' current corporate safety and health policy statement detailing the commitment to providing a safe and healthful workplace for all employees is included as Appendix B of this APP
- **Planning** — A comprehensive plan of action supports the achievement of the SH&E Policy
- **Implementation and Operation** — Resolution Consultants management provides the resources, including human and financial, for effective SH&E management. The PHSP includes procedures and systematic controls for the application of the resources
- **Checking and Corrective Action** — Performance and the effectiveness of SH&E controls are continuously monitored and evaluated. Corrective actions are taken as necessary
- **Management Review** — The PHSP is reviewed and continually improved with the aim of improving overall SH&E performance

Through implementation of the PHSP, Resolution Consultants has established a uniform, systematic and cost-effective approach to addressing safety, health, and environmental issues and

concerns associated with Resolution Consultants personnel and services. The PHSP has been structured to align itself with the key elements of OSHA regulations.

Redacted copies or excerpts of the PHSP may be made available at the discretion of Resolution Consultants without waiving its right to maintain the confidentiality of such materials.

3.b. SH&E Policy Overview

It is the policy of Resolution Consultants to provide a safe and healthy work environment for all of its employees. Resolution Consultants considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency and shortcuts. Resolution Consultants believes that every accident and every injury is avoidable and every reasonable step will be taken to reduce the possibility of injury, illness, or accident.

Resolution Consultants is fully committed to protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by our activities. We strive to ensure that our operations do not pose unreasonable safety or environmental risks. In all of our activities, we will develop and implement appropriate systems and procedures designed to comply with applicable laws, legislation, licensing requirements, and stakeholder expectations.

In order to guide the implementation efforts required by this policy, the Resolution Consultants Management Committee, Program Management Team, and Regional Leaders collaborate to establish SH&E programs that:

- Incorporate a "ZERO injury" and "environmental sustainability" philosophy into design standards and project review processes
- Recognize those who contribute to their improved SH&E performance
- Comply with all applicable SH&E rules and regulations at the local, state, and national level
- Meet client SH&E requirements and standards
- Where no specific regulation exists, comply with Resolution Consultants standards and appropriate industry practices
- Report on performance relative to short- and long-term SH&E metrics designed to help achieve established goals
- Consult with, listen to, and respond to employees, customers and partners in order to continuously improve their SH&E performance.

All employees will be responsible for:

- Conducting themselves in accordance with directives, standards and procedures established by their applicable SH&E program
- Temporarily suspending their personal work activities and requesting guidance from their supervisor before continuing a task when they identify a condition or practice that creates a serious safety, health, or environmental risk
- Immediately reporting safety, health, and/or environmental incidents to their supervisor

Resolution Consultants SH&E policy is formally reviewed annually. However, if substantial changes occur in legislation, organization and/or other business drivers, changes may be made on an interim basis.

3.c. Safety Program Goals

Consistent with the Resolution Consultants corporate SH&E policy, the safety program goals under this contract are ZERO injuries and accidents.

3.d. SH&E Standard Operating Procedures

Resolution Consultants SH&E Standard Operating Procedures (SOPs) establish minimum safety requirements and guidelines for Resolution Consultants United States operations and business lines. Resolution Consultants has developed individual SOPs that serve as the basis for the safe execution of specific tasks associated with field operations. These range from stop work and management authority, to the safe execution of confined space entries. Numerous SOPs are referenced throughout this APP and are included as part of Appendix C. A copy of the SOPs will be kept on site at all times.

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RESPONSIBILITIES AND LINES OF AUTHORITY

4.a. Statement of Responsibility

Resolution Consultants has the ultimate responsibility for the successful implementation and management of the Resolution Consultant's activities at NASWF in correlation to this APP.

4.b. Personnel Responsible for Safety

All personnel are responsible for continuous adherence to the safety and health procedures presented in this APP and attached SSHP during the performance of work. No person may work in a manner that conflicts with the intent of, or the inherent safety and environmental precautions expressed in these procedures. After due warnings, the company will dismiss from the site any person who violates safety procedures.

The Resolution Consultants organization chart for the management of safety at both the corporate and project level for this project is presented as Figure 4-1. The positions/responsibilities presented in the organization chart are discussed below.

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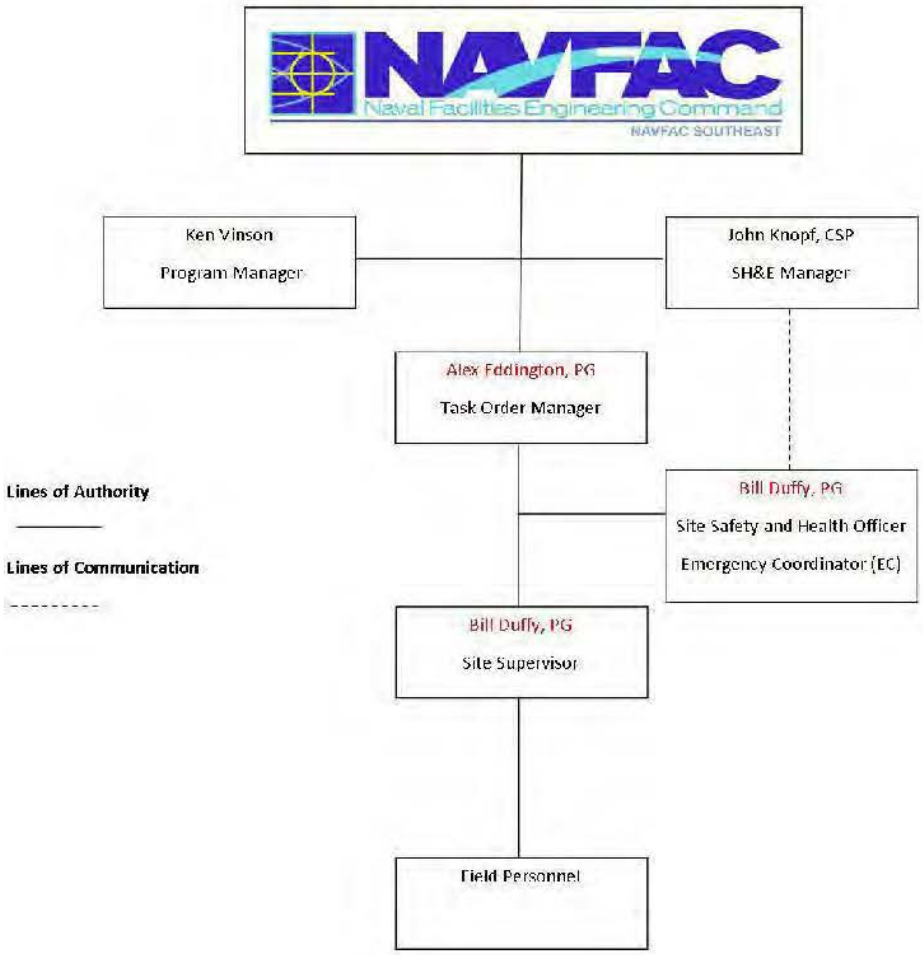

Figure 4-1 Safety Organization Chart

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Program Manager (Mr. Ken Vinson)

The Resolution Consultants Program Manager is responsible for supporting the establishment and oversight of the overall health and safety program presented in the APP.

SH&E Manager (Mr. John Knopf, CSP)

The Resolution Consultants SH&E Manager is a Certified Safety Professional (CSP) with 19 years of experience in managing safety and occupational health at hazardous waste site cleanup operations.

The SH&E Manager is responsible for developing, maintaining, and overseeing the implementation of the APP and SSHP. The SH&E Manager will approve the APP and SSHP prior to final submittal. Specific responsibilities of the SH&E Manager includes the following:

- Approve the appointment of the Site Safety and Health Officer (SSHO) and ensure that he/she has the appropriate training and competencies to perform the duties.
- Participate in quality control planning such as development of Quality Control Plans, safety and health checklists, and perform design and system safety analyses as appropriate.
- Visits the project as needed to audit the effectiveness of the safety and health program.
- Provide safety and health expectations and flow down requirements for subcontractor statements of work.
- Be available on a 24-hour basis for consultation with SSHO during on-site emergencies or as needed.
- Coordinate any modifications to the safety plans with the SSHO and Task Order Manager (TOM), as required.
- Evaluate occupational exposure monitoring/air sampling data and adjust APP/SSHP requirements as necessary.
- Provide continued support for upgrading and/or downgrading the level of personal protective equipment (PPE).
- Participate in the investigation of unplanned events, high loss potential incidents, and accidents.
- Assist in development of on-site training, which will be provided by the SSHO.

Task Order Manager (Alex Eddington, P.G.)

The Resolution Consultants TOM represents the company in all aspects of the project work and is responsible for the following:

- Providing leadership by, among other things, setting an example for all site personnel through actions and words regarding the importance of proper health and safety practices and holding project staff accountable for safety performance.
- Coordinating all work performed by Resolution Consultants personnel and subcontractors for the project.
- Ensuring the APP/SSHP is approved prior to commencing field operations.
- Ensuring all required PPE, other types of equipment and instruments, safety incentives, and other safety-related items are budgeted and provided.
- Ensuring that subcontractor "Statements of Work" include appropriate safety provisions and expectations.
- Ensuring that safety and health requirements are covered during kickoff meetings.
- Participating in the investigation of, and ensuring that unplanned events, high loss potential incidents, and accidents are properly reported to NAVFAC.
- Notifying the SH&E Manager of any changes in the scope of work or site conditions, and ensuring that the APP/SSHP is updated to address new hazards.
- Immediately stopping operations in the event of an emergency or serious hazard, in order to protect personnel and the environment.
- Preparing and submitting required work progress reports.

Site Safety and Health Officer (Bill Duffy, P.G.)

The Resolution Consultants SSHO has more than 16 years of industrial hygiene and environmental, health, and safety related experience and will be on site at all times when work is being conducted. The SSHO will be responsible for managing, implementing, and enforcing Resolution Consultants' health and safety program in accordance with the accepted APP. The SSHO will be a competent person that can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures to eliminate them. The SSHO will have the authority and is responsible for the following actions:

- Be present during investigation operations to implement the APP/SSHP.
- Inspect site activities to identify safety and occupational health deficiencies and correct them.

- Coordinate changes/modifications to the APP/SSHP with the SH&E Manager, TOM, and Site Supervisor.
- Conduct project specific OSHA training.
- Ensure all field personnel, including any subcontractor personnel, assigned to the project have satisfied requirements for training and medical surveillance as specified by 29 Code of Federal Regulation (CFR) 1910.120, and that records of training and medical approval are available and maintained for each person.
- Oversee compliance with the APP/SSHP procedures and OSHA regulations through daily inspections.
- Serve as a member of the quality control staff on matters relating to safety and health.
- Stop work if unacceptable safety and health conditions exist, and take necessary action to re-establish and maintain safe working conditions.
- Operate and maintain air monitoring equipment required at a site for airborne contaminates and prepare air monitoring reports.
- Maintain all required safety and health records (e.g., OSHA 300 Logs, incident/accident reports, training certificates and qualifications, equipment checklists, safety plans, air monitoring data and reports, etc.) throughout the life of the project.

Site Supervisor

The Site Supervisor will manage the on-site investigation operations in accordance with the approved Work Plan and APP/SSHP. The Site Supervisor will coordinate all on-site personnel and equipment conducting investigation operations in a safe manner. The Site Supervisor will coordinate all work with the SSHO to ensure that all safety concerns are adequately addressed and controlled. The Site Supervisor will immediately stop work in the event of an emergency or serious hazard in order to protect personnel and the environment. The Site Supervisor will work with the SH&E Manager, TOM, and SSHO in coordinating changes/modifications to the APP/SSHP, as needed.

Field Personnel

Field Personnel will be responsible for understanding and following the APP/SSHP and performing their work in a safe and responsible manner. Specific responsibilities will include the following:

- Act in a responsible manner at all times in order to prevent incidents, injury, and/or exposure to themselves and their co-workers, this includes exercising Stop Work Authority if needed.

- Report any and all incidents, including near misses, to the Site Supervisor or SSHO.
- Attend and participate in all daily health and safety tailgate meetings.
- Participate in the development of AHAs as required, and follow the provisions as outlined in the final AHAs.
- Follow instructions and directions of the Site Supervisor and SSHO.
- Utilize the prescribed PPE provided for each task.
- Following all field safety procedures for safe work practices (e.g., the buddy system, communication, site control, decontamination, evacuations, and related emergency procedures).
- Perform only those tasks they have been instructed to perform if they are trained, qualified, and capable of performing safely at the time of assignment.
- Report any personal condition that could affect their safety and/or the safety of co-workers (e.g., fatigue, drowsiness, severe illness, impairment by prescription medications, influence by drugs and alcohol, emotional stress, or other condition).
- Ensure that no work tasks are performed in deviation from the APP/SSHP and/or the initial instructions of the Site Supervisor and SSHO.

Site Visitors

Site visitors will:

- Participate in a site briefing before leaving the administrative office or site entry point.
- Follow all site rules and instructions.
- Be escorted at all times by authorized personnel unless otherwise approved by the SSHO.
- Wear PPE provided.

Conformance of everyone with these responsibilities is necessary to achieve the goals of the APP/SSHP. Failure to do so could result in removal from the site.

4.c. Names of Competent and Qualified Personnel

Competent persons are qualified individuals that can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and have authorization to take prompt corrective measures to eliminate them (see Appendix E).

Title	Inspection Role	Name	Proof of Competency
Site Supervisor	Safe Work Inspection	Bill Duffy	Experience, Training
Subcontractor- Lead Driller	Drill Rig Inspection	TBD	Experience
Subcontractor Utility Locator	Locate equipment for Fuel Pipeline and other utility avoidance	TBD	Training
Subcontractor - Excavation	Small Equipment Digging/Excavation to expose fuel pipeline (cut, plugged, and abandoned in-place)	TBD	Experience

4.d. Competent Person Work Requirements

In order to complete certain specified tasks (drill rig operation, excavation inspections, etc.), a designated competent person must be on site to perform the required daily inspections of certain equipment and/or operations. No work may be performed on these tasks unless a competent person is present on the job site. The training requirements for competent persons are specified in the SH&E SOP SH&E SOP 5-202-*Competent Person Designation.*

4.e. Pre-Task Safety and Health Analysis Requirements

AHAs are used to identify hazards and hazard controls associated with a specific job function. AHAs focus on the relationship between the workers, the task, the resources required to complete the task, and the work environment. These variables must be evaluated to identify the potential hazards associated with the task. Once identified, steps can be taken to eliminate, reduce, or control the hazards to an acceptable risk level. Guidelines for developing AHAs are located in SH&E SOP 5-209-*Hazard Assessment and Project Planning*.

4.f. Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions as outlined in SH&E SOP SH&E SOP 5-002-*Stop Work Authority for Unsafe Work*. Whenever the SSHO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the Site Supervisor be unable or unwilling to correct the unsafe conditions, the SSHO is authorized and required to stop work, which shall be immediately binding on all affected Resolution Consultants employees and subcontractors. Upon issuing the stop work order, the SSHO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the SH&E Manager and TOM have concurred that workplace conditions meet acceptable safety standards.

Reviewing and updating the appropriate AHA and other documentation may be necessary to document the change.

All stop work actions must be documented in the field notes and immediate contact made with the Resolution Consultants TOM.

4.g. Lines of Authority

Figure 4-1 illustrates the lines of authority for the personnel responsible for project safety.

4.h. Noncompliance Policies and Procedures

Employee non-compliance with safety requirements is taken very seriously by Resolution Consultants management. Personnel not following procedures are warned and counseled on the proper safety procedures and if the problem persists, are again counseled with notations made in their permanent record. Continued non-compliance can lead to termination of employment.

Resolution Consultants has developed the following progressive discipline policy for the violation of safety requirements. Extremely careless or reckless violations may results in immediate termination. All instances of progressive disciplinary action will be handled in conjunction with the sponsoring joint–venture employer (EnSafe or AECOM) Human Resource Department.

First Violation: An oral warning will be given for the first violation of a SH&E requirement depending on the severity of the violation. The employee will be informed by his or her supervisor of the violation and of the correct safe practice or procedure. The supervisor will review with the employee all applicable safety and health workplace requirements and guidelines. The employee must sign a statement indicating understanding of those requirements and guidelines. The supervisor should inform the employee that future violations will result in higher levels of discipline and may lead to dismissal.

Second Violation: The employee may be given a written warning for the second documented safety and health requirement violation. This warning will specifically identify the violation. The warning will also refer the employee to applicable safety and health requirements and guidelines for review, and also show the date the employee previously read and signed the statement of understanding of safety and health requirements and guidelines. The employee, the employee's supervisor, the department head, Human Resources, and the employee's personnel file receive copies of the warning.

Third Violation: The employee may be given a final warning for the third documented violation of safety and health requirements or guidelines. This warning will specifically identify the violation. It will also state that any further violation of safety and health requirements and guidelines will result in dismissal. All persons who receive a copy of the previously written warning will receive a copy of the final warning.

Any Subsequent Violation: The employee may be dismissed for a subsequent violation. If dismissed, the employee will receive a letter specifically identifying the violation of the safety and health requirement or guideline, as well as rights of appeal through the grievance process.

Immediate Termination: On occasion, an employee can commit a violation of a safety and health requirement or guideline that is so careless and reckless, or that so endangers life or property, that it can be considered imminently dangerous. When this occurs, an employee can be dismissed immediately, without benefit of any warnings. An employee dismissed in this fashion will receive a letter specifically identifying the violation and setting out his/her right of appeal within the grievance process.

Discipline for Subcontractor Personnel: If noncompliance actions are committed by subcontractor personnel, Resolution Consultants will recommend that the employer discipline the employee. If the action continues, Resolution Consultants will have the employer remove the employee from the site. If the employer refuses to adhere to our requirements, they may be dismissed from the project.

Documentation: Employee warnings and disciplinary actions will be documented using Resolution Consultants' Corporate Memorandum format in a manner consistent with the requirements of this policy and the sponsoring joint–venture employer (EnSafe or AECOM) Human Resource Department.

4.i. Manager and Supervisor Accountability

Managers and supervisors are responsible for enforcing safety and health as part of their job descriptions. They are ultimately responsible for protecting the welfare of the employees, as well as minimizing the potential liability associated with on-the-job accidents. Annual performance reviews and incentive plans for managers and supervisors include the assessment of both the individual's safety performance as well as their project safety performance.

SUBCONTRACTORS AND SUPPLIERS

5.a. Subcontractor and Supplier Identification

The following types of subcontractors and suppliers will be utilized for field activities at Site 4, Site 40, and the Flare Disposal Area:

- Direct Push Technology (DPT) Drilling
- Rotosonic Drilling and Monitoring Well Installation
- Monitoring Well Development and Sampling
- Utility Locator
- Digital Geophysical Survey
- Small Equipment Digging/Excavation to expose fuel pipeline (cut, plugged, and abandoned in-place)
- Surveying
- IDW Management

5.b. Subcontractor and Supplier Safety Responsibilities

Subcontractors

Each Resolution Consultants subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required PPE and adherence to all applicable SH&E performance or regulatory standards.

Resolution Consultants' SSHO will be responsible for ensuring subcontractor compliance with the APP/SSHP. Specific responsibilities of subcontractor employees include:

- Compliance with the requirements of their Scope of Work.
- Participate in development of a SSHP with AHAs for their work activities.
- Maintain a safe and healthy work environment.
- Compliance with the APP, contract requirements, laws, regulations, and Engineering Manual (EM) 385-1-1.
- Review the APP to ensure that the health and safety requirements of their specific tasks are satisfied.
- Provide trained and experienced workers for the specific work activities.

- Participate in the Daily Safety Tailgate Meetings.
- Identify additional training needs for unique tasks.
- Enforce company- and project-specific rules and procedures during work activities.
- Report all incidents and participate in the investigations.
- Participate in routine site inspection activities.
- Ensure all equipment brought to the site is in proper working order, is routinely inspected and maintained in safe working order.

5.c. Suppliers

All suppliers of safety-related items are required to provide approved and/or appropriate materials for the project, and meet applicable specifications, testing criteria or third party certifications. These items will be inspected upon receipt by the SSHO.

Each hazardous material supplied for site use will be accompanied by a Material Safety Data Sheet (MSDS) and will be added to the site list of hazardous materials. These materials must be pre-approved for use by the TOM and SSHO prior to being brought onto the jobsite. MSDSs and the list will be maintained by the SSHO.

TRAINING

6.a. New Hire Safety Orientation Training

Employees will be provided with safety and health orientation prior to the start of work. All orientation training will be documented in writing by data, name, content, and trainer. The training will, at a minimum, include:

- Requirements and responsibilities for accident prevention and the maintenance of safe and healthful work environments.
- General safety and health policies and procedures and pertinent provisions of EM 385-1-1.
- Employee and supervisor responsibilities for reporting all accidents.
- Provisions for medical facilities and emergency response and procedures for obtaining medical treatment or emergency assistance.
- Procedures for reporting and correcting unsafe conditions or practices.
- Job hazards and the means to control/eliminate those hazards, including applicable AHAs.

6.b. Mandatory Training and Certifications

Personnel who participate in field activities associated with this project must be qualified Hazardous Waste Operations and Emergency Response (HAZWOPER) workers (unless otherwise noted in specific AHA or by the SSHO), and must meet the training and medical monitoring requirements. Personnel must have successfully completed training, meeting the provisions established in 29 CFR 1910.120 for 40-hour training and 8-hour annual refresher training. Additionally, on-site management and supervisors directly responsible for or who supervise employees engaged in hazardous waste operations, shall receive at least 8 additional hours of specialized hazardous waste operations management training. Appendix F is reserved for project personnel HAZWOPER training and medical monitoring documentation.

Medical Monitoring

Resolution Consultants personnel performing on-site work that may result in exposure to contaminant-related health and safety hazards are enrolled in the medical surveillance program that complies with OSHA standard 29 CFR 1910.120 (f)/29 CFR 1926.62 (f).

They will have successfully completed a pre-placement occupational physical examination and annually thereafter. The medical surveillance program meets the following requirements:

- The physician's opinion concerning the employees' abilities to perform the assigned work shall be provided to the SH&E Manager or designated company HR representative.

- The required written physician's opinion shall be made available upon request.
- All medical records are maintained in accordance with 29 CFR 1910.1020.
- Examinations are given at least once every 12 months unless the attending physician believes a longer interval (not greater than biennially) is appropriate.
- Examinations are administered by a licensed physician who is certified by the American Board of Preventive Medicine.

Medical examinations must meet the requirements specified by the licensed physician. The physician takes into account site-specific contaminant issues during the examinations. This examination has been designed to meet the requirements of 29 CFR 1910.120 (f) requirements for hazardous waste site operations. The employee will be informed of any medical conditions that would result in work restriction or that would prevent them from working at hazardous waste sites.

Resolution Consultants will certify that all employees have successfully completed a physical examination by a qualified occupational health physician and will supply certification of medical clearance for each on-site employee. Certification of medical surveillance program participation is available upon request and would be provided as Appendix F. The certifications include employee name, date of last examination, and name of examining physician.

6.c. Procedures for Periodic Safety and Health Training

The SSHO will maintain training/certification records on site for all personnel as well as track training expiration dates. Prior to expiration, the SSHO will coordinate training of all site personnel with the TOM to maintain valid training/certification requirements.

6.d. Emergency Response Training

Resolution Consultants will provide training in the handling of emergency situations that may arise from project activities or equipment operation. Prior to commencement of project activities, all site personnel will be trained on the posted emergency telephone numbers, location and use of spill kit materials, directions to the hospital, location and use of fire extinguishers, location of first aid kits, and the persons who are certified in first aid and CPR. Additional details on applicable emergency response training and procedures are provided in Section 9.b, Emergency Response Plans.

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SAFETY AND HEALTH INSPECTIONS

7.a. Daily Job Site Safety and Health Inspection

The SSHO will conduct daily jobsite health and safety inspections/audits to identify new or previously unidentified hazards, verify the effectiveness of hazard control measures, observe workers performing tasks, and provide feedback to workers. Deficiencies that pose a significant safety hazard will be corrected immediately, or work will be stopped in the affected area until the deficiency is corrected. The daily jobsite health and safety inspection will be documented in the SSHO logbook.

Safety and health issues and deficiencies identified during the "weekly" level inspections, and the actions, timetable, and responsibility for correcting the deficiencies, will be recorded on an inspection form. Follow-up inspections to ensure correction of any identified deficiencies will also be conducted and documented on an inspection form.

Resolution Consultants will establish a safety and occupational health deficiency tracking log that lists and monitors the status of safety and health deficiencies. The log will be available, be updated daily, and will provide the following information:

- Data of deficiency
- Description of deficiency
- Name of person responsible for correcting deficiency
- Projected resolution date
- Date actually resolved

Table 7-1 lists the safety and health inspection requirements for field operations at NASWF.

Table 7-1
Safety and Health Inspection Requirements

What	Who	When	Documentation
General Site Conditions	SSHO	Daily	Log Book
	SSHO	Weekly	Safety Inspection Form
	Task Order Manager	Monthly	Safety Inspection Form
	SH&E Manager	Quarterly	Safety Inspection Form
Tools and Equipment	Users	Daily	Tag and Remove Defective Items from Service
Personal Protective Equipment	Users	Upon issue and daily thereafter	Reported to SSHO for log book entry

7.b. External Inspections and Certifications

External inspections are not expected for this project. In the event that an OSHA or other regulatory agency inspection, Resolution Consultants will immediately notify and provide NAVFAC the opportunity to accompany Resolution Consultants on the inspection. Resolution Consultants will provide NAVFAC a copy of any citations or reports issued by the inspector and any corrective action responses to the citation(s) or report(s).

ACCIDENT REPORTING

All accidents and incidents that occur on site during any field activity will be promptly reported to the SSHO and the immediate supervisor in accordance with SH&E SOP SH&E SOP 5-004-*Incident Reporting*. If any Resolution Consultants employee is injured and requires medical treatment, the Site Supervisor will contact the Resolution Consultants **SH&E Manager and the TOM immediately**. The Site Supervisor will initiate a written report, using the ***Supervisor's Report of Incident*** form (or equivalent). The report will then be provided to the Regional SH&E Manager before the end of the following shift.

If any employee of a subcontractor is injured, documentation of the incident will be accomplished in accordance with the subcontractor's procedures; however, copies of all documentation (which at a minimum must include the OSHA Form 301 or equivalent) must be provided to the SSHO within 24 hours after the accident has occurred.

All accidents/incidents will be investigated in accordance with SH&E SOP SH&E SOP 5-603-*Incident Investigation and Review*. Copies of all subcontractor accident investigations, whether accomplished in accordance with their own procedures or SH&E SOP SH&E SOP 5-004-*Incident Reporting*, will be provided to the SSHO within five (5) days of the accident/incident.

All personnel at the work site shall use the buddy system, staying within sight of their partner. If a partner becomes incapacitated or severely ill, an ambulance shall be called. In the event that a cessation of work is ordered, all personnel should:

- Assist the SSHO and/or Site Supervisor, if required, in decontaminating the victim and/or administering first aid.
- Leave the contaminated area and undergo decontamination prior to entering the worker rest area.
- Assist emergency response personnel when requested.

All workers receiving medical treatment by a physician will obtain a release from the physician on the date of treatment stating one of the following: (1) the employee is not fit for duty, (2) the employee is fit for restricted duty, or (3) the employee is fit for duty.

8.a. Exposure Data

Resolution Consultants will maintain records of all exposure and accident experience incidental to the project work including Resolution Consultants personnel and subcontractors. These records will

include exposure work hours and a log of occupational injuries and illnesses (OSHA Form 300 or equivalent).

8.b. Accident Investigations, Reports, and Logs

NAVFAC requires that all injuries be reported as soon as reasonably possible, but no later than 24 hours. Notification of accidents, injuries, and illnesses will be evaluated and reported in accordance with applicable NAVFAC requirements. The SH&E Manager will report the incident to NAVFAC by completing a Contractor Significant Incident Report (CSIR). The SH&E Manager will review all documentation associated with the incident, and will assist in the performance of any necessary accident investigation or other follow-up. The TOM will ensure that the recommendations resulting from any investigation are implemented without delay.

Daily records of all first aid treatments not otherwise reportable will be recorded on a first aid treatment form and furnished to NAVFAC upon request.

8.c. Immediate Accident Notification

An accident that has, or appears to have, any of the consequences listed below will be immediately reported by Resolution Consultants to NAVFAC. The following accidents will be investigated in depth to identify all causes and to recommend hazard control measures:

- A fatal injury/illness
- A permanent totally disabling injury/illness
- A permanent partial disabling injury/illness
- The hospitalization of three or more people as inpatients resulting from a single occurrence
- Accidental property damage of $200,000 or more

Resolution Consultants will also notify OSHA when three or more employees are hospitalized or if a fatality occurs relating to work activities.

PLANS (PROGRAMS, PROCEDURES) REQUIRED BY THE SAFETY MANUAL

Based on the scope of site investigation activities, all applicable safety plans, programs, and procedures to address risk and compliance requirements were identified and are described below.

9.a. Layout Plans

Site specific layout plans are presented in the SSHP, as applicable.

9.b. Emergency Response Plans

The Resolution Consultants site team will hold an emergency response plan meeting during mobilization and prior to fieldwork to discuss and define the following:

- Personnel roles and line of authority
- Safe distances from emergency location
- Evacuation/Hospital route, procedures, and pre-determined meeting place
- Medical emergency and communication procedures
- Emergency alert and response procedures
- Emergency equipment and location on site

The Emergency Response Plan (ERP) will be discussed during initial site training and discussed regularly during the Daily Tailgate Safety Meetings. Annually, or as needed, the SSHO and the TOM will review the ERP and make any changes necessary to keep the ERP current with new or changing site conditions and information. The SSHO will conduct drills monthly or more frequently if conditions change to evaluate the response and testing the effectiveness of the ERP. Conditions that may lead to an emergency situation during field activities will be addressed in specific AHAs as tasks are identified. These conditions include:

- Fire
- Vehicle collisions or rollovers
- Environmental release
- Severe weather
- Medical emergency due to heat/cold stress, physical/physiological incident, allergic reactions

9.b.(1) Procedures and Tests

In accordance with the above, a test drill will be conducted on an as need basis to evaluate the effectiveness of the ERP and to ensure all employees on site are adequately accounted for. The drills will consist of mock simulations of differing events requiring emergency response and will be applicable to the type of work being conducted on the site.

Drills will consist of responding to a medical emergency, striking utility lines, environmental releases (i.e., spills), fires, and other typical on-site emergencies as determined applicable to the SSHO. Using the protocols outlined in the subsections below, personnel will be required to perform emergency shutdown operations of equipment/tasks, follow proper evacuation and emergency procedures, and assemble at the pre-determined safe places of refuge where the SSHO will take head-counts of on-site personnel using the Site Control log for the project site. Based on the parameters established for the drill (e.g., medical emergency versus spill response), the list of contact numbers for the appropriate local and company specific emergency notifications will be reviewed with all site personnel as a part of the drill.

A post-drill analysis will be performed by the SSHO to analyze the response actions of site personnel and determine their effectiveness (evacuation times, routes, muster points, accountability, contacts, etc.). If any deficiencies are noted, adjustments to the ERP will be made by the SSHO and site personnel re-trained on the appropriate course of action for the type of emergency.

The SSHO will be responsible for the overall direction and implementation of the ERP, and for overall coordination of any emergency response actions. Specific ERP responsibilities of the SSHO include, but are not limited to, the following:

- Notifying facility police, fire department, and other off-site emergency units, as required.
- Notifying the TOM and providing updates as conditions change.
- Directing off-site emergency response personnel to the scene and providing assistance.
- Site control.
- Completing any follow-up reports.
- Rescuing personnel.
- Accounting for all site personnel and visitors.
- Providing emergency first aid.
- Preventing further injury of personnel.
- Providing current status of the incident to the SH&E Manager.
- Ensuring that on-site emergency response personnel don the proper PPE if needed.
- Assisting on-site emergency response personnel with treatment and transport of sick/injured.

- Providing medical background information of the sick/injured and applicable site health and safety information to the off-site emergency medical responders.
- Accompanying sick/injured personnel to hospital.
- Accounting for all site personnel using the Site Control Log (Sign-in Log).

Resolution Consultants personnel, subcontractors, and visitors will be responsible for:

- Reporting any site emergencies to the SSHO or Site Supervisor.
- Knowing the exit location and evacuation route(s) within the exclusion zone.
- Knowing the pre-planned evacuation assembly point and going there in the event of an emergency.
- Assisting emergency response personnel as requested.

Emergency Recognition and Prevention

An emergency is an unplanned event that threatens the safety of site personnel. Compliance with this APP can assist in the prevention of anticipated site emergencies. These emergency situations can easily be recognized by visual observations, worker complaints, safety audits, and/or monitoring instruments.

Safe Distances and Places of Refuge

The SSHO will determine safe distances and places of refuge. Prior to the start of each workday, the SSHO will hold a safety meeting with all personnel and discuss the following, as applicable:

- Evacuation routes from work areas.
- The assembly point (both primary and secondary) to be used in the event of an emergency.
- Locations of the nearest fire extinguishers and spill containment equipment.
- Discussion on specific safety and health concerns of personnel.

Evacuation Procedures

The SSHO will establish site evacuation routes. Evacuation notification will be three long blasts on an air horn, vehicle horn, or direct verbal communication. If evacuation is necessary, all personnel are to:

- Gather equipment to the extent safely possible.
- Evacuate to the vehicle(s) location, and prepare to move out.

Emergency Procedures

Upon discovering an emergency, the following series of events will occur:

- Notify personnel.
- Establish communication.
- Stop work activities, if necessary.
- Lower background noises (shut down equipment).
- Begin emergency procedures (order is dependent on the situation).
- Survey casualties.
- Assess "Airway, Breathing, Circulation" of each patient.
- Request aid, if necessary.
- Assess existing and potential hazards to site personnel and off-site populations.
- Allocate resources.
- If a certified Emergency Medical Technician is in attendance, help extricate and stabilize victims.
- Evacuate all non-essential personnel.

Alerting and Communications

An employee alarm system will consist of the use of air horns or verbal instructions, either directly or via radio. Air horn signals, (and hand signals if necessary) will be established and employees will be trained in the signals and appropriate response. Telephones will be used to contact off-site emergency responders. Contact lists included in the SSHP will be posted in the site offices, and a copy will be kept in site vehicles. The following information will be communicated:

- Name of the person reporting the emergency.
- Telephone number at the location of the person making the call.
- Name of the injured person, if known.
- Description of the emergency.
- Exact location of the emergency.
- Actions already taken.
- Assistance required.

Coordination with Local Emergency Agencies

Local or base authorities and emergency services will be contacted prior to initiation of work. The work objectives and on-site capabilities will be explained, as well as the most likely emergencies.

Preferred contact procedures will be established and the response capabilities of local or base responders will be determined. Resolution Consultants will ensure there is good coordination between our emergency plan and base requirements. Contact agencies, points of contact, and phone numbers will be provided in the SSHP.

Emergency Response Team

During emergency response operations, safety and health requirements put in place to protect site workers must be maintained. The SSHO will be alerted of the accident or incident that happened, which requires the Emergency Response Team (ERT) response and/or recovery operations.

Response to hazardous substances release will be limited to immediate action available due to equipment and training, (i.e., oil or fuel spills of small quantities). Responding facility emergency response personnel have authority for the site upon arrival. Project ERT personnel will assist local facility emergency response personnel, as needed.

The project ERT will notify base emergency response personnel, project personnel, and NAVFAC in the event of a hazardous substance release. Team response is limited to the confining or recovery of small spills using a spill containment kit, shovel, and approved container with lid. Training of personnel is in accordance with 29 CFR 1910.120(q)(6)(ii).

A first aid kit must be maintained on site and checked weekly (EM 385-1-1 section 03.B.02). A log of items used will be maintained.

Project personnel will rely on base emergency response personnel through the use of the 911 emergency notification system and/or base emergency notification system.

If an injury or illness requires more than first aid, but is not an emergency, the employee will be taken to a pre-determined clinic for examination or observation. If the injury or illness is considered an emergency, emergency services will be contacted to transport the victim to the local hospital or emergency care facility.

9.b.(2) Spill Plans

Potential hazardous spills control measures:

- Provide for secondary containment where required by regulation or contract, and where a spill could result in significant hazard or economic loss.

- Provide other appropriate engineering controls to prevent environmental releases to the ground, water, or air. These will be identified in AHAs or environmental permits (or equivalent).
- Provide equipment and personnel to perform emergency measures to mitigate spills and control their spread.
- Dispose of contaminated materials.
- Provide a decontamination program to clean previously uncontaminated areas.

Spill Contingency Plan

In the event of a spill or release, Resolution Consultants will:

- Take immediate measures to control and contain the release, including contacting local emergency service providers, if necessary.
- Isolate and contain hazardous release areas.
- Deny entry to the spill area to unauthorized personnel.
- Stay upwind, keep out of low areas.
- Keep combustible materials away from the spilled material.
- Collect samples for analysis to determine that cleanup is adequate.
- If liquid, prevent the discharge from traveling beyond site boundaries.
- Prevent spilled materials from reaching storm water receptacle, ditches, creeks and drainage canals.
- Take caution when handling drums and containers.
- Notify base and NAVFAC.

Notification of Spills and Discharges

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the sequence identified for the site.

Resolution Consultants will notify base and NAVFAC immediately of any spill or discharge. Resolution Consultants will make all regulatory notifications for Resolution Consultants generate spills.

In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, the applicable regulatory permit, and/or client-specific reporting procedures. **If reporting to a state or federal regulatory agency is required, Resolution Consultants has 15 minutes from the time of the spill/release to officially report it.**

9.b.(3) Fire Fighting Plan

In any fire situation, it is important to act quickly and decisively in order to contain the spread of the fire. Regardless of the size and nature of the fire, and Resolution Consultants' ability to respond, all fires will be reported immediately to the local fire department. The SSHO will:

- Sound the fire alarm (local or auxiliary).
- Determine the extent of the fire.
- Notify Fire Department — 911 (Fire Department is to be notified of any fires larger in size than a wastebasket). Provide the following information:
  - Name of Facility.
  - Address, including nearest cross street(s).
  - Exact location of the fire within the site.
  - Provide name and phone number.
- Coordinate and manage fire suppression efforts until the additional personnel arrive.
- Coordinate the evacuation of injured or non-essential personnel from the site upwind following the evacuation procedure.
- Check attendance.
- Provide emergency first aid as required.
- If the SSHO has determined that it is safe to do so, site personnel may use available on-site fire extinguishers on incipient stage fires only.
- Remove or isolate flammable or other hazardous materials, which may contribute to the fire.
- Clear access routes for emergency vehicles.

Fire Department officials will determine when it is safe for re-entry.

Documentation and Review

After the response, Resolution Consultants will prepare an Incident Report. It will include such things as a chronological history of the emergency, facts, action, personnel present, sample results (if collected), summary of injuries, and possible exposures. For spills and releases, it will also include:

- Description of material spilled, including identity, quantity, and a copy of the waste disposal manifest.
- Exact time and location of the spill and the description of the area involved.
- Containment procedures utilized.
- Description of the cleanup procedure employed at the site, including disposal of spill residue.
- Summary of the communications Resolution Consultants had with other agencies.

This report will be given to NAVFAC within two (2) days of the incident along with immediate verbal notification. The report will also contain a critique of the response and modifications to this APP will be made if necessary to adequately address subsequent emergencies.

9.b.(4) Posting of Emergency Telephone Numbers

Emergency phone numbers, call signs, and detailed instruction for obtaining emergency response and medical assistance will be posted in the SSHP Section H.14.4, Table H-8. This includes a detailed hospital route map and approximate times and distances. All personnel will be trained on the emergency alert systems in place at the work site.

Safety and Health Information

The Resolution Consultants SSHO will have the appropriate safety and health information available in an area commonly accessed by workers. The information will be maintained current, readily available to affected workers, and protected against the elements and unauthorized removal.

Required postings and general safety awareness reminder posters will be used to communicate information to site participants. The required postings will include copies of the current:

- APP
- AHAs
- OSHA Form 300 (if injury has occurred)
- Safety and Health promotional posters

- Date of last lost workday injury (if injury has occurred)
- OSHA Safety and Health Poster
- A highly visible map showing the route to the nearest emergency room
- Emergency contact numbers

Each office/project site where Resolution Consultants has established a presence will have the appropriate labor posters. Ensure local and state posting are included. At a minimum, ensure OSHA's Occupational Safety Health and Act Poster (OSHA 3165) is available on site and communicated to all affected employees. It is anticipated that all postings will be maintained in the site vehicle in the absence of a dedicated site office.

9.b.(5) Man Overboard/Abandon Ship

This section is not applicable to the current scope of work.

9.b.(6) Medical Support

On-site medical support during project execution will be available from two or more individuals who are trained in First Aid and CPR and blood borne pathogens. A list of individuals and dates of First Aid and CPR training and copies of the certifications can be provided upon request as part of Appendix G. On-site first aid kits will meet the requirements of EM 385-1-1. First aid kits are Type III, 16 unit kits, including one pocket mouthpiece or CPR barrier. Kits will be checked prior to use, and at least weekly when work is in progress to ensure that contents are replaced as used. If a unit is available, the personnel will be trained in the use of the Automated External Defibrillator.

Emergency medical support contact information is contained in the SSHP. Employees can contact emergency personnel by dialing 911 or the appropriate base emergency services contact number. The dispatcher will contact, fire, and/or helicopter evacuation services. The emergency reference sheet attached to the SSHP provides the numbers of the nearest medical center and Resolution Consultants safety personnel. Emergency phone numbers can be found in the SSHP Table H-8 for all jobsites.

9.c. Plan for Prevention of Alcohol and Drug Abuse

Resolution Consultants is committed to providing a safe and healthy workplace for all employees. Consistent with this commitment and in keeping with the federal Drug-Free Workplace Act of 1988, it is the policy of Resolution Consultants to maintain a drug-free workplace.

Key Provisions

Resolution Consultants policy prohibits employees from being under the influence of alcohol or drugs or improperly using medication in any way that could diminish, or raise questions concerning, an employee's ability to perform at his or her best while performing services for or on behalf of Resolution Consultants. While on duty, employees will not use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances.

This policy also prohibits the sale, possession, manufacturing, and/or distribution of illegal drugs, and/or other controlled substances in the workplace or while on company business off premises. Compliance with this policy is considered a condition of employment.

Violations of this policy will be considered to be gross and willful misconduct and will result in disciplinary action, up to and including termination. Any illegal substances discovered in the workplace will be turned over to the appropriate law enforcement agency and may result in criminal prosecution.

Employee Responsibilities

When a worker is impaired by the use of drugs or alcohol, he or she threatens the safety and well-being of everyone at a worksite. As a Resolution Consultants employee, you must do the following to protect workplace safety:

- Understand Resolution Consultants' drug-free workplace policy.
- Follow it and set a good example for others by working drug and alcohol free.
- Seek help if you or your co-worker(s) need it.
- Notify management if you observe use of or impairment from drugs or alcohol that could threaten the health and safety of co-workers.

Confidential help is available, at no cost to employees. If you and/or a co-worker are struggling with drug or alcohol problems, turn to services such as:

- Those provided through the Resolution Consultants sponsoring employer HR department.
- The ***Substance Abuse Treatment Locator:*** (800) 662-HELP or www.findtreatment.samhsa.gov.

If an employee observes drug-free workplace policy violations or obvious, on-the-job impairment you believe poses an immediate danger to any worker on the job:

- DO NOT DELAY or ignore the situation.
- ACT to prevent the worker from committing the unsafe practice, if at all possible.
- NOTIFY your supervisor (and/or SSHO) *immediately.*

Supervisors Responsibilities

When a worker is impaired by the use of drugs or alcohol, he or she threatens the safety and well-being of everyone at a worksite. While it is the responsibility of every employee to work drug free, supervisors can be the first line of defense by taking appropriate action when a worker may be impaired.

Supervisors must familiarize themselves with Resolution Consultants' drug-free workplace policy and be able to explain it to others. In addition, you must ensure that your workers understand their responsibility to:

- Know the Resolution Consultants drug-free workplace policy.
- Follow it and set a good example for others.
- Seek help if they or their co-workers need it.
- Notify you/management if they observe drug or alcohol use or impairment that threatens safety.

Supervisors can play a powerful role in improving workplace safety by intervening and encouraging workers with alcohol or drug problems to seek help. Both on and off the job, symptoms of alcohol or drug use may be **physical** (chills, smell of alcohol, sweating, weight loss, physical deterioration); **emotional** (increased aggression, anxiety, burnout, denial, depression, paranoia); and/or **behavioral** (excessive talking, impaired coordination, irritability, lack of energy, limited attention span, poor motivation).

While different types of drugs produce different physical symptoms or behaviors, there are numerous ways that misuse affects work behavior — and ultimately job performance and safety. It could be a sign of a drug or alcohol problem if a worker is:

- Arriving late, leaving early, and/or often absent.
- Unreliable and often away from assigned job.
- Careless and repeatedly making mistakes.
- Argumentative and uncooperative.

- Unwilling or unable to follow directions.
- Avoiding responsibilities.
- Making excuses that are unbelievable or placing blame elsewhere.
- Taking unnecessary risks by ignoring safety and health procedures.
- Frequently involved in mishaps and accidents or responsible for damage to equipment or property.

Supervisors are not expected to perform the role of police officer or counselor. Since part of the supervisors job is to assess employees' job performance to ensure that all necessary tasks are completed in accordance with specifications and deadlines, supervisors primary role in enforcing the policy is to be observant. When an employee begins to show a consistent pattern of problem behavior, supervisors should take action. Focusing on job performance, even when the problem may be caused by drugs or alcohol, allows the supervisor to balance both the rights of the individual employee to privacy and fair treatment and the rights of the work group to a safe, secure and productive environment.

Do not wait until someone gets hurt to address a worker's drug or alcohol misuse. If you suspect a worker has a problem, follow company guidelines, which include these steps:

- Start documenting evidence of declining job performance.
- List specific incidents (include date and time) and be concrete about what job functions/responsibilities were affected.
- Share this documentation with the appropriate company official who is qualified to advise you on how to handle the situation (human resources manager).
- Meet with the employee and tell him/her that you are concerned about his/her job performance. Describe specific incidents and problems using your documentation as a guide.
- Ask the employee if he/she has any explanation for the problem. Offer the opportunity to make the connection between alcohol/drug use and performance, but do not accuse the employee unless you have "reasonable suspicion" and are going to require a drug test.
- Define what must be done to correct the performance problem and specify the consequences for the employee if the problem is not corrected.
- Refer the employee for professional assistance if he/she has admitted that drug or alcohol use is the root cause of the performance problem. Even if the employee has not admitted

he/she has a problem, reconfirm your concern and suggest he/she seek assistance since personal problems-including, but not limited to, alcohol and drug use — are often the root causes of these types of job performance issues.

- Set a timeframe for improvement and be willing and able to follow through on your promises about consequences.

When a worker has a problem with alcohol or drugs, Resolution Consultants employee assistance programs provided through Resolution Consultants sponsoring employer healthcare benefits are generally the best places to turn for help since they are confidential. Some additional free and confidential resources include:

- **Substance Abuse Treatment Locator**
  1-800-662-HELP
  www.findtreatment.samhsa.gov

- **Alcoholics Anonymous (AA)**
  (212) 870-3400
  www.aa.org

- **Narcotics Anonymous**
  (818) 773-9999
  www.na.org

- **Al-Anon**
  1-888-4AL-ANON
  www.al-anon.alateen.org

- **National Council on Alcoholism and Drug Dependence Hopeline**
  1-800-NCA-CALL
  www.ncadd.org

Testing for Drugs and Alcohol

Employees who are under the influence of alcohol or any controlled substance have the potential for interfering with their own and their coworkers' safe and efficient job performance. Drug and/or alcohol screening may be required:

- Of any applicant to whom a job offer has been made.
- Of any employee where there is reason to believe that he or she may be using illegal or non-prescribed drugs or may be under the influence of drugs and alcohol. "Reason to

believe" includes an injury or accident at work where there is reason to believe that employee impairment may have been a factor. "Reason to believe" may be based on objective symptoms such as the employee's appearance, behavior or speech.

- As part of occasional follow-up testing if the employee is found to have breached these policies but has been permitted to remain employed.
- As required by client contract, project, or if an employee is employed in a safety-sensitive position. Under these limited circumstances, employees may also be subjected to pre-employment and random drug screening.

An employee's cooperation with such drug or alcohol screening tests is required as a condition of employment. The employee's refusal to cooperate with such a request and to provide a specimen may result in termination where there is reason to believe that the employee has violated this policy and the employee's refusal to cooperate has prevented a medical determination of his or her condition. Any violation of this policy may result in immediate termination.

Employees found to be under the influence of or consuming such substances will be immediately removed from the job site. Contractors shall enforce the drug-free workplace requirements.

Any employee under a physician's treatment and taking prescribed narcotics or any medication that may prevent one being ready, willing, and able to safely perform position duties, shall provide a medical clearance statement to his/her supervisor.

9.d. Site Sanitation Plan

Smoking, Eating, and Drinking

Eating and drinking will be permitted only in designated areas at Resolution Consultants project sites. Smoking will be permitted only in areas designated by SSHO and situated in locations that are not in the immediate vicinity of activities associated with work site activities. Additionally, the SSHO will designate each smoking area giving primary consideration to those personnel who do not smoke.

Personnel actively involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER Controlled work areas).

Water Supply

Water supplies will be available for use on site and will comply with the following requirements.

Potable Water

Drinking Water: An adequate supply of cool water will be supplied and will be kept in water coolers in the support zone on site. The water cooler will be kept closed and appropriately sealed to protect the drinking water integrity. Personnel will be instructed to wash their face and hands prior to drinking.

Potable water can be provided in the form of approved well or city water, bottled, or drinking fountains. Where drinking fountains are not available, individual use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.

Non-Potable Water

Non-potable water maintained at the project site and all outlets dispensing non-potable water should have posted the following: "CAUTION – WATER UNSAFE FOR DRINKING, WASHING, OR COOKING." Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers/supplies of non-potable water used will be properly identified/labeled as such.

Toilet Facilities

Chemical toilet(s) will be available for site personnel and visitors. A minimum of one toilet will be provided for every 20 site personnel, with separate toilets maintained for each sex, except where there are less than five total personnel on site. The toilet will be equipped with toilet paper, toilet paper holder, locking door, and adequate ventilation.

For mobile crews where work activities and locations permit transportation to nearby toilet facilities (e.g., gas station, or rest stop), on-site facilities are not required.

Washing Facilities

Site personnel will wash hands and face after completing work activities and prior to breaks, lunch, or completion of workday.

Personal Cleaning Supplies

Cleaning supplies at project sites will consist of soap, water, and disposable paper towels or items of equal use/application (e.g., anti-bacterial gels, wipes, etc.).

Clothing and PPE

All PPE will be kept clean at all times and maintained in accordance with the manufacturer's requirements.

Sanitation

General Work Areas

At all times, work areas will be kept free of dirt and debris that may impact the safety of site personnel and visitors. All trash receptacles will be regularly emptied.

Break Areas and Lunchrooms

Site personnel will observe the following requirements when using break areas and lunchrooms at project sites:

- All food and drink items will be properly stored when not in use.
- Food items will not be stored in personal lockers for extended periods in order to prevent the potential for vermin infestation.
- Perishable foods will be refrigerated whenever possible.
- All waste food containers will be discarded in trash receptacles.
- All tables, chairs, counters, sinks, and similar surfaces will be kept clean and free of dirt, waste food, and food containers at all times.
- Refrigerators used to store food items will be maintained at 45 degrees Fahrenheit and emptied of all unclaimed food items weekly.
- Routine cleaning of refrigerators will also be performed on a regular basis.

Housekeeping

- All work areas shall be kept clean to the extent that the nature of the work allows.
- Every work area shall be maintained, so far as practicable, in a dry condition; where wet processes are used, drainage shall be maintained and platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footgear shall be provided.

- Protruding objects or placement of materials on paths or foot traffic areas present a problem with regard to slips, trips, falls, and puncture wounds. Personnel will use a reasonable amount of effort to keep slip, trip, and fall hazards to a minimum.
- Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal.
- At no time will debris or trash be intermingled with waste PPE or contaminated materials.

9.e. Access and Haul Road Plan

This section is not applicable for the anticipated scope of work for sites listed in this APP.

9.f. Respiratory Protection Program

This section has limited applicability for the anticipated scope of work for sites listed in this APP. All work will be performed in Level D or Modified Level D PPE work attire. Resolution consultants and subcontractors are responsible for their own individual safety and will performed independent air monitoring, as applicable. Resolution Consultants will monitor for VOCs in the work and support areas. If a subcontractor indicates potential presence of organic vapors or if odors are encountered, Resolution Consultants will evaluate the worker's breathing zone for VOCs, oxygen, hydrogen sulfide, and carbon monoxide. The air monitoring equipment and action levels are detailed in the AHAs applicable to the project site and will be included in Attachment 3 of the SSHP as Appendix H. If air monitoring data indicate the need for upgrade to Level C PPE, the SSHO will consult with CTOM and safety personnel to establish alternative administrative controls. Only the SSHO will don Level C PPE in response to encountered odors, for general air monitoring and/or verification of successful implementation of administrative and/or engineering controls, if required.

9.g. Health Hazard Control Program

All operations, materials, and equipment associated with this project will be evaluated/assessed to determine the presence of hazardous environments or if hazardous or toxic agents could be released into the work environment. Additional hazard assessment will be conducted if a change in conditions occurs.

The AHA procedures will be used to identify all substances, agents, and environments that present a hazard and recommend hazard control measures. Engineering and administrative controls will be used to control hazard and in cases where engineering or administrative controls are not feasible, PPE use will be mandated. These controls are detailed in the AHAs applicable to the project site and have been included in Attachment 3 of the SSHP.

The analyses will identify the workplace and activity evaluated; the name of the person certifying that the evaluation has been performed; and the date of the evaluation.

Operations, materials, and equipment involving potential exposure to hazardous or toxic agents or environments shall be evaluated by an Resolution Consultants Certified Industrial Hygienist (CIH), Certified Safety Professional (CSP), or other competent person. Exposure, through inhalation, ingestion, skin absorption, or physical contact, to any chemical, biological, or physical agent in excess of the acceptable limits specified in the most recently published American Conference of Governmental Industrial Hygienists (ACGIH) guideline, "*Threshold Limit Values and Biological Exposure Indices,*" or by OSHA, whichever is more stringent, shall be prohibited.

Identification of Principal Hazards

The following are the principal hazards that can be anticipated while conducting field investigations:

- Chemical hazards
- Biological hazards
- Physical hazards

Hazard/Risk Management

Resolution Consultants has adopted and implemented the composite risk management process, which includes the following steps:

- Identification of the hazard
- Assessment of the hazard
- Development of controls and risk decision
- Implementation of controls
- Supervision and evaluation during task performance

Hazard Identification

A concise statement is prepared identifying the conditions that reflect actual or potential conditions that can cause injury, illness, or death of personnel, damage to the environment, damage or loss of equipment, or degradation of the production goals.

Exposure Control

The following methods will be utilized for the control of exposure to hazardous or toxic agents and environments:

- Substitution, if the substitute process or product is determined to provide the same outcome and to be less of a hazard.
- Engineering controls (such as local/general ventilation), to limit exposure to hazardous or toxic agents and environments within acceptable limits.
- Work practice controls, when engineering controls are not feasible or are not sufficient to limit exposure to hazardous or toxic agents and environments within acceptable limits.
- Appropriate PPE (i.e., respirators, gloves, etc.) and associated programs shall be instituted when engineering, work practice controls or material substitution are not feasible or are not sufficient to limit exposure to hazardous or toxic agents.

Personal Protective Equipment

The purpose of PPE and clothing is to protect individuals from chemical and physical hazards. Specific work tasks with unique hazards and/or PPE requirements will be evaluated or reevaluated prior to beginning work. This task review will be led by the SSHO, and will include knowledgeable individuals such as the worker(s) and the supervisor. PPE requirements, based on this assessment are found in the SSHP and in the AHA for the specific task. All workers must be trained in the requirements of the APP, SSHP, and the applicable AHAs prior to beginning work.

Requirements for task and activity-specific levels of protective clothing are presented on the AHAs. Personnel performing site tasks shall use the appropriate level and type of PPE specified in this APP for each individual task. This APP makes provisions for use of the following levels of PPE, in accordance with the hazards and contamination level anticipated for each task or operation.

Level D Protection

Level D protection is the minimum protection required for project personnel and visitors at the site. Level D protection may be sufficient when no contaminants are present or work operations preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of chemicals.

The following equipment will be used for Level D protection:

- Coveralls or other suitable fieldwork clothing.
- Persons exposed to vehicular or equipment traffic, including signalpersons, spotters, or inspectors, shall wear high visibility apparel meeting American National Standards Institute/Safety Equipment Association (ANSI/SEA) 107 Class 3 requirements.
- Work boots with either steel or composite safety toe, meeting the ANSI Z41 standard.
- Safety glasses or goggles as needed.
- Hardhat if overhead hazard or heavy equipment is encountered or operated.
- Leather work gloves.
- Hearing protection, earplugs, and/or earmuffs as needed.
- Raingear and Rubber Boots (if required).

Should personnel encounter an unusual odor, discolored soil, or an unknown item, they will immediately notify their supervisor and will evacuate the site upwind of the suspected item. The SSHO will notify the TOM of the actions taken.

Modified Level D protection will incorporate all of the above with the addition of chemical protective gloves (nitrile), tyvek coveralls, and rubber over booties for biological hazard avoidance if necessary.

Level C Protection

Level C protection is the next higher level of PPE that encompasses Level D and incorporates additional safety equipment. Level C will be upgraded to if the need for respiratory protection is found by the SSHO. The main components of Level C are as follows:

- Full-face or half-face, air purifying respirators (NIOSH approved).
- Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.

Level B Protection

Level B protection is the next higher level of PPE that encompasses Level C and incorporates additional safety equipment. Level B will be upgraded to if the need for respiratory protection is found by the SSHO. The main components of Level B are as follows:

- Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
- Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots, outer, chemical-resistant steel toe and shank.

Level A Protection

Level A protection is the next higher level of PPE that encompasses Level B and incorporates additional safety equipment. Level A will be upgraded to when directed by the SSHO. The main components of Level A are as follows:

- Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).
- Totally-encapsulating chemical-protective suit.
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots, chemical-resistant, steel toe and shank.

Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

Proper PPE Selection

The selection of the PPE will be done after a thorough evaluation of the hazards involved at the site during each phase of the operation. All persons entering the site area will put on the required PPE according to established procedures in this APP.

Hazard and risk assessment is a continuing process to be conducted by the SSHO, throughout the duration of the project. Changes in specific PPE or levels of PPE may be required in accordance with information obtained from implementation of site activities and data derived from the other sources. As a general rule, levels of PPE will need to be reassessed if any of the following occur:

- Appearance of previously unidentified or anticipated chemicals, conditions, or task hazards.
- Airborne concentrations of known chemicals exceed action levels.

- Ambient weather changes impacting the use of assigned PPE.
- A new task is introduced or a previously assigned and evaluated task is expanded in scope.

Specific levels of protection will be modified when on-site conditions warrant, and based upon the revisions presented in the SSHP for a specific location. The decision to change levels of protection will be made by the SSHO with concurrence from the TOM and the SH&E Manager. Levels of protection will not be downgraded without prior approval from the SH&E Manager.

Head Protection

Resolution Consultants employees and visitors will wear hard hats that meet the requirements of ANSI Z89.1 (as indicated by the manufacturer's label) if there is a potential of exposure to flying/falling objects or overhead hazards. Hard hats can be removed in break areas or where their use presents potential safety hazards. Ear protection and face shields may be attached to hard hats. The following criteria will be followed:

- No modification to the shell or suspension is allowed except when such changes are approved by the manufacturer.
- Hard hats shall be worn with the bill facing forward unless the SSHO has determined exceptions for certain trades in order to accommodate appropriate mission accomplishments.
- No ball caps, knit caps, or other headdress shall be worn under the hard hat that could interfere with the fit or stability of the hard hat.
- Protective headgear and components shall be visually inspected on a daily basis for signs of damage (dents, cracks, etc.) that might reduce the degree of safety integrity originally provided.
- Headgear will be periodically inspected for ultraviolet degradation as evidenced by cracking or flaking of the helmet.
- Drilling holes or in any way changing the integrity of the hard hat is prohibited. Alterations that will reduce the dielectric or impact strength will not be made.
- Chin straps will be worn when wearers are subject to high wind conditions and/or working on elevated structures.

Eye Protection

Eye and face protection equipment shall meet the requirements of ANSI Z87.1, and bear a legible and permanent "Z87" logo to indicate compliance with the standard providing side protection.

When required to wear eye protection, persons whose vision requires the use of corrective lenses in eyeglasses shall be protected by one of the following:

- Prescription safety glasses providing optical correction and equivalent protection.
- Protective glasses with side shields designed to fit over corrective lenses without disturbing the adjustment of the glasses.
- Goggles that can be worn over corrective lenses without disturbing the adjustment of the glasses or goggles that incorporate corrective lenses mounted behind the protective lenses.

The SSHO will ensure that suitable eye protection is available and provided to all on-site personnel.

The use of eye protection by all personnel will meet the requirements of the following minimum requirements:

- Provide adequate protection against the particular hazards for which they are designed.
- Be reasonably comfortable when worn under the designated conditions.
- Fit snugly and not unduly interfere with the wearer's movements.
- Be durable.
- Be easily cleaned and sanitized.

Contact lenses do not provide adequate eye protection. Contact lens wearers must use the same additional eye protection as non-lens wearers. Persons whose vision requires correction and who are required to wear eye protection may wear goggles or spectacles of one of the following types:

- Spectacles whose protective lenses provide optical correction (prescription).
- Goggles that can be worn over corrective (prescription) spectacles without disturbing the adjustment of the spectacles.
- Goggles that incorporate corrective (prescription) lenses mounted behind the protective lenses.

Hearing Protection

Hearing protection will be worn, as appropriate, whenever sound-pressure levels exceed 85-decibel A-weighted (dBA) sound level steady-state expressed as a time-weighted average or 140 dBA impulse, or as desired by individual workers when working around noise-producing equipment. Hearing protection worn by personnel will comply with the requirements of 29 CFR Part 1910.95(j), and will provide a minimum noise reduction rating of at least 21.

Hearing protection will be worn at all times when normal conversation becomes difficult at distances of 3 feet or less, such as during the operation of heavy equipment. The use of hearing protection and its necessity will be detailed in the applicable AHAs for the individual tasks.

Foot Protection

All workers entering designated fieldwork areas will wear sturdy leather or leather/synthetic combination work boots with safety toes that provides adequate ankle support and provide adequate protection for the task being performed. Sandals and other open-top footwear are not acceptable in designated fieldwork areas.

Hand Protection

Employees will use appropriate hand protection when exposed to hazards that could cause injury to the hands. Gloves must resist puncturing and tearing, as well as provide any necessary chemical resistance. Generally, leather or Kevlar gloves will be worn during material and equipment handling activities and Nitrile gloves will be used for chemical protection as indicated in the AHA developed for the specific task and during biological hazard avoidance.

Traffic Safety Vests

When working on or near public roads and when working around moving vehicles at designated field work areas, all personnel will wear traffic safety vests, shirts, or similar colored garment so as to provide high visibility to drivers/operators (e.g., Class I, II or III as required).

PPE Use

All site personnel will be given initial PPE-specific training. This training will be given by the SSHO prior to personnel participating in site operations where PPE is required. All personnel receiving PPE training will be required to demonstrate an understanding of the training topics and the ability to correctly use the PPE. This will be accomplished through the SSHO supervising and visually inspecting each individual's ability to properly don and use the PPE during its initial use. Upon completion of the training and after each employee has successfully demonstrated the requisite understanding, the SSHO will complete any applicable training completion form.

PPE Program Effectiveness

The jobsite shall be evaluated to determine if the incorporated PPE levels are adequate based upon the site conditions and contaminants detected. If additional work tasks, are added to the Statement of Work, after approval of this APP, the TOM and SSHO shall identify and assess the task hazards,

and relay that information to the SH&E Manager. The SSHO, in conjunction with the SH&E Manager, will prepare an amendment to the APP/SSHP and submit the amendment for approval to NAVFAC. The amendment will be added to the APP/SSHP upon approval.

The SSHO will ensure PPE use complies with all applicable OSHA, NAVFAC, and Resolution Consultants requirements.

PPE Inspection and Care

Maintenance of PPE can vary greatly, based upon the complexity of the PPE and the intricacy of the repair involved. The SSHO will become familiar with the manufacturer's recommended maintenance, and when possible, repair defective PPE. If unable or unauthorized to conduct the repair, the SSHO will return the item to the manufacturer for repair, or to procure a replacement.

The SSHO will be responsible for ensuring that PPE is in good, clean, working order prior to the initial issuing of the PPE. Once issued, site personnel will ensure that re-usable articles of PPE are maintained in a clean, sanitary fashion. During the work task, co-workers should periodically inspect each other for the proper use of PPE. For items used inside an exclusion zone, site personnel will follow the requirements of the Site-Specific Decontamination Plan, and ensure that the PPE is properly decontaminated in the Contaminate Reduction Zone before removing the item from the exclusion zone.

9.h. Hazard Communication Program

Resolution Consultants will implement a hazard communication program on field projects managed by the SSHO responsible for maintaining a list of hazardous materials used on the site, as well as MSDS's for each hazardous material. Details of the program are contained in SH&E SOP SH&E SOP 5-507-*Hazardous Materials Communication WHMIS* which includes the development of a site-specific Hazard Communication Plan, complete with inventory log, which will be developed for the project site.

The program establishes procedures for Resolution Consultants employees and subcontractors who handle and store chemical products at project sites. It ensures that hazards of all chemicals purchased are evaluated and the information concerning their hazards is transmitted to employees. The delivery of information is to be accomplished by employee training, container labeling, and other forms of warning and MSDSs. All MSDSs are requested from the suppliers at the time of order. If not available, then a recent MSDS will be downloaded off the internet.

The requirements defined in this program apply to all Resolution Consultants facilities, projects, employees, and subcontractors, which receive, use, handle, store, transport, or distribute hazardous substances.

All hazardous substances found in a particular workplace shall be listed on a Hazardous Substance Inventory (HSI). The HSI will be reviewed at least annually. New hazardous substances entering a workplace (e.g., project-specific materials) shall be added to the HSI upon receiving and reviewing the MSDS. The HSI includes the following information:

- Product name
- Chemical name (if different from product name)
- Manufacturer's name
- Approximate typical quantity
- Location of substance (i.e., work area)
- Description of use

A copy of the most current HSI, along with the corresponding MSDS and a copy of this program (or site-specific program), will be available on site for review by all employees. The name of the material (product or chemical) on the HSI must be consistent with the MSDS for that material. A site map will be attached to the inventory showing where inventoried substances are stored. The inventory and site map will be updated as frequently as necessary to ensure accuracy.

Material Safety Data Sheets

Resolution Consultants does not manufacture, package, or distribute hazardous commodities. However, as an end user, Resolution Consultants must maintain hazard documentation for each hazardous substance used on each job site. This documentation will take the form of a listing of all on-site hazardous substances, and copies of manufacturer developed MSDSs for each listed item.

A MSDS shall be available for every hazardous substance used or stored on each job site. Copies of all MSDS's will be maintained on site as an Appendix to the site-specific SSHP. All site personnel will be briefed as to the location of the MSDS's, and will have immediate access to examine any MSDS at any time during their work shift.

MSDSs received for consumer products, articles and other materials not covered by this procedure will be maintained and made available to employees.

For ongoing projects, each MSDS associated with a material no longer in use will be marked as obsolete and the date it was obsolete. At the completion of any project, the accumulated MSDSs will be maintained as part of the project records. NO MSDS ASSOCIATED WITH ANY PROJECT WILL BE DESTROYED.

Employees are required to report any hazardous substance found at the project site that is not on the list of hazardous substances. The report is to be made to the TOM and Site Supervisor. If no MSDS accompanies a hazardous substance, the manufacturer, distributor, or importer will be immediately notified and requested to provide one as soon as possible. The request will be documented in a letter or telephone log. If this request is not honored, the SH&E Department will be notified.

When purchasing hazardous substances, the verbal or written purchase order will request an MSDS be sent with the shipment. For each facility and/or project, the MSDS will be kept along with the HSI in a location that is readily accessible to all employees at all times during their work periods. Additionally, the MSDSs and HSI will be available to employees for review in such a way so that the assistance of a supervisor is not necessary.

Labels

All hazardous substances received from outside suppliers will conform to legal requirements and display on each container, as a minimum, the following:

- Identification of the hazardous substance(s).
- Appropriate hazard warnings such as a Hazardous Materials Identification System and/or National Fire Protection Association-type label.
- Name and address of the manufacturer, importer, or other responsible party.

Any failure to have a label on the container at the time of receipt will be cause to refuse delivery of the product in addition to the following guidance:

- Stationary process containers may have signs, placards, process sheets, batch tickets, operating procedures, or other written material in lieu of fixed labels on the containers, as long as the alternative method conveys hazard information. The written materials will be readily accessible to the employees in the work area.

- Although the practice is not recommended, if an employee will use the hazardous substance in a portable container immediately, the portable container need not be labeled when the substance is transferred from the labeled container. The term "immediate use" is intended to mean that the hazardous chemical will be exclusively under the control of and used by the person performing the transfer at all times and work will be completed within the current work shift.
- Containers of hazardous substances transferred from labeled containers and not intended for the immediate use of the employee performing the transfer must be labeled in accordance with a hazardous materials identification system or an equivalent commercial system.
- Labels on incoming containers will not be removed or defaced.
- Labels or other forms of warning will be legible, in English, and prominently displayed on the containers, or readily available throughout each work shift.
- Container size is not the determining factor in deciding if a label is required; ALL containers of hazardous chemicals must be labeled.

Hazard Communication Training

Due to the nature of our business, the information and training provided to Resolution Consultants employees with regard to hazard communication will take two forms: general and specific. General training and information will include the following:

- The elements and requirements of the OSHA Hazard Communication standard (29 CRF 1910.1200) and applicable state regulation.
- Tasks and operations where hazardous substances are present.
- The location and availability of the written Hazard Communication Program, including the list(s) of hazardous substances and MSDSs and how employees can obtain and use hazard information.
- The methods and observations that may be used to detect the presence or release of a hazardous substance, such as personal and area monitoring, continuous monitoring devices, visual appearance or odor of hazardous substances when being released, etc.
- The physical and health hazards of the substances in the work area.
- The measures they can take to protect themselves from these hazards, including specific procedures implemented for the project or shop to protect employees from exposure to hazardous substances, such as appropriate work practices, emergency procedures, and PPE to be used.

- The project-specific or shop-specific details of the Hazard Communication Program, including an explanation of the labeling system and the MSDS's, and how employees can obtain and use the appropriate hazard information.
- Information for their physician to receive, regarding hazardous substances to which the employee may be exposed according to provisions of this section.
- Freedom from discharge or other discrimination due to the employee's exercise of the rights afforded pursuant to the provisions of the Hazardous Substances Information and Training Act.

Site-Specific Hazard Communication Training regarding safe handling and use of hazardous materials found on the HSI will be presented during site-specific training programs. This training may be for specific hazardous materials or for groups of hazardous substances, including flammable/combustible liquids, compressed gases, organic solvents, corrosives, and toxic metals. Additional specific training will be provided to the affected employees any time a new hazardous substance is introduced into the workplace (e.g., project specific substances) and/or when an employee is reassigned. All training conducted will be documented and copies of the documentation included in the permanent project files.

The SSHO must ensure that project personnel can immediately obtain the required information about chemicals of concern during an emergency.

Handling Controls and PPE

When engineering and work practice controls or substitution are either infeasible or insufficient, appropriate PPE and chemical hygiene facilities will be provided and used for the transportation, use, and storage of hazardous or toxic agents.

When irritants or hazardous substances may contact skin or clothing, chemical hygiene facilities and PPE will be provided. PPE may include suitable gloves, face/eye protection, and chemical protective suits. Required task-specific PPE are identified in the AHAs.

The CIH, CSP, or other competent personnel will determine the scope and type of protective equipment.

Special attention shall be given to selecting proper chemical protection when working with materials designated with a "skin" notation by Occupational Exposure Limits. Such materials may produce systemic toxic effects through absorption through broken or unbroken skin.

When eyes or body of any person may be exposed to hazardous or toxic agents, suitable facilities for quick drenching or flushing of the eyes and body will be provided in the work area for immediate emergency use and shall be no more than 10 seconds from the hazardous material.

Emergency eyewash equipment must be provided where there is the potential for an employee's eyes to be exposed to corrosives, strong irritants, or toxic chemicals. The emergency eyewash equipment must irrigate and flush both eyes simultaneously while the operator holds the eyes open.

Storage prior to transportation of hazardous chemicals, materials, substances, and wastes will be under the supervision of a qualified person. Transportation, use, and storage of hazardous or toxic agents will be planned and controlled to prevent contamination of people, animals, food, water, equipment, materials, and environment.

All storage of hazardous or toxic agents shall be in accordance with the recommendations of the manufacturer, OSHA, and National Fire Protection Association requirements and accessible only to authorized personnel.

Disposal of surplus or excess hazardous or toxic agents will occur in a manner that will not contaminate or pollute any water supply, ground water, or streams; and will comply with federal, state, and local regulations and guidelines.

Containers used to hold hazardous or toxic agents should not be used to hold other materials unless they have been managed or cleaned under hazardous waste and Department of Transportation (DOT) regulatory requirements. Every hazardous or toxic agent being transported for disposal shall be transported with a copy of the substance's MSDS whenever applicable.

Persons who prepare shipments of hazardous chemicals, materials, substances, and/or wastes that are defined as hazardous material under DOT regulations, are required to be DOT trained, certified, and issued an appointment letter in accordance with Defense Transportation Regulation 4500.9-R, Chapter 204.

9.i. Process Safety Management Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.j. Lead Abatement Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.k. Asbestos Abatement Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.l. Radiation Safety Program

This section is not applicable for the current scope of work for sites listed in this APP.

9.m. Abrasive Blasting

This section is not applicable for the current scope of work for sites listed in this APP.

9.n. Heat/Cold Stress Monitoring Plan

Heat Stress

Heat stress is one of the most common (and potentially serious) illnesses that affect site workers. When site personnel are engaged in operations involving hot environments, a number of physiological responses can occur, which may seriously affect the health and safety of the workers. These affects can be eliminated or controlled through the use of a comprehensive heat stress prevention and monitoring program.

It is the responsibility of the SSHO and each employee to ensure that temperature stress controls are adequate for the site conditions and tasks. All employees, and specifically the SSHO, are empowered and expected to stop or modify work and take any precautionary measures to prevent temperature related illnesses.

Individuals vary in their susceptibility and degree of response to stress induced by increased body heat. Heat stress can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors including environmental condition, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at work sites, regular physiological or area monitoring (as appropriate) and other preventive precautions are vital.

Factors that may predispose a worker to heat stress include:

- Lack of physical fitness.
- Lack of acclimatization to hot environments.
- Degree of hydration.
- Level of obesity.
- Current health (i.e., having an infection, chronic disease, diarrhea, etc.).
- Alcohol or drug use.
- The worker's age and sex.
- Prior history of heat stress.

Effects of PPE

The amount, and type of PPE worn, directly influences reduced work tolerance and the increased risk of excessive heat stress. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the following criteria and that of the recommendations of the ACGIH Threshold Limit Value (TLV) handbook:

- Anticipated work rate.
- Ambient temperature and other environmental factors.
- Type of protective ensemble.
- Individual worker characteristics and fitness.

Sweating does not cool the body unless moisture is removed from the body. The use of PPE reduces the body's ability to eliminate large quantities of heat because the evaporation of sweat is decreased. The body's effort to maintain an acceptable temperature may become impaired and this may cause heat stress. Increased body temperature and physical discomfort also promote irritability and a decreased attention to the performance of hazardous tasks.

Early Symptoms of Heat Related Illness

The following are the early symptoms of heat related problems that may be experienced by the field teams:

- Decline in task performance
- Lack of coordination

- Decline in alertness
- Unsteady walk
- Excessive fatigue
- Muscle cramps
- Dizziness

Heat Stress Disorders

This section outlines the major heat related illness that may result from exposure to high heat environments, which include heat rash, fainting, heat cramps, heat exhaustion, and heat stroke. For the purpose of this program, reference to "liquids" will indicate the use of water or an electrolyte replacement solution, and not tea or coffee (unless it is decaffeinated) or carbonated soft drinks.

Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by wet chafing clothing. This condition can decrease a worker's ability to tolerate hot environments.

- **Symptoms:** Mild red rash, especially in areas of the body that sweat heavily.
- **Treatment:** Decrease amount of time in protective gear and provide powder such as cornstarch or baby powder to help absorb moisture and decrease chafing. Maintain good personal hygiene standards and change into dry clothes if needed.

Heat Cramps

Heat cramps are caused by a profuse rate of perspiration that is not balanced by adequate fluid and electrolyte intake. The occurrence of heat related cramps are often an indication that excessive water and electrolyte loss has occurred, which can further develop into heat exhaustion or heat stroke.

- **Symptoms:** Acute, painful spasms of voluntary muscles such as the back, abdomen, and extremities.
- **Treatment:** Remove victim to a cool area and loosen restrictive clothing. Stretch and massage affected muscles to increase blood flow to the area. Have patient drink one to two cups of liquids immediately, and every twenty minutes thereafter. Consult with physician if condition does not improve. If available, an electrolyte replacement solution should be taken along with liquids.

Heat Exhaustion

Heat exhaustion occurs due to the large fluid and salt loss from profuse sweating. It is a state of very definite weakness or exhaustion caused by increased stress on various organs to meet increased demands to cool the body due to excessive loss of fluids from the body. This condition leads to inadequate blood supply and cardiac insufficiency. Heat exhaustion is less dangerous than heat stroke, but nonetheless must be treated. If allowed to go untreated, heat exhaustion can quickly develop into heat stroke.

- **Symptoms:** Pale or flushed, clammy, moist skin, profuse perspiration, and extreme weakness. Body temperature is normal or slightly elevated, the pulse is weak and rapid, and breathing is shallow. The individual may have a headache, be dizzy or nauseated.
- **Treatment:** Remove the individual to a cool, air-conditioned place, loosen clothing, elevate feet, and allow individual to rest. Consult physician, especially in severe cases. Have patient drink one to two cups of liquids slowly and immediately, and every twenty minutes thereafter. Total liquid consumption should be about one to two gallons per day. If the signs and symptoms of heat exhaustion do not subside, or become more severe, immediate medical attention will be required.

Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by failure of the heat regulating mechanisms of the body. Heat stroke occurs when the body's system of temperature regulation fails and the body temperature rises to critical levels. When this occurs, the body core temperature rises very rapidly to a point (>105.8°F) where brain damage and death may result if the person is not cooled quickly.

- **Symptoms:** The victim's skin is hot, and may or may not be red, dry, and/or spotted, due to the fact that the individual may still be wet from having sweat while wearing protective clothing earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; delirium; convulsions; unconsciousness or coma.
- **Treatment:** Cool the victim immediately. If the body temperature is not brought down quickly, permanent brain damage or death may result. The victim should be moved to a shady area; he should lie down and keep feet elevated. Cool the victim by either sponging or immersing the victim in very cool (not cold) water to reduce the core temperature to a safe level (<102°F). If conscious, give the victim cool liquids to drink. Observe the victim and obtain immediate medical help. Do not give the victim energy, caffeinated or alcoholic beverages. Heat stroke is considered a medical emergency. Medical help should be

summoned immediately. EARLY RECOGNITION AND TREATMENT OF HEAT STROKE ARE THE ONLY MEANS OF PREVENTING BRAIN DAMAGE OR DEATH.

Preventive Measures

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat exhaustion, that person may become predisposed to additional heat injuries. In order to avoid heat related illnesses, proper preventive measures will be implemented whenever environmental conditions dictate the need, normally whenever the temperature reaches at least 70°F. These preventive measures represent the minimal steps to be taken and will include the following procedures.

The SSHO or other authorized person will observe each site worker prior to the start of daily operations, and periodically throughout the day, to determine the individuals susceptible to heat induced stress. Evidence of extreme dehydration, illness, or drug or alcohol use may require the SSHO to restrict the worker's activities until such time as the worker is fit for duty. Personnel identified as being at high risk for heat stress who are allowed to participate in site operations will be monitored frequently by the SSHO.

Site workers will be trained to recognize and treat heat-related illnesses. This training will include the signs, symptoms, and treatment of heat stress disorders. In order to maintain workers' body fluids at normal levels, workers will be encouraged to drink, as a minimum, approximately sixteen ounces of liquids prior to start of work in the morning, after lunch, and prior to leaving the site at the conclusion of the day's activities. Disposable four to twelve ounce cups and liquids will be provided on site. Liquids to be provided will be water. Liquids containing caffeine should be avoided.

When ambient conditions and site workload requirements dictate, as determined by the SSHO, workers will be required to drink a minimum of 16 to 32 ounces of liquids during each rest cycle. The normal thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost sweat. When heavy sweating occurs, workers shall be encouraged to drink even though they may not be thirsty. A shelter or shaded area may be provided where workers can be protected from direct sunlight during rest periods.

Monitoring of ambient or physiological heat stress indices will be conducted to allow prevention and/or early detection of heat-induced stress. Monitoring will be conducted in accordance with applicable paragraphs of this APP.

Site workers will be given time to acclimatize to site work conditions, temperature, protective equipment, and workload. Acclimatization is the adaptive process that usually takes two to six days of continued work in hot environments, resulting in a decrease of the physiological strain and allowing the worker's body to become adjusted to the level and type of work required by the application of a constant environmental stress. This process involves a gradual increase in the individual's workload over the required period, the length of which depends upon the nature of the work performed, ambient temperatures, and the individual's susceptibility to heat stress.

Work schedules will be adjusted as follows:

- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Rotate personnel: alternate job functions to minimize over-stress or over-exertion at one task.
- Add additional personnel to work teams.
- Perform work during cooler hours of the day if possible.

Workers will be encouraged to achieve and maintain an optimum level of physical fitness. Increased physical fitness will allow workers to better tolerate and respond to hot environments and heavy workloads. In comparison to an unfit person, a fit person will have less physiological strain, a lower heart rate and body temperature, and a more efficient sweating mechanism.

Alcohol should not be consumed in a hot environment because the loss of body fluids increases the risk of heat stress.

Heat Stress Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers shall be monitored. Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Monitoring of personnel wearing PPE should begin when the ambient temperature is 72°F or above. Table 9-1 presents the suggested frequency for such monitoring. Monitoring frequency should increase as the ambient temperature increases or as slow recovery rates are observed.

A person with a current first aid certification who is trained to recognize heat stress symptoms should perform heat stress monitoring. Other methods for determining heat stress monitoring, such as the wet bulb globe temperature (WBGT) index from ACGIH TLV booklet or portable heat stress monitoring instrumentation can be used.

Table 9-1
Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers

Adjusted Temperature[1,2]	Normal Work Ensemble[3]	Impermeable Ensemble
90°F (32.2°C) or above	After each 45 min. of work	After each 15 min. of work
87.5°-90°F(30.8°-32.2°C)	After each 60 min. of work	After each 30 min. of work
82.5°-87.5°F (28.1°-28.1°C)	After each 90 min. of work	After each 60 min. of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 min. of work	After each 90 min. of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 min. of work	After each 120 min. of work

Notes:

1 For work levels of 250 kilocalories/hour.

2 Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

3 A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

When workers are wearing permeable clothing (i.e., standard cotton work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current ACGIH TLVs for Heat Stress.

When monitoring the worker physically, measure:

- Heart rate:
  - Count the radial pulse during a 30-second period as early as possible in the rest period.
  - If the working heart rate (while in PPE and performing tasks) exceeds 180 beats per minute minus the workers age, the work cycle should be discontinued and an appropriate rest/recovery period should begin.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period (after 1 minute of rest), shorten the next work cycle by one-third and keep the rest period the same.

— If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

- Oral temperature:
  - — Use a clinical thermometer (three minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
  - — If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
  - — If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following cycle by one-third.
  - — Do not permit a worker to wear a semi-impermeable or impermeable garment when oral temperature exceeds 100.6°F (38.1°C).

For site conditions where personnel are working in Level D PPE, and the ambient temperature is greater than 72°F, the SSHO may conduct WBGT monitoring to assist in controlling the potential for site workers experiencing heat related adverse health effects. The SSHO may take readings on a WBGT monitor throughout the day to determine the work/rest schedule to be implemented (see Table 9-2).

Table 9-2
Permissible WBGT Heat Exposure Threshold Limit Values (TLV)

	Work Load		
Work — Rest Regimen	**Light***	**Moderate***	**Heavy***
Continuous work	86 (30.0)	80 (26.7)	77 (25.0)
75% Work — 25% Rest, each hour	87 (30.6)	82 (28.0)	78 (25.9)
50% Work — 50% Rest, each hour	89 (31.4)	85 (29.4)	82 (27.9)
25% Work — 75% Rest, each hour	90 (32.2)	88 (31.1)	86 (30.0)

Note:
* Consult the ACGIH TLV booklet for definitions of Light, Moderate, and Heavy workloads. Values are given in F and (C) WBGT, and are intended for workers wearing single-layer summer type clothing. Use of semi or impermeable clothing requires monitoring in accordance with the Heat Stress Prevention Program. As workload increases, the heat stress impact on a non-acclimated worker is exacerbated. For non-acclimated workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5°C.

The values outlined in Tables 9-1 and 9-2 are designed such that nearly all acclimatized, fully clothed workers with adequate water and electrolyte replacement liquids intake will be able to function without the body temperature exceeding 100.4°F (38°C).

Heat Stress Documentation

The SSHO will be responsible for recording all heat stress related information. This will include training sessions and monitoring data. Training sessions will be documented on the Safety Meeting and Training Form, and WBGT data and other information will be recorded on a heat stress monitor log.

Cold Stress

If work is conducted in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Work will cease under unusually hazardous conditions (e.g., wind-chill less than 0°F, or wind-chill less than 10°F with precipitation). Systemic cold exposure is referred to as hypothermia. Localized cold exposure is generally labeled frostbite. Recognition of the symptoms of cold related illness will be discussed during the health and safety briefing conducted prior to the onset of site activities. Refer to the 2003 ACGIH TLV for Chemical Substances and Physical Agents for additional information on cold stress prevention, monitoring, and work-warming regimens.

Hypothermia

Hypothermia is a life-threatening condition in which the core body temperature falls below 95°F. Hypothermia can occur at temperatures above freezing particularly, when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe. This accounts for the progressive signs and symptoms ranging from sluggishness and slurred speech to disorientation and eventually unconsciousness (see Table 9-3).

Table 9-3
Progressive Clinical Symptoms of Hypothermia

Core Temperature (°F)	Clinical Signs
95°	Maximum shivering
87° - 89°	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated
84° - 86°	Progressive loss of consciousness; muscular rigidity; respiratory rate decreases
79°	Victim rarely conscious
70° - 72°	Maximum risk of ventricular fibrillation

The ability to sustain metabolic rate and to reduce skin blood flow is diminished by fatigue. Thus, fatigue increases the risk of severe hypothermia by decreasing metabolic heat. Additionally, because blood flow through the skin is reduced to conserve heat, the skin and underlying tissues become more susceptible to frostbite.

Frostbite

Frostbite is both the general and medical term given to areas of cold injury. Unlike hypothermia, frostbite rarely occurs unless environmental temperatures are less than freezing and usually less than 20°F. Frostbite injuries occur most commonly on the distal parts of the body (nose, earlobes, hands, and feet) that are subject to intense vasoconstriction. The three general categories of frostbite are:

Frostnip — A whitened area of the skin, which is slightly burning or painful.

Superficial frostbite — Waxy, white skin with a firm sensation but with some resiliency. Symptomatically feels "warm" to the victim with a notable cessation of pain.

Deep frostbite — Tissue damage deeper than the skin, at times, down to the bone. The skin is cold, numb, and hard.

Prevention of Cold Related Illness

The following are precautions that will be taken to prevent illness relating to cold stress:

- Educate worker to recognize the symptoms of frostbite and hypothermia.
- Ensure the availability of an enclosed, heated environment within the vehicles. The nearest heated environment will be the interior of the vehicles at the site.
- Ensure the availability of dry changes of clothes.
- Record temperature readings.
- Ensure the availability of warm beverages, preferably non-caffeinated.

Monitoring for Cold Exposure

Cold stress monitoring will be conducted in accordance with the ACGIH cold stress TLV. The TLV objective is to prevent the deep body core temperature from falling below 96.8°F and to prevent cold injury to body extremities. Temperature monitoring and recording will be initiated in the following situations:

- At the SSHO discretion when suspicion is based on changes in worker's performance or mental status.
- At worker's request.
- As a screening measure whenever a worker on the site develops hypothermia.
- Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours.

9.o. Crystalline Silica Monitoring Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.p. Night Operations Lighting Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.q. Fire Prevention Plan

All project personnel will be responsible for observing and reporting fires and conditions that could lead to fires. During all on-site activities, the following practices will be used for fire prevention and protection:

- Smoking on site is prohibited in designated work areas, contamination reduction zones, and other areas where smoking may create a fire hazard (e.g., dry fields or forested areas).
- A designated smoking area will be established (if allowed by base regulations) as necessary by the SSHO or Site Supervisors when operations on site begin.
- Accumulations of combustible scrap and debris on site will be promptly removed and properly disposed.
- Care will be taken with all equipment to reduce the possibility of sparks or open flames.
- Inspect all electrical cords and plugs prior to use; keep cords away from water and moisture.
- Fire extinguishers (minimum 2 A:B:C, 10-lb) will be available at the work area and support area.
- A fire extinguisher will be available on all pieces of heavy equipment.

Requirements for storage of flammable and combustible liquids will include:

- A suitable portable fire extinguisher will be available at the location where flammable or combustible liquids are stored.
- "No Smoking" signs will be posted in the storage area.
- Flammable liquids will be stored in closed containers. Type I or Type II metal safety cans (no greater than 5-gallon capacity) will be used for small quantities. Plastic storage containers are not allowed.
- Not more than 60 gallons of Class I or Class II liquids, nor more than 120 gallons of Class III liquids may be stored in a storage cabinet.
- Containers of flammable and combustible liquids shall be stored properly when not in use.

- The grounds around the storage area will be kept free of weeds, trash, and other unnecessary combustible materials.
- Spills will be cleaned up promptly.
- Proper bonding and grounding principles will be observed when transferring flammable liquids from one container to another.

9.r. Fire Extinguishers

Fire extinguishers are divided into categories, based on different types of fires. Each fire extinguisher also has a numerical rating that serves as a guide for the size of fire the extinguisher can handle. The higher the number rating, the more firefighting power of the extinguisher. The following is a quick guide to project management to help choose the right type of extinguisher:

- Class A extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish.
- Class B fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish.
- Class C fires involve electrical equipment, such as appliances, wiring, circuit breakers, and outlets. Never use water to extinguish class C fires – the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive.

9.s. Wild Land Fire Management Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.t. Hazardous Energy Control Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.u. Critical Lift Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.v. Contingency Plan for Severe Weather

Daily weather conditions will be a part of the daily briefing. During severe weather, project personnel will seek shelter in an appropriate location (i.e., building or vehicle). The individual is

ultimately responsible for his/her personal safety and has the right to take appropriate action when threatened by severe weather.

Safe Locations during Severe Weather and Locations to Avoid. No place is absolutely safe from severe weather; however, some places are safer than others:

- Large enclosed structures (substantially constructed buildings) tend to be much safer than smaller or open structures.
- The risk for lightning injury depends on whether the structure incorporates lightning protection, construction materials used, and the size of the structure.
- In general, fully enclosed metal vehicles such as cars, trucks, buses, vans, etc. with the windows rolled up provide good shelter from many weather conditions.

AVOID being in or near: High places and open fields, isolated trees, rain or picnic shelters, communications towers, flagpoles, light poles, bleachers (metal or wood), metal fences, water (lakes, streams, rivers, etc.).

When inside a building AVOID: Use of the telephone, washing your hands, or any contact with conductive surfaces with exposure to the outside such as metal door or window frames, electrical wiring, telephone wiring, cable TV wiring, plumbing, etc., if lightning is a factor. Generally speaking, identify and seek shelter that is appropriate for the type of severe weather you are encountering. Proper shelter will always include sound structure and remove you from the elements. When available, pay attention to weather warning devices such as National Oceanic and Atmospheric Administration weather radio and/or credible weather detection systems; however, do not let this information override good common sense.

Weather-related hazards will directly correlate to the type of weather involved. Hot, dry weather may cause greater dust emissions, particularly during intrusive activities. Rain may increase slip/trip hazards, particularly for ground workers. Additionally, lightning strikes during electrical storms could also be a potential hazard. The following procedures will be implemented once thunder is heard or lightning spotted:

- If thunder is heard, all site personnel are to be alert of any visible lightning flashes. The SSHO will observe the storm front and track the direction it is moving. The SSHO will continue to observe the storm front until it passes or until the prevailing direction is determined to be away from the site.

- If lightning is observed, the Site Supervisor or SSHO are to be notified. When the next lightning flash is observed, a "second" count shall be initiated from the time the lightning is observed until the thunder from the strike is heard.
- The following action guidelines shall be implemented once the "second" count is ≤ 30 seconds:
  - "Second" count > 30, the Site Supervisor or SSHO will continually observe the storm front. If the front is moving away, work will continue. If the front is moving towards the site, the Site Supervisor will initially place workers on alert for potential evacuation.
  - "Second" count ≤ 30, the Site Supervisor will issue the evacuation command and all workers are to report to the break/lunch trailer. Work can be re-initiated once the front has passed by and thunder has not been heard for 30 minutes.
- If lightning is observed and the storm front is moving away from or around the site and is > 20 miles away, work will be permitted to continue. The location of the storm can be confirmed via internet access to a local weather website that has a Doppler radar tracking system.

9.w. Float Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.x. Site-Specific Fall Protection & Prevention Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.y. Demolition Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.z. Excavation/Trenching Plan

Resolution Consultants will subcontract the excavation task for exposing the fuel pipeline. No excavation is anticipated to exceed 4 feet in total depth. Excavation will be limited to exposing the ends of fuel pipeline (abandoned in-place), in order to complete fuel line-tracing/line locate. Equipment operators will be supported by a crew of technicians who will perform spotting activities, provide traffic control and general housekeeping activities on the site.

9.aa. Emergency Rescue

This section is not applicable for the current scope of work for sites listed in this APP.

9.bb. Underground Construction Fire Prevention and Protection Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.cc. Compressed Air Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.dd. Formwork and Shoring Erection and Removal Plans

This section is not applicable for the current scope of work for sites listed in this APP.

9.ee. Precast Concrete Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.ff. Lift Slab Plans

This section is not applicable for the current scope of work for sites listed in this APP.

9.gg. Steel Erection Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.hh. Site Safety and Health Plan for Hazardous Toxic Radiological Waste Work

See the site-specific SSHP, Appendix H to this APP.

9.ii. Blasting Safety Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.jj. Diving Plan

This section is not applicable for the current scope of work for sites listed in this APP.

9.kk. Confined Space Program

No excavation is anticipated to exceed 4 feet in total depth. Excavation will be limited to exposing the ends of fuel pipeline (abandoned in-place), in order to complete fuel line-tracing/line locate. In addition, no personnel entry will be allowed within exaction, at any time. Any excavation 5 feet or

greater in depth would require additional coordination and establishment of controls with the SSHO and such excavation will be evaluated as a potential confined space.

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RISK MANAGEMENT PROCESSES

Risk management processes are implemented to insure all project hazards have been identified by the management team and safety professionals, and that procedures are in place to control the exposure to these hazards.

The following are the major types of hazards that are anticipated for tasks at NASWF for Sites 4, 40, and Flare Disposal Area: (Hazard Types: Chemical, Physical, etc.)

- Drilling (Physical, Biological and Chemical).
- Well Installation and Development (Physical, Biological and Chemical).
- Groundwater Sampling (Physical, Biological, and Chemical).
- Equipment Decontamination and IDW Management and Sampling (Physical, Biological and Chemical).
- Heavy Equipment Operations (Physical and Biological).

Each task or activity will have an AHA developed to define the activity to be performed. The AHA will reflect the work sequences, site conditions, anticipated hazards, control methods, equipment requirements, and training to be implemented to eliminate or reduce the hazards.

Operations at the site may require additional tasks not identified or addressed in the SSHP. Before performing any task not covered in this APP or associated SSHP, an AHA must be prepared, and approved by the Project SH&E Manager.

The specific AHAs identifying the project-specific task hazards and controls are presented in the SSHP, Appendix H to this APP. The following text discusses the major types of hazards.

Chemical Hazards

Chemical hazards include the materials that are found on site during field tasks and those chemicals brought on the site to support the project. Resolution Consultants has effective Hazard Communication, Personal Protective Equipment, and Environmental Monitoring Programs to control chemical hazards.

General Rules and Procedures

Occupational Exposure Limits: The Permissible Exposure Limits of OSHA and the TLVs of the ACGIH will be monitored and appropriate controls will be implemented to maintain our personnel exposure below these limits. Occupational exposure limits for the chemicals in use or anticipated at

this project are listed in the MSDS's for each chemical. To avoid incidental exposure to hazardous chemicals please follow these criteria:

- Develop and practice safe chemical hazard recognition habits.
- Avoid unnecessary exposure to chemicals by any route.
- Do not smell or taste chemicals.
- Wear and inspect gloves before handling chemical containers or contaminated debris.

Eating, smoking, etc:

- Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where chemicals are present.
- Wash hands, face, arms and neck before conducting these activities.
- Storage, handling, or consumption of food or beverages from refrigerators used for samples holding is prohibited.

Personal housekeeping:

- Keep the work area clean and uncluttered.
- Properly label and store chemicals and equipment.
- Clean up the work area on completion of an operation or at the end of each shift.

Personal protection:

- Ensure that appropriate eye protection (ANSI approved Safety Glasses with side shields) is worn by all persons, including visitors, where chemicals are stored or handled.
- Wear appropriate gloves when the potential for contact with toxic materials exists, inspecting them before each use, washing them before removal, and replacing them periodically.
- Use any other protective and emergency apparel and equipment as appropriate.
- Use of contact lenses in areas where chemicals may be encountered is not permitted.
- Remove PPE immediately on discovering significant contamination.

Biological Hazards

Biological hazards, which may be found on jobsites, include insects, arachnids, such as spiders, ticks, mites, and plants. Several varieties of snakes and other wildlife are also common hazards on

job sites. Employee awareness and the safe work practices outlined in the following paragraphs should reduce the risk associated with these hazards to acceptable levels.

The common biological hazards and controls that may be applicable to this project are indigenous hazards that will be discussed during the site orientation training and daily briefings, and where necessary, PPE and first aid treatment protocols will be established during site operations.

Generally speaking, employee exposure to biological hazards is anticipated to be low, however; specific tasks may increase the likelihood of exposure to biological hazards. In an effort to mitigate any potential hazards to employees, the SSHO will assess the work areas during site activities in an effort to delineate the presence of poisonous plants (poison ivy/oak) or other biological hazards. These areas will be adequately delineated and the location of material fully disclosed to all on-site personnel.

Biological Hazard Injury and Illness Prevention

Contact with bodies of water, animals, insects, and plants can cause injury and illness to personnel. Care must be taken to ensure that these types of injuries are avoided. Some examples of biological hazards include:

1. Natural and artificial bodies of water (e.g., lakes, rivers, ponds, lagoons, etc.), may contain a variety of microorganisms. Microorganisms, in particular, present a significant hazard to personnel who may come into contact with water bodies. Contact with microorganisms in water may result in dermatitis, infection (i.e., in cuts/lacerations), digestive distress, and other diseases.

   Always be aware of areas that may contain excessive amounts of microorganisms. Such areas may include areas of standing water; areas of warm water (i.e., cooling tower effluents, etc.); and areas downstream of municipal wastewater treatment. To prevent exposure to microorganisms in water, always adhere to the following:
   - Wear protective gloves (i.e., nitrile, etc.) and other appropriate PPE to prevent skin contact with water.
   - Never drink from natural or artificial bodies of water; such water is considered non-potable and is not safe for drinking.

2. Wild animals, such as snakes, raccoons, squirrels, and rats. These animals not only can bite and scratch, but can carry transmittable diseases (e.g., rabies). Avoid the animals whenever possible. If bitten, go to the nearest medical facility.

3. Insects such as mosquitoes, ticks, bees, and wasps. Mosquitoes can potentially carry and transmit the West Nile Virus. Ticks can transmit Lyme disease or Rocky Mountain Spotted Fever. Bees and wasps can sting by injecting venom, which causes some individuals to experience anaphylactic shock (extreme allergic reaction). Whenever entering areas that provide a habitat for insects (e.g., grass areas, woods), wear light-colored clothing, long pants and shirt, and spray exposed skin areas with a DEET-containing repellent. Keep away from high grass wherever possible. Keep your eyes and ears open for bee and wasp nests. If bitten by insects, see a doctor if there is any question of an allergic reaction.

4. Plants such as poison ivy and poison oak can cause severe rashes on exposed skin. Be careful where you walk, wear long pants, and minimize touching exposed skin with your hands after walking through thickly vegetated areas until after you have thoroughly washed your hands with soap and water. Remember, poisonous vegetation is poisonous year round, not just during the foliage seasons. Examples of common poisonous or irritating plant species, common to the United States, are shown in Figure 10-1.

Poison Ivy • Grows in East, West, Midwest, Texas • Several forms — vine, trailing shrub, or shrub • Three leaflets (can vary 3-9) • Leaves green in summer, red in fall • Yellow or green flowers • White berries	
Poison Oak • Grows in the East (NJ to Texas), Pacific Coast • 6-foot tall shrubs or long vines • Oak-like leaves, clusters of three • Yellow berries	
Poison Sumac • Grows in boggy areas, especially in the Southwest and Northern states • Shrub up to 15 feet tall • Seven to 13 smooth-edged leaflets • Glossy pale yellow or cream-colored berries	

Figure 10-1 — Hazardous Plant Identification Guide

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Response Measures for Contact with Hazardous Plants

If you have been exposed to poison ivy, oak, or sumac, act quickly because the toxin in the plants penetrates the skin within minutes. If possible, stay outdoors until you complete the first two steps:

1. Cleanse the exposed skin with generous amounts of a surfactant/emulsifying agent and wipe the area clean (Technu, Ivy-X wipes, etc.).

2. Wash the skin with water.

3. Take a regular shower with soap and cool water. Do not use soap until this point because it will pick up the toxin from the surface and move it around.

4. Wash clothes, tools, and anything else that may have been in contact with the toxin, with alcohol and water. Be sure to wear hand protection during that process.

Signs and symptoms of exposure include redness and swelling that appears 12 to 48 hours after exposure. Blistering and itching will follow. If you have had a severe reaction in the past, you should see an occupational physician right away. Otherwise, according to the Federal Drug Administration, there are quite a few effective over-the-counter products to help with symptoms, including Cortaid and Lanacort, baking soda, Aveeno oatmeal bath, and calamine lotion. Additional information on the avoidance and protective measures to be implemented from field biological hazards can be found in SH&E SOP *5-313 Wildlife, Plants and Insects*.

Physical Hazards

Resolution Consultants has published safe work practice procedures that will provide general guidelines that are to implement when executing work in the field. These procedures apply to all activities, and personnel working on field projects and operations.

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials. Additional information on the requirements of housekeeping can be found in SH&E SOP 5-307-*Housekeeping Worksite*.

Manual Lifting

Most materials associated with investigation and remedial activities are moved by hand. The human body is subject to severe damage in the forms of back injury, muscle strains, and hernia if caution is not observed in the handling process. Whenever possible, use mechanical assistance to lift or move materials and at a minimum, use at least two people to lift, or roll/lift with your arms as close to the body as possible. For additional requirements, refer to SH&E SOP 5-308-*Manual Lifting Field.*

Appendix A

Resolution Consultants OSHA 300 Form

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 2013

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	2	0	7
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
18	0
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	9	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Establishment information

Your establishment name AECOM-Americas-US Southeast

Street 555 South Flower Street-Suite 3700

City Los Angeles State California Zip 90071

Industry description (e.g., Manufacture of motor truck trailers)
Engineering Services

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)
8 3 1 1

OR North American Industrial Classification (NAICS), if known (e.g., 336212)
5 4 1 3 3 0

Employment information

Annual average number of employees 1,998

Total hours worked by all employees last year 3,995,092

Sign here **Knowingly falsifying this document may result in a fine.**

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive

Executive VP, US South Region Executive
Title

704-553-5543
Phone

30-Jan-14
Date

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for this collection of information is estimated to average 58 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

Appendix B
Resolution Consultants Safety and Health Policy Statement

THE CONTENTS OF THIS APPENDIX B ARE PRESENTED IN SECTION 3.0 STATEMENT OF SAFETY AND HEALTH POLICY OF THIS BASEWIDE APP AND HAVE BEEN INTENTIONALLY OMITTED HEREIN.

Appendix C
Resolution Consultants SH&E Standard Operating Procedures

5-001-Safe Work Standards and Rules

1.0 Purpose and Scope

1.1 Demonstrates Resolution's commitment to the establishment and maintenance of workplaces free from recognized hazards.

1.2 This procedure applies to all Resolution based employees and operations.

2.0 Terms and Definitions

2.1 **Safety Violation:** Not following verbal or written safety policies, rules and procedures (e.g., guidelines, rules, horse play, failure to wear selected PPE, abuse of selected PPE, etc.).

2.2 **Safe Work Practices:** The do's and don'ts about carrying out a task or use of equipment, informing the worker about the hazards present and providing direction on how to safeguard against the hazard. Safe Work Practices are generally guidelines only.

2.3 **Safe Job Procedures:** Written step-by-step set of instructions about completing a specific task safely including control measures and responding to emergency situations.

3.0 References

3.1 Resolution Employee Handbook

4.0 Procedure

4.1 Standard Operating Procedures (SOPs)

4.1.1 Safe Work Practices and Safe Job Procedures are embodied in the SH&E Standard Operating Procedures and are available on Resolution's SH&E website.

4.1.2 Specific Safe Work Practices and Safe Job Procedures have been developed in conjunction with employees and with particular input from those who have significant experience.

4.1.3 Standard Operating Procedures have been developed to provide clear instruction regarding the safety and reporting requirements of staff and operations.

4.2 Inspections and Audits

4.2.1 **Project Managers,** supervisors and **Regional SH&E Managers** shall conduct project audits and office inspections to identify safe work practices and potential safety violations.

4.3 Roles and Responsibilities

4.3.1 All managers and mupervisors are responsible for compliance with all SOP's and governmental requirements, and will be held responsible to prevent or bring any violations to the attention of the appropriate level of Management for corrective actions as per employing JV partner policies.

4.3.2 **Project Managers** (Including field task managers, supervisors) have overall responsibility for implementation of, and compliance with, this procedure.

4.3.3 **Regional SH&E Managers** provide guidance as to safe work standards, rules, requirements and guidelines.

4.3.4 **Human Resource Managers** (from employing JV partner) provide guidance and direction to managers and supervisors implementing the disciplinary process for safety violations (as defined in the Employee Handbook).

4.3.5 **Employees** are responsible for adhering to all Resolution safe work standards, rules, requirements and instructions and to provide input as appropriate.

4.4 Any employee who willfully disregards Resolution or client safety standards, rules or requirements is subject to disciplinary action.

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5.0 Records

None.

6.0 Attachments

5-001 Safety Rules

5-001-Safety Rules

1.0 Rules for all Employees

1.1 Work in a manner that will not put oneself, other personnel or equipment or facilities at risk.

1.2 Identify hazardous conditions and activities in the work environment consistent with the job and training.

1.3 If a hazard cannot be eliminated, report it to the manager or supervisor promptly.

1.4 Implement established control methods consistent with project procedures and/or training.

1.5 Cooperate and comply with all Resolution Policies and Standard Operating Procedures.

1.6 Immediately report all acts of aggression, verbal or physical threats, assaults, sexual or other harassment to your supervisor or manager.

1.7 Take any safety training required for your job function or tasks.

1.8 Use or wear all personal protective equipment, devices or clothing required in accordance with manufacturers' instructions and Resolution training and/or procedures.

1.9 Do not perform any work task or activity which you believe is unsafe. Inform your supervisor immediately.

1.10 Immediately report all incidents (including near misses), injuries, property damage, spills, hazards, safety concerns and safety violations to your supervisor.

1.11 Report all observed unsafe acts, conditions, or behaviors that compromise the safety of Resolution employees, its clients, subconsultants, general contractors, or the public to your supervisor.

1.12 Keep all personal work areas clean from debris and tripping hazards.

1.13 Operate all Resolution vehicles and mobile equipment in accordance with applicable regulations.

1.14 Do not use or operate any equipment, machine or device that may endanger you or another worker.

1.15 Do not remove, damage, disable or make ineffective any protective safety, fire fighting or first aid equipment or devices.

1.16 Use only vehicles, equipment and tools that are in safe operating condition and maintained in accordance with manufacturer's specifications. Report, remove from service, or have repaired, any tool or equipment that is damaged, not working properly or may otherwise be hazardous if used.

1.17 Do not use any hand-held wireless device while driving a vehicle or performing other safety critical tasks like working near traffic or working with power tools.

1.18 When travelling, working alone or working away from the Resolution office, particularly in remote areas, follow applicable call-in procedures.

1.19 Do not bring firearms onto Resolution property or allow them on Resolution projects unless expressed permission is provided by management for the use in wildlife protection.

1.20 Do not smoke in areas designated as "NO SMOKING" or in any Resolution facility.

1.21 Do not use, sell or distribute, be under the influence, or have in their possession any controlled substances, drugs, or alcohol while performing work duties.

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2.0 Project or Field Work

2.1 Always report to site supervisor before performing work on site to determine specific requirements for the site or project. Follow all safety requirements, including Resolution's, or that of a client or prime contractor, as applicable.

2.2 Use only designated project entrances, parking areas and facilities.

2.3 Show or produce evidence of identification or required training if requested to gain entry to or while on a project.

2.4 Obey all warning signs (e.g., "Do Not Enter," "Eye, Hearing or Respiratory Protection Required," "Permit Required Confined Space," "Authorized Personnel Only").

2.5 Do not block, deface or remove any signage, barricade or fencing without approval.

2.6 Keep passageways clean and clear of debris, materials, hoses, cords, and tripping obstructions. Items should be moved to low activity areas or overhead.

2.7 Verify with the **Project Manager** that all required Permits are in place prior to commencing work.

2.8 Be aware of work going on, around or above you including contractor activities and public motor vehicles.

2.9 Do not work alone when performing high risk or remote work.

2.10 Personal cameras, video recorders, and other photographic equipment shall not be permitted on site without the **Project Manager** and client's approval.

2.11 Plan work tasks before beginning work and consider any hazards that may exist and how to avoid them through safe work practices or safe work procedures.

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5-002-Stop Work Authority for Unsafe Work

1.0 Purpose and Scope

1.1 This procedure establishes the requirements for Resolution personnel to stop work if they believe there is an imminent safety, health, or environmental risk as described below that will affect them, their co-workers, the public, or the environment.

1.2 This procedure applies to all Resolution-based employees and operations.

2.0 Terms and Definitions

2.1 **Discrepancy/Deficiency**: An omission or commission, a condition, or a situation that is in conflict with the procedures and requirements of Resolution's SH&E standards.

2.2 **Imminent Danger**: An impending or threatening situation that, if left uncorrected, is likely to result in serious injury, property damage, or environmental impairment.

2.3 **Potentially Dangerous**: Minor violations that present a low potential for serious injury, property damage, or environmental impairment.

2.4 **Stop Work Order**: A directive to cease Resolution-controlled work issued for failure to follow procedures, imminent danger situations/conditions, accumulation of safety violations, etc. The Stop Work Order will apply to Resolution and its direct subcontractors placed at risk by the situations or conditions.

3.0 References

None.

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees** are responsible for stopping all Resolution-directed work and for bringing it to the attention of the appropriate manager, Site Safety Officer, Project Manager, and/or Contractor representative any time an employee identifies a discrepancy, deficiency, or potentially dangerous condition or act that is likely to cause an unsafe or unhealthy situation or an imminent danger situation.

4.1.2 **Employees** may report unsafe working conditions anonymously, but they must provide sufficient detail and promptness to allow Resolution management and the SH&E staff to initiate corrective action.

4.1.3 **The Site Safety Officer** or **Local SH&E Representative** must initiate the development and implementation of corrective actions to eliminate the condition causing the Stop Work Order for Resolution employees and other personnel under Resolution's direct control affected by such condition. Report the details of the Stop Work Order and any corrective actions implemented to the **Project Manager** and the appropriate **Regional SH&E Manager**

4.1.4 **Project managers (field task managers, supervisors)**

- Verify that corrective actions taken appropriately address the conditions leading to the Stop Work Order.
- If Resolution has control over the circumstance that led to the condition, initiate additional corrective actions necessary to correct the conditions leading to the Stop Work Order. Otherwise, remain in communication with the persons or entities that are taking the corrective measures.
- Communicate such corrective actions and the effects of such corrective actions on the project/office to the client and/or Region Management.

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- Ensure that documentation related to the Stop Work Order and corrective actions is placed in the project/office file.

4.1.5 **Regional Business line Managers (regional, district and office managers)**

- Provide support, in accordance with our contractual responsibilities for the project, for the implementation of corrective actions and communications with clients.
- Ensure that no reprimand or reprisal is associated with the initiation of a Stop Work Order.

4.1.6 **Regional SH&E Managers**

- Provide technical guidance for the development and implementation of corrective actions.
- Communicate with the SH&E group and assist with the development of Shared Learning and Safety Alert notices.
- Report all instances when Stop Work Authority has been implemented to the Resolution Consultants SH&E Manager.

4.2 Commitment

4.2.1 It is Resolution's policy and firm commitment that employees are expected to stop their work to prevent unacceptable exposure to workplace hazards, including unsafe conditions or worker behaviors, without fear of reprimand or reprisal.

4.2.2 Cases involving reprisal, reprimand, or any attempt to discourage the initiation of Stop Work Orders or reporting of unsafe or unhealthy conditions or situations within Resolution should be immediately reported to the employee's **Manager, Human Resources Representative**, and **Regional SH&E Manager, Resolution Consultants SH&E Manager**.

4.3 Authority

4.3.1 Resolution's stop work authority applies to all work controlled by Resolution, its employees, and Resolution -controlled subcontractor work activities. All Resolution personnel are authorized to stop work in the event of an identified unsafe condition. If the responsible organization fails to provide resolution, or if at any time their acts or failure to act cause substantial harm or imminent danger to the health and safety of project employees, the public, or the environment, Resolution may issue an order stopping work in whole or in part. In the event that Resolution issues a Stop Work Order, an order issued by Resolution Consultants SH&E Manager (or his designee) authorizing the resumption of work must be in place prior to restarting work.

4.3.2 In most cases, a Stop Work Order affects only those areas immediately involved in the hazardous situation. Resolution may issue a Stop Work Order for a portion of the work area(s) or for an entire work area when unacceptable risks exist that cannot be mitigated by reasonable engineering controls, administrative actions, or personal protective equipment. The Stop Work Order will remain in effect until the responsible organization resolves the problem(s) and brings the work area(s) to satisfactory conformance with established SH&E requirements. Work will not resume until appropriate corrective actions have been completed, ensuring that the condition has been rectified. The Stop Work Order will apply to Resolution and its direct subcontractors placed at risk by the situations or conditions.

4.4 Severity of Hazards

4.4.1 Imminent Danger Situations

- Upon becoming aware of an imminently dangerous situation that Resolution does not control, the employee should immediately inform the persons or entities in control of such imminently dangerous activities and his or her project manager about the situation. If the activities pertain to work that is controlled by Resolution, then the employee may stop the work upon discovering an imminently dangerous situation and then immediately notify his project manager, who may determine the appropriate further action to be taken (including the issuance of a formal Stop Work Order).

- "Stopping work" for Resolution -controlled work includes stabilizing an imminent danger situation to the extent that it can be left unattended for a prolonged period of time until the issue is resolved.
- The person requesting the work stoppage will notify the organization responsible for the work.
- The responsible organization will notify Resolution project/office management immediately of any stop work action(s) taken to rectify the situation.
- An Resolution's failure to comply with any Stop Work Order in whole or in part may result in disciplinary action. An Resolution subcontractor employee's failure to comply with any Stop Work Order may result in immediate removal from the project and/or office location.

4.4.2 Potentially Dangerous Situations

- Informal stop work interventions to correct minor conditions (e.g., to remind workers to put on their hard hats, safety glasses, etc.) do not require formal notification.
- If the minor condition cannot be corrected, a formal Stop Work Order must be issued and work must not be resumed until the situation has been eliminated.

4.5 Management-issued Stop Work Orders

4.5.1 **Project Managers** and/or **SH&E Managers** may issue a formal Stop Work Order for Resolution-controlled work in the following situations:

- Imminent danger exists involving the public or employee's safety and health or damage to the environment, facilities, or property.
- Continuing work or equipment usage will result in significant repair, rework, or removal.
- A project, or any segment of the project, is executed improperly or is out of compliance with applicable regulations or standards.

4.6 Resuming Work

4.6.1 Work associated with the affected area or operation will not resume unless all corrective actions identified in the applicable Stop Work Order have been completed and closed.

4.6.2 All personnel affected by the Stop Work Order will be instructed on the corrective actions and preventative measures taken.

5.0 Records

5.1 The completed Stop Work Order and any corrective action reports generated will be maintained at the project site for the duration of the project and placed in the closed project file.

6.0 Attachments

5-002 Stop Work Order

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5-002- Stop Work Order

This form must be completed if any of the following Criteria are met:

1. Imminent danger exists involving the public or employees' safety and health, the environment, facilities, or property.
2. Continuing work or equipment usage will result in significant repair, rework, or removal.
3. There is a discrepancy, deficiency, or potentially dangerous condition or act that is likely to cause an unsafe or unhealthy situation or an imminent danger situation.

Project Name:			
Project Manager:		**Project #:**	
Reported by:		**Date/Time:**	
Office:		**Address:**	
Stop Work Order is the result of the following:			
Inspection/Audit ☐	**Environmental Impairment** ☐	**Injury/Incident** ☐	
Unsafe Condition ☐	**Unsafe Behavior/Act** ☐	**Improper Scope of Work** ☐	
Other ☐			
Stop Work Order (Describe):			

All Stop Work Orders will be sent to the Regional SH&E Manager for Review

Return to Work

The above Stop Work Order issues/concerns have been corrected and documented. By signing below, I certify that the above Stop Work Order scenario has been corrected and work is safe to resume.

Title	Print Name	Signature
Project Manager:		
Individual/party issuing Stop Work Order:		
Sub-Contractor Supervisor (if applicable):		

5-003-SH&E Training Sign-In Sheet

Course Name:					
Region:		**District:**			
Business Line:		**Dept #:**			
Office:		**Address:**			
Date:		**Start Time:**		**Stop Time:**	
Certification Level (Check One):	**Awareness** ☐	**Performance** ☐	**Competent Person** ☐		
Lead Instructor:		**Instructor 1:**		**Instructor 2:**	

	Employee Name: (PRINT LEGIBLY)	**Region/Office Company (if not Resolution)**	**Employee ID #:**
1.			
2.			
3.			
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5-003-SH&E Training

1.0 Purpose and Scope

1.1 Resolution's Safety, Health and Environmental (SH&E) Training Program is designed to provide training for all personnel which address the safety needs of their assigned job duties and responsibilities.

1.2 This procedure applies to all Resolution based employees and operations.

1.3 Major objectives of the SH&E Training Program include:

- Identify accountability, responsibility, and authority pertaining to the SH&E training program requirements.
- Establish minimum training course and/or instructor criteria to ensure compliance with applicable regulatory requirements as well as Resolution's SH&E Program requirements.
- Define documentation and corresponding archive requirements for the training program.
- Maintain consistency in SH&E training content throughout North America for Resolution.

2.0 Terms and Definitions

2.1 **Training Needs Assessment (TNA):** A documented or electronic selection process whereby each employee identifies SH&E training based on their job role(s), responsibility(s) and associated hazards, and reviews the selected course(s) with his/her supervisor for approval and provision.

2.2 **Learning Management System (LMS):** A documented or electronic process of recording the commitment of the TNA and the successful completion of the associated SH&E training material.

2.3 **SH&E Administrators:** Employees that are located in various offices who coordinate the staff and/or trainers for delivery of SH&E training and record training completion data into the LMS or maintain hard copy files of training data for the location(s).

3.0 References

None.

4.0 Procedure

The requirements included in this procedure are the minimum applicable for Resolution activities. Further training may be identified to meet local jurisdiction or client requirements.

4.1 Training Needs Assessment

4.1.1 For Resolution to provide the necessary SH&E training for all employees to safely perform their work, job hazards that each employee may be exposed to must be identified and appropriate training provided about those hazards.

4.1.2 Upon employment and annually thereafter, employees must review their SH&E training requirements by completing the SH&E Training Needs Assessment (TNA) form. Their supervisor will review and confirm these training requirements and confirm enrolment into the required training programs.

4.1.3 Training Needs Assessments must be reviewed if any employee has been assigned a significantly different job with new hazards or project reassignment.

4.2 Training Delivery

4.2.1 SH&E Training is delivered in several methods to meet Resolution's wide diversity of staff, office and project locations. The local **SH&E Administrator** can work with the **Regional SH&E Manager** to develop a Regional training schedule and appropriate methods of delivery.

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4.2.2 Every employee must attend the required training to meet the commitment established in the TNA and to demonstrate successful participation and knowledge transfer by completing and passing the associated quizzes or examinations.

4.3 Internal Training

4.3.1 Internal training represents training that is performed by Resolution's internal resources and may include intranet and classroom-based training. Generally this training material is customized to meet the specific requirements of Resolution or the project.

4.3.2 Courses that are self-taught and individually paced and delivered via Resolution's intranet: These courses are developed and maintained by the **SH&E Department**. Resolution's intranet will also be used to provided training by an **SH&E Instructor** in a WebEx format to facilitate personnel training based in multiple locations.

4.3.3 Courses taught by an Resolution instructor in a classroom format: Trainers are SH&E Department-approved personnel using materials developed specifically to train Resolution employees. All training course curricula is reviewed and approved by the SH&E Department prior to provision of training.

4.4 External Training

4.4.1 External vendors conduct training that is not available through internal training sources. All external vendors are to be selected and pre-approved by the SH&E Department prior to any employee attending a training class.

4.4.2 Resolution will use Internet training to supplement internal training courses. All Internet-based safety training courses and providers must be approved by the SH&E Department prior to any employee participating in training. Employees will be provided sign-on privileges.

4.5 Project Specific Training

4.5.1 In the course of employment with Resolution, employees may be asked to participate in project work with activities new to them or activities for which they have let their safety, health or environmental training expire. Should this occur they must immediately inform their supervisor and not participate in any tasks with hazards for which they have not been trained.

4.5.2 **Project Managers** must review all employees scheduled to work on their projects for compliance with SH&E training for hazards present or anticipated on their particular project. **Project Managers** must not let any employee that does not have current training for the identified hazards work on their projects.

4.6 Training Tracking

4.6.1 Records documenting employee participation safety training will be maintained in accordance with applicable regulatory and Resolution SH&E Program requirements.

4.6.2 Each region/district is responsible for maintaining documentation of course completion by each individual employee. **SH&E Administrators** will generally maintain such documentation.

4.6.3 For any employee who cannot be entered into the electronic database i.e.: contract employees, subconsultant employees, client personnel, the District or Office **SH&E Administrator** is required to maintain an individual non-employee training file with hard copies of certification from any safety training records.

4.7 Training Program Management

4.7.1 **Regional SH&E Managers** will be responsible for verifying training vendors, Internet training courses, or any other external training programs used by their operating units to comply with applicable regulatory or legislative requirements and Resolution SH&E Program parameters. Resolution will not consider any training received through an unapproved vendor to be valid until reviewed and accepted by a **Regional SH&E Manager**.

4.7.2 Resolution's **SH&E** group may provide training support services (e.g., registration) for Resolution-approved programs in addition to training provided by individual business lines and outside vendors.

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4.8 Roles and Responsibilities

4.8.1 **Employing JV Partner** is responsible for establishing adequate resources (budget, training staff, etc.) within the business line(s) to implement the identified SH&E training.

4.8.2 **Regional Managers** are responsible for supporting the SH&E training program, and for the implementation and enforcement of this procedure within their region. This includes:

- Allocating resources for the effective implementation of this program.
- Participating with the **Regional SH&E Manager** in the development of tools to identify, track and monitor the implementation of SH&E training.

4.8.3 **Project Managers** (including field task managers, supervisors) are responsible that all assigned personnel comply with the requirements of this program. They will also:

- Identify local **SH&E Administrators** to coordinate SH&E training and to handle the training program data for their district/department.
- Confirm that training requirements are reviewed with each employee, based upon anticipated hazards associated with current and probable job functions and past performance if the job has not changed.
- Confirm that a SH&E TNA is completed by each employee and their supervisor as part of an employee's new hire orientation and upon annual review.
- Identify supplemental employee training courses based on local/client requirements.
- Identify additional employee SH&E training requirements based upon prudent risk management considerations and local performance issues.
- Implement corrective actions when employees fail to meet training requirements.

4.8.4 **Resolution Consultants SH&E Manager** is responsible for the following:

- Establishing SH&E Training Program parameters and communicating same to corporate executive management.
- Providing the necessary tools, support, and staff for development of the SH&E training program.
- Developing a list and schedule of training courses, including routine recurring training for standard courses.
- Reporting/communicating training status to senior management.

4.8.5 **SH&E Group** is responsible for the following:

- Developing and maintaining the LMS.
- Developing a list and schedule of training courses, including routine recurring training for standard courses. Communicating such information accordingly.
- Developing a resource of Resolution on-line, vendor or classroom training materials.
- Developing a roster of approved SH&E courses and syllabi.
- Collaborating with the **Regional SH&E Managers** in course development and content.
- Auditing for compliance with training program parameters.
- Reporting the status of the SH&E Training Program to the **Group SH&E Director** and **Regional SH&E Managers**.

4.8.6 **Regional SH&E Manager** is responsible for the following:

- Working with Regional and Business Line management to verify all SH&E training needs are identified and captured in the LMS.
- Developing a schedule and performing internal safety training classes as requested by regional, district, office or **Project Managers**.
- Reviewing and approving qualifications of Resolution employees providing internal safety training.

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- Approving training lesson plans and course agendas for all internal training courses.
- Approving external safety training vendors and on-line (Internet) training providers.
- Monitoring for compliance with training program requirements.

4.8.7 **SH&E Administrators** are responsible for the following:

- Inputting and maintaining records pertaining to all safety training courses, medical monitoring, and other safety events into the LMS.
- Assigning training courses to employees, based on approved TNA results.
- Maintaining a hardcopy file of employee training records, sign-in sheets and other SH&E records related to training (such as quizzes and course evaluations where available).
- Supporting employees in obtaining refresher training prior to expiration.
- Providing office, department, location or business lines managers training compliance reports at an interval agreed upon by manager.

4.8.8 **Employees** are responsible for the following:

- Reviewing with their supervisor the SH&E hazards they may be exposed to in their day-to-day functions, and requesting the training for that hazard by completing a SH&E TNA.
- Coordinating with their supervisor to take the required SH&E training course prior to performing tasks with identified hazards.
- Monitoring their own training expiration dates and coordinating with their local **SH&E Administrator** (and supervisor) for refresher training to prevent expiration of any required training certifications.
- Supplying copies of training completion certificates to the **SH&E Administrator** for inclusion in the LMS.

5.0 Records

None.

6.0 Attachments

6.1 5-003-SH&E Training Sign In Sheet

05-004-Incident Reporting

1.0 Purpose and Scope

1.1 To document and report all SH&E incidents in a timely and accurate manner. Additionally, to gather that appropriate Lessons-Learned from all SH&E incidents and that all information required for regulatory reports is generated and filed as required for compliance.

1.2 This procedure applies to all Resolution Consultants based employees and operations.

2.0 Terms and Definitions

2.1 SH&E Incidents: The following events or situations as applied to Resolution Consultants employees and/or Resolution Consultants-controlled operations are considered SH&E Incidents:

2.1.1 Any injury or illness(including pain and soreness) to an Resolution Consultants employee, that could be potentially work related or become aggravated by the work environment. This includes Resolution Consultants subcontractor, temporary employee or third party contractor, performing work under the control of an Resolution Consultants operation.

2.1.2 Fire, explosion, or flash that is not an intended result of a remediation process, laboratory procedure, or other planned event.

2.1.3 Any accidents involving company-owned, rented, or leased vehicles (including personal vehicles used for company business).

2.1.4 Any breach of a numeric limit attached to a governmental permit or consent.

2.1.5 Any failure to perform the requirements of a non-numeric requirement contained in a government permit or consent.

2.1.6 Any failure to obtain a government permit or consent when required (including failure to obtain revisions before an existing permit or consent expires).

2.1.7 Any notice of violation or notice of non-compliance received from a regulatory authority with enforcement powers.

2.1.8 Property damage resulting from any Resolution Consultants or subcontractor activity.

2.1.9 Unexpected release or imminent release of a hazardous material.

2.1.10 Unexpected chemical exposures to workers or the public.

2.1.11 A safety, health or environmental related complaint from the public regarding Resolution Consultants activities.

2.1.12 SH&E-related incidents that could result in adverse public media interest concerning Resolution Consultants or an Resolution Consultants project.

2.1.13 Any inspection by a federal, provincial, or local safety, health, & environmental enforcement agency.

2.1.14 Any boating incident that includes the following:

2.1.15 Fatality.

2.1.16 A person disappeared from the vessel under circumstances that indicated death or injury.

2.1.17 A person was injured and required medical treatment beyond first aid.

2.1.18 Damage to vessels and other property totaled $2000 or more.

2.1.19 The boat was destroyed (physically destroyed or sinks).

2.2 Near-Miss Incidents: This is defined as an incident having the potential to cause injury, health effects, environmental impairment, or property damage as described in the above categories – but did not. For example:

2.2.1 A crane drops a 454 kilogram (1,000 pound) beam during a lift – and nobody is hurt, no equipment is damaged.

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2.2.2 A work crew is conducting a survey along the highway. A vehicle leaves the roadway and the vehicle enters the survey area at 80 kph (50 mph). The vehicle misses an employee by 1 meter (3 feet), the driver recovers control of the vehicle and leaves the area.

2.2.3 Awareness of an equipment recall or incident that occurs at another similar worksite.

2.2.4 Unsafe condition that could have caused an incident if not corrected.

2.2.5 Awareness of an equipment recall or incident that occurs at another similar worksite.

2.2.6 Unsafe condition that could have caused an incident if not corrected.

2.3 Significant Learning Experience: Defined as a near-miss incident that the affected group (i.e. project team, office staff, etc.) believes could have wide-ranging impacts throughout Resolution Consultants.

2.4 Serious SH&E Incident: Any SH&E Incident that meets/involves the following criteria:

2.4.1 Any amputation.

2.4.2 Hospitalization for treatment (admission).

2.4.3 Absence from work for more than 30 calendar days due to work-related injury/illness.

2.4.4 Any single event resulting in more than one employee requiring medical treatment.

2.4.5 Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity.

2.4.6 Any spill or release of a hazardous material that is reportable to a government agency.

2.4.7 Any Notices of Violation.

2.4.8 Near miss incidents that, in the opinion of the SH&E Manager, Project Manager, or Contract Task Order Manager, may have otherwise resulted in any of the above.

2.5 **Fatality:** Loss of life of any Resolution Consultants employee, Resolution Consultants subcontractor personnel, client personnel or member of the general public that can be perceived to be related to work performed or controlled by Resolution Consultants.

2.6 **General Liability:** Incidents where Resolution Consultants could potentially be held liable.

2.7 **Resolution Consultants Recordable Injury: See *05-601 Recordkeeping* for definitions.**

2.8 **H&W:** Health and Welfare Human Resource office which manages all injury and illness claims.

2.9 **HR:** Human Resource office which manages all injury and illness claims.

2.10 **Lost Time Days:** The total number of days the injured person accumulates before returning back to regular duties.

2.11 **Lost Time Injury or Disease:** A work-related injury or disease that has caused a worker to be absent from his or her regular work following the day that the injury or awareness of the disease occurred.

2.12 **Restricted Work (also called "Modified Work"):** Where an injury is medically treated, but the person is not able to return to regular duties. The restricted duties are done within the limitation of the injured person's abilities. (documentation may be required per regulatory requirements).

2.13 **Restricted Work Days:** The total number of restricted work days the injured person accumulates before being able to return to regular duties.

2.14 **Supervisor's Report of Incident (SRI):** Form used to document incidents which shall be completed within 24 hours.

2.15 **Support Services:** Resolution Consultants entities of Legal, Human Resources, Communications, SH&E Department, etc.

2.16 **WCB:** Workers Compensation Board

2.17 **WC Carrier:** Workers Compensation Insurance Carrier (US).

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3.0 References

3.1 05-606 Modified Duty Program

3.2 05-603 Incident Investigation and Review

3.3 05-601 Recordkeeping

4.0 Procedure

4.1 All incidents, regardless of type or severity, shall be reported to the on-site supervisor immediately.

4.2 All incidents, regardless of type or severity, shall be reported to the employer company safety representative by the supervisor as soon as possible but no later than the end of the current work shift.

4.3 Completed Supervisor's Report of Incident shall be submitted the supervisor, Regional SH&E Manager and the Resolution Consultants SH&E Manager within 24 hours.

4.4 Fatalities and serious SH&E incidents shall be reported to the Regional SH&E Manager and Resolution Consultants SH&E Manager as soon as reasonably possible but no more than 2 hours after the incident.

4.5 Where there is potential for criminal, civil or regulatory action against Resolution Consultants or any of its employees or subcontractors, Resolution Consultants' Contracts Task Order Manager shall be contacted prior to any external communication, correspondence, or meeting concerning any incident, governmental investigation, or environment impact. Resolution Consultants' Contracts Task Order Manager, or the Program Manager, may supplement this Policy or require additional measures to protect the best interests of Resolution Consultants and its employees.

4.6 **Roles and Responsibilities**

4.6.1 Employees. Each employee involved in an SH&E incident will:

4.6.1.1 Notify his/her supervisor immediately that an incident (including a near-miss) has occurred, the circumstances involved, the nature and extent of the injuries/illness, and whether medical treatment may be required. Except for emergency situations, affected employees are required to discuss their injury/illness status with their supervisor and Regional SH&E Manager or project SH&E Professional prior to obtaining medical treatment.

4.6.1.2 Assist supervisor in completing appropriate reporting and investigation forms. If issues are raised regarding the content prepared in the SRI, contact the Regional SH&E Manager for guidance.

4.6.2 Supervisors. In an emergency/life-threatening situation, supervisors will:

4.6.2.1 Use the appropriate local emergency phone numbers and seek immediate medical care for the employee.

4.6.2.2 Address any immediate corrective actions needed. Consult with the Regional SH&E Manager if guidance is required.

4.6.2.3 Call the Regional SH&E Manager and Resolution Consultants SH&E Manager as soon as the situation is stabilized, but not later than the end of the current work shift.

4.6.2.4 Complete the applicable forms and email to the supervisor and the Regional SH&E Manager within 24 hours of the incident.

4.6.2.5 Supervisor's Report of Incident or Near Miss/Observation Report (completed with assistance and acknowledgment from affected employees).

4.6.2.6 Federal/State/Province Specific Forms, if required (contact applicable Support Services for guidance).

4.6.2.7 Notify the appropriate line or lead manager (i.e. manager responsible for personnel involved/project oversight/business line, etc.).

4.6.2.8 As appropriate, initiate an Incident Investigation and Review per the requirements of 5-603 Incident Investigation and Review.

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4.6.2.9 Completion of any external reporting requirements. For example, the U.S. Coast Guard CG-3865, Recreational Boating Accident Report may be required if the incident involved a boat (contact the SH&E Manager for clarification). See 5-004 Form 4 Incident Response and Reporting for further instruction.

4.6.2.10 Report all fatalities and/or serious SH&E incidents to the Resolution Consultants SH&E Manager and Program Manager as soon as reasonably possible but no more than 2 hours after the incident.

4.6.3 Resolution Consultants SH&E Manager or Designee:

4.6.3.1 Coordinate with the appropriate SH&E Incident Reporting Support Staff

4.6.3.2 Upon receipt of an Incident Notification, contact the supervisor to discuss the incident as well as short term and long term corrective actions.

4.6.3.3 Engage Resolution Consultants Medical Provider for non urgent medical guidance, if needed.

4.6.3.4 Notify appropriate Manager of the incident

4.6.3.5 As appropriate, initiate or assist an Incident Investigation and Review.

4.6.3.6 Report all fatalities and/or serious SH&E incidents to the Contracts Task Order Manager and Program Manager as soon as reasonably possible but no more than 2 hours after the incident.

4.6.4 Incident Reporting Support Staff:

4.6.4.1 Inform appropriate personnel that have not already been notified of incidents.

4.6.4.2 Audit data of incident reporting system.

4.6.4.3 Coordinate with Regional SH&E Manager or designee for management of medical support.

4.6.4.4 Forward incident data to support agencies for insurance claims.

5.0 Records

5.1 Incident reports and supporting documentation are maintained in a secure file by the incident reporting support staff.

5.2 The completed Supervisor Report of Incident and supporting documents must be retained by the appropriate Resolution Consultants parent company. Records relating to occupational injury and accidents must be kept for up to 30 years, plus the length of employment.

6.0 Attachments

6.1 05-004-Form 1 Supervisor's Report of Incident

6.2 05-004-Form 2 Near-Miss Observation Report

6.3 05-004-Form 3 Supervisor's Incident Reporting Flowchart

6.4 05-004-Form 4 Incident Response and Reporting Instructions

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05-101-Emergency Response Planning, Office

1.0 Purpose and Scope

1.1 Addresses the requirements for preparation and planning for potential emergencies that may occur at a Resolution Consultants' office.

1.2 Applies to all Resolution Consultants offices and staff.

1.3 The intent of this plan is to

- Promote the safety of workers, visitors, and responders.
- Reduce the potential for destruction of goods and other property.
- Reduce the magnitude of environmental and other impacts.
- Help responders quickly determine and initiate proper remedial actions.
- Reduce recovery times and costs.
- Make workers, visitors, and responders more confident that emergencies will be properly managed.

2.0 Terms and Definitions

2.1 **Emergency:** An unplanned situation or event (including natural disasters) resulting in involvement of public emergency services, including police, firefighters, and paramedics, or environmental regulatory authorities.

2.2 **First Aid Provider:** Occupationally required to be trained in first aid, although may not be required by law to render first aid. A first aid provider responds as a "Good Samaritan." Uses a limited amount of equipment to perform initial assessment and to provide immediate life support and care while awaiting the arrival of emergency medical services.

2.3 **First Responder:** A designated individual who uses a limited amount of equipment to perform initial assessment and intervention and is trained to assist other emergency medical services.

2.4 **Emergency Medical Technician (EMT) Basic:** The second level of professional emergency medical care provider. An EMT is qualified to function as the minimum staff for an ambulance.

2.5 **EMT Intermediate:** The third level of professional emergency medical care provider. Can perform essential advanced techniques and administer a limited number of medications.

2.6 **Paramedic:** The fourth level of professional emergency medical care provider. Can administer additional interventions and medications.

3.0 References

3.1 05-106 Fire Protection, Office

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Office Managers or Administrators** are responsible for developing and implementing emergency response plans for their office.

4.2 First Aid

4.2.1 An assessment shall be made for each office to determine the minimum requirement for trained first aid attendants and first aid kits based on the legislation, office layout, and number of staff. At a minimum, all office floors/levels will have a minimum of

- One (1) designated first aid attendant (meeting legislative standards) for every 50 individuals; and
- One (1) first aid kit (meeting legislative standards).

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4.2.2 All Resolution Consultants offices will maintain adequate first aid kits in convenient and accessible locations as appropriate for the specific location. Contact the **SH&E department** for specific guidance.

4.2.3 First aid training shall be conducted by recognized providers and maintained in accordance with legislative requirements. Additional training may be required for personnel who have access to automated external defibrillators (AED).

4.2.4 Where required by the applicable OSHA, provincial, or territorial OHS legislation, every first aid room will:

- Be located in an area that is easily accessible to workers at all times, and near the work area it is to serve and toilet facilities;
- Have adequate lighting, ventilation, and heating and be covered by a floor made of non-porous material;
- Be of an adequate size to accommodate a stretcher;
- Be equipped with
  - Instructions on how and where to access a first aider,
  - A communication system capable of communicating with the medical facility to which an injured worker would be transported,
  - A permanently installed sink with hot and cold potable running water,
  - A cot or bed with a moisture-protected mattress and two pillows;
- Be clearly identified as a first aid room;
- Be used exclusively for the purposes of administering first aid and medical examinations and to provide rest for persons who are ill or injured;
- During working hours, be supervised by a first aider, as needed, who is readily available to provide first aid; and
- Be kept clean and sanitary.

4.2.5 All first aid equipment and supplies will be:

- Located at or near the work site they are intended to serve.
- Available and accessible during all working hours.
- Maintained in a clean, dry, and serviceable condition.
- Contained in a material that protects the contents from the environment and be clearly identified as first aid equipment and supplies.

4.2.6 During initial orientation and whenever there is a significant office change, staff will be introduced to their office first aid services, equipment, and supplies.

4.2.7 First aid kit location and first aid attendant information will be posted on safety boards and other conspicuous locations.

4.3 Emergency Response Plan

4.3.1 **Office Managers** or **Administrators** will establish and implement an Emergency Response Plan, including communicating the plan to all employees in the office.

4.3.2 The Emergency Response Plan will include:

- The location of the muster point, first aid, fire extinguishers, fire exits, Automated External Defibrillator (AED), and other emergency equipment.
- A contact list that includes fire, police, ambulance, poison control, first aiders onsite, security, SH&E committee (as applicable), SH&E Reporting number for reporting all Resolution Consultants incidents, and other required emergency contacts**.**

4.3.3 The emergency plan will be posted at all entrances and in other suitable locations throughout the workplace or, if posting is not practicable, other measures will be in place to confirm that the information is effectively communicated to workers. (See *5-101 Form 1 Emergency Response Plan Sample* for a sample template.)

4.3.4 The **Office Manager** is responsible for confirming that an evacuation drill is completed annually or more frequently as required by legislation, to confirm the effectiveness of the procedure and, as

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needed, take correction action. The 5-*101 Form 2 Emergency Response Drill Report* will be used to confirm the completion and effectiveness of the drill.

4.3.5 The **Office Manager** will confirm that the correct class, size, and number of extinguishers is available on every floor/level of the office in appropriate locations (e.g., lunch rooms). Fire extinguishers will be maintained in accordance with *5-106 Fire Protection, Office*.

4.3.6 Sinks and/or eye wash stations will be available where appropriate to hazards.

4.3.7 Location-specific emergency response plans and emergency kits will be maintained appropriate to the hazards associated with the location (e.g., earthquakes, tornadoes, hurricanes, etc.).

4.3.8 Emergency Response Plans shall be part of site SH&E audits.

4.3.9 Parking areas shall not restrict access by emergency personnel and vehicles.

4.4 Visitors

4.4.1 Reception shall maintain a Sign In/Out record for all guests. This record will be used to check and make sure all guests have been taken to the muster point in the event of an evacuation.

4.4.2 In the event of an evacuation, visitors working directly with an Resolution Consultants host will be the escorted by their host to the muster point.

4.4.3 For in-house meetings, safety orientations will be delivered before the meeting begins so all visitors are aware of the evacuation routes and procedures.

4.5 Travel Between Offices

4.5.1 If you are leaving the office for a day trip, leave details with reception, your supervisor, or other responsible party regarding your location and expected time of return.

4.6 Emergency Response

4.6.1 EMPLOYEES RESPONDING TO EMERGENCY SITUATIONS SHOULD TAKE NO UNNECESSARY RISK.

4.6.2 In the case of an emergency, the first aid attendant will promptly provide injured workers with a level of care within the scope of the attendant's training, objectively record observed or reported signs and symptoms of injuries and exposures to contaminants, and refer for medical treatment workers with injuries considered by the first aid attendant as being serious or beyond the scope of the attendant's training.

4.6.3 All incidents will be reported in accordance with *5-004 Incident Reporting*.

4.6.4 If emergency action is required to correct a condition that constitutes an immediate threat to workers, only those qualified and properly instructed workers necessary to correct the unsafe condition may be exposed to the hazard, and every possible effort will be made to control the hazard while this is being done.

4.7 Emergency procedures are outlined in *5-101 Form 3 Emergency Response to Specific Hazards*; however, in situations where no specific procedures have been established, common sense and sound judgment should be followed to determine the safest course of action.

4.7.1 Upon evacuation or dismissal, no unauthorized or nonessential personnel are allowed access to the facility during an emergency.

4.7.2 All emergency sites will be immediately secured to prevent unauthorized access or the possibility of further risk to workers, property, or the public at large.

4.7.3 All emergencies will be handled by the highest-ranking Resolution Consultants representative at the office.

4.7.4 Employees are required to assist, as able to do so, and follow directions from a lead manager in any emergency operation.

4.7.5 Employees should render assistance in the safest possible manner, using appropriate personal protective equipment and precautions.

4.7.6 In the event of an emergency, all employees and visitors will gather together at the muster point for a roll call.

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4.7.7 During an emergency, Resolution Consultants staff shall take direction from outside professional responders who shall be in control of the situation and Resolution Consultants members of the emergency team, e.g., emergency coordinator, floor wardens.

4.8 Post-Emergency Follow Up

4.8.1 Prior to resuming operations, the work area will be inspected to ensure that conditions are under control. In the case of a fire or bomb threat, this inspection is to be done by the ranking public emergency responder.

5.0 Records

5.1 Fire Drill Reports shall be maintained in the office safety files.

6.0 Attachments

6.1 05-10- Form 1 Emergency Response Drill Report

6.2 05-101-Form 2 Emergency Response Plan Sample

6.3 05-101-Form 3 Emergency Response to Specific Hazards

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05-101 Form 1 Emergency Response Drill Report

Administrative Information	
Office location:	**Type of drill (fire, earthquake, etc.):**
Date of drill:	**Time of drill:**
Drill conducted by:	**Emergency response drill report prepared by:**
Anticipated start date: **End date:**	**Are any environmental permits required?** ☐ **Yes** ☐ **No** **Describe:**
Drill Coordination	
Fire hall/department notified (name/phone #):	**Building supervisor notified (name/phone #):**
Date: **Time:**	**Contacted by:**
Drill Results	
Names of participants:	
Total # of participants:	**Time taken to complete the drill:**
Notes	
Comments/concerns:	
Follow-up required:	

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05-101 Form 2 Emergency Response Plan Sample

EMERGENCY EQUIPMENT & ESCAPE ROUTE PLAN

17107 - 107 Ave. (NUTANA II - SECOND FLOOR)

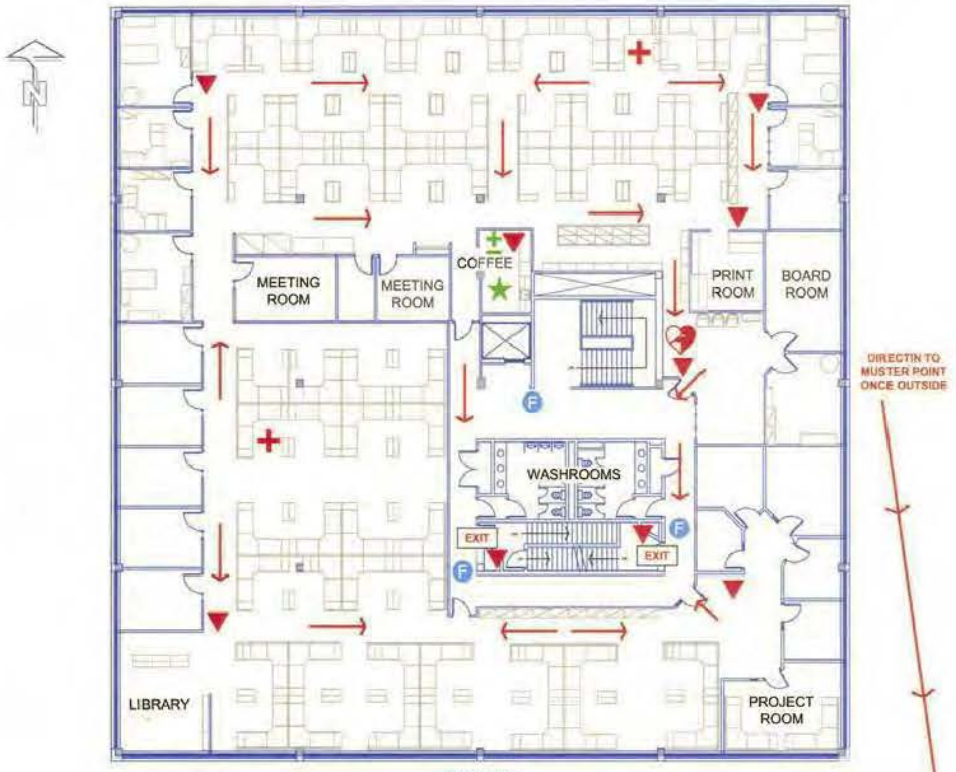
EMERGENCY EXIT PROCEDURE

1. AT THE SOUND OF THE ALARM, ALL STAFF ARE TO VACATE THE BUILDING THROUGH THE INDICATED STAIR WELLS AND OUT THE NEAREST EXTERIOR DOOR. DO NOT CLOSE THE DOOR TO YOUR OFFICE OR ROOM AS YOU LEAVE. **DO NOT USE THE ELEVATOR OR THE MAIN STAIRWELL**

2. FLOOR FIRE CAPTAINS ARE RESPONSIBLE FOR THE TIMELY EVACUATION OF THE EMPLOYEES IN THEIR DESIGNATED AREAS AND THE CLOSING OF ALL INTERIOR DOORS.

3. THE EMERGENCY MUSTER POINT IS LOCATED IN THE SOUTH PARKING AREA IN THE SOUTH DRIVING LANE MIDWAY BETWEEN NUTANA I AND II.

4. EMPLOYEES AND ANY GUESTS, CLIENTS, ETC. SHOULD REMAIN AT THE DESIGNATED MUSTER POINT UNTIL THE ALL SAFE HAS BEEN GIVEN TO GO BACK INTO THE BUILDING.



SECOND FLOOR

LEGEND

- ★ —— YOU ARE HERE
- ± —— FIRST AID STATION
- ✚ —— FIRST AID VOLUNTEER
- (F) —— FIRE ALARM PULL BOX
- ▼ —— FIRE EXTINGUISHER LOCATION
- AUTOMATED EXTERNAL DEFIBRILLATOR
- (M) —— APPROXIMATE MUSTER POINT LOCATION

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EMERGENCY FIRST AID PROCEDURES

(Life threatening and/or serious injury/illness)

DIAL 9 - 911

THEN dial 0, let reception know where the emergency is located and ask the receptionist to page for a first aid volunteer

POISON CONTROL 1-800-332-1414
ENVIRONMENTAL SPILLS 780-496-8200

FIRE CAPTAINS

FIRST FLOOR	EXT	SECOND FLOOR	EXT
RANDY ASH	7907	RADEANA BLAKEY	5933
DENISE NAGLE	7901	JONG MADRINAN	7095
RICK STUCKENBERG	7622		

FIRST AID VOLUNTEERS

FIRST FLOOR	EXT	SECOND FLOOR	EXT
LESTER CHUTE	7611	DANIEL TYRALKO	0714
AKKE PLESMAN	7014	DOBRY MIHOV	7670
JAYCEE KOZAR	3024		

NON-EMERGENCY PHONE NUMBERS

EDMONTON POLICE DEPARTMENT
WEST DIVISION STATION
ADDRESS: 16505 100 AVENUE
PHONE 780-423-4567

EDMONTON FIRE DEPARTMENT
PHONE 780-496-3800

MISERICORDIA COMMUNITY HOSPITAL
ADDRESS: 16940 87 AVENUE
PHONE: 930-5611

AMBULANCE SERVICES
PHONE 780-496-3600

WESTEND MEDICENTER
ADDRESS: 9509 156 STREET
TELEPHONE: 489-4975

ENVIRONMENT CANADA
PHONE 780-951-8625

SH&E COMMITTEE

LANCE PEPPER (MANAGER CO-CHAIR)	780-486-7098	KRISTI BECKMAN	780-732-9451	JULIE BILUK	780-486-7903	RADEANA BLAKEY	780-486-5933
NEIL PFEFFERLE (EMPLOYEE CO-CHAIR)	780-732-9476	RAYMOND CLARKE	780-638-2219	TRICIA HAMILTON	780-732-9452	AKKE PLESMAN	780-486-7014
		NICK OKE	780-486-7057	JAWAD RASHID	780-486-7942	GURPREET SINGH	780-486-7069
		STEVE WHITENECT	780-732-9441	GREG WRIGHT	780-486-5922	WOJTEK ZIELECKI	780-486-7673

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5-101 Form 3 Emergency Response to Specific Hazards

1.0 Injury or Health-Related Emergencies

1.1 In the event of serious illness or injury:

1.1.1 Do not move the victim or leave him or her alone unless absolutely necessary.

1.1.2 Call for emergency medical assistance.

1.1.3 Provide first aid to the level of qualification. Record the first aid given in the First Aid Treatment Record.

1.1.4 Request assistance from other first aiders as necessary.

1.1.5 Notify the immediate supervisor or manager.

1.1.6 If you are the injured or ill party, call for help and do not drive yourself to the hospital.

1.1.7 Arrange for hospital emergency service, medical practitioner's office emergency service, or medical practitioner's appointment, as needed.

1.2 In the event of minor injuries:

1.2.1 If required, summon assistance.

1.2.2 Initiate first aid immediately as necessary.

1.2.3 Follow up as needed.

2.0 Fire

2.1 If you discover a fire:

2.1.1 If the building has a fire alarm, use the pull station at the nearest exit to sound the alarm. If the building does not have fire alarm pull stations, follow the building's designated fire alarm procedures.

2.1.2 Leave the building immediately and assemble at the designated muster place. Do not go back to your desk for your coat, bag, etc.

2.1.3 If you cannot reach an exit because of smoke or fire, go to an alternate exit. If all exits are blocked, go to a perimeter office and seal the bottom of the door with an article of wet clothing or tape if possible. Call 911 to advise the operator of your location. If the room begins to fill with smoke, move toward the window in a crouched position. Signal firefighters by waving a white object in the window.

2.1.4 Confirm that everyone is out of the building and notify the designated fire warden or emergency services of anyone whose whereabouts is unconfirmed.

2.1.5 Once outside, you will be instructed when it is safe to return to the building.

2.2 If you hear an alarm:

2.2.1 Leave immediately via the designated exits.

2.2.2 Move away from the building and go to designated muster point.

2.2.3 If you cannot reach an exit because of smoke or fire, go to an alternate exit. If all exits are blocked, go to a perimeter office and seal the bottom of the door with an article of wet clothing or tape if possible. Call 911 to advise the operator of your location. If the room begins to fill with smoke, move toward the window in a crouched position. Signal firefighters by waving a white object in the window.

2.2.4 Confirm that everyone is out of the building and notify the designated fire warden or emergency services of anyone whose whereabouts is unconfirmed.

2.2.5 Once outside, you will be instructed when it is safe to return to the building.

3.0 Electrical Storms

3.1 Guidelines

3.1.1 Lightning can strike several miles/kilometres from its source, so early precautions are crucial. If thunderstorms are in the forecast, reassess your plans for outdoor activities.

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3.1.2 If you can hear thunder, then you are close enough to the storm to be at risk.

3.1.3 You are considered to be in the high danger zone if you are less than 6 miles/10 kilometres away. Use the 30/30 Rule to help you. If you can count 30 seconds or less between seeing lightning and hearing thunder, you should seek shelter immediately.

3.1.4 Do not resume any outdoor activities until you have waited at least 30 minutes after hearing the last clap of thunder. It is crucial to ensure that the risk of a lightning strike has passed completely.

3.2 **Do:**

3.2.1 Stay clear of high ground and open spaces.

3.2.2 Seek shelter in a house, large building, or motor vehicle (if there is no other shelter). Keep windows and doors shut.

3.2.3 If you are riding a bicycle, motorcycle, or ATV, get off and seek shelter immediately. The rubber tires will not protect you.

3.2.4 If you are boating, head for shore. If caught on the water, crouch low in the boat.

3.2.5 If you are in a flat, open field, bend down and put your hand on your knees. Maintain minimum contact with the ground.

3.2.6 Avoid contact with metal. Stay at least 30 metres away from metal fences and take off shoes that have metal cleats.

3.2.7 Stay away from water, including lakes and puddles.

3.2.8 Stay sheltered until the storm is over.

3.3 **Don't:**

3.3.1 Don't seek shelter under a tree, in a shed, or in a small, open building.

3.3.2 Don't lie down on the ground.

3.3.3 Don't take a shower or bath. If lightning strikes the plumbing system it can be conducted into the tub or shower.

3.3.4 Don't use the phone or electrical appliances unless absolutely necessary. Electricity travels through wires.

3.3.5 Don't use a mobile phone outdoors.

3.3.6 Don't hold a golf club, umbrella, or fishing rod.

3.3.7 Don't travel in a severe storm. If you are caught in your car, keep windows closed and park off the road away from power lines.

3.3.8 Don't try to finish your activity; find shelter and wait out the storm.

3.3.9 Staff will not travel in areas where there is a severe thunderstorm warning.

4.0 Tornadoes

4.1 Guidelines

4.1.1 When a tornado approaches, anyone in its path should take shelter indoors—preferably in a basement or an interior first-floor room or hallway. Avoid basement or firs-floor shelter areas with heavy equipment located on the floor directly above.

4.1.2 Make yourself as small as possible by crouching into a ball-like position covering your head and neck.

4.1.3 Avoid windows and seek additional protection by getting underneath large, solid pieces of furniture.

4.1.4 Avoid automobiles and mobile homes, which provide almost no protection from tornadoes.

4.1.5 Those caught outside should lie flat in a depression or on other low ground and wait for the storm to pass.

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5.0 Hurricanes

5.1 Guidelines

5.1.1 Coastal residents should form evacuation plans before a warning is issued to identify a safe shelter and a route to get there.

5.1.2 Stock up on emergency supplies including food, water, protective clothing, medications, batteries, flashlights, important documents, road maps, and a full tank of gasoline.

5.1.3 As a storm unfolds, evacuees should listen to local authorities on radio or television. Evacuation routes often close as a storm develops.

5.1.4 Dedicated professionals and improved technology have made hurricane forecasting more accurate than ever before, but it is far from precise.

5.1.5 If forced to weather a storm, get inside the most secure building possible and stay away from windows.

5.1.6 Remember that a lull often signifies the storm's eye—not its end. Anyone riding out a hurricane should wait for authorities to announce that the danger has passed.

6.0 Earthquakes

6.1 Drop down; take cover under a strong desk or table and hold on.

6.2 Stay indoors until the shaking stops and you are sure that it is safe to exit.

6.3 Stay away from bookcases or furniture that can fall on you.

6.4 Stay away from windows. In a high-rise building, expect the fire alarms and sprinklers to go off during a quake.

6.5 If you are in bed, hold on and stay there, protecting your head with a pillow.

6.6 If you are outdoors, find a clear spot away from buildings, trees, and power lines. Drop to the ground.

6.7 If you are in a car, slow down and drive to a clear place. Stay in the car until the shaking stops.

7.0 Gas Leak

7.1 Gas Odor

7.1.1 Leave the area immediately.

7.1.2 Notify your immediate supervisor/manager and Local Business Continuity Coordinator.

7.1.3 Refrain from using ignition sources (cigarettes, electrical devices, etc., including cell phones).

7.1.4 Do not turn on lights or other electrical switches.

7.1.5 Warn others in the area.

7.1.6 Meet with responding personnel to identify the location of the odor.

7.2 Major Leak

7.2.1 Initiate building evacuation as designated by the building's emergency evacuation plan.

7.2.2 Call 911.

7.2.3 Do not re-enter the building until authorized by the Chief Fire Warden.

7.2.4 Secure area and warn others.

7.2.5 Meet with responding personnel to provide additional information.

7.2.6 Refrain from using ignition sources (cigarettes, electrical devices, etc including cell phones).

7.2.7 Do not turn on lights or other electrical switches.

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8.0 Violence or Potential for Violence

8.1 Threat is not imminent or clearly evident:

8.1.1 Remain calm.

8.1.2 If they are in an Resoultion Consultants-controlled workplace, ask the person to leave the area and the building or advise the person that you will call your supervisor to assist them.

8.1.3 Do not put yourself at increased risk.

8.1.4 Speak in a soft, non-threatening manner.

8.1.5 Do not touch the person or try to disarm them.

8.1.6 Avoid hostile actions or interactions, except to maintain personal safety.

8.1.7 Try to leave the area, get into the nearest room, or out of sight of the person.

8.1.8 Report the incident as soon as possible.

8.2 If the threat is imminent:

8.2.1 Get to a safe place, or hide under a desk or other piece of furniture or equipment.

8.2.2 Block the entrance to your room, if possible.

8.2.3 Keep still, stay silent, and listen.

8.2.4 If possible, call 911 and report the emergency.

8.2.5 Stay in your safe place and listen for instructions from emergency response team or other rescuers from emergency services.

9.0 Bomb Threat

9.1 When the threat is received by phone:

9.1.1 Remain calm.

9.1.2 Unless you are told that the bomb is set to go off within several minutes, try to keep the caller talking.

9.1.3 Write down all the information you receive; use exact words when possible. Get these key facts if you can:

9.1.4 Date and time of the call.

9.1.5 When the bomb is set to go off.

9.1.6 Which part of the building is it in?

9.1.7 Type of bomb.

9.1.8 Identifiable characteristics of the caller; e.g. male/female, accent, laughing /serious.

9.1.9 Any background noises you can hear.

9.1.10 Do not hang up the phone.

9.1.11 Do not put the caller on hold or transfer the call.

9.1.12 Try to alert someone close by to call a supervisor or 911.

9.1.13 After the call has ended, record as much information as possible. Try to note the caller's gender and age, the length of the call, time, and date the call was received, and any of the following:

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Caller's Voice Characteristics		
calm	normal	ragged
angry	distinct	clearing throat
excited	slurred	deep breathing
slow	whispered	cracking
rapid	nasal	disguised
soft	stutter	accent
loud	lisp	familiar (who did it sound like)
laughter	raspy	
crying	deep	
Background Sounds		
street noise	motor	local
dishes	office machinery	cell
voices	factory machinery	long distance
PA system	animals	booth
house noises	clear	other
Language Type		
well spoken	incoherent	message read by the threat maker
foul	taped	
irrational	accent (from where)	

9.2 **Written threat message:**

9.2.1 Remain calm.

9.2.2 Notify your supervisor and provide details.

9.2.3 Preserve the evidence.

10.0 Mail Threat

10.1 **Should a threat be received by mail:**

10.1.1 Cease handling the mail.

10.1.2 Evaluate the circumstances and inform the Office Manager or the Manager of Administration.

10.1.3 Notify the police by calling 911.

10.1.4 The police/ Management Team will decide if evacuation is required.

10.1.5 No one must touch the mail until turned over to the police.

11.0 Suspicious Package

11.1 **Should a suspicious package or explosive be found:**

11.1.1 Do not handle or disturb the package.

11.1.2 Evacuate everyone to a safe distance.

11.1.3 Inform the Office Manager or the Manager of Administration.

11.1.4 Notify the police by calling 911.

11.1.5 The police/senior management will decide if evacuation is required.

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05-106-Fire Protection, Office

1.0 Purpose and Scope

1.1 Establishes the Resolution Consultants requirements for the selection, placement, use, and inspection of fire extinguishing and fire detection equipment.

1.2 This procedure applies to all Resolution Consultants offices and staff.

2.0 Terms and Definitions

2.1 **Combustible liquid**: A liquid that will be heated to a temperature of 100° F or 37.8^{o} C to emit sufficient vapors to form an ignitable mixture with the air.

2.2 **Flammable liquid**: A liquid that gives off enough vapor to form an ignitable mixture with air at ambient temperatures (less than 100° F or 37.8^{o} C).

3.0 References

3.1 05-004-Incident Reporting

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 The **Office Manager** shall confirm that any fire extinguishing and detection equipment established at Resolution Consultants facilities or leased facilities is appropriately inspected by the building's facilities management.

4.1.2 The **Office Manager** shall determine the leased building facility's arrangement for the inspection and servicing of fire extinguishing, detection, and suppression equipment.

4.1.3 The **Office Manager** shall confirm that fire protection equipment that Resolution Consultants owns or leases shall be inspected and maintained in accordance with local fire codes.

4.1.4 **Employees** shall familiarize themselves with the fire response and protection procedures that apply to their office and client sites when working for extended periods of time within the facilities of a client.

4.1.5 It is the responsibility of the office **Fire Warden** or equivalent (in conjunction with the **safety committee** where applicable) to confirm that the extinguishers are kept charged and checked regularly for corrosion or any other external damage.

4.2 Planning

4.2.1 All offices will be equipped with a fire extinguisher and/or fire protection equipment appropriate to the number of staff, location of the work, and job task, as dictated by legislation or client requirements.

4.2.2 All employees shall be constantly on the alert for conditions that might contribute to a fire and shall remove or report the hazard.

4.2.3 Do not use gasoline or other flammable liquids as degreasing or cleaning agents. Use only approved solvents or other combustible liquids.

4.2.4 All employees shall know the location of firefighting equipment in their work area.

4.2.5 Access to a firefighting equipment will never be blocked by material, equipment, or shelving.

4.2.6 A schedule for inspecting fire equipment to confirm that it is in place, accessible, and fully charged shall be developed. Inspection and maintenance shall be conducted in accordance with the manufacturer's instructions.

4.3 In the Event of a Fire

4.3.1 Activate the nearest fire alarm or call for help, if available, before attempting to extinguish a fire. If the fire is too big to control with the equipment at hand, retreat.

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4.3.2 Never turn your back on a fire. Always back away until you are at a safe distance.

4.3.3 Never use water on an electrical fire.

4.3.4 All fire extinguisher contents shall be applied from upwind and directed at the base or outer edge of the fire with a sweeping motion. Never return a discharged fire extinguisher to its normal location. Take it out of service for recharging and replace it with a fully charged unit.

4.4 Fire Extinguishers

4.4.1 A minimum of one fire extinguisher shall be present in all offices in an obvious location that is known to all staff.

4.4.2 Fire extinguishers will also be available in locations where flammable or combustible materials are stored, handled, or used.

4.4.3 Fire extinguishers will be readily accessible, properly maintained, regularly inspected, and promptly refilled immediately after use.

4.4.4 Only trained personnel should use a fire extinguisher. In the event of a fire, follow the site-specific or project-specific emergency procedures for contacting the local fire department.

4.4.5 Location and Identification of fire extinguishers. Fire extinguishers will be located and installed as follows:

- Located where they are readily seen. If an obstruction is unavoidable, then a sign indicating the location of the extinguisher and/or color symbol (e.g., red markings) will be used.
- Fire extinguishers will always be positioned with the label visible.
- If extinguishers of different classes (e.g., one Class A and one Class B) are stored together, then they will be marked using stencils or signs indicating clearly for which type of fire each will be used.
- If an extinguisher contains an electrically conductive agent (e.g., water), it will be clearly labeled with a sign that states “Not for Electrical Fires” with letters visible from at least 3 feet away.
- Extinguishers will not be left on the floor but will be hung on a wall, column, or other appropriate support or will be of the wheeled or cart type. Extinguishers of not more than 40 pounds will be hung so that the top is not more than 5 feet above the floor. Extinguishers greater than 40 pounds will be hung so that the top is not more than 3½ feet from the floor. The bottom of the extinguisher will not be less than 4 inches from the floor.
- Extinguishers will be suitable for use at temperatures of 40 degrees to 120 degrees Fahrenheit. Therefore, the locations mounted will allow for maintenance of the extinguishers within the temperature range.

4.5 Fixed Fire Protection Equipment

4.5.1 The design of fixed fire protection equipment will be reevaluated whenever the occupancy changes (e.g., increases) or the fire hazards increase.

4.5.2 Fixed fire protection systems will be installed in all areas inside buildings in which flammable liquids are mixed, dispensed, applied, or used for washing or quenching, except:

- A dip tank holding less than 150 gallons, having a surface area less than 4 square feet, or both.
- As dispensed from approved safety containers of 5 gallons or less.

4.5.3 Sprinkler heads will not be painted or coated.

4.5.4 An automatic sprinkler will be replaced every 50 years or earlier if it shows evidence of corrosion, leakage, or damage.

4.5.5 Sprinklers will be installed or removed only using a sprinkler wrench designed specifically for that purpose.

4.5.6 Pipe hangers will be replaced/repaired when broken or loose.

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4.5.7 New sprinkler installation will be designed and installed as required by applicable safety standards and building codes.

4.5.8 Fire detection systems will be located away from or by other means protected from mechanical or physical damage.

4.6 Inspection of Fire Equipment

4.6.1 Inspection, Maintenance, and Testing of Portable Extinguishers

- The use or discharge of any fire extinguisher by an Resolution Consultants employee shall be immediately reported to the Supervisor. A Supervisor's Incident Report shall be developed and submitted in accordance with 0*5-004 Incident Reporting*.
- Extinguishers are to be inspected monthly to ensure that they are still in the proper location, have not been used or tampered with, are still properly charged, and have no obvious external damage. The initials of the inspector and the date of inspection will be noted on the tag attached to the extinguisher.
- Any extinguisher showing damage will be replaced.
- A thorough inspection will be performed annually by personnel specifically trained in the inspection (e.g., extinguisher supplier).
- Extinguishers will be tested and recharged by qualified contractors as required by the applicable regulations and standards.

4.6.2 Inspection, Maintenance, and Testing of Fixed Systems

- Fixed fire protection equipment will be inspected and maintained by personnel specifically trained in the specific procedures to perform these tasks.
- Records of the testing and inspection of fixed systems will be maintained for at least three years.
- Sprinkler systems will be tested at a minimum as follows:
  - Annually – perform a main drain flow test.
  - Every 2 years – open the inspector's test valve to ensure that the system operates properly.
- Any hose and standpipes will be inspected annually by appropriately trained personnel.
- Test fire detection systems (e.g., smoke alarms) annually and record the results of the test. This testing will be performed by personnel specifically trained to do the testing.

5.0 Records

5.1 Fire Extinguisher Inspection reports will be maintained in the office safety files.

6.0 Attachments

6.1 05-106-Form 1 Portable Fire Extinguishers

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05-106 Form 1 Portable Fire Extinguishers

1.0 Portable Fire Extinguishers

1.1 Selection Requirements

Portable extinguishers will be selected based on the following classifications:

Classification	Type of Fire
Class A	Combustible materials
Class B	Flammable liquid, gas, or grease
Class C	Electrical equipment
Class D	Combustible metal

In addition, portable fire extinguisher selection, placement, and fire protection systems designed for use on a project or in an Resolution Consultants office will be made in conjunction with an Resolution Consultants SH&E Representative, the local Fire Department, or a professional fire protection systems contractor. Unless otherwise approved by an Resolution Consultants SH&E Representative, fire extinguishers selected for use will be of the Type A, B, and/or C variety, typically charged with water, carbon dioxide, nitrogen, a dry chemical, or other approved extinguishing agent.

1.2 Class A Extinguishers

The number of Class A extinguishers will be based on the following:

	Light (low) Hazard Occupancy	Ordinary (moderate) Hazard Occupancy	Extra (high) Hazard Occupancy
Minimum rated single extinguisher	2-A	2-A	2-A
Maximum floor area per unit of A	3,000 sq. ft.	1500 sq. ft.	1000 sq. ft.
Maximum floor area for extinguisher	11,250 sq. ft.	11,250 sq. ft.	11,250 sq. ft.
Maximum travel distance to extinguisher	75 ft.	75 ft.	75 ft.

The availability of Class A extinguishers can be satisfied with the use of extinguishers with multiple ratings (e.g., Class A, B, and C). In addition, where automatic sprinkler systems are present, the maximum floor area for each extinguisher does not apply; however, the 75-foot travel distance does.

1.3 Class B Extinguishers

Class B extinguishers will be provided according to the severity of the hazard as listed below:

Fire extinguishers labeled prior to June 1, 1969	
TYPE OF HAZARD	BASIC MINIMUM EXTINGUISHER RATING
Light	4B
Ordinary	8B
Extra	12B

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Fire extinguishers labeled after June 1, 1969	
TYPE OF HAZARD	BASIC MINIMUM EXTINGUISHER RATING
Light	5B, 10B
Ordinary	10B, 20B
Extra	20B, 40B

An open tank in a building having flammable liquids in depth exceeding ¼ inch will be provided with sufficient extinguishers to provide 1 numerical unit of Class B or each square foot of tank surface area, the minimum extinguisher being a 5B (using labels after June 1, 1969). For example, a tank with a surface area of 50 square feet will require two Class 20B (or one 40B) and one Class 10B extinguisher. For tanks exceeding 100 square feet in surface area, a fixed extinguisher will be provided, in addition to sufficient portable extinguishers for the numerical unit of Class to equal 100 (e.g., two Class 40B and one Class 20 B).

All Class B extinguishers will be located on the same floor as the hazard, with a travel distance of no more than 50 feet. For widely separated hazards (e.g., boiler rooms, paint storage areas, kitchens), a separate extinguisher for each class of hazard will be provided if the travel distance is more than 25 feet.

1.4 Class C Extinguishers

Class C extinguishers (one 15-pound carbon dioxide or equivalent) will be provided within 25 feet of a high hazard area containing an electrical distribution source such as a generator, transformer, or main switchgear. Also, the extinguisher size and locations will be determined based on the expected type of fire (combustible-Class A or flammable-Class B) as noted above.

1.5 Class D Extinguishers

A Class D extinguisher for the specific type of combustible metal will be kept within 25 feet of the area where the metal is machined or processed.

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05-106-Portable Fire Extinguishers

1.0 Portable Fire Extinguishers

1.1 Selection Requirements

Portable extinguishers will be selected based on the following classifications:

Classification	Type of Fire
Class A	Combustible materials
Class B	Flammable liquid, gas, or grease
Class C	Electrical equipment
Class D	Combustible metal

In addition, portable fire extinguisher selection, placement, and fire protection systems designed for use on a project or in an Resolution Consultants office will be made in conjunction with an Resolution Consultants SH&E Representative, the local Fire Department, or a professional fire protection systems contractor. Unless otherwise approved by an Resolution Consultants SH&E Representative, fire extinguishers selected for use will be of the Type A, B, and/or C variety, typically charged with water, carbon dioxide, nitrogen, a dry chemical, or other approved extinguishing agent.

1.2 Class A Extinguishers

The number of Class A extinguishers will be based on the following:

	Light (low) Hazard Occupancy	Ordinary (moderate) Hazard Occupancy	Extra (high) Hazard Occupancy
Minimum rated single extinguisher	2-A	2-A	2-A
Maximum floor area per unit of A	3,000 sq. ft.	1500 sq. ft.	1000 sq. ft.
Maximum floor area for extinguisher	11,250 sq. ft.	11,250 sq. ft.	11,250 sq. ft.
Maximum travel distance to extinguisher	75 ft.	75 ft.	75 ft.

The availability of Class A extinguishers can be satisfied with the use of extinguishers with multiple ratings (e.g., Class A, B, and C). In addition, where automatic sprinkler systems are present, the maximum floor area for each extinguisher does not apply; however, the 75-foot travel distance does.

1.3 Class B Extinguishers

Class B extinguishers will be provided according to the severity of the hazard as listed below:

Fire extinguishers labeled prior to June 1, 1969	
TYPE OF HAZARD	BASIC MINIMUM EXTINGUISHER RATING
Light	4B

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Ordinary	8B
Extra	12B
Fire extinguishers labeled after June 1, 1969	
TYPE OF HAZARD	BASIC MINIMUM EXTINGUISHER RATING
Light	5B, 10B
Ordinary	10B, 20B
Extra	20B, 40B

An open tank in a building having flammable liquids in depth exceeding ¼ inch will be provided with sufficient extinguishers to provide 1 numerical unit of Class B or each square foot of tank surface area, the minimum extinguisher being a 5B (using labels after June 1, 1969). For example, a tank with a surface area of 50 square feet will require two Class 20B (or one 40B) and one Class 10B extinguisher. For tanks exceeding 100 square feet in surface area, a fixed extinguisher will be provided, in addition to sufficient portable extinguishers for the numerical unit of Class to equal 100 (e.g., two Class 40B and one Class 20 B).

All Class B extinguishers will be located on the same floor as the hazard, with a travel distance of no more than 50 feet. For widely separated hazards (e.g., boiler rooms, paint storage areas, kitchens), a separate extinguisher for each class of hazard will be provided if the travel distance is more than 25 feet.

1.4 Class C Extinguishers

Class C extinguishers (one 15-pound carbon dioxide or equivalent) will be provided within 25 feet of a high hazard area containing an electrical distribution source such as a generator, transformer, or main switchgear. Also, the extinguisher size and locations will be determined based on the expected type of fire (combustible-Class A or flammable-Class B) as noted above.

1.5 Class D Extinguishers

A Class D extinguisher for the specific type of combustible metal will be kept within 25 feet of the area where the metal is machined or processed.

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5-202-Competent Person Designation Form

Company:	Resolution Consultants		
Project Location:	Naval Air Station Whiting Field, Milton, FL	**Job Number:**	JM44 and JM57
Designated Competent Person:	Bill Duffy	**ID Number:**	

Check the technical activity for which the Designation will apply:

☐ Asbestos	☒ Ionizing Radiation
☐ Blasting & Explosives	☐ Lead
☐ Concrete & Masonry Construction	☐ Material Hoists & Personnel Hoists
☒ Confined Space Entry	☐ Stairways & Ladders
☒ Control of Hazardous Energy (Lockout/Tagout)	☒ Respiratory Protection
☐ Cranes & Derricks	☐ Rigging Equipment
☐ Demolition	☐ Scaffolds
☐ Electrical Wiring Design & Protections	☐ Steel Erection
☐ Fall Protection	☒ Trench & Excavations
☒ Hearing Protection	☐ Underground Construction
☐ Heavy Equipment	☐ Welding & Cutting

Other (Explain):

The Resolution employee identified has been designated as the Competent Person in the technical area specified, and by the Project Manager identified. This designation is based on the following:

1. The Project Manager is authorizing the competent person to allocate whatever resources that are necessary to perform tasks associated with the area of competency to provide a safe work environment and comply with applicable regulatory and legislative requirements, and Resolution SH&E procedures and policies.
2. The Project Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience

Print name and sign below

Designated by: _____ **Date:** _____
(Resolution Project Manager)

Designated by: _____ **Date:** _____
(Resolution Regional SH&E Manager or Designee)

Comments:

Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.

5-202-Competent Person Designation Form

Company:			
Project Location:		**Job Number:**	
Designated Competent Person:		**ID Number:**	

Check the technical activity for which the Designation will apply:

☐ Asbestos	☐ Ionizing Radiation
☐ Blasting & Explosives	☐ Lead
☐ Concrete & Masonry Construction	☐ Material Hoists & Personnel Hoists
☐ Confined Space Entry	☐ Stairways & Ladders
☐ Control of Hazardous Energy (Lockout/Tagout)	☐ Respiratory Protection
☐ Cranes & Derricks	☐ Rigging Equipment
☐ Demolition	☐ Scaffolds
☐ Electrical Wiring Design & Protections	☐ Steel Erection
☐ Fall Protection	☐ Trench & Excavations
☐ Hearing Protection	☐ Underground Construction
☐ Heavy Equipment	☐ Welding & Cutting

Other (Explain):

The Resolution employee identified has been designated as the Competent Person in the technical area specified, and by the Project Manager identified. This designation is based on the following:

1. The Project Manager is authorizing the competent person to allocate whatever resources that are necessary to perform tasks associated with the area of competency to provide a safe work environment and comply with applicable regulatory and legislative requirements, and Resolution SH&E procedures and policies.
2. The Project Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience

Print name and sign below

Designated by: _____ **Date:** _____
(Resolution Project Manager)

Designated by: _____ **Date:** _____
(Resolution Regional SH&E Manager or Designee)

Comments:

Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.

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5-202-Competent Person Designation

1.0 Purpose and Scope

1.1 Outlines the process and minimum requirements necessary for classifying an Resolution employee as a “Competent Person” in one or more activity areas.

1.2 This procedure applies to all Resolution based employees and operations where Resolution is self-performing the identified activities and where Resolution controls projects performing the activities requiring a Competent Person. Client-mandated requirements may apply on a project-specific basis and shall be addressed in supplemental documents (e.g., Task Hazard Analysis or Health and Safety Plan).

1.3 It is recognized that regulations and legislation may contain alternate definitions for Competent Person and it will be the responsibility of the **Project Manager** to determine if conflicts exist between Resolution and applicable regulatory/legislative definitions and resolve the conflict.

1.4 When a qualified employee within Resolution is not available to be designated as the Resolution Competent Person, the **Project Manager** in coordination with their **Regional SH&E Manager** may designate an appropriately qualified and trained Contractor employee as the Competent Person for the project.

2.0 Terms and Definitions

2.1 **Competent Person:** One who is capable of identifying existing and predictable hazards in surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization and resources to take prompt corrective measures to eliminate them.

2.2 **HASP:** Project Health and Safety Plan.

3.0 References

None.

4.0 Procedure

4.1 The following activities require an individual to be designated as a competent person:

4.1.1 Asbestos

4.1.2 Blasting & Explosives

4.1.3 Concrete & Masonry Construction

4.1.4 Confined Spaces

4.1.5 Control of Hazardous Energy (Lockout-Tagout)

4.1.6 Cranes & Derricks

4.1.7 Demolition

4.1.8 Electrical Wiring Design & Protections

4.1.9 Fall Protection

4.1.10 Hearing Protection

4.1.11 Heavy Equipment

4.1.12 Ionizing Radiation

4.1.13 Lead

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4.1.14 Material Hoists & Personnel Hoists

4.1.15 Stairways & Ladders

4.1.16 Respiratory Protection

4.1.17 Rigging Equipment

4.1.18 Scaffolds

4.1.19 Steel Erection

4.1.20 Trench & Excavations

4.1.21 Underground Construction

4.1.22 Welding & Cutting

4.2 The Resolution competent person field functions are dependent on the project activities and Resolution's field function. Refer to each SH&E Standard Operating Procedure (SOP) for the activities listed above and the associated legislative (e.g., OSHA) standard to determine the details of responsibility. Generally, it is the Competent Person's responsibility to be onsite at all times when Resolution staff are performing work governed by this SOP, make daily inspections of the conditions and work activities, and take actions to control any hazards associated with those activities.

4.3 The *5-202-Competent Person Designation* shall be used on all projects for documenting Competent Person designations. It must be filled out completely and updated as necessary by the contractor.

4.4 **Roles and Responsibilities**

4.4.1 A Competent Person in Resolution is an employee who functions in a technical role when either Resolution self-performs associated field work (above) or oversees and directs the work of subcontractors. For operations where Resolution is providing oversight of subcontractors (ex. drilling services), it is the subcontractors employee who is the Competent Person on-site for that phase of operation.

4.4.1.1 Any Resolution employee considered for designation as a "Competent Person" shall:

- Complete a Training Needs Assessment (TNA) with their Supervisor under the guidance of the **Regional SH&E Manager**, regarding competent person's requirements;
- Obtain approval from their supervisor prior to enrolling in any Resolution-sponsored safety competent person training program.
- Track his or her own training anniversary dates and arrange for appropriate refresher training at least 30 days prior to expiration of certification

4.4.1.2 Contractor Competent Persons

- Unless Resolution is self-performing, the Contractor is responsible for determining the safe means and methods of its work activities.
- The Contractor is responsible for designating its Competent Person(s) for each category of work it undertakes as required above.
- The Contractor's Competent Person is responsible for technically supporting the Contractor's site operations for the safe execution of its activities.
- The Contractor's Competent Person should be knowledgeable about the work activities, compliance with the associated safety and health regulations, identifying and removing any attendant field hazards and the Contractor's work practices and procedures.
- For work on Resolution controlled sites, the **Project Manager** confirms that the Contractor designates a Competent Person(s) for its activities. *5-202-Competent Person Designation* or the equivalent may be use for this purpose.

4.4.2 **Project Manager**/Field Task Manager/Supervisor are responsible for ensuring that all assigned personnel, including personnel utilized from other offices to support their operations, comply with the requirements of this procedure. The **Project Manager** shall:

- Designate the Competent Person based on the work activity using *5-202- Competent Person Designation***;**
- Implement corrective actions when employees fail to meet training requirements;
- Identify supplemental employee training needs based on local/client requirements;
- Verify competent person training requirements are reviewed with each employee, based upon current and anticipated job functions and past performance on a routine basis;
- Identify additional employees requiring competent person training based on this procedure;
- For projects controlled by Resolution, when these activities are contracted to another party, secure the identity of the Contractor's Competent Person(s), provide them with a copy of this SOP to verify the Contractor's capability to comply with the requirements within, and obtain documentation to support the designation of the Contractor employee as a Competent Person for Resolution;
- Verify the designation of the Competent Person for a specific activity is effectively communicated to field personnel on site during daily tailgate safety meetings.

4.4.3 The **Regional SH&E Manager** or designee will work with operations to assess the competency of all designated persons based on specific requirements outlined in this procedure. With the **Project Manager** or designee determining the work-specific Competent Person, the **Regional SH&E Manager** provides guidance as needed. The SH&E Department (i.e., **Regional SH&E Manager**) with operations is responsible for:

- Establishing competent person training/experience requirements and communicating these requirements to line management.
- Monitoring the overall implementation of this SOP.
- Monitoring field compliance of this procedure.
- Providing technical assistance/support as requested by **Regional and District Managers**.
- Performing internal safety training classes as requested by **Regional and District Managers**.
- Supporting the **Project Manager** in establishing minimum competent person requirements for regulated job activities based on individual job descriptions, applicable regulatory requirements, operational considerations, and management directives.
- Reviewing and approving as requested by designated operations representatives the Competent Person's qualifications for Resolution employees.
- Develop and maintain a process to track employee training compliance and anniversary dates.

5.0 Records

5.1 Resolution Competent Person Designation forms shall be maintained in the project file.

5.2 Documentation as to daily inspections and corrective measures by the Resolution Competent Person shall be maintained in the project file.

6.0 Attachments

6.1 5-202-Competent Person Designation Form

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05-205-Equipment Inspections and Maintenance

1.0 Purpose and Scope

1.1 This procedure establishes the Resolution Consultants requirements for the maintenance, inspection, and repair of Resolution Consultants-owned equipment used by Resolution Consultants staff to prevent unsafe conditions from developing.

1.2 This procedure applies to all Resolution Consultants staff and operations.

1.3 This procedure does not apply to Personal Protective Equipment.

2.0 Terms and Definitions

2.1 **Equipment**: Any machinery, tools, or other devices that serve a function and are used during work for Resolution Consultants business.

2.2 **Inspection**: A formal (planned, documented) or informal (ongoing observations/physical checks, not documented) review of the condition and function of the equipment, the purpose of which is to identify any damage or condition that might pose a hazard or impair the proper functioning of the equipment.

2.3 **Maintenance**: Regular care and upkeep of equipment in accordance with manufacturers' instructions, at a minimum, and with Resolution Consultants specified schedules and requirements where applicable.

3.0 References

3.1 None.

4.0 Procedure

4.1 Inspections and maintenance of Resolution Consultants-owned or -leased equipment shall be completed by qualified/competent persons.

4.2 Supervisors and managers will confirm that staff assigned to use equipment are familiar with the specific inspection and maintenance requirements of that equipment.

4.3 **Maintenance**

4.3.1 All Resolution Consultants-owned or -leased equipment shall be maintained in good working order, free of defects or conditions that may pose a risk to employees, the public, or the environment.

4.4 Large mobile equipment or equipment that has associated high risk exposures (e.g., electrical or radiation) shall have an established, documented, preventative maintenance program. Examples of equipment that will have documented maintenance inspections include

- Nuclear densometers
- Resolution Consultants leased or owned vehicles
- Resolution Consultants leased or owned boats, ATVs, or snowmobiles
- Electrofishers
- Lab equipment

4.4.1 The maintenance program shall:

- Adhere to applicable regulations, standards, and manufacturers' specifications;
- Provide for service by appropriately qualified maintenance personnel; and,
- Require maintenance schedules and records of maintenance.

4.4.2 **Office Managers** shall determine and inventory the equipment within their operation requiring scheduled maintenance. Using applicable regulations, industry standards, best practices, and

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manufacturer's recommendations, the office must develop a maintenance schedule with defined responsibility, required actions, and frequency (*5-205 Form 1 Equipment Maintenance Inventory*).

4.4.3 Employees who are assigned equipment or tools that require maintenance under this program will review maintenance schedules for that equipment and will confirm that required maintenance has occurred or see that it is undertaken.

4.5 Inspections

4.5.1 Employees will inspect all tools and equipment before using them to identify:

- Damage
- Unsafe conditions
- Need for recertification
- Suitability of the tool or equipment for the intended work process

4.6 Repairs and Out of Service

4.6.1 All tools or equipment that an employee deems defective will immediately be repaired, or, if repair is not practicable, tagged "Out of Service" and sent for repairs or discarded.

4.7 Defects or other unsafe conditions observed during an Resolution Consultants inspection shall be recorded and tracked until the equipment is repaired and ready to return to service (*5-205 Form 2 Equipment Inspection Report*).

4.8 Rented or Personal Equipment

4.8.1 Any equipment that is not owned by Resolution Consultants (e.g., rental or personal equipment used for Resolution Consultants business) will be inspected by employees prior to use.

4.8.2 Any defects or unsafe conditions will be reported to the supervisor, rental agency, or owner of the equipment, and the equipment will not be used until the equipment is repaired, the condition is corrected, or alternate equipment is found.

5.0 Records

5.1 Completed maintenance inventories (*5-205 Form 1 Equipment Maintenance Inventory*) and associated maintenance records will be stored in local office files.

5.2 Completed inspection reports (*5-205 Form 2 Equipment Inspection Report*) and associated repair records will be stored in local office files.

6.0 Attachments

6.1 5-205 Form 1 Equipment Maintenance Inventory

6.2 5-205 Form 2 Equipment Inspection Report

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5-205 Form 1 Equipment Maintenance Inventory

Equipment	Frequency of service	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

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5-205 Form 2 Equipment Inspection Report

EQUIPMENT	DATE	RESULTS	ACTION REQUIRED	COMPLETED (DATE)

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05-206-Fire Protection, Field

1.0 Purpose and Scope

1.1 This procedure establishes the Resolution Consultants requirements for the selection, placement, use, and inspection of fire extinguishing and fire detection equipment.

1.2 This procedure applies to all Resolution Consultants North America-based field work.

2.0 Terms and Definitions

2.1 **Combustible liquid:** Liquid that must be heated to a temperature of 100° F or 37.8° C to emit sufficient vapors to form an ignitable mixture with the air.

2.2 **Flammable liquid:** Liquid that gives off enough vapor to form an ignitable mixture with air at ambient temperatures (less than 100° F or 37.8°C).

3.0 References

3.1 05-004-Incident Reporting

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 The **Project Manager** shall confirm that fire protection equipment is available at all field sites or in vehicles as required.

4.1.2 The **Project Manager** shall confirm that any fire extinguishing and detection equipment established at Resolution Consultants temporary worksites (and vehicles) are appropriately maintained and inspected in accordance with local fire codes.

4.1.3 The **Project Manager** shall confirm that all field staff who may have to use a portable fire extinguisher or other fire protection equipment are adequately trained in their use.

4.1.4 **Employees** shall familiarize themselves with the fire response and protection procedures that apply to the site on which they are working.

4.2 Planning

4.2.1 All field sites (including vehicles) will be equipped with a fire extinguisher and/or fire protection equipment appropriate to the number of staff, location of the work, and job task, as dictated by legislation or client requirements.

4.2.2 Fire protection equipment may include:

- Fire extinguishers, of the appropriate size, class, and type for the hazard
- Round-nosed shovel, as required
- Pulaski tool or mattock, as required
- Hand-tank pump containing at least 18 liters of water, as required to meet regulations

4.2.3 All **employees** shall be constantly on the alert for conditions that might contribute to a fire and shall remove or report the hazard.

4.2.4 Do not use gasoline or other flammable liquids as degreasing or cleaning agents. Use only approved solvents or other combustible liquids.

4.2.5 All work sites housing large volumes of chemicals shall ensure that placards identifying the chemicals are in place.

4.2.6 All **employees** shall know the location of fire fighting equipment in their work area.

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4.2.7 Access to fire fighting equipment must never be blocked by material, equipment, or vehicles.

4.2.8 A schedule for inspecting fire fighting equipment shall be developed to confirm that it is in place, accessible, and fully charged. Inspection and maintenance shall be conducted in accordance with the manufacturer's instructions.

4.3 In the Event of a Fire

4.3.1 Activate the nearest fire alarm or call for help, if available, before attempting to extinguish a fire. If the fire is too big to control with the equipment at hand, retreat.

4.3.2 Never turn your back on a fire. Always back away until you are at a safe distance.

4.3.3 Never use water on an electrical fire.

4.3.4 All fire extinguisher contents shall be applied from upwind and shall be directed at the base or outer edge of the fire with a sweeping motion.

4.3.5 Never return a discharged fire extinguisher to its normal location. Take it out of service for recharging and replace it with a fully charged unit.

4.4 Fire Extinguishers

4.4.1 Vehicles used for field work may be required to carry fire extinguishers as well, depending on client and/or industry standards. These fire extinguishers must be secured to the vehicle and never carried in the cab. It is the responsibility of all field staff to confirm that these fire extinguishers are kept charged, secured, and available in good working condition.

4.4.2 Fire extinguishers are to be readily available wherever the potential for fire exists (e.g., during welding, grinding, or open flame operations).

4.4.3 Fire extinguishers must be available in locations where flammable or combustible materials are stored, handled, or used.

4.4.4 Fire extinguishers will be readily accessible, properly maintained, regularly inspected, and promptly refilled immediately after use.

4.4.5 Fire extinguishers will be secured to all mobile equipment.

4.4.6 Only trained personnel should use a fire extinguisher. In the event of a fire, follow the site or project-specific emergency procedures for contacting the local fire department.

4.5 Location and Identification of Fire Extinguishers

4.5.1 Fire extinguishers will be located and installed as follows:

- Located where they are readily seen. If an obstruction is unavoidable, then a sign indicating the location of the extinguisher and/or color symbol (e.g., red markings) will be used.
- Fire extinguishers will always be positioned with the label visible.
- If extinguishers of different classes (e.g., one Class A and one Class B) are stored together, then they will be marked using stencils or signs clearly indicating the type of fire for which each should be used.
- If an extinguisher contains an electrically conductive agent (e.g., water), it will be clearly labeled with a sign that states "Not for Electrical Fires" with letters visible from at least 3 feet away.
- Extinguishers will not be left on the floor, but will be hung on a wall, column, or other appropriate support or shall be of the wheeled or cart type. Extinguishers of not more than 40 pounds will be hung so that the top is not more than 5 feet above the floor. Extinguishers greater than 40 pounds will be hung so that the top is not more than 3-½ feet from the floor. The bottom of the extinguisher will not be less than 4 inches from the floor.
- Extinguishers will be suitable for use at temperatures of 40°F to 120°F. The mounting locations will allow the fire extinguishers to be kept within this temperature range.

4.6 Inspection of Fire Equipment

4.6.1 Inspection, Maintenance, and Testing of Portable Extinguishers

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- The use or discharge of any fire extinguisher by an Resolution Consultants employee shall be immediately reported to the Supervisor. A Supervisor's Incident Report shall be developed and submitted in accordance with *5-004 Incident Reporting.*
- Extinguishers are to be inspected monthly to ensure they are still in the proper location, have not been used or tampered with, are still properly charged, and that they have no obvious external damage. The initials of the inspector and the date of inspection will be noted on the tag attached to the extinguisher.
- Any extinguisher showing damage will be replaced.
- A thorough inspection will be performed annually by personnel specifically trained in the inspection (e.g., extinguisher supplier).
- Extinguishers will be tested and recharged by qualified contractors as required by the applicable regulations and standards.

4.7 Forest Fires

4.7.1 If a crew discovers an uncontrolled, unattended forest fire, they will:

- Notify the appropriate authorities;
- If possible, use the fire fighting equipment at their disposal to suppress the fire; or
- If the fire is out of control or the crew determines the area to be unsafe, evacuate the area; and
- Immediately notify their project manager and other Resolution Consultants personnel in the area.

4.7.2 If a crew is to be working in an area where a known wildfire is burning or a wildfire starts, they will:

- Monitor the current status of the fire using radios and contact with the local authorities;
- Evacuate the area if an evacuation alert is given; and
- Immediately notify their project manager and other personnel in the area if the hazard or circumstances change.

4.7.3 If crews must start or monitor a fire for any reason, they will:

- Obtain the appropriate permits;
- Monitor any fire bans in the area; and
- Take every precaution to keep the fire in control and in a designed containment area.

5.0 Records

5.1 Fire extinguisher inspections shall be maintained in the appropriate office safety files.

6.0 Attachments

6.1 05-106-Portable Fire Extinguishers

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5-208-Personal Protective Equipment Program

1.0 Purpose and Scope

1.1 Provide an effective Personal Protective Equipment (PPE) Program to protect Resolution employees from potential workplace safety and health hazards.

1.2 This procedure applies to all Resolution employees and operations.

1.3 The proper use of appropriate PPE, in combination with effective engineering and administrative controls, can provide Resolution employees with protection against potential workplace hazards and can reduce the potential for workplace injury and illness.

2.0 Terms and Definitions

2.1 **PPE**: Personal Protective Equipment

2.2 **ANSI:** American National Standards Institute

3.0 References

3.1 Occupational Safety and Health Administration (OSHA) PPE standard (29 CFR 1910.132) requires Resolution to assess workplace(s) to determine if hazards that necessitate the use of PPE exist in the workplace, and, if such hazards are present, to

3.1.1 Select the appropriate types of PPE and

3.1.2 Provide employees with training about the use and care of the selected PPE.

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Regional SH&E Professional

- Provide guidance to Project Managers, Field Task Managers, Supervisors, and field staff on the assessment of hazards and the selection of PPE.
- Provide training materials to Project Managers, Field Task Managers and Supervisors for employee training.

4.1.2 Project Managers (Field Task Managers, Supervisors)

- Conduct Hazard Assessments to identify hazards present and to specify PPE appropriate for those hazards.
- Determine which of your staff members will require employee-issued PPE.
- Approve the purchase of company-issued PPE.
- Verify that appropriate PPE is utilized by your employees when required or necessary.

4.1.3 Employee

- In accordance with your training and instructions, utilize appropriate PPE that has been issued to them when required or necessary.
- Inspect your PPE prior to use to confirm that it is functional, and maintain your PPE in a clean and functional condition.
- Follow instructions and manufacturers' guidance on the care, use, and storage of your PPE.
- Prior to using any type of PPE, confirm that it is in good shape, free of dirt and debris, and that you are familiar with its correct use. Always make sure PPE fits adequately to perform the use intended.
- Refrain from wearing PPE outside of the work area for which it is required if doing so would constitute a hazard.

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4.2 Hazard Assessment for Office Locations

Office Hazard Analysis will be completed for applicable tasks as required in 29 CFR 1910.132 following the guidelines as specified in OSHA Pamphlet 3151-12R 2003 (Personal Protective Equipment),

4.3 Hazard Assessment for Off-Site Locations

4.3.1 HAZWOPER Locations

- Each Health and Safety Plan (HASP) that is prepared for waste site investigations/remediation includes a hazard assessment for each proposed field activity. Task-specific PPE requirements are listed in the HASP. Therefore, the HASP will serve as the certificate of hazard assessment for each project that involves off-site work activities that require the use of PPE.

4.3.2 All Other Off-Site Locations

- The Task Hazard Analysis will serve as the certificate of hazard assessment for projects that involves offsite work activities that require the use of PPE. The checklist will be reviewed with the entire field team prior to arriving at the site.

4.4 Training

4.4.1 Staff will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training:

- What PPE is required.
- When it is required.
- Why it is required.
- How to properly don, doff, adjust, and wear the PPE described.
- The limitations of the PPE, including its expected useful life.
- How to properly care for, maintain, and dispose of the PPE.

4.4.2 Field staff are responsible for confirming that they have reviewed the operation manual for the PPE before work commences.

4.4.3 All staff will receive an orientation to the hazards on the job site as well as initial Field Safety orientation that outlines appropriate PPE requirements.

4.4.4 Resolution Consultants employees who have participated in the 40-hour HAZWOPER training course are considered to have met the employee training requirements of the PPE standard. The training certificates that are issued as documentation of successful completion of the 40-hour HAZWOPER course will also serve as documentation of training as required by the PPE standard. Employees who have not participated in the HAZWOPER training will be provided PPE training specific to your assignment and/or location. The PPE Facts Sheets (attached) can serve as the basis for training.

4.5 Determining the Need for PPE

4.5.1 Using the Task Hazard Assessment or HASP, the need for the following types of PPE will be evaluated.

4.5.2 PPE will:

- Be selected and used in accordance with recognized standards and provide effective protection.
- Not in itself create a hazard to the wearer.
- Be compatible, so that one item of PPE does not make another item ineffective.
- Be maintained in good working order and in a sanitary condition.

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4.5.3 Prior to entering any regulated work area, confirm that you have access to or are equipped with the following CSA-approved PPE, appropriate to the site hazards:

- Head Protection
- Eye & Face Protection
- Foot Protection
- Hi-Visibility Vests
- Hearing Protection

4.5.4 After the hazard assessments have been completed, the Project Manager will select the appropriate PPE for each job category or task, as necessary. The selected equipment will be indicated on the hazard assessment. PPE will be provided to each employee appropriate for the hazards present. All PPE selected and purchased by Resolution will meet or exceed the American National Standards Institute (ANSI) standards, Canadian Standards Association (CSA) standards, or other standards as dictated by provincial, territorial, or state legislation.

4.6 Eye and Face Protection

4.6.1 The OSHA standard requires that Resolution employees use appropriate eye and face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acid and caustic liquids, chemical gases or vapors, and injurious light radiation. The standard further requires that eye protection provide side protection when there is a hazard from flying objects.

4.7 Head Protection

4.7.1 Protective helmets (hard hats) are required when employees are working in areas where there is a potential for falling objects to cause injury to the head. When working near exposed electrical conductors that could contact the head, helmets designed to reduce electrical shock will be worn.

4.8 Foot Protection

4.8.1 Protective footwear is required when employees are working in areas where there is a danger of foot injuries from falling and rolling objects or from objects piercing the sole and where an employee's feet are exposed to electrical hazards.

4.9 Hand Protection

4.9.1 Appropriate hand protection is required when employee's hands are exposed to hazards such as those from skin absorption of harmful substances, severe cuts and lacerations, severe abrasions, punctures, chemical burns, thermal burns, or harmful temperature extremes.

4.9.2 Chemically Resistant Clothing

4.9.3 Chemically resistant clothing is required when there is significant potential for the employee to come in direct contact with the chemicals he/she is handling. Tasks that involve chemical handling will be evaluated for the potential of splashing or spilling.

4.9.4 High-Visibility Apparel

4.9.5 High-visibility apparel with reflective banding (ANSI Class II and III garment) is required for all field activities in close proximity to moving traffic and other modes of transportation (transit, airlines, marine, etc.), in proximity to heavy equipment operations, or whenever otherwise specified in a project HASP. Color of apparel (orange or lime) may be client/project-specific.

4.10 Personal Clothing

4.10.1 For personal safety on the job site, do not wear

- Loose or unsecured clothing or loose fitting cuffs.
- Greasy or oily clothing, gloves, or boots.
- Torn or ragged clothing.

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4.10.2 Neck chains are hazardous and will be worn under clothing so that they do not hang out. Long hair will be tied back or otherwise confined.

4.10.3 Clothing made of synthetic fibres can be readily ignited and melted by electric flash or extreme heat sources. Cotton or wool fabrics are recommended for general use.

4.11 Specialized PPE

4.11.1 In addition to basic PPE, additional specialized PPE may be required to provide appropriate protection to the employee. Refer to applicable OH&S legislation and related Standard Operating Procedures for additional information on PPE requirements.

- Fall Protection: Only full body harnesses with shock-absorbing lanyards will be used for personal fall arrest.
- Respiratory Protection: Respiratory protection shall be selected based on the contaminant and concentration to which the employee will be exposed. Refer to*5-519 Repiratory Protection Program* and the task- or project-specific Baseline Hazard Assessments for specific requirements.
- Fire Resistant Clothing: Approved fire resistant outer clothing may be required at work locations with flammable or explosive materials or environments.
- Other Head Protection: Operators and passengers (if permitted) of all terrain vehicles and snowmobiles will wear approved helmets.
- Chemical Protective Clothing: Approved chemical protection appropriate to the hazard will be worn. Review applicable Material Safety Data Sheets (MSDSs) for appropriate PPE.
- Protection from Drowning: Employees being transported by boat are required to wear life jackets. Employees exposed to any other drowning hazards are required to wear personal flotation devices. Life jackets and personal flotation devices will have the proper regulatory approval.

4.12 PPE Supplies

4.12.1 Each Resolution office will maintain a supply of safety equipment including safety glasses, gloves, and chemically resistant clothing based on the nature of their field activities. The Office Manager or designee will be responsible for maintaining this inventory. PPE that is required for large field efforts will be ordered by the Project Manager or their designee.

4.12.2 At a minimum, the office will review its PPE program annually.

4.13 Obtaining Personalized Safety Gear

4.13.1 The OSHA standard in 29 CFR 1910 - Subpart I / 29 CFR 1926 requires that protective equipment, including PPE for eyes, face, head, and extremities, protective clothing, and respiratory devices, be provided to employees wherever necessary by reason of hazards.

4.13.2 Employees are not expected to provide their own general PPE. Although each Resolution office stocks and issues various general issue safety gear such as hard hats, plan safety glasses, disposable gloves and coveralls, fall protection, and hearing protection, certain personalized safety gear such as prescription safety glasses, safety-toed (capped) boots, and cotton coveralls will be ordered and sized specifically for the user.

4.13.3 Most PPE will be provided to the employee at no charge, with the exception of the above personalized safety equipment (safety glasses, safety toed boots, washable coveralls). A partial cost reimbursement to the employee may be made based on legacy company practice or project stipulations.

4.13.4 Prescription Safety Glasses

- As with all hazards, staff will be notified of their potential for injury and will be provided with the appropriate PPE. If wearing contact lenses poses a hazard to the worker's eyes during work, the worker will be advised of the hazards and the alternatives to wearing contact lenses.
- Eligibility

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- Employees will wear safety glasses during activities that involve exposure to eye hazards such as flying particles, chemical splash, or certain types of radiation such as ultraviolet light from welding operations. Typically, the following types of field activities will require the use of safety glasses:
  - Site investigation or remediation and construction activities.
  - Stack monitoring and other types of air emissions monitoring.
  - Audits and assessments in industrial or manufacturing facilities.
  - Activities conducted within laboratories.
  - Activities at client facilities where safety glasses are required.
- Eligibility to obtain prescription safety glasses will be determined by the employee's supervisor based upon the guidance above.

- Procurement of Prescription Safety Glasses
  - Except for eye examinations, associated prescription eyewear costs will be paid by Resolution. The employee may be asked to pay an optician's dispensing fee, which may be submitted on an expense report for reimbursement. Because eye examinations are not covered, employees who have had recent eye examinations should contact the eye care professional in advance to determine their procedure for handling a current prescription.
  - Employees who are eligible will be allowed to order one pair of prescription safety glasses every other year from the selection of glasses offered by the program.
  - Contact the Regional SH&E Professional for guidance on the procurement of prescription safety glasses.

4.13.5 Safety Toed Boots/Shoes

- Eligibility
  - Employees will wear safety boots/shoes during activities that pose the potential for foot injury from dropped objects or penetrations through the sole. Typically, safety toed boots/shoes will be required for the same type of activities, with the exception of laboratory activities, for which safety glasses are required. In addition, work around all types of heavy equipment will typically require the use of safety shoes.
  - Eligibility to obtain safety shoes will be determined by the employee's supervisor based upon the guidance above.
- Procurement of Safety Shoes
  - Eligible employees will be allowed to purchase one pair of safety shoes every other year.
  - Employees who have been authorized to purchase safety shoes by their supervisor should consult the Regional SH&E Manager for obtaining for detailed instructions on how and where to purchase the equipment. The style chosen (i.e., boot or shoe) should be determined based upon the application. For example, low cut shoes may be appropriate for audits and assessments in light industry applications, while safety boots will be more appropriate for environmental remediation, construction, and heavy industry work with significant foot hazards. Before purchasing, the employee is required to verify that the safety boots or shoes meet the specifications above.
  - After the purchase, an employee expense report, including a dated receipt for the shoes, should be submitted for approval and reimbursement. Resolution will reimburse the employee up to a amount that is specified by the SH&E Department or Regional Operations management.

4.13.6 Reusable Coveralls

- Eligibility

- Reusable cotton (or some other washable fabric) coveralls may be made available to employees who regularly perform field work based on conditions. Coveralls can be worn over personal clothing to help protect and keep them clean.
- Eligibility to obtain washable coveralls will be determined by the employee's supervisor based upon the guidance above.

5.0 Records

None.

6.0 Attachments

None.

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05-209-Project Hazard Assessment and Planning

1.0 Purpose and Scope

1.1 Resolution Consultants and its employees must assess all projects and sites for anticipated hazards and plan to mitigate those hazards through a series of controls. This procedure establishes the requirements and provides the tools for this process of pre-work planning and risk assessment.

1.2 The objective is to enhance SH&E performance, to reduce losses due to injury, illness, property damage, or environmental impairment incident, and maintain regulatory compliance.

1.3 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Task Hazard Analysis (THA):** A THA *(05-209-Form 1 Task Hazard Analysis)* is a technique for evaluating the component parts of any work method or procedure for the purpose of:

- Identifying the SH&E hazards and risks connected with the work;
- Identifying and implementing control methods to eliminate, nullify, or reduce to a minimum the consequences of such hazards and risks; and,
- Evaluating the effectiveness of risk control measures and making modifications as needed.

2.2 **Plan:** A comprehensive document which outlines at length, in a report-style format, all of the operational controls necessary to mitigate the anticipated hazards for a project's sites and activities. Resolution Consultants will use two established planning templates:

- **Health and Safety Plan (HASP**) for work involving environmental contaminants (e.g., HAZWOPER), or
- **Safe Work Plan (SWP)** for all other SH&E planning documentation.

2.3 **High Risk Classification:** Any task where the identified hazard, if further controls are not implemented, has a combined severity and probability that is either catastrophic or very likely, or some combination thereof (but where the result is not minor or rare). (Refer to 0*5-209-Form 2 Hazard Identification, Classification and Controls* for further details.) The following may be classified as High Risk; consult the SH&E Department for clarification:

- Confined space,
- HAZWOPER,
- Contaminated sites,
- Radiation,
- Lead,
- Asbestos,
- Resolution Consultants camp or construction sites,
- Competent person requirements,
- Sites with potential for client system failures,
- Significant physical hazards (e.g., fall, water, equipment, etc.),
- Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO) Ops
- Potential for significant environmental incident, or
- Sites with medical surveillance requirements.

3.0 References

None.

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4.0 Procedure

4.1 All projects must have a completed Task Hazard Analysis at a minimum. In addition, all field projects must have an Emergency Response Plan. These two documents may be all a project needs for administrative safety requirements, depending on the hazards identified.

4.2 The table below helps illustrate the further planning documentation which may be required, depending on the hazards identified in the THA.

Task Hazard Analysis	• Most basic requirement • All sites and tasks including walk-through site visits	• Prepared by employees/supervisors • Confirmed by **Project Manager** or designee
Safe Work Plan (SWP)	• High risk activities • Complex projects with multiple stakeholders, long-duration • Non-HAZWOPER	• SH&E Department review and guidance required
Health & Safety Plan (HASP)	• HAZWOPER regulated sites and all other sites with potential chemical exposures • Client directed	• Only for sites with potential chemical exposures and Hazardous Waste Operations and Emergency Response (HAZWOPER) • SH&E Department review and guidance required

4.3 Task Hazard Analysis (THA)

4.3.1 A THA must be completed for all (routine and non-routine) tasks and sites.

4.3.2 A THA must be completed prior to the commencement of work so that all controls can be planned, equipment purchased/inspected, and staff adequately trained for the hazards.

4.3.3 The THA must identify all known and potential physical hazards as well as potential occupational exposures for noise, biological, or chemical contaminants, and environmental issues.

4.3.4 The assessment must include the identification and implementation of control measures to prevent worker injury, exposure and contamination.

4.3.5 Hazard identification and risk assessment must be ongoing. This requires the project team to consider the timing and frequency of the THA reviews, as affected by the following types of issues:

- The need to determine whether existing risk controls are effective and adequate,
- The need to respond to new hazards,
- The need to respond to changes that Resolution Consultants itself has made,
- The need to respond to feedback from monitoring activities, incident investigation, emergency situations or the results of testing of emergency procedures,
- Changes in legislation,
- External factors, e.g. emerging occupational health issues,
- Advances in control technologies,
- Changing diversity in the workforce, including contractors, or
- Changes proposed by corrective and preventive action.

4.3.6 THAs will be prepared by the supervisor and employee(s) directly responsible for the work.

4.3.7 Final drafts shall be submitted for review and approved by the **Project Manager** prior to commencing work activities.

4.3.8 Resolution Consultants subcontractors will prepare their own THA and submit them to the **Project Manager** for review and acceptance prior to the start of subcontracted work activities. These reviews are not approvals, and do not relieve the subcontractor for being responsible for their own safety on the project site.

4.3.9 The **Project Manager** shall maintain all approved/signed THA copies (including revisions) in the project files and make them available during project audits and for use during the training of new project personnel.

4.3.10 THAs shall be used to facilitate project SH&E tailgate meetings. Comments and suggestions relative to the completed THA shall be encouraged from attendees and incorporated into revised documents. Any modifications must be reviewed as corrective measures to confirm that no new hazards are created.

4.3.11 THAs that have been found to be inadequate or incomplete should be suitably annotated by the project management team to be used as lessons learned.

4.3.12 The THA will be reviewed by all personnel involved in the task, as well as any visitors or additional or new crews brought on to perform the work. This is a minimum of a one-time review and signature with supplement reviews conducted on a pre-determined basis by the **Project Manager** or their designee.

4.4 Planning Documents

4.4.1 An SH&E plan (in addition to the THA) may be required in the following circumstances:

- Tasks with high risk classification designations,
- Tasks with medium risk classification designations, where circumstances warrant, and/or
- Complex projects where it is necessary to communicate to numerous stakeholders and clearly define all controls including emergency response, incident reporting, inspections, security requirements, or other details.

4.4.2 The planning document shall be titled a **Safe Work Plan** UNLESS it involves Hazardous Waste Operations and Emergency Response (HAZWOPER) requirements, then it will be called a **Health and Safety Plan (HASP)** and will clearly address the specific requirements associated with the hazardous waste exposures.

4.4.3 Specific plan needs will vary for each project. In some cases it may be acceptable to utilize general (non-site/non-project-specific) SH&E procedural documentation prepared for the type of work activities being performed, while in others project/site/activity-specific documentation is required to be developed as part of the project planning process. The specific operational needs of individual projects will be determined as part of the initial coordination between the **Project Manager** and the SH&E Department.

4.4.4 The following requirements apply to all Resolution Consultants SH&E planning documentation:

- Preparation of the SH&E documentation can be performed by a member of the project team or the SH&E Department.
- All SH&E documentation (including draft versions of documents) will be approved by the SH&E Department prior to release for outside agency review (e.g., clients, regulatory agencies, etc) and prior to its field implementation.
- All changes to approved SH&E documentation require concurrence from a designated member of the SH&E Department. This includes those made in response to changing field conditions or operational requirements and those made in response to regulator/client comments. Any written responses made to regulator/client comments also must be reviewed and approved by the SH&E Department.
- The SH&E documentation for any project lasting twelve (12) months or longer will be reviewed at periodic intervals determined by the SH&E Department, but at least annually. The **SH&E Representative** will review the changes and determine whether modifications are required to the existing SH&E planning documentation. This confirms that the documentation continues to reflect the current project scope and knowledge of site conditions, and that any revised regulatory requirements are properly addressed. The **Project Manager** will provide a master copy of the SH&E documentation to be maintained on site for reference by personnel, together with copies of any required SH&E-related records or operational documentation. The master copy must be current in all respects, and will include any changes or modifications made as work progresses.
- **Project Managers** will confirm that ALL plans and THAs have been reviewed with project personnel prior to implementation of field work. Sign-off and concurrence is mandatory and to be kept in the project records.

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4.5 Roles & Responsibilities

4.5.1 **SH&E Department** responsibilities include the following:

- Assisting project management personnel to identify any necessary project-specific SH&E planning documentation required for all new and ongoing projects.
- Assisting in the preparation of necessary SH&E planning documentation.
- Reviewing and approving all SH&E planning documentation prior to its implementation for field activities.

4.5.2 **Project Manager (or their designee)** responsibilities include the following**:**

- Confirming the completion of SH&E planning documentation (THA, SWP or HASP), as required, that addresses the full range of project activities, safety risks and that all requirements and procedures are implemented and enforced during the field activities.
- Confirming SH&E requirements and Standard Operating Procedures are implemented successfully, including but not limited to:
  - Subcontractor evaluations
  - SH&E Training
  - Personal Protective Equipment
  - First aid and emergency response
  - Client requirements
- Contacting the SH&E Department to discuss SH&E planning documentation needs/ requirements at the start of each new project involving Resolution Consultants and at designated intervals (not to exceed one year) or when changes occur to the work operations or work location/ conditions, when work activities are modified/ changed, or when additional tasks are added to the work scope.
- Confirming that all SH&E planning documentation (draft or final) has been reviewed and approved by the SH&E Department prior to its use by Resolution Consultants personnel, or prior to release to outside agencies or organizations.
- Making appropriate resources available to protect the health and safety of Resolution Consultants employees, the environment and to comply with occupational health and safety, and environmental legislation and for the effective implementation of this procedure.

4.5.3 **Employee** responsibilities include the following**:**

- Participating in hazard identification training at the commencement of their employment with Resolution Consultants or prior to commencing field preparations.
- Reviewing and understanding the potential hazards and controls of the project before work commences.
- Complying with all required controls as identified in the THA and/or associated safety plans.

5.0 Records

5.1 Completed THAs, SWPs, and HASPs will be filed in their appropriate project file.

6.0 Attachments

6.1 05-209-Form 1 Task Hazard Analysis

6.2 05-209-Form 2 Hazard Identification, Classification and Controls

05-209-Form 1 Task Hazard Analysis

This THA (worksheets 1 & 2) must be completed for all field work.

HAZARDS 1
- Identify hazards
- Classify hazards
- Identify controls

CONTROLS 2
- Summarize controls
- Acknowledgement / Sign off

EMERGENCY RESPONSE 3
- Emergency contacts
- Emergency procedures
- Emergency equipment

Required for all projects/sites which do not have an existing emergency response plan

Hazard Identification

- **Natural (biological)** – bacteria, viruses, insects, plants, birds, and animals
- **Chemical** – exposure to chemical toxins, acute or chronic, by way of inhalation, ingestion or absorption
- **Physical** – slipping/tripping, being struck by moving objects, repetitive movement, strains from lifting
- **Environmental** – extreme heat or cold, noise, vibrations, magnetic fields, pressure extremes and air quality
- **Psychosocial** – stress, violence

Hazard Classification

- Considers the potential severity of the outcome
- Considers the likelihood of the occurrence
- Used to prioritize and determine extent of required controls

Controls

- **Elimination (first)** – choose a different process; modify an existing process; substitute with less hazardous substance
- **Engineering Controls (second)** – physically alter the plant or equipment design in order to circumvent possible hazards; place guards on machinery
- **Administrative Controls (third)** – change the job procedure and/or process; limit the amount of time an individual is in a hazardous environment through job rotation
- **Personal Protective Equipment (last option)** – provide employees with direct physical protection while working in a hazardous environment

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Project Name:	Project Number:	Client:	
Supervisor:	Project Manager:	Location:	
THA Developed By:		Date:	
Task Name:		Regularity of Task: One-time ☐	Routine ☐

TASK HAZARD ANALYSIS

	Job Event Sequence *(List the major steps of the individual task)*	Hazards *(List primary hazards)*	Hazard Classification *(before controls)* Severity	Likelihood	Risk Level	Hazard Classification	Controls *(List controls that Resolution Consultants will implement)*
1					0		
2					0		
3					0		
4					0		
5					0		
6					0		
7					0		
8					0		
9					0		
10					0		

Hazard Classification Guidelines

Severity

1 Remote potential for injury, property damage/$ loss, or env damage

2 Potential for minor first aid injury, property damage/$ loss, or environmental damage

3 Potential for moderate personnel injuries, including medical treatment, property damage/$ loss, environmental damage, or negative public impact

4 Potential for a serious injury, major property damage/$ loss, serious impact to the environment, and public health

5 Catastrophic damage to people, property/equipment, environment, or public health

Likelihood of Occurrence

1 Very unlikely

2 Unlikely

3 Likely

4 Very likely

5 Certain

Hazard Classification Matrix

Likelihood \ Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Risk Level
Low
Medium
High

Risk Level = Likelihood x Severity

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Project Name:	Project Number:	Client:
Supervisor:	Project Manager:	Location:
THA Developed By:		Date:
Task Name:		

SUMMARY OF CONTROLS

Personal Protective Equipment (*check all that apply*)

- CSA/ANSI Safety-Toed Boots (Leather or Rubber)
- CSA/ANSI Safety Glasses or Goggles
- CSA/ANSI-approved Hard Hat
- CSA/ANSI Type II/III Reflective Traffic Safety Vest

Air Monitoring (reference HASP monitoring plan)

☐ No air monitoring required ☐ Air monitoring required (*see procedures below*)

Parameter	Location/Monitoring Interval	Response/Action Levels	Response Activity

Required Training (associated with this THA)	Key SOPs (associated with this THA)		Client & Other Requirements
1			
2			
3			
4			
5			
6			

Acknowledgement / Signatures

Project Manager / Supervisor (signature): Date:

Name	Signature	Company	Date	Name	Signature	Company	Date

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	Project Name:	Project Number:	Client:
	Supervisor:	Project Manager:	Location:
	THA Developed By:		Date:
EMERGENCY RESPONSE PLAN	Task Name:	Regularity of Task: ☐ One-time	☐ Routine

Check-in Procedures			
Check-in Times	Check-in Person	Phone Number	Cell Phone Number
Alternate:			

Emergency Coordinators / Key Personnel			
Name	Title	Phone Number	Cell Phone Number
	On-site First Aid Attendant		
	Project Manager		
	Site Supervisor		
	Regional SH&E Manager		
	Incident Reporting Line		
	Client Contact		

Emergency Agencies / Public Utilities			
Name	Type	Details	Phone Number
	Police		
	Fire		
	Ambulance		
	Nearest Hospital / Clinic		
	Poison Control Center		
	Pollution / Environmental		

Emergency Equipment & Supplies		Other Emergency Plan Details
☐ First Aid Kit - Type:	☐ Eye Wash	
☐ Blankets / Survival:	☐ Spill Kit	
☐ Fire Extinguishers Type:	☐ Other:	
☐ Communication Device		
☐ Vehicle Safety Equipment		

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05-209 Form 2 Hazard Identification, Classification & Controls

The following information is intended to guide staff in completing the Task Hazard Analysis.

1.0 Hazard Identification

1.1 Hazards occurring in the workplace may be:

- Natural (biological) – bacteria, viruses, insects, plants, birds, and animals
- Chemical – exposure to chemical toxins, acute or chronic, by way of inhalation, ingestion or absorption
- Physical – slipping/tripping, being struck by moving objects, repetitive movement, strains from lifting
- Environmental – extreme heat or cold, noise, vibrations, magnetic fields, pressure extremes and air quality
- Psychosocial – stress, violence

1.2 When identifying hazards, remember to consider the following:

- Routine and non-routine activities;
- Activities of all persons having access to the workplace (including contractors and visitors);
- Human behavior, capabilities and other human factors;
- Identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of Resolution Consultants;
- Hazards created in the vicinity of the workplace by work-related activities under the control of Resolution Consultants;
- Infrastructure, equipment and materials at the workplace, whether provided by Resolution Consultants or others;
- Changes or proposed changes within Resolution Consultants;
- Modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities;
- Any applicable legal obligations relating to risk assessment and implementation of necessary controls;
- The design of work areas, processes, installations, machinery/equipment, operating procedures and work organization, including their adaptation to human capabilities.

1.3 It is often useful to break the job or task down into a sequence of steps ("Job Event Sequence") to help identify the primary hazards which may be encountered when you complete a job task. The "events" identified should be only as detailed as required to identify the primary hazards (e.g., drive to worksite; inspect bridge decking; take water samples, etc.)

2.0 Hazard Classification

Once identified, all hazards should be classified based on both their potential outcome and the probability of its occurrence as follows:

2.1 **Severity**

- Insignificant – no injuries, low environmental/financial impact = 1
- Minor – first aid required, some environmental/financial impact = 2
- Moderate – medical treatment required, contained environmental impact, high cost = 3
- Major – serious injury, severe environmental damage, major cost = 4

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- Catastrophic – death, environmental disaster, extensive damage, extended downtime for company or site, huge cost = 5

2.2 **Probability**

- Unlikely – Incident will probably not occur during the work activity = 1
- Rarely – Incident will rarely occur during the work activity = 2
- Possibly – Possibility of incident occurring sometime during the work activity = 3
- Likely – Likelihood of incident occurring sometime during the work activity = 4
- Very Likely – Likelihood of incident happening often during course of the work activity = 5

2.3 High Hazard – Practice or condition whose sum of severity and probability is greater than or equal to 8.

2.4 Medium Hazard – Practice or condition whose sum of severity and probability is equal to either 6 or 7.

2.5 Low Hazard – Practice or condition whose sum of severity and probability is less than or equal to 5.

2.6 Inputs to the hazard classification can include, but are not be limited to, information or data on the following:

- Details of location(s) where work is carried out,
- The proximity and scope for hazardous interaction between activities in the workplace,
- Security arrangements,
- The human capabilities, behavior, competence, training and experience of those who normally and/or occasionally carry out hazardous tasks,
- Toxicological data, epidemiological data and other health related information,
- The proximity of other personnel (e.g. cleaners, visitors, contractors, the public) who might be affected by hazardous work,
- Details of any work instructions, systems of work and/or permit-to-work procedures, prepared for hazardous tasks,
- Manufacturers' or suppliers' instructions for operation and maintenance of equipment and facilities,
- The availability and use of control measures (e.g. for ventilation, guarding, personal protective equipment (PPE), etc.),
- Abnormal conditions (e.g. the potential interruption of utility services such as electricity and water, or other process failures),
- Environmental conditions affecting the workplace,
- The potential for failure of plant and machinery components and safety devices or for their degradation from exposure to the elements or process materials,
- Details of access to, and adequacy/condition of emergency procedures, emergency escape plans, emergency equipment, emergency escape routes (including signage), emergency communication facilities, and external emergency support, etc.,
- Monitoring data related to incidents associated with specific work activities,
- The findings of any existing assessments relating to hazardous work activity,
- Details of previous unsafe acts either by the individuals performing the activity or by others (e.g. adjacent personnel, visitors, contractors, etc.),
- The potential for a failure to induce associated failures or disabling of control measures,
- The duration and frequency at which tasks are carried out,
- The accuracy and reliability of the data available for the risk assessment,

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- Any legal and other requirements which prescribe how the risk assessment has to be performed or what constitutes an acceptable risk, e.g. sampling methods to determine exposure,
- Use of specific risk assessment methods, or permissible exposure levels.

2.7 Considering all of the hazards associated with the job task (and using the Hazard Matrix), provide an overall classification for the job/task in the Task Hazard Analysis. This classification can be used as a guideline for prioritizing and determining the level and number of controls required.

Hazard classification matrix

Severity		Probability				
		Very Likely	Likely	Possibly	Rarely	Unlikely
		5	4	3	2	1
Catastrophic (death, environmental disaster, extensive damage, extended downtime for company or site, huge cost)	5	10	9	8	7	6
Major (serious injury, severe environmental damage, major cost)	4	9	8	7	6	5
Moderate (medical treatment required, contained environmental impact, high cost)	3	8	7	6	5	4
Minor (First aid required, some environmental/financial impact)	2	7	6	5	4	3
Insignificant (no injuries, low environmental/financial impact)	1	6	5	4	3	2

Probability: How likely is it to happen?

Very Likely	Likelihood of incident happening often during course of the work activity
Likely	Likelihood of incident occurring sometime during the work activity
Possibly	Possibility of incident occurring sometime during the work activity
Rarely	Incident will rarely occur during the work activity
Unlikely	Incident will probably not occur during the work activity

Hazard Classification:

- **HIGH**
- **MED**
- **LOW**

3.0 Hazard Control

Once identified and classified, all hazards must have an effective means of control which can be accomplished by using one or more of the following means of control:

3.1 Elimination (first)

- Choose a different process
- Modify an existing process
- Substitute with less hazardous substance

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3.2 Engineering Controls (second)

- Physically alter the plant or equipment design in order to circumvent possible hazards
- Place guards on machinery
- Construct catwalks to divert traffic from hazardous areas

3.3 Administrative Controls (third)

- Affect the job procedure and/or process in order to reduce hazards
- Implement rules to change unsafe behaviors
- Limit the amount of time an individual is in a hazardous environment through job rotation

3.4 Personal Protective Equipment (fourth)

- Provide employees with direct physical protection while working in a hazardous environment

All identified hazards must have an effective means of control to minimize the potential for an incident; however, hazards with higher classifications should be addressed first and will undoubtedly require a variety of the types of controls mentioned above.

05-210-Project Safety Meetings

1.0 Purpose and Scope

1.1 Establishes the requirements for conducting and documenting meetings on topics that are designed to promote Safety, Health & Environmental (SH&E) awareness and facilitate discussion regarding hazards and risks.

1.2 This procedure applies to all Resolution Consultants employees and operations in the performance of services directed and controlled by Resolution Consultants.

2.0 Terms and Definitions

None.

3.0 References

None.

4.0 Procedure

4.1 Project Initiation/Kick-off meeting

4.1.1 A project initiation/kick-off safety meeting will be conducted prior to the start of field operations. Discussion points for this meeting will come from the project-specific SH&E documentation (e.g., Health and Safety Plan (HASP), Safe Work Plan, Task Hazard Analysis, etc.). The meeting will involve representatives from all organizations with a direct contractual relationship with Resolution Consultants on the job site. Topics for this meeting will include:

- Communication to all participants regarding on site SH&E responsibilities and authority.
- Establishing safety points of contact for each organization and phase of work.
- Communication of organizational SH&E performance expectations.
- Identification of significant project SH&E issues, risks, and solutions.
- Coordination of organizational SH&E conflicts and interactions.

4.2 Timing of Meetings

4.2.1 Change in Scope/Activity– Conducted for all Resolution Consultants staff and site personnel with a direct contractual relationship with Resolution Consultants to discuss changes to scope or a new phase of work.

4.2.2 Periodic – Conducted at a regular, recurring frequency of not less than biweekly, but preferably once per week.

4.2.3 Daily – Daily safety discussions as part of daily routine project coordination meetings. Daily meetings are required for HAZWOPER activities and other activities as identified in the safety plan. Daily safety discussions will involve representatives from all organizations with a direct contractual relationship with Resolution Consultants on the job site.

4.2.4 Significant Personnel Turn-over – Conducted at the start of any workday where a new organization begins work on site or when more than 25 percent of the day's work force is new to the site.

4.2.5 Post-Incident – Conducted at the start of the work day following the occurrence of a significant incident as defined in *5-004 Incident Reporting*. All project initiation/kick-off safety meetings will be documented using the *5-210 Form 1 Tailgate Safety Meeting Log*.

4.2.6 All special situation safety meetings listed above will include review of applicable Task Hazard Analyses for the scope of services to be performed and be documented using the *5-210 Form 1 Tailgate Safety Meeting Log* or equivalent.

4.2.7 Daily safety discussions not otherwise required by HAZWOPER or the project safety plan will be documented.

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4.3 **Supplemental Training Meetings**

4.3.1 The PM, Site Supervisor or Site Safety Officer (SSO) will implement worker training on general safety topics as part of routine on-site training activities. Where such training is conducted it will be documented on the *5-210 Form 1 Tailgate Safety Meeting Log*.

4.4 Safety Orientation

4.4.1 All project employees will attend a project-specific safety orientation and training session prior to the start of any project and/or task.

4.4.2 The PM, site supervisor, or SSO will conduct the meeting based on project specifics (e.g., location, unique hazards and risks, client requirements, etc.) and any mandatory topics required by *5-003 SH&E Training*. The Regional SH&E Manager can provide examples of project safety orientation material for reference.

4.4.3 The depth/level of training will be commensurate with the job function(s) to be performed. Site visitors will receive general orientation and task-specific training.

4.4.4 At a minimum, employee orientation and training will consist of the items listed below:

- Identification of hazards associated with the individual's job function and responsibilities.
- Specific safety procedural instruction needed to perform his or her required job function or task.
- Content of the HASP and any Task Hazard Analyses (THA) in accordance with *5-209 Project Hazard Assessment and Planning*.

4.5 Periodic Safety Training Meetings

4.5.1 Sit-down safety training meetings will be scheduled and conducted throughout the duration of the project.

4.5.2 Meetings shall give project personnel an opportunity to maintain a high degree of safety awareness through timely and quality safety education. Meeting time will be used to discuss specific safety topics and obtain employee feedback.

4.5.3 Safety meetings will be conducted by the PM, Site Supervisor or SSO and supplemented by lead persons of the various crafts represented at the site (e.g., electrician, heavy equipment operator, foreman, inspector, resident engineer, etc.).

4.5.4 Topics for discussion will include SH&E hazards noted during routine and non-routine work situations and an explanation of job safety procedures unique to the project.

4.5.5 The PM and SSO will monitor safety meetings to ensure that subject matter is properly presented.

4.5.6 All periodic safety meetings will be documented using the Safety Training Log (Attachment 3). Sign-in of every meeting participant is required to ensure proper accountability and to meet Resolution Consultants project recordkeeping requirements.

4.5.7 Safety, Health and Environmental considerations will be discussed at every project meeting. Once on-site:

- All on-site personnel must review and acknowledge the form or plan at a “tailgate” or “toolbox” meeting.
- Any new or previously unidentified hazards must be documented on the form or plan as a Revision and acknowledged with initials by all on-site staff.
- The Project Safety Plan must be reviewed regularly as required and documented on the plan.

4.5.8 All signed copies of the field forms and project plans must be placed in the appropriate project folder.

4.6 Roles and Responsibilities

4.6.1 **SH&E manager** shall provide assistance to Project Managers (PM) as required to carry out the requirements of this Standard Operating Procedure (SOP), particularly in the area of making training materials available and providing spot-checks of proper documentation.

4.6.2 **Task Order Managers** shall ensure that PMs of projects within their areas of responsibility are conducting and properly documenting safety meetings in accordance with requirements of this SOP.

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4.6.3 **Project Managers (field task managers, supervisors)** shall ensure that all employees and personnel under the control of Resolution Consultants (e.g., subcontractors, temporary agency employees) assigned to projects within their areas of responsibility participate in project initiation/kick-off meetings, special situation meetings, task hazard analyses, on-site safety inspections, and supplemental training meetings.

5.0 Records

None.

6.0 Attachments

6.1 5-210 Form 1 Tailgate Safety Meeting Log

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05-210-Tailgate Safety Meeting Log

This sign-in log documents the topics of the tailgate safety briefing and individual attendance at the briefing. Personnel who perform work operations onsite are required to attend each safety briefing and acknowledge their ability to ask questions and receipt of such briefings daily. Please provide a brief narrative of the following topics as applicable to the Project.

Name of Meeting Leader	**Signature**

PROJECT NAME & LOCATION

PROJECT NO.	**DATE/TIME**	**WEATHER CONDITIONS**

TOPIC
Discussion – check one

Today's Scope of Work (All tasks)	☐ yes	☐ n/a	Access / Egress / Slips, Trips, & Falls	☐ yes	☐ n/a
Schedule / New Work / Scope Changes	☐ yes	☐ n/a	Smoking, Eating, & Drinking	☐ yes	☐ n/a
Reviewed Procedures, THA, etc.	☐ yes	☐ n/a	Washroom / Facilities Location	☐ yes	☐ n/a
Emergency Action Plan & Procedures	☐ yes	☐ n/a	Heat/Cold Stress	☐ yes	☐ n/a
Communications Protocol	☐ yes	☐ n/a	Exclusion Areas Barricades / Cones	☐ yes	☐ n/a
Required PPE	☐ yes	☐ n/a	Required Permits, Passes, Keys, etc.	☐ yes	☐ n/a
Required Monitoring / Instruments	☐ yes	☐ n/a	Decon Procedures / IDW Mgmt.	☐ yes	☐ n/a
Site Control / Work Zones / Security	☐ yes	☐ n/a	Eqpmt. Inspections/Safety Checklists	☐ yes	☐ n/a

COMMENTS/OTHER

Tailgate Meeting Attendees

Print Name	**Signature**

SIX QUESTIONS FOR SUCCESS – As your final preparedness take two minutes to think through and answer these questions**:**

1. What are we about to do?
2. What equipment are we going to use?
3. Have I/we been trained to use this equipment?
4. Have I/we been trained to do this job?
5. How can I/we be hurt?
6. How can I/we prevent this incident?

If you and your team aren't prepared to do the assigned work, STOP WORK, and take time to properly prepare.

END OF DAY SIGN-OFF:

_____

Site Safety Officer Signature

☐ No Incidents Occurred

☐ Number of Near Misses/Observations Reported

☐ All Incidents Reported the Incident Reporting Line

LESSONS LEARNED/COMMENTS/OTHER

5-213-Subcontractors

1.0 Purpose and Scope

1.1 Provides a process through which Resolution Subcontractors are evaluated to determine if the use of that Subcontractor will pose an unacceptable risk to Resolution and/or its clients, employees, equipment, or property.

1.2 This policy applies to all Resolution North America based operations.

2.0 Terms and Definitions

2.1 **Subcontractor:** Any contractor or organization procured to provide direct services for, or in support of, an Resolution managed activity or operation. This is inclusive of any Resolution managed activity or operation that requires the physical presence of that contractor at the location to conduct the contracted service. Examples include, but are not limited to:

- Heavy equipment operations
- Surveying
- Construction/renovation/clean-construction operations
- Demolition
- Well abandonment
- Electrical system installation/service
- HAZWOPER Activities

2.2 **Resolution field site:** A site at which Resolution is providing field-related services.

3.0 References

None.

4.0 Procedure

4.1 **Subcontractor Selection Requirements**

4.1.1 For all subcontractors, the selection process will include consideration of the candidate firms' SH&E management and performance indicators.

4.1.2 Subcontractor bids/submittals shall include a completed Subcontractor SH&E Evaluation. Each questionnaire will be evaluated during the subcontractor selection process to identify any organizations whose past SH&E performance may disqualify them from selection.

4.1.3 Prior to the start of their on-site operations, the selected subcontractor firms are required to provide copies of any SH&E documentation (e.g., insurance carrier supplied Experience Modification Rates documents, insurance certificates, safety plan, manual of safety procedures, employee training/medical monitoring certifications) to the Project Manager and/or subcontractor selection manager.

4.1.4 Although the questionnaire is to be used as a guideline to determine whether a bidder's safety and health record is acceptable, there are no simple pass/fail criteria. The guidance outlines the standards Resolution's JV Partner's SH&E Department has established to reflect performance acceptability. Marginal performance (Score is less than 3) will require evaluation for final approval of a subcontractor by the PM in coordination with the SH&E Department. Priority will be given to subcontractors who have obtained certification standards (e.g., OHSAS 18001; Certificate of Recognition).

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4.2 **Procurement Phase.** Prior to starting fieldwork, each subcontractor organization shall provide the Resolution Project Manager (or Resolution representative) with at least one of the following for review and acceptance:

4.2.1 Site-specific SH&E documentation addressing specific performance requirements for the subcontractor's on-site work activities, site safety coordinator's name and responsible persons; or

4.2.2 A written statement of adoption of the provisions in Resolution's project SH&E documentation as the subcontractor's minimum procedures while working on the job site. This documentation must be in letter format (company letterhead), and must include the following information:

- Site location
- Anticipated scope of work activities to be performed and equipment to be used by the subcontractor
- Name of the subcontractor's Site Safety Officer, with contact phone numbers
- Name of the subcontractor's Health and Safety Manager, with contact phone numbers
- In addition to the subcontractor's own SH&E requirements, a statement adopting the Resolution's project SH&E documentation as the subcontractor's minimum requirements for the project
- Statement requiring that only qualified and trained personnel (to the level of assigned responsibilities) will perform assigned work activities on the site
- Designation of required personal protective equipment anticipated for the subcontractor's assigned work activities
- Copies of supplemental or additional subcontractor-specific provisions, policies, procedures and/or protocols that will be implemented by the subcontractor during site activities

4.3 **On-Site Subcontractor SH&E Requirements**

4.3.1 Subcontractor organizations are responsible for safely performing their assigned work activities in accordance with all applicable federal and state/provincial/territorial occupational safety and health regulations, acts, and codes.

4.3.2 Subcontractors are responsible for providing Resolution with a copy of their project-specific SH&E documentation for the subject work. The specification of minimum acceptable on-site SH&E performance should be included.

4.3.3 Subcontractors are responsible for confirming that their employees are provided the appropriate equipment and training to perform the work safely.

4.3.4 All subcontractors must provide input to, and be orientated to, the hazards associated with the site and activities of the project.

4.3.5 All subcontractors must provide proof of safety training as required for the hazards identified, inclusive of any required medical surveillance documentation.

4.3.6 Subcontractors will be provided with a copy of Resolution's project-specific SH&E documentation for the specification of minimum acceptable on-site SH&E performance.

4.3.7 If at any time the subcontractor obtains the services of another subcontractor, consultant, or lower tier subcontractor for any portion of the work to be performed, a copy of the Statement of Work and the approved project-specific SH&E documentation shall be provided as part of the package submitted to each respective subcontractor, consultant, or lower-tier subcontractor. Prior to the start of work, the subcontractor shall submit in writing to the PM, subcontractor selection manager, or their designee the names of any lower-tier subcontractors that may be used in the project that have yet to be approved. The start of work is conditional upon this approval.

4.4 **Roles and Responsibilities**

4.4.1 **Regional Management** is responsible for:

- Providing the resources to implement the subcontractor evaluation process.
- Maintaining all subcontractor SH&E performance data (developing and managing a database recommended).

4.4.2 **Project Managers** are responsible for confirming that all subcontractors have been properly evaluated for SH&E performance and potential risk. This includes:

- Communicating the requirements established in this procedure to the subcontractor and providing them with the Subcontractor SH&E Evaluation form.
- Reviewing the completed subcontractor evaluation and confirming their potential risk prior to the start of work.
- Providing a completed evaluation to the project file and the administrator or database manager in their region.
- Verifying a subcontractor's minimum level of insurance coverage as stipulated by Resolution's Legal and Procurement Departments (Workers' Compensation, Auto Insurance, General Liability, etc.).

4.4.3 **Regional SH&E Manager** is responsible for:

- Providing support to the project managers in understanding the subcontractor evaluation process and requirements.

5.0 Records

5.1 Business Line management will maintain subcontractor evaluations and associated documentation either in the project file, or, preferably, in a centralized database for tracking.

6.0 Attachments

5-213-Subcontractor SH&E Evaluation

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5-301- Confined Space Entry Permit

1. Permit space to be entered:_ Project Name & No.:
2. Purpose of entry:_____
3. Good on this date only: From:_ AM/PM To: AM/PM
4. Designated entry personnel:

Authorized Entrants	Authorized Attendants	Entry Supervisor

5. Hazards within the permit space:_
6. Permit space preparation:
   1. Work area isolated with signs/barriers? ☐ Yes ☐ No ☐ NA
   2. All energy sources locked/tagged out? ☐ Yes ☐ No ☐ NA
   3. All input lines capped/blinded? ☐ Yes ☐ No ☐ NA
   4. Permit space contents drained/flushed/neutralized? ☐ Yes ☐ No ☐ NA
   5. Permit space cleaned/purged? ☐ Yes ☐ No ☐ NA
   6. Ventilation provided before entry? ☐ Yes ☐ No ☐ NA

7. Initial atmospheric testing:

Measured Parameter	Reading	Time	Acceptable Level
Percent Oxygen (%)			19.5% to 23.5%
Explosivity/LEL %*			< 10%
Carbon Monoxide			< 25 ppm
Hydrogen Sulfide*			< 10 ppm
VOC			Chemical Specific
* Does this parameter require the use of a Correction Factor (CF)?			

8. Multiple depth/location/time testing:

Test(s) To Be Taken	Permissible Entry Levels	Test 1	Test 2	Test 3	Test 4
Percent Oxygen	19.5% to 23.5%				
Explosivity/LEL	<10%				
Carbon Monoxide	< 25 ppm				
Hydrogen Sulfide	< 10 ppm				
VOC	Chemical Dependent				
Name of Tester					
Test Times					

9. Rescue services: ☐ On Site ☐ Off Site

   Identity and phone # for rescue services or means of summoning:

10. Communication devices and procedures to be used during entry:

11. Safety equipment required for entry:

    PPE: ☐ NA ☐ No ☐ Yes

    Specify:

    Testing Equip: ☐ NA ☐ No ☐ Yes

    Specify:

    Alarm System: ☐ NA ☐ No ☐ Yes

    Specify:

    Rescue Equip: ☐ NA ☐ No ☐ Yes

    Specify:

    Other: ☐ NA ☐ No ☐ Yes

    Specify:

12. Additional permits required:

    Hot work: ☐ Yes ☐ No

    Other: ☐ Yes ☐ No

    Specify:

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13. Permit authorization:

    I certify that I have inspected the work area for safety and have reviewed all safety precautions recorded on this permit.

    Permit Authorization by Entry Supervisor

    (Signature): Date/Time

14. Permit conditions verification:

    Physical conditions at confined space checked and verified to be in accordance with the permit

    ☐ Yes ☐ No

    If no, please record the deviation observed and the corrective action taken:

    Verified by: _____

    (Entry Supervisor)

    Date Time

15. Review & closeout:

    Please list any problems encountered during the entry:

    Corrective/preventive action(s) taken:

    Additional precautions/recommendation for future entry:

    Based on this review, this confined space will be considered:

Permit-required Confined Space	☐ Yes	☐ No
Non-permit-required Confined Space	☐ Yes	☐ No
Alternate Procedure Confined Space	☐ Yes	☐ No

    Reviewed by: _____

    (Entry Supervisor) Date

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5-301-Confined Space Hazard Assessment

PART I. CONFINED SPACE IDENTIFICATION

Confined Space Name:

Dimensions:

Description of Space:

Is this space entered on a routine basis? ☐ Yes ☐ No

Described Tasks and Frequency:

PART II. NATURE OF THE HAZARDS—ASSUMPTIONS: Tanks are empty and clean, all energy sources have been identified and isolated, and no other hazards are introduced into the spaces.
A more formal hazard assessment must be done at the time of entry.

Potential Atmospheric Hazards	**Potential Non-Atmospheric Hazards**
☐ O_2 Deficient /Enriched	☐ Contains material that could engulf entrant?_____
☐ Combustibles/Flammables	☐ Internal configuration could trap entrant?_____
☐ CO	☐ Electrical (live circuits)? _____
☐ H_2S	☐ Mechanical (pipes, linkages)?_____
☐ Other Toxics	☐ Slick/residue-covered surfaces?_____
	☐ Equipment preventing safe exit?_____
	☐ Low/inadequate lighting?_____
	☐ Hazardous chemicals present? _____
	☐ Fall potential?_____
	☐ Potential for dropped objects?_____
	☐ Multiple work groups/nature of work_____
	☐ Other _____

Insert photo of space here.

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5-303-Excavation and Trenching

1.0 Purpose and Scope

1.1 To evaluate all excavation operations to provide for proper protective systems for employee protection from associated hazards.

1.2 This SOP applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Benching (Benching system)**: A series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels to protect employee from cave-ins.

2.2 **Cave-in (collapse)**: The separation of a mass of soil or rock material from the side of an excavation or the loss of soil from under a trench shield or support system and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

2.3 **Competent person**: Person, who, by way of training, knowledge, and/or experience, is capable of classifying soils and is also capable of identifying existing and predictable hazards in excavation/trenching work area and who has the authority to take prompt corrective measures to eliminate them. The person must also be familiar with the requirements in the regulation.

2.4 **Excavation**: A manmade cut, cavity, trench, or depression in an earth surface formed by earth removal. Examples include trenches, tunnels, shafts, caissons and open cut holes.

2.5 **Faces (or sides)**: The vertical or inclined earth surfaces formed as a result of excavation work.

2.6 **Failure:** A structural member's integrity and supportive capabilities is compromised, causing a breakage, displacement, or permanent deformation.

2.7 **Hazardous Atmosphere**: An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful may cause death, illness, or injury.

2.8 **Protective Systems**: Devices or methods in protecting employees in an excavation from cave-ins, a collapse or falling material. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

2.9 **Ramp**: An inclined walking or working surface that is used to gain access to one point from another and is constructed from earth or from structural materials such as steel or wood.

2.10 **Registered Professional Engineer**: An engineer who can authorize any state of work by his professional designation. However, a professional engineer registered in the state, province, or territory is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

2.11 **Shield (Shield system)**: A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

2.12 **Shoring (Shoring system)**: A structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and that is designed to prevent cave-ins.

2.13 **Sloping (Sloping system)**: An alternative to shoring is trench sloping. This means that the trench walls are cut back to decrease the possibility of cave-ins. The angle of incline required to prevent a cave-in varies with such factors as soil type, environmental conditions of exposure, and application of surcharge loads.

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2.14 **Stable rock:** A natural solid mineral material that can be excavated with vertical side wall; unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against cave-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

2.15 **Support system**: A structure such as underpinning, bracing, or shoring that provides support to an adjacent structure, underground installation, or the sides of an excavation.

2.16 **Trench:** An open narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width (measured at the bottom) is often not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered a trench.

2.17 **Trench Box:** A trench box is a unit of shoring that is an engineered shoring system capable of protecting workers in case of cave-in of trench walls. The space between the trench wall and the trench box must be backfilled.

3.0 References

None.

4.0 Procedure

4.1 Restrictions

4.1.1 Because of their inherent dangers, entry into trenches and excavations shall not be performed if there are means other than entry to perform the work. Where entry into trenches and excavations is necessary, strict adherence to the procedures specified below is extremely important. Whenever there are questions regarding the safety of trench or excavation entry, contact shall be made with the Competent Person or the Regional SH&E Manager.

4.1.2 No one shall enter any trench or excavation until the walls have been adequately cut back or temporary protective structures have been installed unless the trench or excavation is shallower than the legal minimums and the soil is stable.

4.1.3 Excavation work must be completed and inspected in accordance with the written instructions of a qualified professional and in accordance to the provincial, territorial, state, or federal regulations.

4.2 Competent Person

4.2.1 For the purpose of this SOP, a competent person is defined as an individual, who by education or experience, is capable of evaluating the hazards associated with trench or excavation collapse and is capable of classifying soils. The competent person for the project will be indicated in the Task Hazard Analysis for the project.

4.2.2 The competent person:

- Will determine the maximum allowable slope for the walls of the trench or excavation.
- Will classify the soil in the trench or excavation in accordance with the requirements specified in the legislation (e.g., CFR 1926 subpart P, Appendix A Soil Classification) prior to determining that a maximum allowable slope, other than 34° with the horizontal is selected.
- Will inspect the excavation or trench on a daily basis when the potential for employee exposure to the hazards of the trench or excavation exists (*5-303-Daily Excavation Checklist*).

4.3 Project Managers

4.3.1 All projects under their direct control or authority and involve excavations or trenching are conducted in a safe and efficient manner and in accordance with the requirements of this SOP.

4.3.2 All projects under their direct control or authority have a written HASP prepared for the activity.

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4.4 Underground and Overhead Utilities

4.4.1 Prior to beginning any excavation work at a site, the location of all underground and overhead utilities shall be identified and work locations will be carefully planned to avoid any potential for inadvertent contact with them.

4.4.2 Locate underground utilities and expose prior to excavating.

4.4.3 Identify any overhead power lines and de-energize or protect by other appropriate means.

4.5 Excavation Requirements

4.5.1 Soil conditions, wall slope, or shoring must be identified and designed by a professional engineer or qualified professional to meet the federal, state, provincial, territorial regulations.

4.5.2 Excavated (spoil) material shall be kept at least 1.0 metre (3.2 feet) from the edge of the excavation, or further if local regulations are more stringent.

4.5.3 If the walls of an excavation or trench are not sloped or cutback, barriers must be placed around the perimeter. The barrier must be at least 1.1 metres (3.6 feet) in height.

4.5.4 Workers must be protected whenever shoring is being installed or removed.

4.5.5 If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored regularly to ensure proper operation.

4.5.6 If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require regular inspections.

4.5.7 All excavations must be secured at the end of the day with a protective covering or appropriate barriers to prevent the public from falling into the open excavation.

4.5.8 Backfill trenches as soon as reasonably possible after work is complete.

4.6 Sloping or Shoring Protection Requirements

4.6.1 A Professional Engineer or Qualified Soils professional can properly assess the need for and the type of shoring required for specific applications. Shoring may not be needed in all cases, but failure to recognize the need for shoring can be catastrophic.

4.6.2 **Exceptions.** Each individual in an excavation shall be protected from cave-ins and trench collapse by an adequate protective system except when

- Excavations are made entirely in stable rock.
- Excavations are less than 5 feet (and as above) in depth and an examination of the excavation by a competent person reveals no indication of a potential cave-in.

4.6.3 The depth of the excavation is to be measured at its greatest vertical dimension. Be aware that crouching or kneeling in a trench that is greater than 3 feet in depth may still pose significant hazard for the employee involved. The three means for supporting trench walls are sloping, shoring, and trench boxes.

4.6.4 The protective system may include sloping the excavation walls, shoring the excavation walls, or installing a shielding system. The protective system chosen must have the capacity to resist, without failure, all loads to be applied to the system.

4.6.5 Any excavation deeper than 20 feet (6.0 m); a professional engineer must approve and sign on all protective systems.

4.6.6 Trenches must be protected from cave-ins or loss of ground prior to workers entering the trench when the following conditions apply:

- The trench is greater than 3’11” (1.2 m) in depth (however, even if the trench is less than 1.2 meters deep the potential for a cave-in exists, and appropriate controls must be implemented prior to entry to ensure the trench is safe);
- A worker is required to enter the trench;
- A worker is required to be closer to a trench wall than the height of the trench wall; and,

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- If an excavation may affect the stability of an adjacent building or structure, precautions must be taken to prevent damage to the structure. The precautions shall be specified in writing by a professional engineer.

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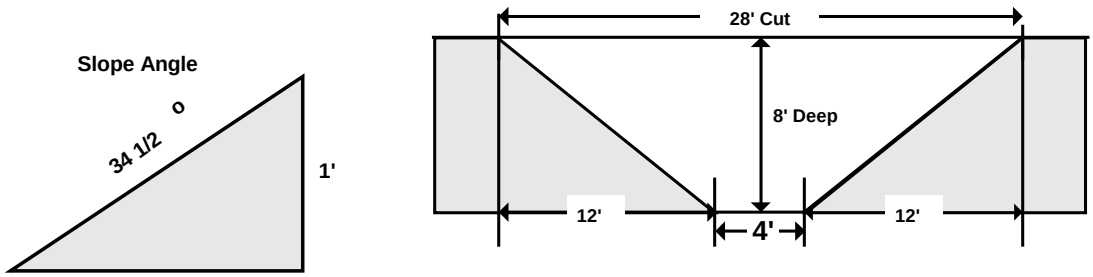
5.0 Daily Excavation Checklist

Daily Excavation Checklist			
Competent Person:		Date:	
Site Location:		Job Number:	
Soil Type:	Excavation Depth:	Excavation Width:	
Type of Protective System Used:			
Indicate for each item: Yes – No – or N/A for not applicable:			
1. General Information:	**Yes**	**No**	**N/A**
A. Is excavation less than five feet in depth?			
B. Is there a potential for a cave-in? ***IF YES, excavation must be sloped, shored, or shielded.**			
C. Is excavation deeper than 5 feet? *** IF YES, excavation must be sloped, shored, or shielded.**			
D. Is sloping used as your protective system?			

Slope information to keep in mind:



Example of a Simple 34-degree Slope commonly used around the site for cave-in protection.

E. 1- Manual and 1- Visual Method utilized to determine Soil Classification as A-B-C.			
2. Inspection of Job Site	**Yes**	**No**	**N/A**
A. Excavations, adjacent areas, and protective systems inspected by a competent person daily before the start of work.			
B. Competent person has the authority to remove all individuals from the excavation immediately.			
C. Surface encumbrances removed or supported.			
D. All individuals protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.			
E. Hard hats, safety-toed boots, and safety glasses worn by all individuals.			

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F. Spoils, materials, and equipment set back at least 2 feet from the edge of the excavation.			
G. Adequate barriers provided at all excavations, wells, pits, shafts, etc.			
H. Warning vests or other highly visible clothing provided and worn by all individuals. Wearing a vest at all times around heavy equipment is required.			
I. All individuals are required to stand away from vehicles being loaded or unloaded.			
J. Warning system established and utilized when mobile equipment is operating near the edge of the excavation (e.g., barricade tape, signalpersons, stop logs, etc).			
K. All individuals prohibited from going under suspended loads.			
3. Utilities	**Yes**	**No**	**N/A**
A. Location of utilities marked.			
B. Prior to the use of equipment, underground utilities have been located by hand digging.			
C. Underground utilities are protected, supported, or removed when excavation is open.			
4. Means of Access and Egress:	**Yes**	**No**	**N/A**
A. Travel distance to means of egress no greater than 25 feet in excavations 4 feet or more in depth.			
B. Straight ladders used in excavations extend at least 3 feet above the edge of the trench.			
C. Ramps being used for employee access have been designed by the competent person.			
D. All individuals are protected from cave-ins when entering or exiting the excavation.			
5. Wet Conditions:	**Yes**	**No**	**N/A**
A. Precautions have been taken to protect all individuals from the accumulation of water.			
B. Water removal equipment monitored by a competent person.			
C. Surface water or runoff is diverted or controlled to prevent accumulation in the excavation.			
D. Inspections have been made after every rainstorm or other hazard-increasing occurrence (freeze/thaw, local demolition, rerouting of traffic, etc).			
6. Hazardous Atmosphere: The atmosphere within the excavation must be tested where there is a reasonable possibility of an oxygen deficiency or a combustible or other harmful contaminant exposing any individual to a hazard.	**Yes**	**No**	**N/A**
A. Are there exposed sewer or natural gas lines in excavation?			
B. Is excavation near a landfill area, or are hazardous substances being stored close to the excavation?			
If you answered YES to A or B, then treat the excavation as a confined space.			
C. All individuals will contact the Fire/Rescue Group at prior to entry and in case of emergencies.			
7. Support Systems:	**Yes**	**No**	**N/A**

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A. Materials and/or equipment for support systems are selected based on soil analysis, trench depth, and expected loads.			
B. Materials and equipment used for protective systems have been inspected and are in good condition.			
C. Materials and equipment not in good condition have been removed from service.			
D. Protective systems installed without exposing all individuals to the hazards of cave-ins, collapses, or the threat of being struck by materials or equipment.			
E. Members of support system are securely fastened to prevent failure.			
F. Support systems are provided to ensure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc.			
G. Excavations below the level of the base of a footing have been approved by a registered Professional Engineer.			
H. Removal of support systems progresses from the bottom, and members are released slowly so that you can note any indication of possible failure.			
I. Backfilling progresses with the removal of the support system.			
J. Material is excavated to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.			
K. A shield system has been placed to prevent lateral movement.			
M. All individuals are prohibited from remaining in the shield system during vertical movement.			
8. Training:	**Yes**	**No**	**N/A**
A. All individuals have had Excavation Safety Awareness Training.			

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5.1 Use of Sloping as a Means of Protection

5.1.1 Sloping the walls of the trench or excavation is the preferred, and typically simplest, means of protecting employees who must enter trenches or excavations which are greater than 5 feet (1.5 m) in depth or where there is danger of collapse.

5.1.2 The trench or excavation walls may be sloped back so that the ratio of the horizontal distance to the vertical rise (H:V ratio) of the sloped wall is at least 1½:1 (i.e., equivalent to an angle with the horizontal of 34° or less) or,

5.1.3 In many cases, determining the maximum allowable slope may allow the use of a steeper slope, which will result in a narrower excavation. However, determination of soil classification is complicated and requires that the competent person be familiar with the manual and visual tests. Since incorrect soil classification may result in the use of a steeper, and potentially unsafe, slope, it is recommended that an angle of 34° (or less) with the horizontal typically be selected.

5.2 Use of Shoring or Shielding as a Means of Protection

5.2.1 Where sloping the walls of the trench or excavation is unfeasible (e.g., when there are dimensional constraints or adjacent structures), the use of shoring or shield systems (e.g., trench boxes) may be necessary.

5.3 Work Around the Trench/Excavation

5.3.1 While workers are in a trench, an aboveground observer must be present to warn of earth movements and to advise equipment operators of the presence and location of those in the trench so as to avoid vibrating equipment near trenches or excavations.

5.3.2 If there is a danger of a worker or equipment falling into an excavation, or whenever the edge is not clearly visible, you must identify the trench or excavation perimeter with visual markers (e.g., barricade tape, wooden railings, stop logs, etc). If the trench or excavation is 4 ft (1.2 m) or greater in depth, the visual barrier must be a minimum of 6 ft (1.8 m) from the edge.

5.3.3 Personnel must notify workers of the excavation through flagging, marking, safeguards, or other appropriate and effective means.

5.3.4 Where employees or equipment are required or permitted to cross over excavations, walkways, or bridges, walkways or bridges over excavations must have a minimum clear width of 20 inches (0.6 meters), be fitted with standard guard rails and extend a minimum of 24 inches (0.6 meters) past the surface edge of the trench. If vehicle crossings over excavations are required, they must be designed by and installed under the direction of a registered professional engineer.

5.3.5 Precautions must be taken to isolate loose rocks or other materials that may slide, roll, or fall into the trench and onto workers are stripped prior to entry by workers into an excavation.

5.3.6 While operating heavy equipment in the work area, the equipment operator shall maintain communication with a designated signal person through either direct voice contact or approved standard hand signals.

5.3.7 When mobile equipment is operated adjacent to an excavation or when such equipment is required to approach the edge of an excavation and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs shall be used. If possible, the grade should be away from the excavation.

5.3.8 All site personnel should maintain a safe distance and remain clear of the swing of operating excavation equipment.

5.3.9 Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.

5.3.10 All site personnel that operate or work in the vicinity of heavy equipment shall wear all Resolution Consustants-required safety equipment.

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5.3.11 All materials such as pipe, rebar, etc., shall be kept out of traffic lanes and access ways. Materials and equipment shall be stored in a designated area so as not to endanger personnel at any time.

5.3.12 A flagman with roadwork, signs, cones, and high-level warning signs shall be provided when it is necessary to control normal vehicular traffic due to vehicles, such as end-dumps, entering, or leaving the site.

5.4 Work Within the Trench/Excavation

5.4.1 Employees shall not work in excavations in which there is accumulated water or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

5.4.2 A stairway, ladder, ramp, or other safe means of egress shall be located in excavations or trenches that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees. Ladders should extend at least 3 feet (0.75m) above the trench top.

5.4.3 Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design and shall be constructed in accordance with the design.

5.4.4 Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement. Structural members used for ramps and runways shall be of uniform thickness. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping. Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

5.5 Hazardous Atmospheres

5.5.1 Confined spaces may exist in excavations where there is limited access or egress and in which a hazardous gas, vapor, dust, or fume or an oxygen-deficient atmosphere may occur.

5.5.2 Adequate precautions, such as mechanical ventilation or appropriate respiratory protection, shall be taken prior to entry into trenches and excavations in which the oxygen concentration is less than 19.5 percent or the concentration of flammable gases or vapors is in excess of 10 percent of the lower explosive limit (LEL).

5.5.3 When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to confirm that the atmosphere remains safe. Atmospheric testing will be conducted in the anticipated breathing zone of the work area to determine oxygen content, combustible gas, and toxic gases and vapors, if applicable.

5.5.4 Appropriate respiratory protection shall be donned prior to entry into any trench or excavation in which airborne levels of toxic substances are present at concentrations in excess of their Threshold Limit Value (TLV) or Permissible Exposure Limit (PEL).

5.6 Stability of Adjacent Structures

5.6.1 Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

5.6.2 Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when

- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or
- The excavation is in stable rock; or
- A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

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- A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

5.6.3 In addition, sidewalks, pavements, and appurtenant structures shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

5.7 Inspections

5.7.1 Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.

5.7.2 An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

5.7.3 Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

5.8 Personal Protective Equipment

5.8.1 Hard hats

5.8.2 Steel-toed boots

5.8.3 Reflective vest

5.8.4 Respiratory equipment, as required

5.8.5 Safety glasses with side shields

5.9 Special Excavation Entry Permit Required for California

In California, for the construction of trenches or excavations that are 5 feet/1.5 m or deeper and into which a person is required to descend, an additional permit must be obtained from Cal/OSHA.

6.0 Records

6.1 Completed Daily Excavation Checklist—must be retained for +1 year

7.0 Attachments

7.1 5-303-Daily Excavation Checklist

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5-305- Hand and Power Tools

1.0 Purpose and Scope

1.1 This procedure provides Resolution Consultants' requirements for all manually-operated hand and power tools and equipment use, handling and storage.

1.2 Applies to all Resolution Consultants staff and field worksites.

2.0 Terms and Definitions

None.

3.0 References

3.1 5-305-Hand and Power Tools

3.2 5-410-Hazardous Energy Control

3.3 5-302-Electrical, General

3.4 5-208-Personal Protective Equipment Program

3.5 5-510-Hearing Conservation Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager (Field Task Manager, Supervisor)** Each Manager/Supervisor must ensure that all aspects of this procedure are followed and adhered to on all Resolution Consultants projects, sites and locations. If a specific tool is not included in this work instruction section of this SOP, appropriate guidelines shall be established prior to work associated with that equipment, including following manufacturer's recommendations.

4.1.2 **Regional SH&E Professionals** provides technical guidance and support as to this procedure.

4.1.3 **Employees** shall not work with any tool that they are not familiar with without first obtaining training associated with that equipment. In addition, employees must following manufacturer's recommendations for its use and must not modify the equipment without first obtaining authorization from the manufacturer.**.**

4.2 Restrictions

4.2.1 No employee shall use any hand tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

4.2.2 All tools will be used in accordance with manufacturer's specifications.Personnel involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER-controlled work areas).

4.3 Training

4.3.1 Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool.

4.4 Personal Protective Equipment

4.4.1 Lockout devices (padlocks, multiple lock hasps, tags), gloves appropriate to the task, safety-toed boots, as required, hard hats and eye & face protection, as required.

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4.5 **Inspections**

4.5.1 All tools must be inspected prior to each use. Any tool that is defective or has missing parts must not be used. Every broken or defective tool must be tagged or identified as such. Tagged tools will be returned to your supervisor for repair or replacement. Tagged tools will be immediately removed from service.

4.5.2 All tools must be inspected to manufacture's specifications according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly.

5.0 Records

None.

6.0 Attachments

None.

7.0 Records

None.

8.0 Attachments

None.

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5-306-Highway and Road Work

1.0 Purpose and Scope

1.1 To address potential hazards that may occur during highway construction and during work within the right of way of a public or private roadway.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Personal Protective Equipment (PPE)**: Safety clothing and equipment worn by workers in traffic areas to provide protection and heightened visibility from physical hazards including moving vehicles and construction equipment.

2.2 **Traffic areas**: Any work area where workers are located within 20 feet of moving traffic, existing or anticipated.

2.3 **Traffic Control Plan**: A written document containing drawings and text that describes the physical controls to be established to isolate workers from moving vehicles.

2.4 **WOF:** Workers on foot.

3.0 References

3.1 None.

4.0 Procedure

4.1 **Roles and Responsibilities**

4.1.1 **Project/Lead Manager or Resident Engineer** is responsible for administering the procedure and for determining the measures and configuration of the temporary traffic control zone in accordance with specifications for workers, motorists, and pedestrians and the protection of Resolution Consultants employees within the contract. The Lead Manager will also see that employees assigned to work in traffic areas are trained in the use of traffic control systems and PPE.

4.1.2 **Site Safety Coordinator** is responsible to the lead manager for the implementation of safety and the internal traffic control plan within a highway construction/demolition worksite. The Site Safety Coordinator will

- Be responsible for traffic safety coordination on office projects.
- Be appointed by each office that has any field work involving Resolution Consultants staff working in or near traffic. This is not a dedicated role and may be a committee member.
- Receive training in the requirements of the governing transportation authority and the applicable OH&S legislation through training sanctioned by the respective authorities.
- Be involved in conducting hazard assessments, developing the mitigating strategies and Safe Job Procedures, and reviewing their implementation for any project where traffic is identified as a hazard to our team members.

4.2 **Personal Protective Equipment**

4.2.1 High visibility safety vest /apparel

4.2.2 Retro-reflective stripes (for night work)

4.2.3 Protective headwear (hard hat)

4.2.4 Two-way radio or other means of effective communication

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4.2.5 Traffic Accommodation equipment, as required by the traffic protection plan:

- A rooftop beacon light for the vehicle, where required
- Pylons, Glo-posts, flags, barricades and/or flagging tape, warning lights, flashing light boards
- Signage
- Flagging equipment, as required:
  - Daytime:
    - Flag person's "Stop and Slow" paddle
    - A blaze orange flag person's vest over white coveralls
    - Safety head protection (hard hat)
    - Drinking water
    - Bug repellent and/or sun screen as conditions warrant
    - Optional radio communication (if required)
  - Night time (additional requirements):
    - A retro-reflective "Stop and Slow" paddle
    - A flashlight fitted with a red signaling baton
    - Flashing yellow beacons set up in advance of the flag person

4.3 **Restrictions**

4.3.1 Applicable legislated requirements governing all aspects of traffic safety, including directing traffic, signage, PPE, traffic control devices in temporary construction, maintenance and utility work zones, will be reviewed in preparation for the site-specific traffic accommodation.

4.3.2 No personnel will be allowed onto the site without first reviewing the project-specific traffic protection plan.

4.4 **Training**

4.4.1 All staff will receive on-site orientation to the hazards and controls.

4.4.2 Only staff with appropriate flag person training will act as a flag person.

4.5 **Traffic Control Plan**

4.5.1 Transportation incidents and workers struck by vehicles or mobile equipment account for many fatal construction work injuries. Workers in highway construction activities including flagging, demolition, surveying, utility, clean-up, emergency responders, and others in areas where traffic exists are exposed to being struck by moving vehicles. Work zones are used to move traffic in an approved direction and are typically identified by signs, cones, barrels, and barriers.

4.5.2 The procedures appropriate for work in traffic areas will vary depending on the work environment. Very simple procedures are needed in an inactive parking lot, and more complex procedures are needed when working in a construction zone on a highway. Each Resolution Consultants project team shall prepare a project Health and Safety Plan (HASP) or Safe Work Plan (SWP) addressing traffic controls and worker protection appropriate for the team's project and exposures. Plans shall address the following if applicable:

- Attenuator vehicles
- Closures within a closure
- Communications
- Driving: seatbelts and rollover protection should be used on equipment and vehicles as stated by the manufacturer
- Night operations and work within traffic controls

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- PPE
- Sanitation
- Signage
- Traffic control devices
- Traffic control plans and permits
- Training
- Work zone protections: various styles of concrete, water, sand, collapsible barriers, crash cushions, and truck mounted attenuators are available to limit motorist intrusions into the construction work zone
- Worker: heavy equipment interface

4.5.3 A Traffic Control Plan will be completed for the movement of vehicles in areas where workers are conducting other tasks.

4.5.4 Drivers, workers on foot (WOF), and pedestrians will be able to see and understand the routes they are to follow.

4.5.5 Where there are several projects, coordinated vehicle routes and communication between contractors will reduce vehicular struck-by incidents.

4.5.6 Hazard identification and plan development shall be performed in accordance with this procedure. The plans shall include the identification of the responsibility for personnel and implementation of the safety program under highway construction activities.

4.5.7 Other requirements for supporting activities such as excavations, heavy equipment usage, personal protective equipment, etc. shall be applicable and addressed in accordance with other Standard Operating Procedures.

- A traffic protection plan will be an integral part of the HASP or SWP whenever staff will be exposed to the hazards of vehicular traffic during project work (this may include surveys, drilling and soils inspections, bridge or overpass inspections, inspection of roadway construction projects).
- Work duration, road width, and traffic volume are some of the key considerations to be contemplated when designing a traffic protection plan. The traffic protection plan will address the specific vehicular hazards and describe the measures that will be implemented to protect employees.
- Traffic accommodation plans will be developed in consultation with a qualified supervisor or manager experienced in traffic control. In addition, a supervisor will be designated to oversee the implementation of the protection plan until work is completed.
- OH&S regulations and associated standards or guidebooks provide instruction on the use of traffic control devices in temporary construction, maintenance, and utility work zones for worker and motorist safety and to minimize the disruption of traffic flow.
- Schedule work to avoid periods of heavy traffic.
- Alert traffic of work ahead, by placing signs or cones well ahead of the work area.
- If the work area is being managed under a Traffic Control Plan or Traffic Accommodation Plan, obtain copies of these plans before commencing work.
- Traffic accommodation that is adequate in good weather conditions and daylight may not be adequate under adverse weather conditions and/or hours of darkness. Reassess the accommodation based on conditions.
- Traffic accommodation will be planned to provide safe conditions for the protection and safe passage of motorists, pedestrians, and employees at all work sites. It will include all areas located within the traveled portion of a roadway including shoulders, ditches, and boulevards.

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4.6 **Short-Term Traffic Protection**

4.6.1 Always wear the appropriate PPE to maintain your visibility to vehicular traffic. Wear a tear-away fluorescent reflective vest (and retro-reflective stripes on the arms and legs for night work or during periods of limited visibility) at all times.

4.6.2 Pull your vehicles off as far to the right of the traveled portion of the road as possible. Confirm that the shoulder of the highway or street where you will park your vehicle is wide enough to allow for safe access to and egress from the vehicle.

4.6.3 Always park your vehicle at least 30 metres from the flag person station. The vehicle should be positioned between the flag person and the work crew.

4.6.4 Activate the four-way flashers for your vehicle prior to exiting the vehicle.

4.6.5 Plan an escape route prior to exiting the vehicle.

4.6.6 Load and unload materials or equipment from the passenger side of the vehicle.

4.6.7 Avoid turning your back to oncoming traffic.

4.6.8 Be aware of mobile equipment that may be operating in the work area.

4.6.9 Do not enter onto the traveled portion of the road except to cross the road. Road crossings should be made at a 90 degree angle to the direction of the road.

4.7 **Long-Term Traffic Protection**

4.7.1 Traffic accommodation will be provided BEFORE the work starts and will be maintained until the work is completed. This may mean 24 hours a day, 7 days a week.

4.7.2 Generally, for long-term duration work activities that are performed at construction projects, the Constructor for the project is required to develop a traffic protection plan.

4.7.3 If Resolution Consultants has assumed the role of Constructor for the project, the traffic protection plan will be developed and implemented prior to the commencement of work activities at the project.

4.7.4 If Resolution Consultants is not the Constructor for the project, the traffic protection plan for the project will be developed by our Client or a Constructor designated by the Client.

4.7.5 The traffic protection plan should be reviewed with Resolution Consultants employees during orientation to the Project. If the traffic protection plan is not discussed at the project-specific orientation, employees should discuss the issue with the Site Supervisor or Client contact for the Project.

4.8 **Signage**

4.8.1 Standard highway signs for information, speed limits, and work zones will assist drivers in identifying designated traffic paths.

4.8.2 Provide appropriate instructional signage such as: EVACUATION ROUTE; DO NOT ENTER; REDUCED SPEED AHEAD; ROAD CLOSED; and NO OUTLET.

4.8.3 Using standard highway signs for internal construction worksite traffic control will assist workers in recognizing the route they are to use at the construction site.

4.8.4 Traffic Signs

- Signage will be of acceptable standards, in good condition, clean, legible, and suited to the purpose.
- Signage will be secured or weighted.
- Routinely inspect signage for placement, cleanliness, and physical damage.
- Cover road traffic control signage when no activity is present.

4.9 **Traffic Control Devices**

4.9.1 Standard traffic control devices, signals, and message boards will instruct drivers to follow a path away from where work is being done.

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4.9.2 The authority in charge will determine the approved traffic control devices such as cones, barrels, barricades, and delineator posts that will be used as part of the traffic control plan.

4.9.3 These standard devices should also be used inside the work zone.

4.10 **Work Zone Protections**

4.10.1 Various styles of concrete, water, sand, collapsible barriers, crash cushions, and truck-mounted attenuators shall be used to limit motorist intrusions into the construction work zone, as appropriate.

4.10.2 All Resolution Consultants staff shall be made aware of controls established by the Contractor.

4.10.3 Resolution Consultants staff shall wear the required safety equipment at all times including a hard hat, work boots, eye protection, and a high-visibility safety vest as a minimum and shall observe all project rules and requirements.

4.10.4 In the absence of a contractor, when Resolution Consultants staff are in the field alone—e.g., investigations, surveys—all appropriate DOT traffic control standards and devices shall be observed and placed in position.

4.10.5 The work zone shall be made safe by its separation from traffic.

4.11 **Flagging**

4.11.1 Flaggers and others providing temporary traffic control will wear high visibility clothing with a background of fluorescent yellow-green or orange-red and white, silver, yellow-green, orange, or yellow retro-reflective material.

4.11.2 In areas of traffic movement, PPE will make the worker visible for at least 1,000 feet so that the worker can be seen from any direction and will make the worker stand out from the background. Check the label or packaging to confirm that the garments are performance Class 2 or 3 (class requirement may be project-specific).

4.11.3 Drivers should be warned in advance with signs that there will be a flagger ahead.

4.11.4 Flaggers should use STOP/SLOW paddles, paddles with lights, or flags (flags should be used only in emergencies.). The STOP sign should be octagonal with a red background and white letters and border. The SLOW sign should be octagonal with an orange background and black letters and a border.

4.11.5 Flag Persons

- A traffic control person (flag person) will stand in a safe position, preferably on the driver's side of the lane under control, be clearly visible, have an unobstructed view of approaching traffic, and be positioned at least 25 m (80 ft) away from the work area unless circumstances or space requirements, such as working at or near an intersection, dictate otherwise.
- Flag persons will be trained and competent and will use appropriate PPE.
- Flag persons will be instructed in traffic control and flagging procedures, will be provided with sufficient breaks, and will not be permitted to work alone for extended periods as per local regulations.
- Flag persons will not get involved in needless conversation and will stay alert at their points of duty until relieved.
- Except for brief flagging operations, or in an emergency, "Flag Person Ahead" signs will be posted in advance of each flag person's station. Such signs will be removed promptly when the flagging operation terminates.

4.12 **Lighting**

4.12.1 Flagger stations should be illuminated. Lighting for workers on foot and equipment operators is to be at least 5 foot-candles or greater.

4.12.2 Where available lighting is not sufficient, flares or chemical lighting should be used.

4.12.3 Glare affecting workers and motorists should be controlled or eliminated.

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4.13 **Training**

4.13.1 Flaggers should be trained/certified and will use the signaling methods required by the authority in charge.

4.13.2 WOF, equipment operators, and drivers in internal work zones need to know the routes that construction vehicles will use.

4.13.3 Equipment operators and signal persons need to know the hand signals used on the worksite.

4.13.4 Operators and WOF need to know the visibility limits and the "blind spots" for each vehicle on site.

4.13.5 WOF should wear high visibility safety garments designated as Class 1, 2 or 3.

4.13.6 Workers should be made aware of the ways in which shift work and night work may affect their performance.

4.14 **Driving**

4.14.1 Seatbelts and rollover protection will be used on equipment and vehicles as stated by the manufacturer.

4.14.2 When pulling off to the side of the road, Resolution Consultants personnel will park their vehicles at minimum of 20 feet or the width of two traffic lanes from moving traffic.

4.15 **Night Operations and Work Within Traffic Controls**

4.15.1 Night work on roadways should not be done unless absolutely necessary and unless the work area is adequately lit.

4.15.2 Operations with night activities will have a written plan that addresses the safety issues of working at night. The plan will address, but is not limited to:

- Reflectivity
  - All equipment used in the work zone shall have DOT-approved reflective material placed to increase the visibility of the equipment.
  - All reflective surfaces shall be cleaned as required so that the reflectivity of the material is not degraded. Any areas of reflective surface that is damaged or obscured will be replaced.
  - Personnel working at night will have reflective tape on their hardhats and will wear retro-reflective vests at a minimum. The reflective bands on vests will be vertical and horizontal around the entire upper body.
  - Additional measures such as white disposable coveralls, reflective bands, and personal battery-operated strobe lights may be used when practical.
- Illumination
  - Whenever feasible and practical, light plants will be used to illuminate the work area.
  - On mobile operations, additional lighting on equipment may be used to illuminate the work area.
  - All equipment shall, at a minimum, have working strobe or warning beacon lights.
  - All equipment shall have working lights confirmed through daily visuals.
  - All flag persons will be placed in illuminated areas only.
  - All lighting is to be checked after setup to confirm that it is not blinding approaching traffic or other equipment in the work zone.
- Hazard Analysis and Communication
  - Prior to the start of any night operation, a detailed Hazard Analysis will be made addressing the possible hazards of night work. The Hazard Analysis will be reviewed with the crews and updated as needed. At the start of each shift, the Daily Safety Reminder will be used to reaffirm the provisions of the night work requirements as found in the hazard analysis and this policy.
  - The hazard analysis should also provide for:

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- The selection of a competent person responsible for maintaining surveillance on the work area to alert other workers of vehicles encroaching on the work zone.
- A method to signal workers when vehicles encroach on the work zone.
- A system to account for workers at all times, which may include a buddy system.
- Emergency communication or warning signals used by a worker such as a radio, signal horn, or whistle, which will be used to call for help.

4.16 **Attenuator Vehicles**

4.16.1 Although not required, it is good construction practice to place an attenuator truck or pick-up truck (minimum) immediately ahead of workers in a work zone.

4.16.2 The vehicle of choice should be placed to provide the best protection for workers.

4.16.3 The tires should be placed so that when struck the vehicle will turn away from workers.

4.17 **Closures within a Closure**

4.17.1 On occasion, satellite operations may be performed under full freeway traffic closures. For this type of work, special precautions referred to as a "closure within a closure" is to be implemented in accordance with the following:

- Posted speed limits within closures should be set at 15 miles per hour.
- Signs are to be installed approximately 250 feet in advance of and behind the work zone to alert drivers who may approach from either direction of the upcoming work zone.
- The work area is to be completely delineated with Type 1 barricades (candlesticks).
- Any vehicle used for AECOM field work shall be equipped with a functioning rotating beacon placed on the roof of the vehicle.

5.0 Records

5.1 Traffic Protection Plans and completed Equipment Checklists will be maintained in project files.

6.0 Attachments

6.1 5-306 Form 1 Equipment Checklist

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5-306-Form 1 Equipment Checklist

Name of Contractor:

Location: Project #:

Date: Time: Weather:

Person Conducting Inspection: Title:

*Note: As you conduct your inspection you should be able to answer each question with a **YES**. If the answer to any question is **NO,** this deficiency should be corrected as soon as possible.*

	YES	NO	OK	N/A
		Deficiency Corrected?		
Are accident prevention signs, tags clearly visible?	☐	☐	☐	☐
Are danger signs used where immediate hazards exist?	☐	☐	☐	☐
Are caution signs used to warn against potential hazards or to caution against unsafe practices?	☐	☐	☐	☐
Are exit signs posted at all exit locations?	☐	☐	☐	☐
Are proper visual warning signs posted prior to (in advance of) the work area?	☐	☐	☐	☐
Are flaggers provided with signs, signals, and barricades to provide the necessary protection?	☐	☐	☐	☐
Are flaggers using red lights when signaling during periods of darkness?	☐	☐	☐	☐
Are flaggers wearing highly visible warning garments?	☐	☐	☐	☐
Are the flaggers trained in proper flagging procedures?	☐	☐	☐	☐
Are warning garments worn at night reflectorized?	☐	☐	☐	☐
Are highly visible flags used by the flaggers at least 18 inches square?	☐	☐	☐	☐
Are barricades used to totally obstruct the passage of people and vehicles to protect the work area?	☐	☐	☐	☐
Do barricades meet the requirements set forth in the Manual of Uniform Traffic Control Devices? (MUTCD)	☐	☐	☐	☐

COMMENTS:

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5-307 Housekeeping, Worksite

1.0 Purpose and Scope

1.1 This procedure provides Resolution Consultants' work practices as well as personal hygiene and work site sanitation standards for housekeeping.

1.2 Applies to all Resolution Consultants staff and field worksites.

2.0 Terms and Definitions

None.

3.0 References

None.

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager (Field Task Manager, Supervisor)** is responsible for the procedure's implementation and the details of addressing housekeeping policy within the construction/demolition worksite.

4.1.2 **SH&E Professionals** will monitor, assess, and report on project housekeeping when visiting locations.

4.1.3 Employees are responsible for reporting any areas of concern to the Site Supervisor for prompt resolution as well as for maintaining worksites that are free from debris, clutter, and slipping or tripping hazards.

4.2 Smoking, Eating, and Drinking

4.2.1 Eating and drinking will be permitted in designated areas at Resolution Consultant project sites and as specified on client sites. Smoking will be permitted only in areas designated in compliance with applicable local laws, regulations, legislation, and ordinances, by the Field Supervisior and situated in locations that are not in the immediate vicinity of activities associated with work site activities. Additionally, Field Supervisior will designate each smoking area giving primary consideration to those personnel who do not smoke.

4.2.2 Personnel involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER-controlled work areas).

4.2.3 Site personnel will first wash hands and face after completing work activities and prior to eating or drinking.

4.3 Water Supply

4.3.1 Water supplies will be available for use on site and will comply with the following requirements:

4.3.2 Potable Water: An adequate supply of drinking water will be available for site personnel consumption. Potable water can be provided in the form of approved well or city water, bottled water, or drinking fountains. Where drinking fountains are not available, individual use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified and tape sealed in order to distinguish them from nonpotable water sources and protect the potable water integrity.

4.3.3 Nonpotable Water: Nonpotable water will not be used for drinking purposes. Nonpotable water may not be used for hand washing or other personal hygiene activities but may be used for other types of cleaning activities. All containers/supplies of nonpotable water used will be properly identified and labeled as such.

4.4 Toilet Facilities

4.4.1 Toilet facilities will be available for site personnel and visitors. Should subcontractor personnel be located on-site for extended periods, it may become necessary to obtain temporary toilet facilities.

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Exceptions to this requirement will apply to mobile crews where work activities and locations permit transportation to nearby toilet facilities.

4.4.2 A minimum of one toilet will be provided for every 20 site personnel, with separate toilets maintained for each sex, except where there are less than five total personnel on site. For mobile crews where work activities and locations permit use of nearby toilet facilities (e.g., gas station, or rest stop), on-site facilities are not required.

4.4.3 Washing Facilities

4.4.4 Hand and Face: Site personnel will wash hands and face after completing work activities and prior to breaks, lunch, or completion of workday.

4.4.5 Personal Cleaning Supplies: Cleaning supplies at Resolution Consultant project sites will consist of soap, water, and disposable paper towels or items of equal use/application (e.g., anti-bacterial gels, wipes, etc.).

4.5 Clothing and Personal Protective Equipment (PPE)

4.5.1 All PPE will be kept clean at all times and maintained in accordance with the manufacturer's, Resolution Consultant's. and applicable regulatory, legislative, or provincial requirements.

4.5.2 General Work Areas

4.5.3 At all times work areas will be kept free of dirt and debris that may impact the safety of site personnel and visitors. All trash receptacles will be emptied regularly.

4.5.4 Break Areas and Lunchrooms

Site personnel will observe the following requirements when using break areas and lunchrooms at Resolution Consultant project sites:

4.5.5 All food and drink items will be properly stored when not in use.

4.5.6 Food items will not be stored in personal lockers for extended periods in order to prevent the potential for vermin infestation.

4.5.7 Perishable foods will be refrigerated whenever possible.

4.5.8 All waste food containers will be discarded in trash receptacles.

4.5.9 All tables, chairs, counters, sinks, and similar surfaces will be kept clean and free of dirt, waste food, and food containers at all times.

4.5.10 Refrigerators used to store food items will be maintained at 45 degrees Fahrenheit and emptied of all unclaimed food items weekly. Refrigerators used to store food will be labeled as such so that only food and drinks are stored within the refrigerator.

4.5.11 Routine cleaning of refrigerators will also be performed on a regular basis.

4.6 Vermin Control

4.6.1 Every enclosed workplace shall be constructed, equipped, and maintained, so far as reasonably practicable, to prevent the entrance or harborage of rodents, insects, and other vermin.

4.6.2 A continuing and effective extermination program shall be instituted where the presence of rodents, insects, or other vermin is detected.

4.7 General Housekeeping

4.7.1 All work areas shall be kept clean to the extent that the nature of the work allows.

4.7.2 Every work area shall be maintained, so far as practicable, in a dry condition. Where wet processes are used, drainage shall be maintained and platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footgear shall be provided.

4.7.3 Protruding objects or placement of materials on paths or foot traffic areas present a problem with regard to slips, trips, falls, and puncture wounds. Personnel will use a reasonable amount of effort to keep slip, trip, and fall hazards to a minimum.

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4.7.4 Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal.

4.7.5 At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.7.6 Material and equipment must be placed, stacked, or stored in a stable and secure manner. Stacked material or containers must be stabilized as necessary by interlocking, strapping, or other effective means of restraint to protect the safety of workers.

4.7.7 An area in which material may be dropped, dumped, or spilled must be guarded to prevent inadvertent entry by workers or protected by adequate covers and guarding.

4.7.8 Floors, platforms, ramps, stairs, and walkways available for use by workers must be maintained in a state of good repair and kept free of slipping and tripping hazards. If such areas are taken out of service, the employer must take reasonable means for preventing entry or use.

4.7.9 Hazardous areas not intended to be accessible to workers must be secured by locked doors or equivalent means of security and must not be entered unless safe work procedures are developed and followed.

4.8 Worksite Offices and Trailers

Worksite offices and trailers will be maintained in accordance with *RC-103-Housekeeping, Office.*

5.0 Records

None.

6.0 Attachments

None.

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5-308-Manual Lifting, Field

1.0 Purpose and Scope

1.1 This procedure provides the requirements for use when performing manual materials handling activities (e.g., lifting/handling of items or materials).

1.2 This procedure applies to all field staff for Resolution Consultants operations.

2.0 Terms and Definitions

2.1 **Manual Materials Handling:** Moving or handling things by lifting, lowering, pushing, pulling, carrying, holding, or restraining.

2.2 **Team Handling:** Team handling occurs when more than one person is involved during the lift.

3.0 References

3.1 OSHA Technical Manual: http://www.osha.gov/dts/osta/otm/otm_vii/otm_vii_1.html

3.3 National Safety Council: www.nsc.org

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 The **Project Manager** will effectively implement the procedure, providing resources as required, and providing direction on proper lifting/handling techniques.

4.1.2 The **Resolution Consultants Health and Safety Manager** will assist in identifying activities with a high potential for lifting/handling strains/injuries as well as the associated mitigation strategies and training on proper lifting/manual materials handling techniques.

4.1.3 **Employees** are responsible for reviewing and following *5-308- Manual Lifting Safe Work Practices*.

4.2 Mechanical Controls

4.2.1 Mechanical equipment or assistance such as dollies, carts, come-alongs, or rollers are preferable to be used whenever possible rather than the employee physically moving materials.

4.2.2 Mechanical assistance will be of proper size, have wheels sized for the terrain, and be designed to prevent pinching or undue stress on wrists.

4.2.3 Objects to be moved will be secured to prevent falling and properly balanced to prevent tipping.

4.3 Administrative Controls

4.4 When significant, sustained lifting work is required, it is desirable to rotate employees to spread the work load among several people and thereby avoid fatigue.

4.5 Rotation is not simply performing a different job but instead is performing a job that utilizes a completely different muscle group from the ones that have been overexerted.

5.0 Records

None.

6.0 Attachments

None.

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5-309 Mobile or Heavy Equipment

1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near mobile equipment and heavy equipment operation.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Heavy equipment:** All excavating equipment include scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.

2.2 **Operator:** Any person who operates the controls while the heavy equipment in is motion or the engine is running.

2.3 **Ground personnel/workers:** Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

3.0 References

3.1 5-205 Equipment Inspections & Maintenance

4.0 Procedure

4.1 For work under Resolution Consultants' control, Project Managers are responsible for ensuring all equipment is in good working order and all equipment operators are qualified on the piece of machinery they are assigned.

4.2 Staff will confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.

4.3 The operator of mobile equipment is the only worker permitted to ride the equipment unless the equipment is a worker transportation vehicle.

4.4 A person will not operate mobile equipment unless the person has received adequate instruction and training in the safe use of the equipment, has demonstrated to a qualified supervisor or instructor competency in operating the equipment.

4.5 The operator of mobile equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment

4.6 **Communication**

4.6.1 Communication between site supervisors/managers, heavy equipment operators, and other site personnel is a key method of preventing serious injury or death during heavy equipment operations.

4.6.2 The following outline the communication requirements during heavy equipment operations:

- Site supervisors/managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
- Site supervisors/managers shall inform all ground personnel before changes are made in the locations of designated work areas.
- Prior to work initiating onsite the site supervisor/manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
- Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.

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- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (i.e., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a guide shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

4.7 **Ground Personnel**

4.7.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.7.2 The following outline the clearance requirements during heavy equipment operations:

- Ground personnel shall always yield to heavy equipment.
- Ground personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment.
- A job-specific hazard analysis that identifies any special precautions shall be completed and communicated to all Resolution Consultants personnel.
- Site supervisors/managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas. Designated areas shall include boundaries and travel routes for heavy equipment. Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
- When feasible, site supervisors/managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground personnel shall never stand between two pieces of heavy equipment or other objects (i.e., steel support beams, trees, buildings, etc.).
- Ground personnel shall never stand directly below heavy equipment located on higher ground.
- If working near heavy equipment, ground personnel shall stay out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
- Ground personnel shall never work near heavy equipment.
- Personnel shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Personnel shall not talk on a cell phone while standing or walking on a roadway or other mobile equipment path.

4.7.3 At a minimum, all ground personnel and operators outside of heavy equipment shall wear the following:

- High visibility, reflective (Class 2) safety vest that is visible from all angles and made of fluorescent material and orange, white, or yellow reflective material (confirm that vest is not faded or covered with outer garments, dirt, etc.).
- Retro-reflective striping for arms and legs (night work)
- ANSI-CSA approved hard hat
- ANSI-CSA approved safety glasses with side shields
- ANSI-CSA approved work boots (unless project requirements are more stringent)
- ANSI-CSA approved hearing protection as needed
- Appropriate work clothes (i.e., full length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

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4.8 Prior to work commencing

4.8.1 All mobile equipment will be regularly inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.

4.8.2 The operator will report defects and conditions affecting the safe operation of the equipment to the supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.

4.8.3 Exposed moving parts on mobile equipment which are a hazard to the operator or to other workers will be guarded and if a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

4.8.4 An approved Underwriter's Laboratories (UL) 4A40BC fire extinguisher should be present on all mobile equipment.

4.8.5 Inform the operators of the equipment that Resolution Consultants employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, mobile equipment has the 'right of way'.

4.8.6 Where the operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

4.8.7 Mobile equipment in which the operator cannot directly or by mirror or other effective device see immediately behind the machine will have an automatic audible warning device which activates whenever the equipment controls are positioned to move the equipment in reverse, and if practicable, is audible above the ambient noise level.

4.9 Operation

4.9.1 The operator of mobile equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment.

4.9.2 A supervisor will not knowingly operate or permit a worker to operate mobile equipment which is, or could create, an undue hazard to the health or safety of any person.

4.9.3 The operator of mobile equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement such as by setting the parking brake, placing the transmission in the manufacturer's specified park position, and by chocking wheels where necessary.

4.9.4 The operator will maintain the cab, floor and deck of mobile equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

4.9.5 If mobile equipment has seat belts required by law or manufacturer's specifications, the operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

4.9.6 When approaching or crossing the intended path of travel of mobile equipment, establish eye contact with the operator of the mobile equipment and confirm that it is safe to proceed.

4.9.7 Have vehicle headlights on at all times when driving in the area.

4.9.8 Park motor vehicles off the haul roads, or away from the work areas.

4.9.9 Do not wear loose clothing where there is a danger of entanglement in rotating equipment.

4.9.10 Do not enter the swing area of machines such as cranes, mobile drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so.

4.9.11 Stay out of the blind areas around mobile equipment and never assume that the equipment operators have seen them or are aware of their presence.

4.9.12 Maintain a distance of 60 cm (2 ft.) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, the area will be barricaded or guarded to prevent access.

4.9.13 Vibration from moving traffic or mobile equipment can cause excavations or spoil piles to become unstable. Be aware of the risk and keep clear.

4.9.14 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

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4.9.15 All heavy equipment shall be operated at safe speeds.

4.9.16 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

4.9.17 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.

4.9.18 When feasible, operators shall travel with the “load trailing”, if the load obstructs the forward view of the operator.

4.9.19 Slow down and sound horn when approaching a blind curve or intersection. Flagmen equipped with 2-way radio communications may be required to adequately control traffic.

4.9.20 Operators shall remain in cab while heavy equipment is being loaded.

4.9.21 Equipment shall be shut down prior to and during fueling. Do not smoke or use electrical devices while fueling. Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

4.9.22 Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended. Buckets and blades are to be placed on the ground and with hydraulic gears in neutral. Heavy equipment parked on slopes shall have the wheels chocked.

4.9.23 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

4.9.24 Never exit heavy equipment while it is in motion.

4.9.25 Passengers shall only ride in heavy equipment designed for occupancy of passengers.

4.9.26 Never ride on the outside of a piece of heavy equipment (e.g., tailgates, buckets, steps, etc.).

4.9.27 Site vehicles will be parked in a designated parking location away from heavy equipment.

4.9.28 Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

4.9.29 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

4.9.30 Equipment left unattended at night adjacent to traveled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (or the regulatory requirement for the work location) to the active roadway.

4.9.31 Pneumatic-tired earthmoving haulage equipment, with a maximum speed exceeding 15 miles per hour, shall be equipped with fenders on all wheels.

4.9.32 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not exceeded.

4.9.33 Steering or spinner knobs shall not be attached to steering wheels.

4.9.34 High lift rider industrial trucks shall be equipped with overhead guards.

4.9.35 When ascending or descending grades in excess of 5%, loaded trucks shall be driven with the load upgrade.

4.9.36 All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded when exposed to contact by persons or when they otherwise create a hazard.

4.9.37 All hot surfaces of equipment, including exhaust pipes or other lines, shall be guarded or insulated to prevent injury and fire.

4.9.38 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

4.9.39 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

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4.9.40 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

4.10 **Utilities**

4.10.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc.

4.10.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (i.e., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath of aboveground utilities.
- If equipment must travel underneath overhead utility lines, a spotter shall be utilized to communicate with the equipment operator about equipment clearance, etc.
- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc.

4.11 **Training**

4.11.1 The operator or other qualified supervisor will provide all on-site personnel with an orientation to the mobile equipment and its associated hazards and controls.

4.11.2 Only designated, qualified personnel shall operate heavy equipment.

4.11.3 Operators shall have all appropriate local, state, or federal licenses or training to operate a designated piece of heavy equipment.

4.11.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an Resolution Consultants operator in which case a practical evaluation is needed. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.12 **Inspection and Maintenance**

4.12.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel during work hours.

4.12.2 Maintenance records will be maintained on the site or project for mobile equipment.

4.12.3 Servicing, maintenance and repair of mobile equipment will not be done when the equipment is operating, unless continued operation is essential to the process and a safe means is provided.

4.12.4 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use. Operators shall not operate heavy equipment that has not been cleared for use. All machinery and mechanized equipment will be certified to be in safe operating condition (certification form attached) by a competent individual seven days prior to on-site operation, and is valid for one year.

4.12.5 All heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the site supervisor/manager immediately. Inspection records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use the Heavy Equipment Pre-Operation Inspection Checklist (attached).

4.12.6 Defective heavy equipment shall be immediately taken out of service until repaired.

4.13 **Fueling and batteries**

4.13.1 Appropriate PPE shall be utilized when fueling or changing batteries (gloves, safety glasses, etc.)

4.13.2 A well-ventilated area shall be used for refueling.

4.13.3 Only the type and quality of fuel recommended by the engine manufacturer shall be used.

4.13.4 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

4.13.5 No one shall spill fuel on hot surfaces. Any spillage should be cleaned before starting an engine.

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4.13.6 Spilled fuel shall be cleaned with cotton rags or cloths; do not use wool or metallic cloth. If the spill results in ground impact, you shall immediately contact the Regional HSE professional for additional assistance.

4.13.7 Open flames, lighted smoking materials, or sparking equipment shall remain well away from the fueling area.

4.13.8 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.

4.13.9 Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

4.13.10 The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.

4.13.11 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

4.13.12 Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent buildup of a static charge. If this is not possible then the use of a bonding strap shall be utilized to achieve bonding equilibrium.

4.13.13 Batteries shall be serviced in a ventilated area while wearing appropriate PPE.

4.13.14 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first.

4.13.15 When installing a battery, the battery shall be connected ground post last.

4.13.16 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

4.13.17 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

4.13.18 Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water.

4.13.19 Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention sought immediately.

4.13.20 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around battery by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least 25 feet away from battery-charging stations.

5.0 Records

5.1 Inspection records shall be maintained with the equipment.

6.0 Attachments

6.1 5-309 Form 1 Certification of Machinery and Mechanized Equipment

6.2 5-309 Form 2 Heavy Machinery Pre-Operation Checklist

6.3 5-309 Form 3 Brokk180 Safety Card

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5-309 Form 1 Certification of Machinery and Mechanized Equipment

1.0 General Guidelines

1.1 Subcontractor equipment shall comply with all applicable requirements for motor vehicles and material handling heavy equipment contained in 29 CFR 1926 Subpart O. Heavy equipment includes, but is not limited to, drill rigs, front end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

2.0 Equipment Safety Inspections

2.1 The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

1.1.1 All machinery and mechanized equipment will be certified to be in safe operating condition (using the attached form) by a competent individual seven days prior to onsite operation. This certification is valid for one year.

1.1.2 Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.

1.1.3 Inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.

1.1.4 Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist or on equivalent subcontractor forms.

1.1.5 Exhaustive preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the subcontractor's internal policies, schedules, and equipment SOPs.

1.1.6 Only designated qualified persons shall operate machinery and mechanized equipment.

1.1.7 The contractor shall maintain records of tests and inspections at the site and shall make the records available upon request of the designated authority; the records shall become part of the official project file.

1.1.8 Equipment found to not be in safe operating condition or to have a deficiency that affects the safe operation of the equipment shall immediately be taken out of service and its use shall be prohibited until safe conditions have been corrected.

1.1.9 All equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

1.1.10 Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.

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TO: Resolution Consultants

DATE:

FROM:

Project Name:

Project Location:

1. This form provides certification of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and certification of machinery and mechanized equipment, as required by Resolution Consultants, has been made prior to but within seven calendar days in advance of use on the project site. Recertification will be required for equipment that is used on the project site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated above, and is CERTIFIED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title	
Company			
Signature		Date	

4. If there are any questions regarding this certification, please contact the following Resolution Consultants representative:

_____

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5-309 Form 2 Heavy Equipment Pre-Operation Checklist

Project Name/Location:															
Number/Name:							**Make/Model:**								
Hour meter reading:															
Check the following as appropriate	**Operator Name/Date**			**Operator Name/Date**			**Operator Name/Date**			**Operator Name/Date**			**Operator Name/Date**		
	SAT	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**
1. Operator qualified															
2. Overhead guard (ROPS)															
3. Horn															
4. Lights															
5. Parking brake															
6. Service brakes															
7. Steering															
8. Oil level															
9. Hydraulic oil level															
10. Radiator fluid level															
11. Major fluid leaks															
12. Windows															
13. Backup alarm															
14. Tires (visual)															

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15. Seat belts															
16. Fuel leaks															
17. Fire extinguisher															
18. Fuel lines secure															
19. Electrical lines															
20. Exhaust components															
Comments/Remarks:															

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5-309 Form 3 Brokk180 Safety Card

1.0 Objective/Overview

The Brokk 180 is an electric-powered hydraulic device used for demolishing concrete structures and refractory linings as well as excavating. This machine includes attachments designed exclusively for demolishing work (e.g., grapple, bucket, hydraulic hammer, etc.). By using the remote control unit, an operator can move the machine and attachments in different directions and speeds from afar.

2.0 Safe Operating Guidelines

2.1 Prior to use, complete a pre-operation inspection to determine if the unit is in safe working condition.

2.2 Position the unit to safely perform the intended task, then deploy the outriggers to stabilize the unit.

2.3 Confirm that the operator knows what the lifting capacity is; do not exceed the lifting capacity.

2.4 Complete a subsurface utility clearance prior to excavating.

2.5 Establish a minimum 15-foot clearance around the unit.

2.6 Do not allow debris to build-up around the unit. Maintain good housekeeping practices.

2.7 Prior to removing debris from under the boom, stop, disengage the unit, and position the boom so that the attachment is at rest on the ground.

2.8 Personnel operating the unit with the remote control device will be properly trained and certified by a competent person.

2.9 The operator will be able to maintain line of sight visual contact with the unit at all times to assess hazards and site security.

2.10 Maintenance in excess of preventive maintenance activities (e.g., lubrication, replenishing fluids, etc.) will be performed by manufacturer personnel ONLY.

2.11 All operations will comply with the manufacturer's recommended policies.

3.0 Potential Hazards

3.1 Flying debris.

3.2 Crush/impact/pinch from extendable boom, tracks, and tipping over.

3.3 Electrocution from subsurface utilities (when excavating).

3.4 Hearing loss.

4.0 Training Requirements

4.1 Review of applicable SOPs.

4.2 Complete knowledge and understanding of remote control functions.

4.3 Review and follow manufacturers' recommended policies and practices**.**

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5.0 Personal Protective Equipment (Level D ensemble)

5.1 Reflective traffic safety vest.

5.2 Hearing protection (ear plugs and/or ear muffs).

5.3 Leather gloves.

6.0 Other Safety Tips

6.1 Never stand under a raised boom.

6.2 Maintain a clearance of 15 feet around the unit while operating.

6.3 Pay close attention to power cords for potential tripping hazard and equipment entanglement.

6.4 Maintain line of sight visual contact with unit at al times (especially when operating from a distance).

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5-310-Rigging, Hoisting, Cranes, and Lifting Devices

1.0 Purpose and Scope

1.1 Establishes the minimum requirements for rigging, hoisting, and crane operations.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **ASME**: American Society of Mechanical Engineers

2.2 **Assembly/Disassembly Director(A/D Director):** An individual who meets this subpart's requirements for an A/D director, irrespective of the person's formal job title or whether the person is nonmanagement or management personnel. Assembly/disassembly will be directed by a person who meets the criteria for both a competent person and a qualified person or by a competent person who is assisted by one or more qualified persons. If the assembly/disassembly is being performed by only one person, that person will meet the criteria for both a competent person and a qualified person. For purposes of this standard, that person is considered the A/D director.

2.3 **Crane**: Any power-operated equipment that can hoist, lower, and horizontally move a suspended load.

2.4 **Critical lifts**: Hoisting operations in which a critical item or load is hoisted or moved, or in which a noncritical item is hoisted or moved in an area where critical systems or equipment could be affected. Critical lifts are lifting operations that exceed 75 percent of the crane's rated capacity or any activity involving a part, component, assembly, or piece of equipment ("item") whose dropping, upset, or collision could cause or result in the following:

- Damage that would result in serious economic consequences.
- Damage that would result in an unacceptable delay to schedule or other significant deleterious programmatic impact (such as the loss of vital data).
- Undetectable damage that would jeopardize the future operations or safety of a facility.
- A significant release of hazardous material to the environment or the creation of an undesirable condition.
- Personnel injury or significant adverse health impact, either onsite or offsite.

2.5 **Controlling Entity**: An employer that is a prime contractor, general contractor, construction manager or any other legal entity that has the overall responsibility for the construction of the project, including planning, quality, and completion.

3.0 References

3.1 29 CFR Part 1926.1400 – Cranes and Derricks in Construction

3.2 5-003 SH&E Training

3.3 5-202 Competent Person Designation

3.4 5-309 Mobile or Heavy Equipment

3.5 5-406 Electrical Lines, Overhead

3.6 5-408 Elevated Work Platforms and Aerial Lifts

3.7 5-413 Process Safety Management

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4.0 Procedure

4.1 **Roles and Responsibilities**

4.1.1 **Project Managers (includes Supervisors)** are responsible for confirming that all aspects of this procedure are followed and adhered to on all Resolution Consultants sites and locations for critical lifts for which Resolution Consultants is the controlling entity.

4.2 **General Requirements**

4.2.1 Resolution Consultants personnel will not operate powered cranes and/or tuggers without approval from the **Project Manager**, **SH&E Manager**, and legal.

4.2.2 Some Resolution Consultants project sites may require the setup and use of tower cranes, hydraulic cranes, boom trucks, or helicopters to facilitate movement of equipment or materials on the site or project. The hazards and controls associated with these activities will be documented on the Project Safety Plan and communicated to all site personnel before work commences.

4.2.3 Prior to mobilization, **Project Managers** will confirm that cranes and crane operators, signal persons, and riggers are certified/qualified and that a Crane Pre-Operational Inspection Checklist (see *5-310 Form 1 Crane Pre-Operation Inspection* or its equivalent) is completed and reviewed prior to each use/shift.

4.3 **Assembly/Disassembly**

4.3.1 Prior to assembly of any cranes, all crews will confirm:

- Their tasks.
- The hazard associated with their tasks.
- Hazardous locations they need to avoid.

4.3.2 Should a crew member change a task then that crew member will be instructed that the above requirement will be met.

4.3.3 No assembly/disassembly of cranes shall be performed underneath power lines.

4.4 **Addressing Specific Hazards**

4.4.1 The assembly/disassembly director supervising the operation will address the following hazards associated with the operation:

- Site and ground bearing conditions will be adequate for safe operation and to support the equipment.
- Blocking material will be sufficient in size, amount, condition, and method of stacking to sustain loads and maintain stability.
- Proper location of blocking. When used to support lattice booms or components, blocking will be appropriately placed to protect the structural integrity of the equipment and prevent dangerous movement and collapse.
- Verifying assist crane loads. Loads that will be imposed on the assist crane at each phase will be verified before operations begin.
- Boom and jib pack points. The attachment points of rigging to a boom/ boom sections, or to jib/jib sections, will be suitable for preventing structural damage and for facilitating safe handling of the components.
- The center of gravity will be identified, if necessary, for the method used for maintaining stability.
- Measures designed to prevent unintended dangerous movement will be used where there is insufficient information.
- Stability upon pin removal. Boom sections, boom suspension systems, and components will be rigged or supported to maintain stability upon the removal of the pins.
- Snagging. Suspension ropes and pendants will not be able to catch on the boom or jib connection pins or cotter pins (including keepers and locking pins).

- Struck by counterweights. The potential for unintended movement from inadequately supported counterweights and from hoisting counterweights.
- Boom hoist brake failure. The brake will be tested prior to each time reliance is to be placed on the boom hoist brake to prevent boom movement.
- If found to be insufficient, a boom hoist pawl, other locking/back-up braking device, or another method of preventing dangerous boom movement (such as blocking or using an assist crane) from a boom hoist failure will be used.
- Loss of backward stability. Backward stability before swinging upward, during travel, and when attaching or removing equipment components.
- Wind speed and weather. The effect of wind speed and weather on the equipment.

4.5 **Prerequisites and Physical Qualifications**

4.5.1 Operators, riggers, and inspectors shall meet the minimum requirements established by this procedure as it relates to their work.

4.5.2 As part of this procedure, all site-specific training shall be in accordance with procedure *5-209 Project Hazard Assessment and Planning* and 29 CFR Part 1926.1400 Cranes and Derricks in Construction.

- All sling and hoist systems used on Resolution Consultants sites will be operated, inspected, and maintained in compliance with regulations.
- Resolution Consultants will only employ qualified/certified licensed equipment operators, signal persons, and riggers (for cranes, helicopters, etc.).

4.6 **Personal Protective Equipment**

4.6.1 All Resolution Consultants personnel operating lifting or hoisting equipment and/or functioning as riggers or signal persons shall wear a reflective equipment.

- Hard hats
- Steel-toed boots
- Reflective vest

4.6.2 Class II high visibility vest in addition to their normal personal protective Power Line Safety gear.

4.6.3 All cranes shall maintain the following minimal clearance distance from power lines**.**

Voltage (nominal, kV, alternating current)	**Minimum clearance distance (feet)**
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1000	45
Over 1000	As established by the utility owner/operator.

4.7 **Training Programs**

4.7.1 Power Line Safety Training

- Each operator and crew member assigned to work with the equipment will be trained on Power Line Safety.
- Spotter: Workers as dedicated spotters will be trained to enable them to effectively perform their task under section 29 CFR 1926.1430(g) as applicable in the US.
- Fall Protection: Any Resolution Consultants employee will be trained who may be exposed to fall hazards while on or hoisted when exposed to a fall greater than 6 feet.

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- Crush/Pinch points: All Resolution Consultants employees who work with the equipment shall be trained to keep clear of holes and crush/pinch points (i.e., work area controls).

4.8 **Basic Operator Training**

4.8.1 Topics to be included in the basic certification criteria operator training programs shall include as a minimum the requirements listed below:

- The individual knows the information necessary for safe operation of the specific type of equipment the individual will operate, including the following:
  - The controls and operating/performance characteristics.
  - Use of and the ability to calculate (manually or with a calculator) load/capacity information on a variety of configuration of the equipment.
  - Procedure for preventing and responding to power line contact.
  - Technical knowledge:
    - Wire rope.
    - Rigging devices and their use.
    - Technical limitations of protective measure against electrical hazards.
    - The effects of load share and load transfer in multi-crane lifts.
    - Basic crane terms.
    - The basics of machine power flow systems.
    - The significance of the instruments and gauge reading.
    - The effects of thermal expansion and contraction in hydraulic cylinders.
    - Background information necessary to understand preoperation and inspection requirements.
    - How to us the safety devices and operation aids required under 29 CFR 1926.1415 and 1416.
    - How to calculate net capacity for every possible configuration of the equipment using the manufacturer's load chart.
    - How to use manufacturer-approved attachments and their effect on the equipment.
    - How to obtain dimensions, weight, and center of gravity of the load.
    - The effect of dynamic loading from wind, stopping and starting, impact loading, and moving with the load.
    - The effects of side loading.
    - The principles of backward stability.
    - Site information.
    - How to identify the suitability of the supporting ground.
    - Proper use of mats, blocking/cribbing, outriggers, stabilizers, or crawlers.
    - Identification of site hazards.
    - How to review operation plans with supervisors and other workers.
    - How to determine if there is adequate room for extension of cralers or outriggers/stabilizers and counterweights.
    - How to pick up, carry, swing, and place the load smoothly and safety on rubber tires and on outriggers/stabilizer or crawlers.
    - Proper procedure and methods of reeving wire ropes.

- How to react to change in conditions.
- How to shut down and secure the equipment properly while leaving it unattended.
- Know how to apply the manufacturers' specification for operating in various weather conditions and understand how environmental conditions affect the safe operation of the equipment.
- How to properly lever the equipment.
- How to verify the weight of the load and rigging prior to initiating the lift.
- How to determine where the load is to be picked up and placed and how to verity the radii.
- Know basic rigging procedures.
- How to carry out the shift inspection.
- Know that the following operations require specific procedures and skill levels:
  - Multi crane lifts.
  - Hoisting personnel.
  - Clamshell/dragline operations.
  - Pile driving and extracting.
  - Demolition operations.
  - Operations on water.
  - Multi drum operation.
- Know the proper procedure for load control and the use of handheld tag lines.
- Know the emergency response site procedures.

- Any necessary repairs or adjustments needed for the equipment will be communicated to all affected employees at the beginning of the shift.
- Other topics identified by the training or operating organizations.

4.9 **Basic Training for Signal Person**

4.9.1 Topics to be included in the basic certification criteria signal person training programs shall include as a minimum the requirements listed below:

- Know and understand the type of signal used.
- Know and understand the standard method of hand signaling.
- Have a basic understanding of equipment operation and limitations, including the crane dynamics involved in swinging and stopping loads and bood deflection from hoisting load.
- Demonstrate that the signal person meets the requirements of 29 CFR 1926, 1400 through an oral or written test and through a practical test.

4.10 **Basic Training for Special Equipment Operators**

4.10.1 Operators of special equipment will first complete training requirements for the most applicable equipment category, such as overhead, gantry, and polar cranes; hoists; or mobile cranes. The operator of special equipment will then complete any additional classroom instruction required specific to that equipment, and will complete an on-the-job (OJT) training program for the special equipment.

4.11 **Rigger Training Programs**

4.11.1 It is recommended that training for riggers be divided into two categories:

- Training for personnel who do rigging as a major part of their job assignment.
- Training for personnel who do simple rigging jobs as an incidental part of their job assignment.

4.11.2 Topics in both categories shall include the same basics but the depth of detail shall match the job assignment.

4.11.3 Topics shall include the requirements listed below:

- Equipment operating characteristics, capabilities, and limitations.
- Use and inspection of slings, wire rope, chain, and synthetic fiber.
- Effect of sling angles on resultant sling loads.
- Restriction on use of come-alongs.
- Determination of load weights, load-weight calculations, and individual sling loads.
- Use of load-indicating devices.
- Safe work practices.
- Hand signals and communications between the signal person and operator.
- Use and inspection of all major rigging accessories or assemblies.
- Critical lift classifications and requirements.
- Use of spreader bars and other below-the-hook lifting devices.

4.12 **Crane Inspection Training**

4.12.1 Inspector training shall be established to train personnel in the inspection categories listed below.

- Overhead, gantry, and polar cranes.
- Monorail, jib, and other hoists.
- Mobile cranes.
- Wire rope.
- Rigging and rigging hardware.
- Special equipment.

4.13 **Inspector Training Subcategories**

4.13.1 To meet the needs of the discipline, the training may divide these categories into subcategories. For example, an inspector may be trained to inspect only mechanical portions of monorail hoists.

4.14 **Scope of Inspector Training**

4.14.1 Inspector training shall include basic inspection techniques and the application of manufacturer-supplied information, OSHA, ASME, and acceptance/rejection criteria.

4.15 **Testing and Examination**

4.15.1 Testing Phases

- Testing for operator, rigger, and inspector classifications shall include, as a minimum, a written examination comprised of questions covering training topics and a practical examination to demonstrate knowledge of equipment operating characteristics and practical application. A qualified instructor shall grade the practical examination. Documentation of training shall be maintained on site.

4.15.2 Examination Scores

- Scope standards shall be set for each examination by the training organization. The minimum passing score shall depend on the subject, testing technique, and test difficulty. A candidate may be given additional opportunities to take and pass the examination if the materials have been reviewed and the employee tests satisfactorily.

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4.16 **Qualification, Requalification, or Disqualification**

4.16.1 Training Certificate

- After the training, testing, and OJT (if required) is successfully completed, a certificate shall be issued to the operator, rigger, or inspector. The operator's certificate shall list the equipment the operator is qualified to operate.

4.16.2 Qualification Period

- Operator, signal person, rigger, and inspector qualifications may be dependent on state or local regulations.

4.16.3 Refresher Training

- Resolution Consultants will provide refresher training on relevant topics for each employee based on the employee's conduct or an evaluation of the employee's knowledge or another indication that retraining is warranted. If for any reason the employee's manager determines that the employee should be disqualified, the manager shall write a letter of disqualification. This written statement of disqualification shall state the reason for disqualification and when, or if, the employee will be eligible to requalify.

4.17 **Critical Lift Procedure**

4.17.1 Critical Lift Plan

- Prior to commencing any critical lift activity, the PM will confirm that a Crane Pre-Operational Inspection Checklist and a Critical Lift Checklist (see attachments) are prepared for all critical lifts.

4.17.2 Critical Lift Plan Approval

- The Crane Operator and the Rigging Site Supervisor will review and approve the Critical Lift Plan (procedure); on projects that Resolution Consultants controls, the Resolution Consultants SH&E Department will also review and approve the Critical Lift Plan.
- Revisions to the procedure will be reviewed and approved in the same manner as the original procedure.

4.17.3 Pre-Lift Meeting

- Before the Critical Lift is performed, a safety meeting with participating personnel will be held. During this meeting, the relevant portions of the applicable Task Hazard Analysis (THA) will be covered, the Critical Lift procedure will be reviewed, and questions/concerns related to personnel involved in the lift and operation of equipment will be resolved. The safety meeting will be documented on a Tailgate Safety Briefing Form as required by 5-210-Project Safety Meetings.

4.17.4 Critical Lift Plan Documentation

- Once completed, the SH&E Department will maintain copies of the Critical Lift Plan. Documentation of a critical lift will include the following:
  - The Critical Lift Checklist, recording job completion with approval signatures.
  - Documentation of the safety meeting including, at a minimum, the meeting date and list of attendees.
  - Any additional documentation deemed appropriate by the SH&E Department or other responsible personnel (e.g., lessons learned).

4.17.5 Preparing for Rigging & Hoisting

- The passing of loads over client facility equipment, trailers, public roads, and sidewalks shall only be done if the necessary precautions have been taken for the safety of all workers and other persons.
- When operating conditions are such that the boom of the crane swings over property lines or operating transportation systems for the site or project, the owners of adjacent properties or systems shall be consulted. A diagram should be prepared detailing the proposed swing paths for the crane.

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- All rigging equipment, fittings, and devices will be of adequate strength for the application. All components will be capable of supporting at least five times the maximum load to which they may be subjected. If the load exceeds 85 percent of the equipment capacity or involves multi-lifts, hoisting and rigging operations will be approved by a professional engineer.
- At no time is the operator of the equipment to perform lifts that exceed the load rated capacity of the equipment.
- Only loads that have been properly rigged or have been placed in containers designed for hoisting may be lifted.
- Loads should only be rigged for hoisting by qualified persons.
- Inspect all slings before each use and maintain them in good condition. All ropes, hardware, and other fittings will be inspected regularly for wear, cracks, severe corrosion, kinks, bird caging, broken strands, burn marks, chemical damage, deformation, or other signs of obvious damage.
- Use slings of proper reach. Never shorten a line by twisting or knotting or with chain slings. Never use bolts and nuts.
- Estimate the center of gravity or point of balance. The lifting device should be positioned immediately above the estimated center of gravity.
- Select shackle and sling sizes that exceed the minimum working load limits.
- The signaller will be properly identified and will understand proper signaling techniques.
- Hoisting areas will be secured with a barrier in areas where public access is a concern. Appropriate warning signage will be posted to indicate that overhead work is being performed in the area.
- Wire ropes will be lubricated to reduce friction between wires and strands.
- Tag lines will be used to control loads.
- When two or more slings are to be connected to a hook, a shackle should be used.

4.18 **During Transport of the Load**

- When being assisted by a signal person ("spotter"), the equipment operator will maintain continuous communication with the signal person. If communication with the signal person is lost, the operator will not continue until communication has been restored.
- All personnel will be clear of the load being lifted and the load will be double-checked to ensure that it is secure before it is lifted.
- No one shall be permitted to ride the lifting hook, ball, or load.
- At no time are loads to be passed over any workers or other persons.
- No one shall pass under any part of a suspended load. Always try to anticipate the movement of the load and avoid entering the swing path of the load.
- Prepare a place to land the load and lower the load gently to keep it stable before slackening the sling or chain.
- Stay clear of loads when slings are being pulled out from underneath.
- Loose loads will be blocked before unhooking.
- If you are using a sling, a significant amount of electrical charge is generated by a helicopter and rain or light blowing snow can increase this electrical charge. To avoid receiving a stunning (but not harmful) shock, the hookup person (who is trying to unhook the load) should resist reaching up to the machine or the cable as it hovers over the load. It is important to let the load or the cable ground itself first. Under some conditions the current can arc up to 20 centimeters.

5.0 Records

5.1 All training records shall be maintained in accordance with 5-003-SH&E Training.

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5.2 All inspection records will be maintained on site with the machine.

6.0 Attachments

6.1 5-310-Form 1 Crane Pre-Operation Inspection

6.2 5-310-Form 2 Critical Lift Checklist

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5-310 Form 1 Crane Pre-Operation Inspection

Project Information	
Project Name:	
Project/Contract Number:	Date:
Site Safety Coordinator:	Crane Operator:
Crane Model No:	Crane Manufacturer:
Crane Number:	Hours:

GENERAL REQUIREMENTS

1. Safety Manager has reviewed and accepted work platform use ☐ Yes ☐ No
2. Job Hazard Analysis completed and attached ☐ Yes ☐ No
3. Critical Lift Checklist completed and attached ☐ Yes ☐ No
4. Area barricaded or otherwise secured from unauthorized personnel entrance ☐ Yes ☐ No

CRANE REQUIREMENTS

5. Load lines are capable of supporting 5 times maximum intended load (10 times for rotation-resistant wire rope) ☐ Yes ☐ No
6. Total weight of loaded platform and related rigging does not exceed 50 percent of rated capacity per boom angle and radius ☐ Yes ☐ No
7. Crane does not have live boom; load line hoist is regulated with a device other than the hoist brake that regulates lowering speed. ☐ Yes ☐ No
8. Crane has a positive acting anti-two-block device that deactivates hoisting action ☐ Yes ☐ No
9. Boom angle indicator is functional and readily visible to the operator ☐ Yes ☐ No

RIGGING REQUIREMENTS

10. Wire rope, shackles, and other rigging hardware are capable of supporting 5 times the maximum intended load ☐ Yes ☐ No
11. Lifting bridles are four legs of equal length connected by common ring ☐ Yes ☐ No
12. All eyes in wire rope slings are fabricated with thimbles ☐ Yes ☐ No
13. Shackle bolts are secured against displacement (pinned or moused) ☐ Yes ☐ No
14. Safety line passes through the eye of each bridle leg and is attached above the headache ball or to the crane hook ☐ Yes ☐ No
15. Hook throat opening has been closed by pinning, bolting, or mousing safety latch ☐ Yes ☐ No
16. Rigging is dedicated for platform use and is not used for any other purpose when not hoisting personnel ☐ Yes ☐ No

PLATFORM REQUIREMENTS

17. Platform is posted with its weight and rated load capacity or maximum intended load ☐ Yes ☐ No
18. A grab rail is installed inside the entire perimeter of the platform ☐ Yes ☐ No
19. Access gates, if installed, do not swing outward and have a device to prevent accidental opening ☐ Yes ☐ No
20. In addition to hard hats, employees are afforded overhead protection by the platform when exposed to falling objects ☐ Yes ☐ No
21. All edges exposed to employee contact are smoothed to prevent injury from punctures or lacerations ☐ Yes ☐ No

PLATFORM LOADING

22. The platform is not loaded in excess of its rated capacity ☐ Yes ☐ No
23. The number of employees does not exceed the number required for the work to be performed ☐ Yes ☐ No
24. The platform is not used to hoist tools or materials except for those necessary for employees to perform the work ☐ Yes ☐ No
25. Personnel, tools, and materials are evenly distributed within the platform ☐ Yes ☐ No

PROOF-TESTING, TRIAL LIFT, AND INSPECTION

26. The platform and rigging has been proof tested to 1.25 times the rated capacity (minimum duration, 5 minutes) ☐ Yes ☐ No
27. After proof testing, the platform has been inspected for deficiencies ☐ Yes ☐ No
28. Loaded at least to anticipated weight, a trial lift from the ground to each location the platform is to be hoisted and positioned has been conducted (may be done concurrently with proof testing and must be repeated if the crane is repositioned). ☐ Yes ☐ No
29. After trial lift and prior to hoisting employees, an inspection has been made to ensure that the hoist rope is free of kinks, that multiple lines (if used) are not twisted around each other, that the primary attachment is centered over the platform, and that the load rope is properly stated on drums and sheaves. ☐ Yes ☐ No

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OTHER		
30. Tag lines are attached and ready for use, or a determination has been made that the use of tag lines creates an unsafe condition	☐ Yes	☐ No
31. A pre-lift meeting with all affected employees has been conducted	☐ Yes	☐ No
32. There is no adverse weather condition, winds are less than 15 mph, and there is no electrical storm activity or heavy rain	☐ Yes	☐ No
33. Employees will remain in continuous sight of and in communication with the operator or signal person. If radios are used, they have been tested	☐ Yes	☐ No
34. Employees have been tied off with full body harness above the headache ball, or to the load block	☐ Yes	☐ No

Remarks:

Crane Inspector:

Print Name Signature Organization Date

Site Safety Representative:

Print Name Signature Organization Date

Project Manager:

Print Name Signature Organization Date

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5-310-Form 2 Critical Lift Checklist

A critical lift is any lift that exceeds 75% of the crane's rated capacity, involves more than one crane, involves unusual or severe hazards, or any lift the PM identifies as Critical.

ADMINISTRATIVE INFORMATION:	
PROJECT NAME:	
PROJECT MANAGER (PM):	**DATE:**
SUBCONTRACTOR NAME:	**SUBCONTRACTOR PM:**
SUPERVISOR IN CHARGE:	**CRANE OPERATOR:**
SIGNAL PERSON 1:	**SIGNAL PERSON 2:**

CRITICAL LIFT REQUIREMENTS:

1. LIFT CONDITIONS:

a. Crane pad level, firm & stable ..... ☐ Yes ☐ No
b. Has longest lift radius been identified ..... ☐ Yes ☐ No
c. Have special hazards been identified ..... ☐ Yes ☐ No
   i. Power lines ..... ☐ Yes ☐ No
   ii. Obstructions in lift path ..... ☐ Yes ☐ No
   iii. Location of utilities and structures ..... ☐ Yes ☐ No
   iv. Weather conditions ..... ☐ Yes ☐ No
d. Has a lift sequence been established and reviewed ..... ☐ Yes ☐ No
e. Are personnel clear of lift area ..... ☐ Yes ☐ No

2. LOAD CONDITIONS:

a. Is exact load weight known ..... ☐ Yes ☐ No _____Pounds
b. Is weight of rigging known ..... ☐ Yes ☐ No _____Pounds
c. Is the weight of the load block and line known ..... ☐ Yes ☐ No _____Pounds
d. Has the center of gravity of the load been established ..... ☐ Yes ☐ No
e. Is rigging adequate and in good condition ..... ☐ Yes ☐ No

3. COMMUNICATIONS:

a. Have hand signals been reviewed ..... ☐ Yes ☐ No
b. Has location of spotters been established ..... ☐ Yes ☐ No
c. If radios are used: ..... ☐ Yes ☐ No
   i. Have they been tested from location of use ..... ☐ Yes ☐ No
   ii. Is frequency clear of other radio traffic ..... ☐ Yes ☐ No

4. CONDITION OF CRANE (CHECKED BY OPERATOR):

a. Is pad blocking adequate and substantial ..... ☐ Yes ☐ No
b. Is the crane level ..... ☐ Yes ☐ No
c. Are ropes and pendants in good condition ..... ☐ Yes ☐ No
d. Are adequate parts of line being used ..... ☐ Yes ☐ No
e. Is line revved properly ..... ☐ Yes ☐ No
f. Are controls in good working condition to insure smooth operation ..... ☐ Yes ☐ No
g. Is the load within chart limits for the above conditions ..... ☐ Yes ☐ No

h. What is the boom length .....

i. What is the maximum boom angle .....

j. What is the maximum load radius .....

5. PRE-LIFT MEETING:

Has a pre-lift meeting been conducted with all persons involved to review this information ..... ☐ Yes ☐ No

6. LIFT DIAGRAM (INCLUDE CRANE SETUP, RADIUS, LOAD, ETC.):

APPROVAL SIGNATURES:	
SUBCONTRACTOR SUPERVISOR IN CHARGE:	**SUBCONTRACTOR PM:**
AECOM PROJECT MANAGER:	**AECOM SAFETY REPRESENTATIVE:**

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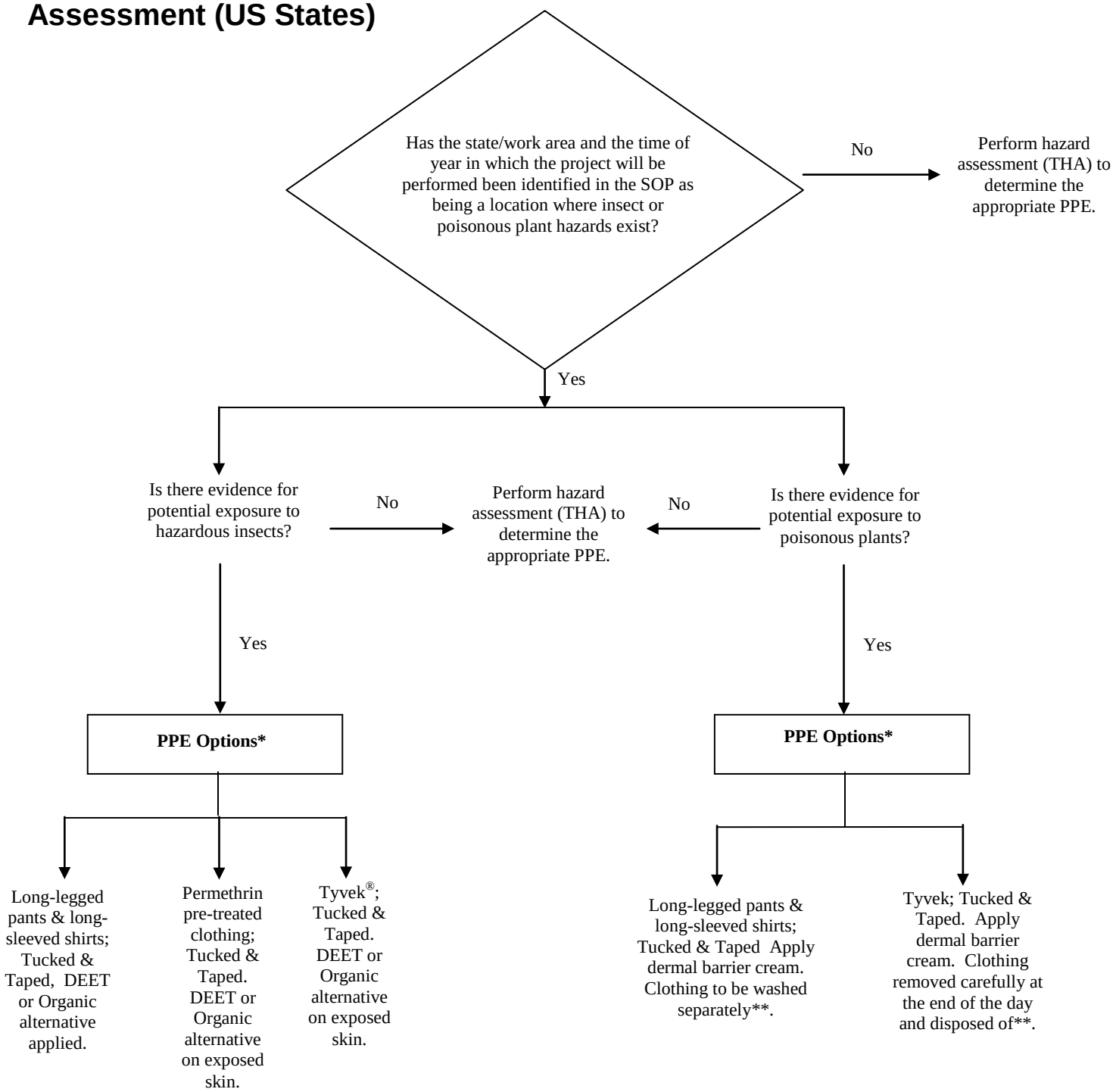
5-313-Biological Hazard Assessment Decision Flow Chart Hazard Assessment (US States)



* indicates that when both insect and poisonous plant hazards are recognized hazards at a project site, the most conservative combination of the available PPE choices will be selected.

** indicates that clothing that has been known or suspected to have come in contact with poisonous plants must be washed before it can be worn again. Similarly, Tyvek® that has been known or suspected to have come in contact with poisonous plants will be disposed of rather than reused during a subsequent day or project.

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State by State Guideline for Exposure

States	Tick-Borne Diseases	Mosquito-Borne Diseases	Poisonous Plants
Alabama	Year Round Low Risk	Year Round	Year round
Alaska	No Risk	No Risk	No Risk
Arizona	No Risk	March - July	March - November
Arkansas	March - November	March - November	March - November
California	Low Risk	March - November	Year Round
Colorado	Low Risk	March - November	No Risk
Connecticut	March - November	Low Risk March - November	March - November
Delaware	March - November	Low Risk March - November	March - November
Florida	Year Round Low Risk	Year Round	Year round
Georgia	Year Round Low Risk	Year Round	Year round
Hawaii	No Risk	No Risk	No Risk
Idaho	No Risk	Low Risk March - November	No Risk
Illinois	March - November	March - November	March - November
Indiana	March - November	March - November	March - November
Iowa	March - November	March - November	March - November
Kansas	Low Risk	March - November	March - November
Kentucky	March - November	March - November	March - November
Louisiana	Year Round Low Risk	Year Round	Year round
Maine	March - November	March - November	March - November
Maryland	March - November	Low Risk	March - November
Massachusetts	March - November	March - November	March - November
Michigan	March - November	March - November	March - November
Minnesota	March - November	March - November	March - November
Mississippi	Year Round	Year Round	Year round
Missouri	March - November	March - November	March - November
Montana	Low Risk March - July	Low Risk March - July	No Risk
Nebraska	Low Risk	Low Risk	Low Risk
Nevada	Low Risk March - July	Low Risk March - July	Low Risk March - November
New Hampshire	March - November	March - November	March - November
New Jersey	March - November	March - November	March - November
New Mexico	No Risk	Low Risk March - July	No Risk
New York	March - November	March - November	March - November
North Carolina	March - November	March - November	March - November
North Dakota	No Risk	March - November	No Risk
Ohio	Low Risk March - November	March - November	March - November
Oklahoma	March - November	Low Risk March - November	March - November
Oregon	Low Risk March - November	Low Risk March - November	March - November
Pennsylvania	March - November	March - November	March - November
Puerto Rico	???	Low Risk March - November	Year round

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States	Tick-Borne Diseases	Mosquito-Borne Diseases	Poisonous Plants
Rhode Island	March - November	Low Risk March - November	March - November
South Carolina	March - November	Low Risk March - November	March - November
South Dakota	Low Risk March - November	March - November	March - November
Tennessee	March - November	March - November	March - November
Texas	Year Round Low Risk	Year Round	Year round
Utah	Low Risk March - July	Low Risk March - July	No Risk
Vermont	March - November	Low Risk March - November	March - November
Virginia	Low Risk March - November	March - November	March - November
Washington	Low Risk March - November	Low Risk March - November	March - November
West Virginia	Low Risk March - November	March - November	March - November
Wisconsin	March - November	March - November	March – November
Wyoming	No Risk March - July	Low Risk March - July	No Risk

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5-313-Alligators

1.0 Hazard

1.1 Your chance of encountering an alligator is greatest during the animal's courtship and mating season, which takes place from March through September. This is when male alligators become most dominant and aggressive as they try to intimidate rival males and attract females by their show of power. Some males end up having to travel to find a mate. July through September is when mother alligators are guarding nests.

1.2 Mating season takes up much of the warmer months - a very popular time in the southeastern USA for outdoor activities - and alligators are solar-powered, so-to-speak. The warmth from the sun fires up their metabolism, giving them renewed energy; and renewed energy means great potential for conflict.

2.0 Encounter

2.1 The alligator is naturally wary of humans, and will flee quickly if you get too close to it, or it may utter a very audible and compelling warning hiss. In some cases; however, alligators may charge or attack. Here are some examples of such cases:

2.1.1 An alligator that is accustomed to being fed by humans may not be so shy.

2.1.2 An alligator that is surprised and alarmed by your approach may attack, thinking that it is being attacked itself.

2.1.3 A mother alligator caring for her nest or for live babies. If you see alligator babies, or if you encounter a nest (usually a mound of vegetation mixed with mud), remove yourself to a safe distance, the mother alligator is sure to be close by. If you get close, the mother may sound a very audible and intimidating warning hiss. Such a nest may be difficult to identify for a non-expert, but it is likely the mother will issue you a warning.

2.1.4 Alligator mothers are well-known to be practically fearless when defending their offspring, whether the little ones have hatched or not. A mother alligator was observed leaping, jaws agape, to attack a helicopter as it approached the nest area to land! (The helicopter carried biologists studying alligator nests.)

2.2 Also be careful near heavy vegetation in or near the water's edge. This is where an alligator likes to enjoy privacy and peace during the daylight hours. If you trudge through there and surprise it, the outcome may not be positive.

2.3 Generally, a good minimum distance to keep between you and an alligator or nest is 15 feet/ 4.6 meters.

2.4 When trying to get past an alligator, make sure not to walk between the alligator and the water, because if it's spooked, it's going to run to the water.

2.5 If an alligator does approach in a threatening manner, make as much noise and movement as possible. This should show the alligator that he has taken on more than he can handle and he'll back away.

3.0 Alligator Charge

3.1 The alligator is not a natural runner. Those short legs obviously don't serve it like a horse's legs do, and the alligator can actually tire out in a relatively short time. When it charges after a human or animal, it is either trying to scare it away or seize it. It has a fast and furious burst of energy which

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serves it well for stealth hunting -- grabbing prey when it doesn't expect it. Furthermore, the reptile is opportunistic, which means, quite simply, it doesn't like to work very hard to get its food if it doesn't have to.

3.2 In the very rare event you are charged or chased by an alligator, move in as straight a line as possible away from it as fast as you reasonably can. In many cases, the vegetation features of the wild will serve to protect you by slowing the alligator down, like trees, bumps, bushes, etc. -- your comparatively long legs usually make it easier for you to maneuver through the trees and brush than an alligator's short legs do.

3.3 Most adult humans can outrun even a fast crocodilian, which has been clocked at a maximum of about 10 mph/17 kilometers per hour (kph), compared to a human speed of 15-17 mph/24-27 kph. But this doesn't matter much; an alligator will often give up the chase because it sees that the runner is moving away too quickly, and realizes that too much effort will be required to continue pursuit.

3.4 You may have heard somewhere that the zigzag run (running in a "z" pattern, side-to-side) is a good idea, but this is not only an unnecessary maneuver but probably a very unwise one. Here's why:

3.4.1 Unless you're an Olympic athlete, running zigzag over natural topography increases your risk of tripping and falling over rocks, plants, roots, and the like. And it goes without saying that falling while being pursued by an alligator is not good.

3.4.2 Furthermore, an alligator doesn't have the degree of stereoscopic vision we have. It actually has a small 'blind spot' directly in front of it. Hence, the alligator's vision is most effective in the 'sides' of its field of view. So, running zigzag not only slows your rate of distance from your pursuer, it may clearly indicate to the animal exactly where you are; even this point hardly matters since in many cases the alligator may keep its eyes shut while pursuing so as not to get them hit by twigs, grass stalks and branches in its path.

3.4.3 Finally, an alligator bites very effectively in a side-swiping motion, so if you are trying to run zigzag and are slowed down by plants, rocks, or other obstacles, the backwards flying leg of a running human is an optimal target for side-swiping, chomping jaws (the operative word here is "side").

3.5 Simply put, when faced with an attack, move directly away from the alligator as quickly as possible, navigating the terrain as carefully as possible. The zigzag idea will likely not serve you well.

4.0 Alligator Attack

4.1 If it seizes prey, and the prey fights back hard, the alligator may release it, depending on factors such as its own size relative to that of the victim, its own level of aggression, and its measure of hunger. Merely struggling to break free may not be enough counter-aggression to stop an alligator, and may actually prompt a devastating "death roll" response, in which the reptile furiously spins on its central axis to tear muscle and bone free of the victim's body.

4.2 These armored saurian are among the toughest beasts in the animal kingdom, so an attack victim should channel his or her nervous energy and will to survive and take the offensive by fighting hard. Not struggling...fighting very, very, very hard. Others on hand during such an event may be able to help by fighting the reptile, too. This should include punching the snout, poking the eyes, and even jabbing the ears, which are seen as small slits behind the eyes.

5.0 Additional Resources

5.1 Additional resources can be found at:

5.1.1 http://www.tpwd.state.tx.us/huntwild/wild/species/alligator/index.phtml

5.1.2 http://corkscrew.audubon.org/Wildlife/Alligators.html

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5-313-Configuration Clothing for Protection Against Ticks and Insects

1.0 Configuration of Clothing

1.1 Loose-cuff trousers must be tucked into socks, wrapped with duct tape (or equivalent) completely around the cuff of the sock up on to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse-wrapped with “sticky” side out (see figure below). Once the clothing is configured , insect repellent containing DEET (or acceptable alternative) should be applied to the clothing.

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5-313-Insect Repellent Active Ingredient Product Information

1.0 Application of Insect Repellent

1.1 Immediately prior to the commencement of work in the field, an Resolution Consults -approved insect repellent shall be applied to exposed skin, and to the outer surface of pant leg cuffs tucked into socks, shirt tails tucked into pants at the waist, and shirt cuffs.

1.2 Table 1 provides a list of Resolution Consults-approved insect repellent active ingredients; employees may utilize any brand containing the minimum concentration of active ingredients as listed.

1.3 All products are registered with the EPA and recommended by the CDC.

1.4 Employees should select the Resolution Consults approved repellent which is best for them based on skin sensitivity/allergies, and personal preference, but be aware that reapplication frequency will be greater for Picaridin and lemon eucalyptus products.

1.5 Employees shall carefully read and comply with manufacturer recommendations and instructions on product labels prior to application. Repellent shall not be applied beneath clothing to minimize the potential for irritation and/or allergic reaction.

1.6 The chemical N,N-diethyl-*m*-toluamide (DEET) shall not be applied to Nomex™ fire retardant clothing as it reduces the effectiveness of the fabric.

Table 1
Approved Insect Repellents

Active ingredient and minimum concentration	Products Available	Approximate Duration of Effectiveness	Notes and Web Link to Product Safety Information
Permethrin (0.5%)	-Repel® Permanone -Coulston's Duranon™	2 weeks[1]	-Application to clothing and equipment only
DEET (23.8%)	-Deep Woods Off! ® -Repel® Sportsmen Formula®	5 hours[2]	-Cannot be applied to Nomex™ fabric
Picaridin (7%)	-Cutter Advanced™	4 hours[3]	-Protection equivalent to approximately 10% DEET
Oil of Lemon Eucalyptus (30%)	-Repel® Lemon Eucalyptus	2 hours[2]	-Protection equivalent to approximately 7% DEET -Natural, plant based product

[1] – New York State Department of Health, 2007
[2] – Fradin and Day, 2002
[3] – Spectrum Brands, 2007

1.7 Repellent shall be reapplied multiple times daily over the course of the day at a frequency identified during the hazard assessment based on manufacturers' recommendations, the approximate effective period provided in Table 1, and other factors such as perspiration, precipitation, etc.

1.8 All approved repellents are available at most department or sporting goods stores.

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Product Safety Information

Facts about the repellants recommended by Resolution Consults are available by clicking on the embedded link.

National Pesticide Telecommunications Network Fact Sheet: Permethrin and Picaridin

Picaridin

Picaridin Fact Sheet.pdf

Permethrin

Permethrin Fact Sheet.pdf

DEET

DEET Fact Sheet.pdf

Lemon Eucalyptus

Lemon Eucalyptus fact sheet.pdf

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5-313-Mosquito-Borne Diseases

1.0 Background

1.1 CDC data indicates that mosquito-borne illnesses, including encephalitis, are a health risk to employees working in outdoor environments.

1.2 Mosquitoes pose a risk of causing infection with various forms of encephalitis and other diseases in Resolution Consultants employees. This section will focus on the transmission of encephalitis. West Nile encephalitis is an infection of the brain that is caused by a virus known as the West Nile virus.

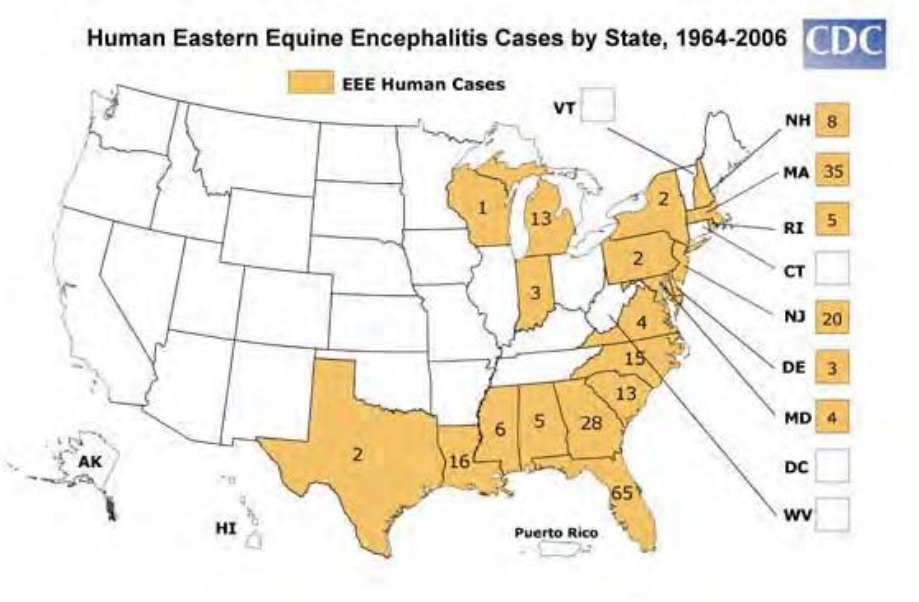
1.3 If other mosquito-borne diseases are identified in the project area, the local Public Health Department and CDC should be consulted to determine what diseases are present and exposure prevention recommendation.

1.4 According to the CDC, arboviral encephalitis is a virus that is "maintained in nature through biological transmission between susceptible vertebrate hosts by blood feeding arthropods", e.g., mosquitoes. It exists in various forms in global distribution, and in four primary forms in the U.S.: 1) eastern equine encephalitis (EEE), 2) western equine encephalitis (WEE), 3) St. Louis encephalitis (SLE), and 4) La Crosse (LAC) encephalitis; all of which are transmitted by mosquitoes.

1.5 Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water. Typically, mosquitoes will fly only a quarter of a mile (400 meters) from their breeding location.

2.0 Distribution

Figure 1
Distribution Map for EEE Cases



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/EEE_Map.jpg

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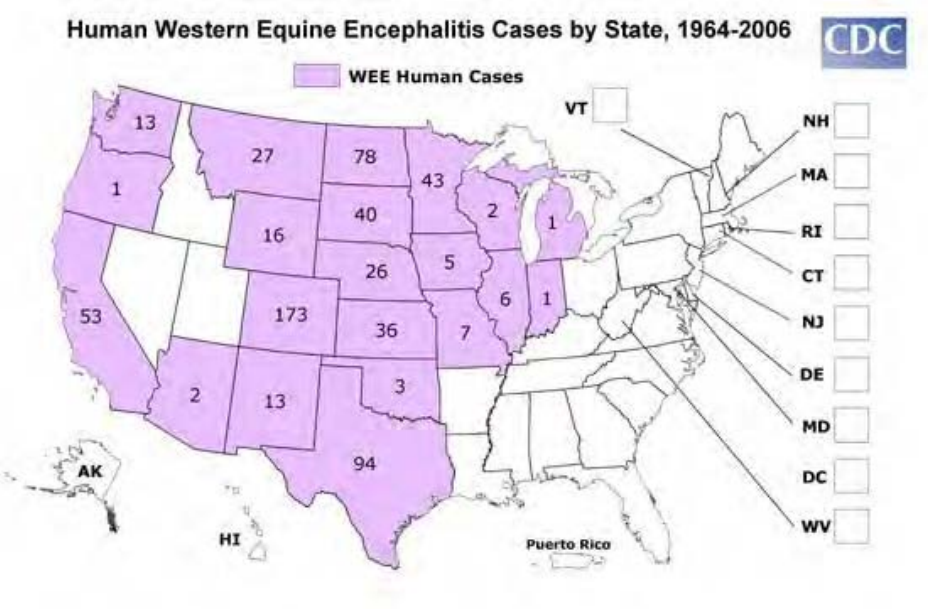
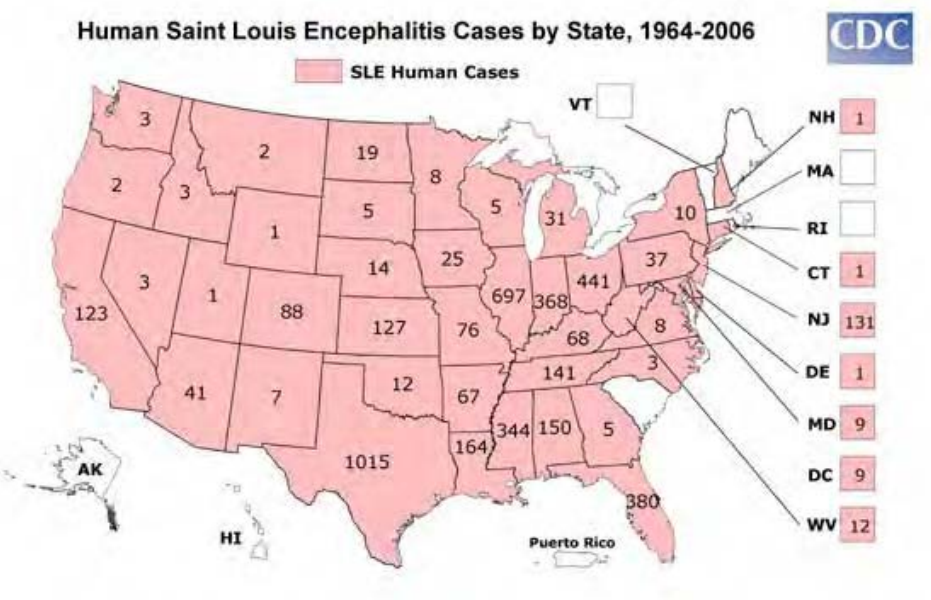
Figure 2

Distribution Map for WEE Cases



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/WEE_Map.jpg

Figure 3
Distribution Map for SLE Cases



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/SLE_Map.jpg

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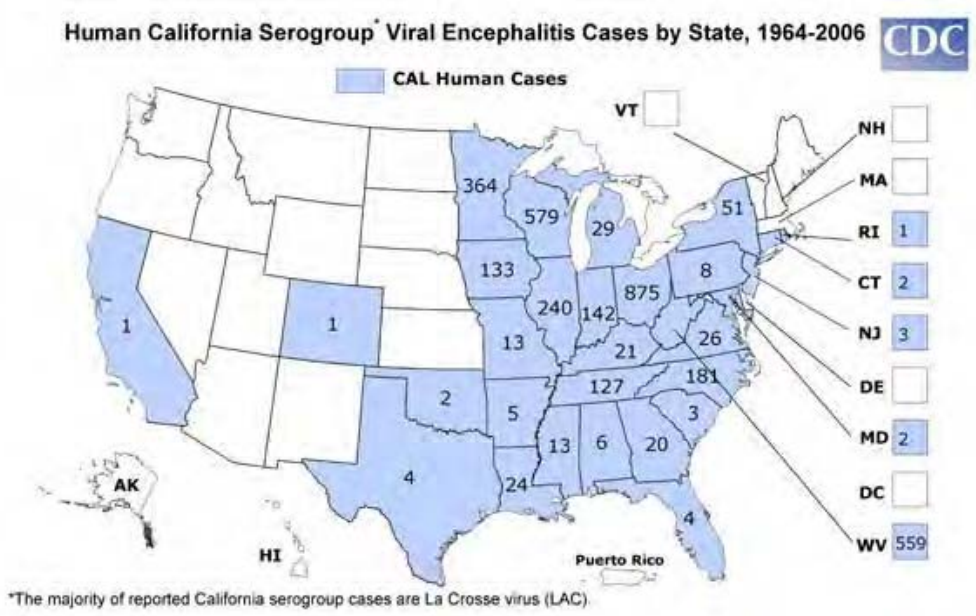
Figure 4
Distribution Map for LAC Cases



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/LAC_Map.jpg

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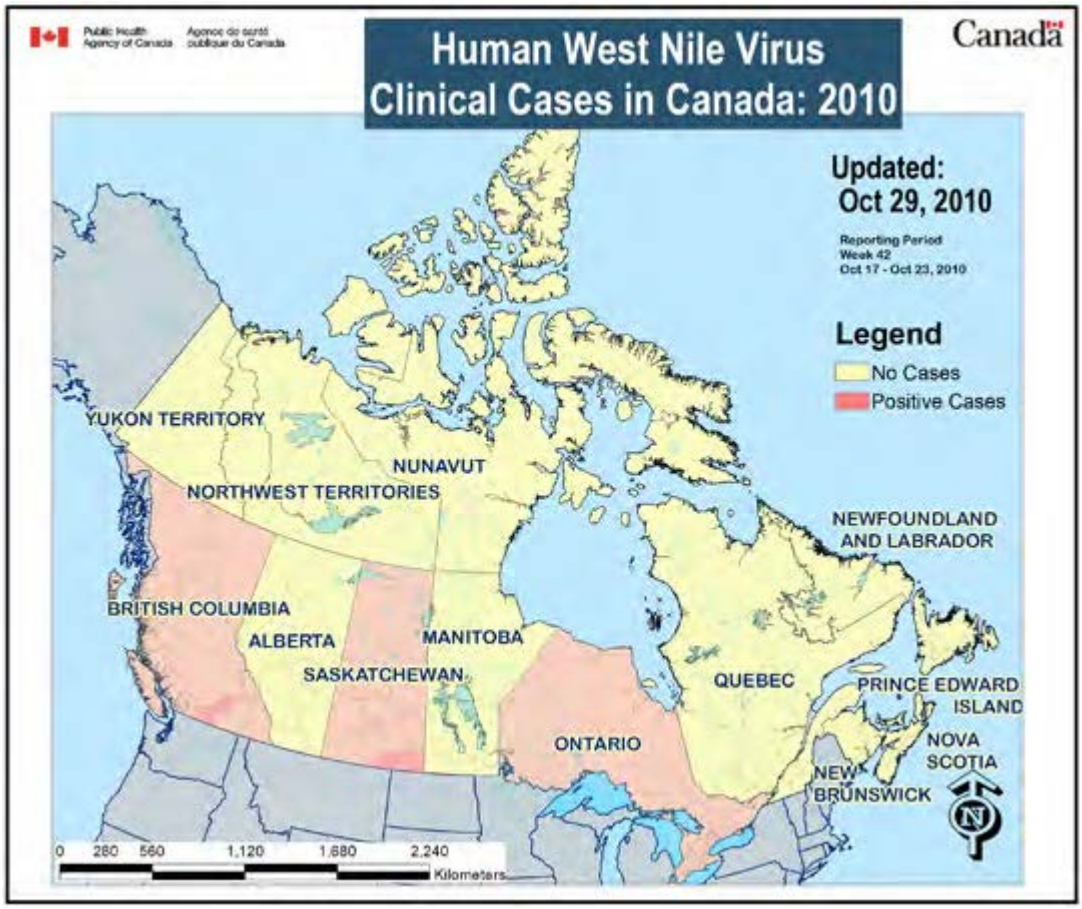
Canadian Mosquito Borne Diseases



Source: http://www.eidgis.com/wnvmonitorca/

Disease	Distribution
California encephalitis	Canada-wide
Western equine encephalitis	Western Canada
Eastern equine encephalitis	Quebec, Ontario
St Louis encephalitis	Ontario, Quebec, Manitoba, Saskatchewan
Cache Valley	Ontario, Manitoba, Saskatchewan, Alberta

Source: Paediatr Child Health. 2000 May–Jun; 5(4): 206–212.

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5-313-Plants of Concern

1.0 Background

1.1 Poison ivy, oak and sumac (poisonous plants) pose a significant threat to Resolution Consultants employees due to the dermatitis that results from exposure to the oil on these plants, called urushiol.

1.2 Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the infected area, increasing susceptibility for an infection to result from the rash.

1.3 It should be noted that each time an employee is exposed to urushiol, it increases the severity of the reaction they will have in subsequent exposures.

2.0 Treatment

2.1 In cases that involve severe rashes, medical treatment may be necessary to control the rash.

2.2 Employees that develop a rash as a result of exposure to poison ivy, oak or sumac should report the exposure immediately to their Supervisor, Project Manager and RSHEM.

Figure 1

Distribution Map for Poison Ivy

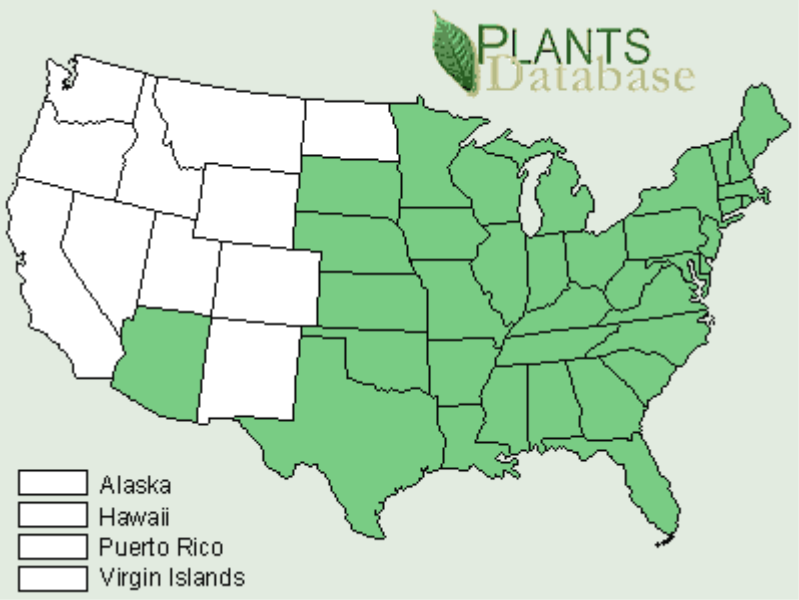

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Figure 2
Distribution Map for Poison Oak

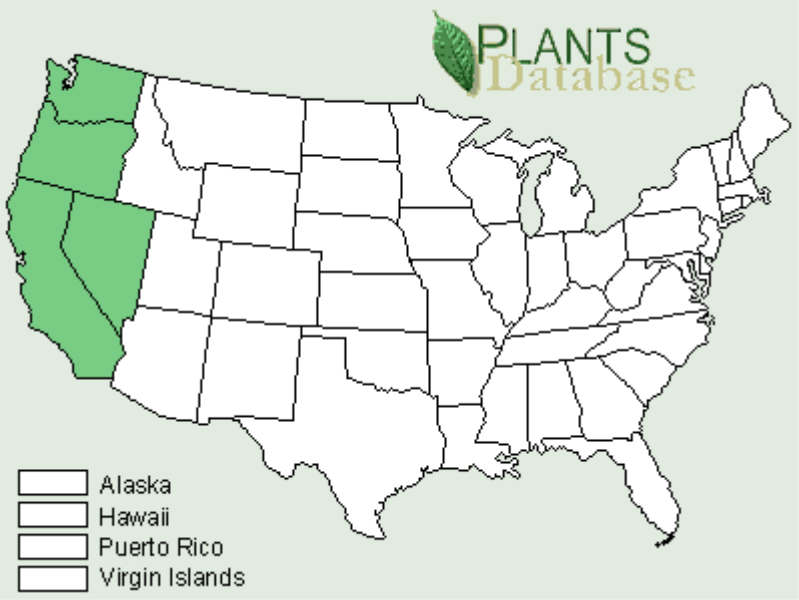
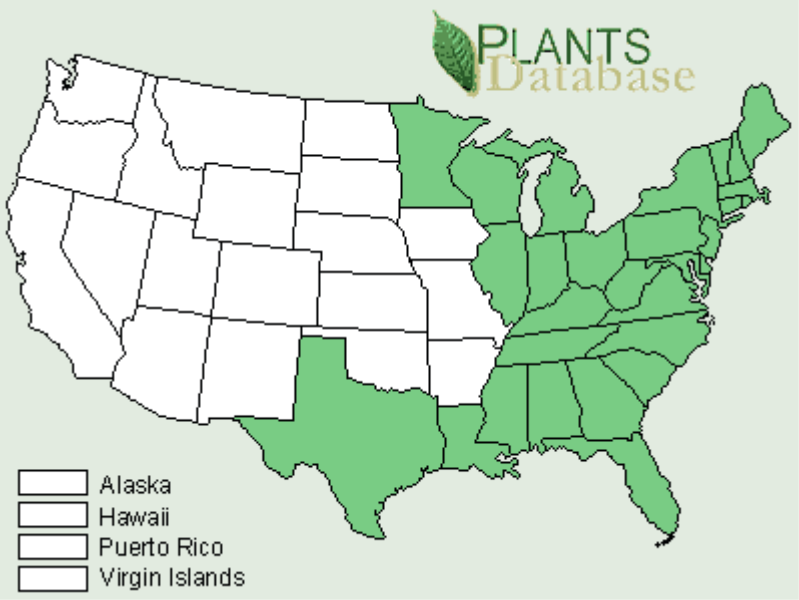


Figure 3
Distribution Map for Poison Sumac



Source for Figures 1, 2, and 3: http://www.tecnuextreme.com/plant-map.htm

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5-313-Poisonous Spider Identification

Black Widow Spider

- Abdomen usually shows hourglass marking.
- The female is 3-4 centimeters in diameter.
- Have been found in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light, local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.

Brown Spiders (Recluse)

- Central and South U.S., although in some other areas, as well.
- ¼-to-½-inch-long body and the size of silver dollar.
- Hides in decaying wood, baseboards, ceilings, cracks, and undisturbed piles of material.
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.

Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If bitten by a spider, attempt to identify the spider, notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or any swelling or numbness beyond the site of the bite.

Additional USA Spider Identification charts are available at http://www.termite.com/spider-identification.html

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5-313-Snakes

1.0 Hazard

1.1 **Snakes have the ability to inject venom.** A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

2.0 Personal Protective Equipment

2.1 Long pants and shirts.

2.2 Heavy gloves if staff will be handling debris or be close to the ground.

2.3 Rubber boots, or boots that fully cover the foot (not sandals!) and preferably are at least 10” high.

2.4 Snake Chaps that cover at least the shin.

2.5 Personal first aid kit.

3.0 Restrictions

3.1 Staff must not work alone in areas where the risk of a snake encounter is high.

4.0 Training

4.1 Staff must be notified of the hazard before work commences.

5.0 Safe Work Practice

5.1 Staff working in areas known to be inhabited by venomous snakes should take extra precautions, be able to identify the local snake species, and understand the best practices for administering first aid.

5.2 Most snakes in Canada are non-venomous; and most snake bites are not fatal, only painful. Learning to identify snake species will assist you in responding appropriately to an encounter, and will assist medical professionals in determining if antivenin needs to be administered if anyone is bit.

5.3 Most snakes are non-aggressive and will only attack if immediately threatened.

5.4 **Prevention**

5.4.1 Before venturing out into the wilderness, familiarize yourself with the snakes in your area, both venomous and non-venomous species.

5.4.2 Learn which habitats the venomous species in your region are likely to be encountered in, and use caution when in those habitats.

5.4.3 Try as much as possible not to take a snake by surprise.

5.4.4 Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs, or when collecting firewood. Take care when overturning any objects on the ground when in snake country.

5.4.5 If you see a snake, give it as much room as possible. Most snakes have a strike distance that is only half the length of their body.

5.4.6 If you get very close to a rattlesnake, hold very still until it calms down and starts to move away. Then slowly move backwards until you are at least one snake-body length away.

5.5 **Treatment**

5.5.1 Venomous snakebites are rare, and they are rarely fatal to humans. Of the 8,000 snakebite victims in the United States each year, only about 10 to 15 die. In Canada the number of snake bites each year is very small. However, for any snakebite the best course of action is to get medical care as soon as possible.

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5.5.2 Try to keep the snakebite victim still, as movement helps the venom spread through the body.

5.5.3 Keep the injured body part motionless and just below heart level.

5.5.4 Keep the victim warm, calm, and at rest, and transport him or her immediately to medical care.

5.5.5 Do not allow him to eat or drink anything.

5.5.6 If medical care is more than half an hour away, wrap a bandage a few inches above the bite, keeping it loose enough to enable blood flow (you should be able to fit a finger beneath it). Do not cut off blood flow with a tight tourniquet. Leave the bandage in place until reaching medical care.

5.5.7 If you have a snakebite kit, wash the bite, and place the kit's suction device over the bite. (Do not suck the poison out with your mouth.) Do not remove the suction device until you reach a medical facility.

5.5.8 Identify the snake that caused the bite to determine if it is venomous, and if antivenin needs to be administered. Do not waste time or endanger yourself trying to capture or kill it. Note the shape & color of the snake's head.

5.5.9 If you are alone and on foot, start walking slowly toward help, exerting the injured area as little as possible.

- Note that there are several species of snakes that superficially resemble rattlesnakes. Several species, including Bull, Milk, Fox, and Rat Snakes will even rattle their tails when startled.
- Massasauga Rattlesnake is recognized as a Threatened Species in Ontario and it is an offence to harass, , or destroy the habitat of this species.
- One scorpion species, the Northern Scorpion (*Paruroctonus boreus*) occurs in semi-arid areas of southern British Columbia, Alberta, and Saskatchewan. It carries a stinger on the end of its tail. The sting is painful but not life threatening unless there is an allergic reaction.

6.0 Species

6.1 Venomous Snakes in Canada

Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) found around Wainfleet, Windsor, Bruce Penninsula and eastern Georgian Bay in Ontario.	Eastern Massasauga Rattlesnake picture by Michael Redmer/Courtesy Lincoln Park Zoo
Northern Pacific Rattlesnake (*Crotalus viridis*) found primarily in Okanagan and Thompson River valleys of southern British Columbia.	

Prairie Rattlesnake (*Crotalus viridis*) found in south eastern Alberta, and south western Saskatchewan.	

6.2 Venomous snakes in the U.S.

Rattlesnake(*Crotalus cerastes)* found mostly concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake. The rattlesnake is found in many different biomes ranging from along the coast at sea level, the inland prairies and desert areas to the mountains at elevations of more than 10,000 feet. Species include: Sidewinder, Santa Catalina, Western, Mojave, Red Diamond, Western Diamond, Ridge Nosed, Eastern Diamondback, and Pigmy.	Western Rattlesnake Eastern Diamondback
Copperhead (*Agkistrodon contortrix*) is the most common venomous snake found in the eastern US. It can be found in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Tennessee, Kentucky, Virginia, Illinois, Indiana, Ohio, Iowa, Pennsylvania, Maryland, New Jersey, Delaware, New York, Connecticut, and Massachusetts.	
Cottonmouths (water moccasins) (*Agkistrodon piscivorus)* found in the eastern United States from Virginia, south through the Florida peninsula and west to Arkansas, eastern and southern Oklahoma, and east and central Texas..	

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Coral Snake (*Micrurus sp.)* found in the southern range of many temperate US states including North Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Kentucky, Arizona, and New Mexico.	Eastern Coral Snake, *Micrurus fulvius*

7.0 References

7.1 *The Eastern Massasauga Rattlesnake Stewardship Guide. A resource and field guide for living with rattlesnakes in Ontario.* Sponsored by the Government of Canada, and distributed on behalf of the Toronto Zoo and the Eastern Massasauga Rattlesnake Recover Team.

7.2 http://www.rattlesnakes.us/

7.3 **http://drdavidson.ucsd.edu/Portals/0/snake/Crotalus.htm**

5-313-Tick Test Request Form

IGeneX, Inc.
795 San Antonio Road
Palo Alto, CA 94303
800/832-3200
www.igenex.com

TICK TEST REQUEST FORM

Revised: JUNE 2008

TO SEND A TICK:

- Place ticks (up to 20) in a small tube or plastic baggy with a small piece of moist cotton.
- Place container in a sealed plastic bag.
- Fill out lower portion of this form.
- Place form, check and sealed plastic bag in padded envelope or box.
- Send to IGeneX, Inc. and mark front of envelope or box with "TT".
- IGeneX does not "TYPE" or determine the species of the ticks. If you want to "TYPE" your tick, please contact your local Vector Control Center.
- Once your tick(s) have been processed, the tick can not be returned to you.
- For Multiple Ticks: up to 20 ticks will be tested together at one time unless indicated otherwise.
  If ticks are tested separately, the charge is per tick. Please test my ticks separately. Yes ☐

Please test the tick by PCR for:

☐	Test 140	Lyme Disease (B. burgdorferi)	$65.00
☐	Test 689	Babesiosis (B microti and/or B duncani)	$65.00
☐	Test 148	Ehrlichiosis (Ehrlichia)	$65.00
☐	Test 290	Bartonella henselae	$65.00
☐	Test 975	Rickettsia	$65.00

Name and Address of Sender:

_____

_____

_____

Phone: (_____) _____

If you would like results faxed or called, please indicate below. Otherwise, results will be mailed by USPS.

_____Please fax my completed results to:
(_____)_____-_____

_____Please call me with my results at:
(_____)_____-_____

☐ Check enclosed payable to IGeneX, Inc.

☐ Please charge my credit card for the above tests:

☐ Visa ☐ Mastercard ☐ Discover

Card Number: _____

Exp. Date_____

Signature_____

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5-313-Ticks

1.0 Background

1.1 The Public Health Agency of Canada (PHAC) works with the provinces, health authorities and other experts on research to define and monitor the occurrence of the ticks that carry *Borrelia burgdorferi*, the bacterium that causes Lyme disease. In Canada, the blacklegged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western blacklegged tick (*Ixodes pacificus*) are the species known to transmit this disease-causing agent, as well as other less common agents.

1.2 In Quebec, blacklegged tick populations are becoming established in parts of the Monteregie and Estrie regions in the southeast of the province. In Ontario, populations can be found in Long Point; Point Pelee National Park; Rondeau Provincial Park; Turkey Point; Prince Edward Point National Wildlife Area and St. Lawrence Islands National Park in the Thousand Islands region of eastern Ontario. In Nova Scotia, blacklegged tick populations are found in the Lunenburg, Bedford and Shelburne areas. An established population has also been found in the southeastern corner of Manitoba. Western blacklegged ticks, on the other hand, are found in British Columbia; they are fairly widely distributed but populations are largest in the lower mainland, on Vancouver Island, and in the Fraser Valley.

1.3 Although the distribution of blacklegged ticks in Canada appears to be limited, surveillance indicates that some of the established populations are spreading within certain areas of southern Canada. The potential expansion of localized tick populations makes it difficult to precisely define the geographic limits of any given population; however, people living in or visiting areas adjacent to established tick populations may have a greater chance of contact with blacklegged ticks. Although current evidence does not suggest a widespread distribution of blacklegged tick populations in Canada, the establishment of new populations appears to be an ongoing process. Hence, it is desirable to continue surveillance and to take precautions to reduce tick contact.

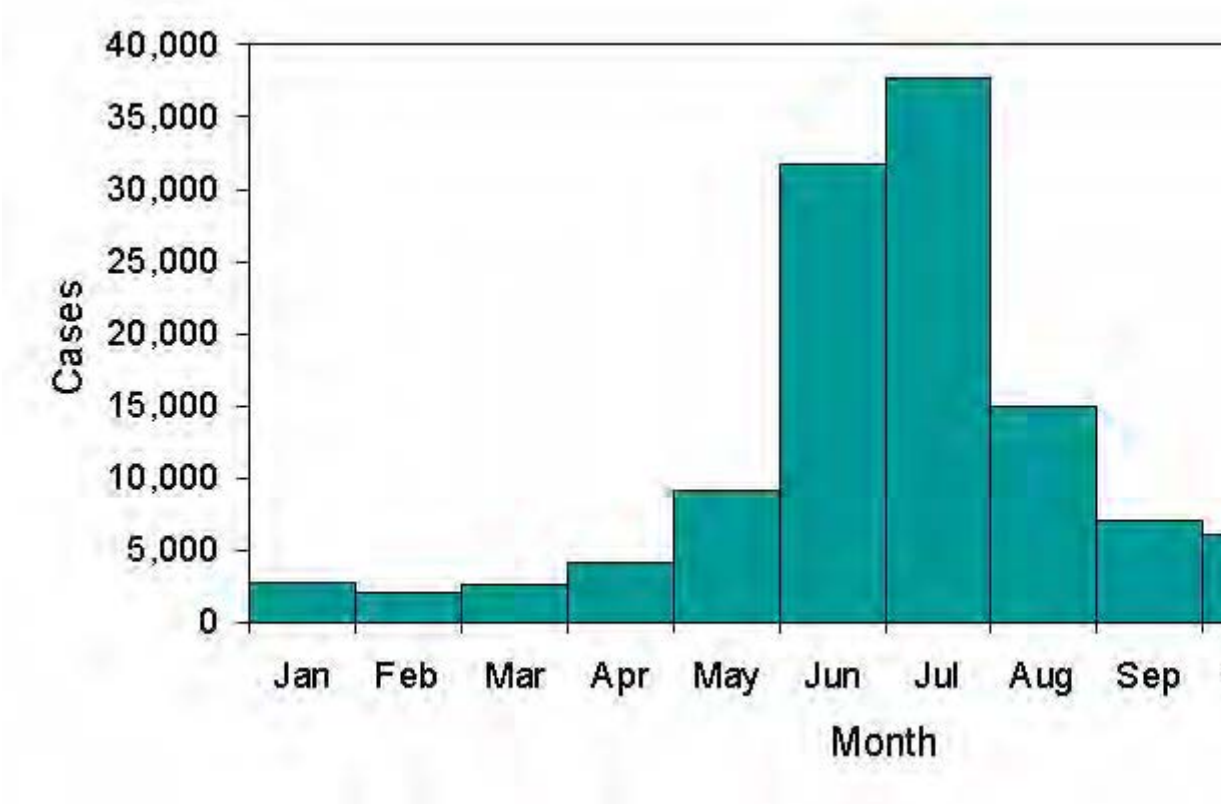
1.4 The rate of infection of ticks with the bacterium that causes Lyme disease varies. Infection rates are typically higher in adult ticks compared to the other stages (nymphs and larvae). Despite the lower rates of infection, people are most likely to acquire Lyme disease from a nymph because this stage is so small (see Figure 2) and thus more likely to go unnoticed and feed for a sufficient amount of time for the Lyme disease bacterium to be transmitted (24-36 hours). Infection rates are often greater in tick populations that have been established for long periods of time (such as Long Point) compared to newly established ones. As many as 60 percent of the adult ticks at Long Point are infected; however, infection rates in adults are more often between 10 and 25 percent at the other localities where ticks are established. Partly because of differences in the types of hosts that they feed upon, infection rates of the Lyme disease agent in *Ixodes pacificus* are much lower (1-3 percent) than *Ixodes scapularis*.

1.5 While there is a higher risk of coming in contact with infected blacklegged ticks in areas where populations are established, there is also a low risk of Lyme disease being contracted almost anywhere in Canada because migratory birds transport infected ticks over large geographic distances. Surveillance data indicates that about 12 percent of the ticks detected outside of areas where tick populations are established, and likely transported there on migratory birds, are infected with the agent of Lyme disease.

1.6 Source: http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php

Figure 1

Reported Cases of Lyme Disease by Month of Illness Onset United States, 1992-2004



Lyme disease patients are most likely to have illness onset in June, July, or August and less likely to have illness onset from December through March.

Lyme disease likelihood = April through November http://www.cdc.gov/ncidod/dvbid/lyme/ld_rptmthofill.htm

2.0 Tick removal tips from CDC

http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm

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3.0 To Remove Attached Ticks

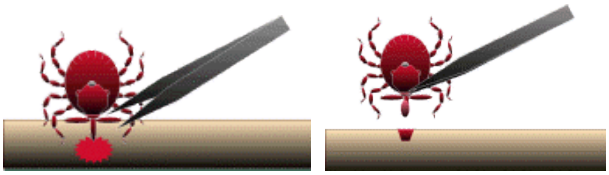
3.1 Use fine-tipped tweezers or notched tick extractor, and protect your fingers with a tissue, paper towel, or latex gloves (see figure). Persons should avoid removing ticks with bare hands.

3.2 Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your health care provider if illness occurs.)

3.3 After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

3.4 Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms. Skin accidentally exposed to tick fluids can be disinfected with iodine scrub, rubbing alcohol, or water containing detergents.

3.5 Save the tick for identification in case you become ill. This may help your doctor make an accurate diagnosis of potential diseases by determining what type of tick it is. Place the tick in a sealable plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.



4.0 Devices Designed for Removing Ticks

4.1 **The Tick Tool - http://www.ticktool.com/index.html**

5.0 Folklore Remedies Don't Work

5.1 Folklore remedies, such as the use of petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva or regurgitate gut contents, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided.

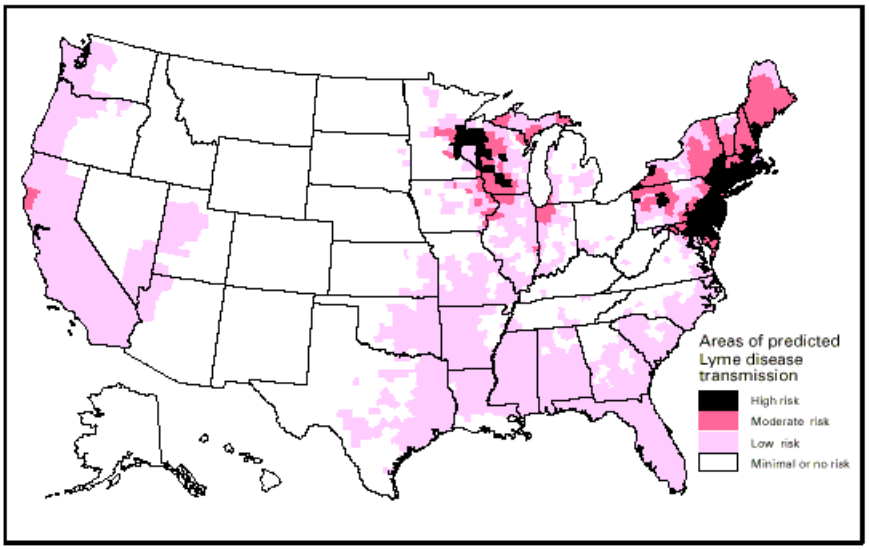
Information Regarding Common Tick-Borne Diseases and Tick Removal Procedures

Table 1
Common Tick-Borne Diseases in the U.S. and Information Resources

Disease	Tick Species	CDC Informational Web Pages
Lyme disease	• Black-legged or deer tick • Western black legged tick	http://www.cdc.gov/ncidod/dvbid/lyme/
Ehrlichiosis	• Lone star tick • Black-legged or deer tick • Western black legged tick	http://www.cdc.gov/Ncidod/dvrd/ehrlichia/Index.htm
Rocky Mountain spotted fever	• American dog tick • Rocky Mountain wood tick • Brown dog tick	http://www.cdc.gov/ncidod/dvrd/rmsf/index.htm

6.0 Distribution

Figure 2
Distribution Map for Lyme Disease Risk, U.S.



Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. Risk categories are defined in the accompanying text. Information on risk distribution within states and counties is best obtained from state and local public health authorities.

Source: CDC, http://www.cdc.gov/ncidod/dvbid/lyme/riskmap.htm

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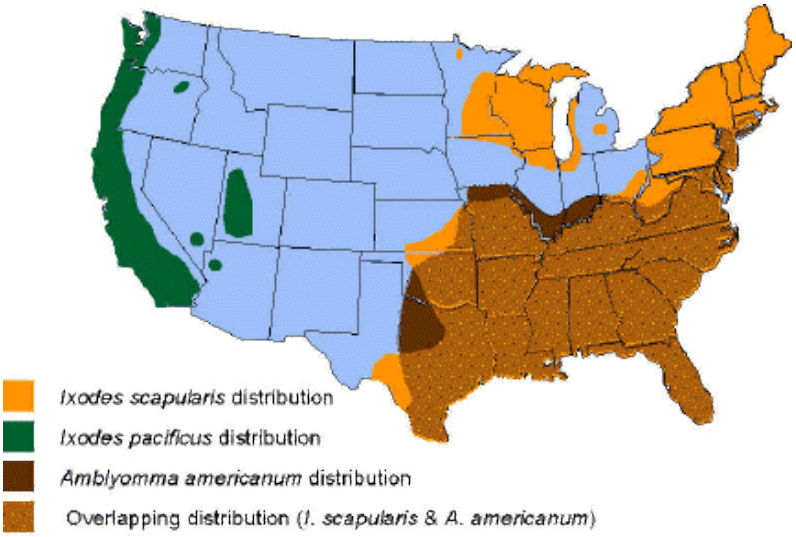
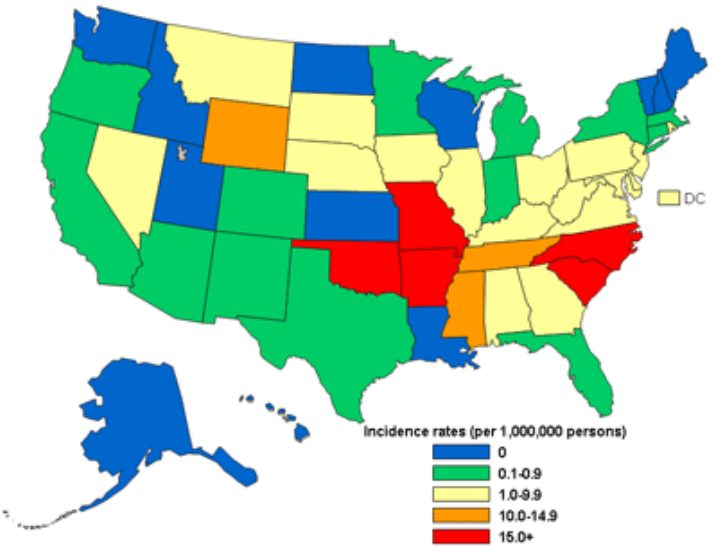
Figure 3
Distribution Map of Vector

Tick Species for Human Ehrlichiosis, U.S.



Source: CDC, http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm

Figure 4
Distribution Map of Annual Incidence
of Rocky Mountain Spotted Fever, U.S



Data for calendar year 2002

Source: CDC, http://www.cdc.gov/ncidod/dvrd/rmsf/Epidemiology.htm

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5-313 Wildlife, Plants and Insects

1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by Resolution employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as “biological hazards”.

1.2 This procedure applies to all Resolution employees and operations.

2.0 Terms and Definitions

2.1 **Field Work**: Field work is defined as any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance (OM&M), biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous:** Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment:** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of CERCLA defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called “All Appropriate Inquiry” or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment:** Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 References

3.1 Public Health Agency of Canada (http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php) on Ticks and Lyme Disease in Canada

3.2 Public Health Agency of Canada (http://www.phac-aspc.gc.ca/wn-no/index-eng.php) on West Nile Virus

3.3 United States Center for Disease Control (CDC) (http://www.cdc.gov/ncidod/dvbid/lyme/index.htm) on Lyme Disease

3.4 New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents. http://www.health.state.ny.us/nysdoh/westnile/pdf/2737.pdf

3.5 Spectrum Brands, 2007. Personal Insect Repellent Products. http://www.spectrumbrandshomeandgarden.com/CorpNav/AboutSpectrum/ProductCategories/insect_repellent.htm

3.6 U.S. Centers for Disease Control and Prevention, 2004. Tick Management Handbook. http://www.cdc.gov/ncidod/dvbid/lyme/resources/handbook.pdf

3.7 U.S. Environmental Protection Agency, 2006. Permethrin Facts: Preregistration Eligibility Decision Fact Sheet. http://www.epa.gov/oppsrrd1/reregistration/REDs/factsheets/permethrin_fs.htm

3.8 U.S. National Pesticide Information Center, 1997, National Pesticide Telecommunications Network Fact Sheet for Permethrin. http://npic.orst.edu/factsheets/permethrin.pdf

3.9 U.S. Environmental Protection Agency, 2005. New Pesticide Fact Sheet, Picaridin http://www.epa.gov/opprd001/factsheets/picaridin.pdf

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Project Managers and Supervisors

- **Project Managers** and **Supervisors** responsible for managing field work will work with employees conducting the work to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- If biological hazards are identified as an exposure risk in the workplace, control measures that may be applied at the project site will be implemented to reduce the potential for employees to be exposed to injuries and illnesses while working.
- If the exposures cannot be eliminated or managed with engineering controls, the **Project Manager** or **Supervisor** will approve the use of PPE and protective repellents and lotions and ensure that exposed employees have and use these products.

4.1.2 District Operations Manager

- Approve the costs associated with the PPE and materials necessary to protect employees from the biological hazards covered by this Procedure.
- During the performance of project site visits, managers will assess the precautions being taken against the requirements of this Procedure.

4.1.3 Regional SH&E Manager

- Participate in incident reporting and investigations when appropriate.
- Work with office SH&E Department and project Safety Professionals, provide training and guidance to employees consistent with this procedure.
- Assist project teams in identifying hazards and selecting appropriate control measures.

4.1.4 Operational Managers

- Assure implementation of this procedure in their regions and offices.
- Participate in incident reporting and investigations when appropriate.

4.1.5 Employees

- Participate in required training on this procedure.
- Participate in the development of THAs for the project, identify control measures to limit exposure and request PPE, repellents, and protective lotions required by this Procedure.
- Obtain approval from **Project Managers** and/or **Supervisors** to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting as detailed within the Procedure.
- Participate in incident reporting and investigations when appropriate.

4.2 Overview

4.2.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to Resolution employees. Note that this discussion is not a fully encompassing list of hazards and as part of the Task Hazard Analysis conducted by the project team, additional consideration must be given to other biological hazards.

4.2.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this Procedure.

4.2.3 If additional biological hazards are identified, the project team should contact the **Resolution SH&E Manager** to discuss the hazards and identify effective control measures that can be implemented at the project site.

4.3 Planning and Hazard Assessment

4.3.1 The Resolution project team shall ensure that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this SOP are integrated into the project planning process and conveyed to Resolution employees conducting the field work. This information shall be communicated in the site specific Safe Work Plan (SWP), Health and Safety Plan (HASP), the THA, pre-project kickoff meetings, and tailgate meetings at the project site.

4.3.2 It is important to note that the precautions to be taken by Resolution employees to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the project-specific hazard assessments in accordance with *5-511 Heat Stress Prevention.*

4.3.3 During the preparation of the project specific Safe Work Plan (SWP), HASP and project specific THA, **Project Managers**, **Supervisors**, and the project staff will determine what biological hazards might be encountered during the project and will prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.3.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40°F for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.3.5 The hazard assessments must also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.3.6 Employees in the field where biological hazards exist will not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the affected employees shall stop work and not proceed until the THA has been amended and protective measures implemented.

4.3.7 A decision flow chart and table for determining the potential for biological hazards in US states has been provided in *5-313-Biological Hazard Assessment Decision Flow Chart Hazard Assessment (US States).*

4.4 Restrictions

4.4.1 Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements.

4.5 Employee Sensitivity

4.5.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin, therefore it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Staff should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.5.2 Employees also need to consider whether they are sensitive to the use of insect repellents.

4.6 Personal Protective Equipment

4.6.1 The selection of Personal Protective Equipment is dependent on the hazard present and a PPE Hazard Analysis should be conducted to determine situation specific PPE required. (refer to SOP *5-208 Personal Protective Equipment Program*)

4.6.2 At a minimum, in addition to any project specific PPE, long sleeves and pants should be worn on field projects where the risk of biological encounter exists.

4.6.3 PPE for insects should include sunscreen, bug nets, bug jackets, or insect repellent. Socks should be pulled over pant legs and rubber boots should be worn where the threat of exposure is anticipated.

4.6.4 Epi-pens[1] or other personal medication should be carried by those staff that are aware that anaphylactic shock is a possibility for them.

4.7 Remedies

4.7.1 If you suspect exposure to an irritant, identify the cause including obtaining a specimen if possible. Document the occurrence as a safety precaution if the exposure should lead to complications.

4.7.2 Go to a doctor or call WorkCare for advice if necessary.

4.8 Training

4.8.1 Field staff must learn to recognize organisms that represent a threat in the regions in which they work – experienced field staff must provide on the job training to assist staff with hazard recognition.

4.8.2 Staff who have severe allergic reactions are strongly recommended to notify their project manager, field supervisor, and co-workers of the potential for a reaction and demonstrate what medication they might need and how it is administered.

4.9 Insects

4.9.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, Fire Ants and European Fire Ants.

4.9.2 Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.

4.9.3 Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will insert mouthparts to drink blood. The most serious concern is a possibility of contracting Lyme disease which is spread by the Black-legged or Deer Tick. The larger Wood Ticks are widespread in the west but these rarely carry diseases. Occasionally a tick can cause Tick Paralysis if it is able to remain feeding for several days. Full recovery usually occurs shortly after the tick is removed.

4.9.4 The Fire Ant (southern and western US) and the European Fire Ant (northeastern US and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.10 Ticks

4.10.1 Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and therefore most related illnesses.

4.10.2 The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *5-313-Ticks,* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.

4.10.3 When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.

4.10.4 To remove ticks that are embedded in skin, use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out.

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[1] *Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self administer the dose.*

4.10.5 Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If noted, report to medical help for inoculation.

4.10.6 If possible, submit any ticks found or captured to the following laboratories for species identification.

- Canada – National Microbiology Laboratory (NML) (Phone: (204) 789-2000; email: ticks@phac-aspc.gc.ca). The NML will conduct diagnostic testing for the Lyme disease agent as well as several other disease-causing agents. The NML results will not only benefit anyone bit by the tick, but will also assist the NML in their goal to accurately map the distribution of the tick species and associated diseases in Canada.
- US – IGeneX, Inc. (Phone: (800) 832-3200; www.igenex.com). IGeneX will test the tick for the presence of the Lyme bacteria. They also test ticks for *Babesia microti* and/or *Babesia duncani* (formerly WA-1), Ehrlichia, Bartonella henselae and Rickettsia (Rocky Mountain Spotted Fever). These diseases are also carried by ticks. The testing request form is attached as *5-313-FM Tick Test Request Form*.

4.10.7 If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

4.11 Chiggers

4.11.1 Chiggers are mite larvae, approximately ½ mm in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.

4.11.2 Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

4.12 Spiders

4.12.1 Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.

4.12.2 Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the US and others outside the US inject a toxin that causes extensive tissue damage and intense pain.

4.12.3 Additional information on spider identification can be found in attachment *5-313-Poisonous Spider Identification*.

4.13 Mosquitoes

4.13.1 Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus. Positive cases of West Nile Virus have been confirmed throughout North America since 2007.

4.13.2 Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death ,so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus.

4.13.3 When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.

4.13.4 CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk to employees working in outdoor environments. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:

- Eastern Equine encephalitis (EEE)
- Western Equine encephalitis (WEE)
- West Nile Virus
- St. Louis encephalitis (SLE)
- La Crosse (LAC) encephalitis

4.13.5 Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *5-313-Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

4.14 Bees and Hornets

4.14.1 Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, and even on open ground. The flying/stinging insects are not specifically included in the scope of this procedure and the PPE and other protective measures are not normally effective against aggressive, flying insects. Avoid reaching into areas where visibility is limited.

4.14.2 If stung by a wasp or bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.14.3 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. Resolution highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

4.15 Poisonous Plants

4.15.1 Poisonous plants including poison ivy, oak and sumac, which contain the oil urushiol that produces a rash, can lead to dermatitis and infections. Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the affected area, increasing susceptibility for an infection. It should be noted that each time an employee is exposed to urushiol the severity of the reaction increases. In cases that involve severe rashes, medical treatment may be necessary to control the rash.

4.15.2 Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves..

4.15.3 Plants that field staff should recognize and take precautions to avoid include: Poison Sumac, Poison Ivy (terrestrial and climbing), Poison Oak, Giant Hogweed[2] (or Giant Cow Parsnip), Wild Parsnip, Devil's Club and Stinging Nettle. Many others are extremely poisonous to eat (e.g., Poison Hemlock; Water Parsnip) – do not eat anything that has not been identified.

4.15.4 See *5-313-Plants of Concern* for information on locations where some of these poisonous plants are found in the US.

4.15.5 Of the toxic plants in the cashew family, Poison Ivy (*Rhus radicans*) is most widespread occurring across southern Canada. It is usually a low sprawling shrub or ground cover but in southwestern Ontario it also grows as a thick woody vine that grows high into the tree canopy. Poison Oak (*Rhus diversiloba*) is a low shrub that grows only in southwestern British Columbia and Poison Sumac (*Rhus vernix*) is a tall shrub that grows in southern Ontario but is quite rare. All of these plants possess urushiol oils in nearly all parts of the plant. Touching the plant causes an itchy skin rash that shows up several days following contact. People have a wide range of reactions which in severe cases can lead to oozing blisters on large parts of the body. Some people apparently never react and others may develop an allergy after no reaction after years of frequent contact.

4.15.6 Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the Giant Hogweed (*Heracleum mantegazzianum*), a garden that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 5 m in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by Meadow Parsnip (*Pastinaca sativa*) and Cow Parsnip (*Heracleum lanatum*). Meadow Parsnip can be very abundant on disturbed sites.

4.15.7 Nettles, particularly Stinging Nettle (*Urtica dioica*) and Wood Nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The

[2] *Phytodermatisi producer: keep skin covered and wash well after exposure*

irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.

4.15.8 Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. Fragile Prickly Pear cactus (*Opuntia fragilis*) is common in semi arid areas of the southern Prairie Provinces and interior British Columbia. Pieces will break off and imbed into one's ankle by scarcely brushing them. Devils Club (*Oplopanax horridum*) can form dominant understorey in humid forests among the western mountains. It contains semi-soft spines on the stems that will break off in the skin causing considerable irritation for days. In some areas of Ontario, Prickly-ash (*Zanthoxylon americanum*) a tall shrub with sturdy spines, sometimes forms dense single stands that are nearly impenetrable.

4.15.9 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying not to eat any berries or plants if you are not absolutely sure of their identity.

4.15.10 Of all the plants, Giant Hogweed presents the most serious health risk. Field staff should learn to recognize and avoid it if encountered.

4.15.11 Employees who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will then forward the report to the **Regional SH&E Manager**.

4.16 Additional Biological Hazards

4.16.1 Additional Work Instructions are provided for protection and prevention from the following:

- *5-313-Snakes*
- *5-313-Alligators*

4.17 Habitat Avoidance, Elimination, and/or Control

4.17.1 Ticks, Spiders and Insects

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the project site of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks, spiders, and poisonous plants during the clearing process.
- Resolution projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the Resolution project manager shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
- When projects must be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures outlined in this SOP shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. Project Managers and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.17.2 Poisonous Plants

- If poisonous plants are identified in the work area, employees will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other employees to avoid the designated area. If employees decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the **Project Manager** and/or Client to gain approval.

- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion will need to occur with the **Project Manager** and Client to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- Resolution employees shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure including PPE is prepared in advance and approved by the Regional SH&E Manager. If a SWP or HASP is prepared for the project, the clearing procedure should be included and the required PPE specified.

4.17.3 Bird Droppings

- Bird excrement may be encountered due to the nesting of pigeons and other birds and winged animals (e.g., bats) on or in structures. Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE.

4.18 Personal Precautions and Personal Protective Measures

4.18.1 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Wear protective clothing.
- When working in areas where there may be small insects that “hitchhike” (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins.

4.18.2 PPE

- The following recommendations may be considered by the project team to determine if the use of PPE is necessary for the type of work planned: Disposable gloves may be cotton, leather, or synthetic materials and must not be reused after removing.
- Clearing activities present the greatest risk of employee exposure but reduce the risks once completed. Recommendation – Resolution employees actively participating in clearing will use full protection from ticks and insects during the clearing activities including insect repellents, Tyvek® coveralls, and gloves.
- If the foliage being cleared includes poisonous plants, exposed skin will be treated with a dermal barrier cream such as Tecnu®’s Oak ‘n Ivy Armor or Enviroderm’s Ivy Block and either a full face respirator or a half face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.
- Work in habitats with direct exposure to ticks, mosquitoes, and poisonous plants is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from biological hazards including insect repellents, Tyvek® coveralls or full length clothing, poisonous plant barrier creams and wipes, and gloves.
- Work in habitats with direct exposure to ticks and mosquitoes and no exposure to poisonous plants is likely and the scope of work typically does allow for worksite control measures like vegetative clearing: Recommendation – Protection including insect repellents and Tyvek® coveralls or full length clothing.
- Work in habitats with direct exposure to poisonous plants and no exposure to ticks or insects is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from poisonous plants including insect repellents, Tyvek® coveralls or full length clothing, poisonous plant barrier creams and wipes, and gloves.
- Industrial/Commercial/Office Facilities – Direct contact with biological hazards is considered unlikely or low risk: Recommendation – PPE for biological hazards are not required; however, Tyvek coveralls and insect repellentrepellent should be available if exposure to spiders, flying insects, or other biological hazards is encountered.

- Work in areas where no biological hazards are expected because of the local environment, winter weather, or property development: Recommendation – PPE for biological hazards is not required; however, Tyvek® coveralls and insect repellentrepellent should be available if exposures to spiders, flying insects, or other biological hazards are encountered.
- The following precautions and protective measures shall be implemented by Resolution employees conducting field work where the biological hazards covered by this SOP exist:

4.18.3 Insects, Spiders, and Ticks

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Application of insect repellent to clothing and/or exposed skin.
- Routine personal checks.
- Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If stung by an insect or bitten by a spider or tick, attempt to identify the attacker and notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite, or any swelling or numbness beyond the site of the bite.
- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the Centers for Disease Control and Prevention for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, employees can apply DEET to their skin and let dry prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.18.4 Poisonous Plants

- Employees working in areas where poisonous plants exist shall wear either long sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. Employees must not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants will be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.
- Employees who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will forward the report to the RSHEM.
- For dermatitis caused by Poison Ivy, Poison Oak, or Poison Sumac, calamine lotion is effective.

4.19 Selection and Configuration of Field Clothing

4.19.1 At a minimum, employees will wear long legged pants and long sleeve shirts or Tyvek® coveralls to reduce the amount of exposed skin when biological hazards are identified at the work site. Gloves will also be worn consistent with the recommendations of the site-specific SWP, HASP and/or THA to minimize hand exposure.

4.19.2 Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically-treated clothing will be taped to the work boots.

4.19.3 See *5-313-Configuration Clothing for Protection against ticks and insects* for illustrations and instructions for configuring, taping, and tucking clothing.

4.19.4 Chemical Treatment of Field Clothing

- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the Centers for Disease Control and Prevention for effective protection against mosquitoes that may carry the West Nile virus and related diseases.

- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, employees can apply DEET to their skin prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.19.5 Permethrin

- When selected as part of a project's PPE requirements, the Resolution **Project Manager** shall ensure that field teams wear clothing treated with the chemical Permethrin, which is an insecticide with repellent properties registered with the U.S. Environmental Protection Agency (EPA), and recommended by the CDC. Information regarding the toxicity and product safety of Permethrin is provided in *5-313-Insect Repellent Active Ingredient Product Information*. Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) employee treatment of their personal clothing using 0.5% Permethrin spray. Resolution strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *5-208 Personal Protective Equipment Program* and with the approval of your **Supervisor**.
- The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for 5 wash cycles.
- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that must be applied directly to the skin.. Costs for clothing shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as a department expense. **Supervisor** or **Department Manager** approval is required prior to purchase.
- If an employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they must either: 1) wear Tyvek® coveralls taped to the boots, 2) full length clothing consisting of long legged pants and long sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an organic alternative to their work clothing.

4.19.6 Manual Treatment of Field Clothing

- If clothing pre-treated with Permethrin is not available or not purchased prior to field work, employees may manually treat their clothing with Permethrin spray. The outer surfaces of all external clothing to be worn during field work should be treated with 0.5% Permethrin spray a minimum of 2 to 4 hours prior to field work (boots, trousers, shirt, jackets, rain gear; refer to Section 4.16 for selection of field clothing) in accordance with recommendations provided by the New York State Department of Health. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. Clothing treatment will last for approximately 5 wash cycles (check the specific instructions for the product used.)

4.19.7 Lemon Eucalyptus

- Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.

4.19.8 Purchase of PPE and Repellents and Lotions

- Costs for clothing, repellents, lotions, and other PPE shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as a department expense. Supervisor or Department Manager approval is required prior to purchase.
- Material Safety Data Sheets (MSDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a MSDS should be

obtained for the products used and placed into the office MSDS library and site-specific health and safety plans.

4.20 Personal Hygiene and Body Checks

4.20.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.20.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.20.3 Employees will shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *5-313-Ticks*, the tick should be preserved with the date and location of the bite noted, and retained for identification if medical treatment is needed as described in Section 4.13.1 of this Procedure.

4.20.4 The presence of an imbedded tick, rash, or abnormal reactions will be reported as an SH&E Incident to the **Project Manager** or **Supervisor** who will forward the report to the RCSHEM for follow up.

5.0 Records

None.

5-315-Water, Working Around

1.0 Purpose and Scope

1.1 Establishes the minimum requirements and guidance for Resolution Consultants personnel assigned to projects that place them at risk of falling into water, including working ashore near to or over water.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **PFD:** Personal Flotation Device

2.2 **Life Jacket:** A personal flotation device that will turn over an unconscious worker in the water so their face and nose are not submerged.

2.3 **USCG:** United States Coast Guard

2.4 **TC:** Transport Canada

2.5 **Lifebuoy:** A throwable buoyant rescue ring with 28 M (90 feet) buoyant line attached.

3.0 References

3.1 Cold Water Boot Camp - http://www.coldwaterbootcamp.com

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager (PM)** is responsible for the overall success of a project and the performance of employees engaged in project activities. The PM shall confirm that all appropriate Safety, Health and Environmental (SH&E) procedures are identified and implemented:

- Determining the applicability of this SOP during the planning stage of field investigation projects.
- Allocating appropriate resources to implement the required measures.
- Designating a field team member to implement and maintain these measures, maintain related documentation, and to communicate with appropriate parties as necessary.
- Consulting with the purchasing department on the appropriate vendors for rentals/leases.
- Confirm that boat/watercraft rental/leasing vendors have appropriate paperwork (licenses, insurance, maintenance records, orientations, etc.).
- Confirming that the project is properly staffed with trained employees.
- Developing and submitting a Health and Safety Plan, Task Hazard Analysis, and other SH&E Planning Documents for review and approval by the **Resolution Consultants Regional SH&E Manager**.

4.1.2 **SH&E Manager** is responsible for providing support to the **PM** and his/her designee in the evaluation of safety and health risks and the identification of applicable policies, procedures, and appropriate precautions.

- Review all project related Health and Safety Plans, Task Hazard Analysis as required.
- Provide access to safety records, including training records, for field staff.
- Provide support to **PM.**

4.1.3 **Field Task Manager, Supervisor**

- The **Field Task Manager (FTM)** is responsible for verifying current status of field staff's training and equipping them for the work at hand.
- The **FTM** is also responsible for conducting daily safety meetings, performing field safety inspections, confirming that all safety issues and equipment deficiencies are properly corrected, and that the proper equipment is available to the field staff to safely meet the goals and quality objectives of the project.

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4.1.4 **Field Staff**

- Employees are responsible for complying with the safe work practices specified in this policy and all other applicable Resolution Consultants SH&E policies or procedures and reporting all unsafe working conditions.
- Review, contribute to, and sign the Task Hazard Analysis prior to beginning the project and whenever new tasks or environmental changes occur.
- Confirming that their SH&E training is up to date.
- Confirming that equipment is properly maintained and functioning.
- Confirm they wear all required PPE.

4.2 General Safety Considerations

4.2.1 During project preparation, consideration shall be given to the nature of the site, the type of water hazard, the equipment being used, and the location to determine the PPE and level of emergency preparedness that is required. All projects working near water hazards shall have the appropriate SH&E Plan prepared, including task hazard analysis.

4.2.2 Personal protective equipment (PPE) specified in the Task Hazard Analysis (THA) is to be worn as required, to meet the specific regulations of the work area, including local and federal legislation.

4.2.3 Whenever there exists the possibility of falling into water, personnel shall be attired in a USCG approved Type III or Type V PFD or Life jacket. The vest shall be properly sized for the individual and shall be secured at all times. For cold water conditions (water temperature less than 55 degrees), a USCG approved Shallang suit shall be worn to protect personnel from risks of cold water immersion.

4.2.4 Swimming is prohibited, unless it is being conducted by certified divers in the completion of their assigned task, or to prevent a serious injury or loss of life in a person in a water/person overboard emergency.

4.2.5 The buddy system shall be utilized whenever there is the possibility of falling into water, in which two persons operate as a single unit in order to monitor and assist each other in performing tasks.

4.2.6 Conducting shoreline work alone should be avoided, unless constant communications is maintained between personnel and prior approval by the **Project Manager** is granted.

4.2.7 A throwable lifebuoy with required rescue line attached (Type IV flotation aid) shall be available.

4.2.8 Additional equipment (i.e., sounding alarms, lifting gear, or rescue boat) as required by legislation shall be immediately available to recover an individual from the water. If the shortest dimension of the water body is greater than the length of line attached to the throw buoy, a skiff or boat shall be available to facilitate a rescue.

4.3 Personal Protective and Safety Equipment

4.3.1 Personal Protective Equipment (PPE) shall be selected based on the task-specific hazard analysis. The minimum PPE required for wading in water above the knees includes:

- Personal Flotation Devices or lifejackets shall be worn by all workers who are exposed to the danger of drowning in water deep enough for the lifejacket to be effective.
- All inflatable PFD or life jackets shall be approved and have documented regular inspections.
- Shallang suits: In water temperatures below 55° F (regardless of air temperature) personnel are required to wear a USCG approved Shallang jacket or full flotation suit, depending on field conditions. This requirement will replace the need for a wearable PFD as these suits (if properly maintained) will provide adequate flotation.
- Waders with slip resistant sole suitable for the substrate.
- Eye protection (to reduce glare).
- Wading pole (for supporting and testing the substrate before wading).

4.3.2 Rescue equipment shall be on-site that is appropriate to the situation (e.g., life buoys with 28 m (90 ft) of retrieval line, rescue boat, sounding device).

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4.3.3 Blankets and an appropriate first aid kit shall be on-site.

4.3.4 Immersion suits, or survival suits as they are often called, can significantly improve survival time in cold water. Recognizing that hypothermia is a major factor in lives lost at sea, the U.S. Coast Guard requires that vessels operating in offshore waters north of 32 degrees North latitude carry an immersion suit for each person aboard. These suits are to be used in place of a Type I PFD in an abandon ship situation. It is recommended that personnel familiarize themselves with their use and practice donning the suit before leaving the dock. It is recommended that personnel be able to get into an immersion suit in under a minute. If necessary to abandon ship, personnel, attired in an immersion suit with head covered in a hat, should enter the water slowly, if possible, keeping their head out of the water.

4.3.5 Suits should be stored in a clean and dry location. Avoid stacking or compressing the suits in storage as it may result in a loss of buoyancy. Federal regulations require that immersion suits be stowed so that they are readily accessible to the individual for whom they are intended, from both the individual's normal work area and berthing area. If there is no location readily accessible to both areas, then a suit shall be stowed at each location.

4.4 Land-based (shoreline/bridge/pier – includes wading)

4.4.1 Use a short line and harness to prevent entry into the water, or approved PFD, when working near fluid filled tanks, ponds, lagoons, or natural waterways and stay close enough to shore to be pulled back to shore by an attendant.

4.4.2 Wading in a stream or water body:

- Always proceed upstream so that the wading team is walking into clear water (no turbidity caused by walking), there is good visibility for any debris floating downstream, and there is a reduced risk that the wading team will be pushed against debris or pushed into a deep hole by the current.
- Wading in water deep enough to become submerged in will be done as a two person crew. If conditions or legislation warrant a "rescue team," then an appropriately sized crew should be used, with the rescue team stationed on the shore with the appropriate rescue equipment, as per the site-specific rescue plan.

4.4.3 Wading will not occur in the following circumstances:

- If the water is too turbid or too deep to see tripping hazards or deep holes.
- If it appears the bottom is composed of soft sediments where stepping in may result in sinking, or if the bottom consists of clay where slipping is likely.
- If large woody debris is abundant and will be difficult to step over or move around.
- If the water is over the waist of the shortest person on the wading teaming. This does not preclude wading in water bodies that have shallow shorelines that grade into deeper waters. By not wading over waist level there will be approximately 30 cm (12 Inches) of "safety distance" on the chest waders, should a member of the wading team step or slip into a deeper area.
- If there is a risk of the current pushing a member of the team downstream.

4.5 Cold Water Operations

4.5.1 Cold water operations are defined as any situation that exposes an individual to falling into water that has a temperature of 55ºF (13ºC) or less.

4.5.2 Sudden immersion in cold water can induce a gasping reaction and uncontrolled breathing which may cause the victim to ingest water and begin choking, experience cardiac arrest, and other physical body conditions all of which can result in a quick drowning.

4.5.3 Cold water incapacitation precedes hypothermia, making swimming and grasping for safety extremely difficult. So while death by hypothermia may occur in roughly one hour in a water temperature of 55ºF (13ºC), incapacitation due to failing muscle function will occur in as little as 10 minutes, so regardless of your age, physical conditioning, or ability to swim – your odds of survival are greatly enhanced if you wear a life jacket.

4.5.4 Resolution Consultants requires personnel to wear an approved USCG Shallang suit at all times whenever there is the risk of falling into water. Employees working in these conditions view a training

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video on the physiological effects of cold water immersion found at: http://www.coldwaterbootcamp.com.

4.5.5 Consideration should be given to the use of immersion of survival suits when project work involves cold water operations.

4.6 Working on Ice

4.6.1 Situations which expose personnel to the risk of falling onto ice covered waters. Working on water with the presence of ice either in the waterway or encroaching in from the shoreline.

4.6.2 Working in situations where ice exists shall be strictly limited due to the extreme hazards associated with falling through the ice cap, cold water immersion, and the logistical difficulties associated with executing a rescue.

4.6.3 Personnel working on ice shall be attired in a USCG approved Shallang survival suit and be supported by shore side personnel to assist in recovery in the event of a break through. Depending on the nature of the project, on-ice personnel should either wear a harness tethered back to shore, or push a flat bottom boat along on the ice and have the boat tethered back to shore.

4.6.4 Personnel working on ice covered waters should dramatically reduce vessel speed to avoid damaging propellers, shafts, and rudders. Personnel should be cognizant of shoreline ice which can prevent access to alternative ramps and docks that were considered as egress points in emergency planning.

4.6.5 Personnel should be wary that boat ramps on tidally influenced waters can flash freeze at low tide, precluding or compromising safe access and egress.

4.6.6 Extra safety equipment:

- Extra blankets should be kept on site (in a vehicle) when working on or near frozen water bodies.
- An ice pick, ice chisel, and/or ice auger should be used by a member of the crew with experience or training in identifying thin or weak ice.
- A braided rope, preferably 30 m in length.

4.6.7 **Training**

4.6.8 All field staff and Project Managers working on projects with exposure to open water shall receive training in the hazards, precautions, and rescue procedures associated with working in or over water.

4.6.9 All staff working on or near frozen water bodies shall complete Ice Safety Awareness e-learning.

4.6.10 Staff who will be working on frozen water bodies regularly or for extended periods of time should take an Ice Rescue Training course, or obtain management approval based on their level of experience/competence working on ice.

4.6.11 Staff working near cold water shall complete awareness level training on Cold Water Immersion.

5.0 Records

None.

6.0 Attachments

None.

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5-405 Drilling, Boring, and Direct Push Probing

1.0 Purpose and Scope

1.1 Provides the minimum requirements to be followed when drilling and boring work are performed.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

None.

3.0 References

None.

4.0 Procedure

4.1 All client on-site safety procedures shall be understood and adhered to.

4.2 Be aware of the provincial/territorial regulations that govern drill rig operations and exposed moving parts.

4.3 **Roles and Responsibilities**

4.3.1 **Project Manager or Resident Engineer** is responsible for ensuring that sound principles of safety, training, inspection, maintenance, and operation consistent with all resource data available from the manufacturer, OSHA, and ANSI is provided to the operator and users by the Contractor or operating entity.

4.3.2 **Site Safety Officer (SSO)** shall assist the **Project Manager** in compliance with the requirements of this procedure.

4.3.3 The **H&S Department** shall assist site management with guidance about this procedure.

4.3.4 **Resolution Consultants employees** engaged in project field activities shall be cognizant of contractor activities that may affect their safety and shall follow these procedures.

4.3.5 **Resolution Consultants Equipment Operator**

- In cases where Resolution Consultants owns and operates drilling, boring, or probing equipment, the lead equipment operator is responsible for the maintenance and safe operation of equipment under their control consistent with those responsibilities of a Contractor.
- Operations will be terminated during an electrical storm, and all crew members will move away from the rig. If lightning is observed, shut down all rig operations immediately.

4.3.6 **Contractors**

- **Contractors** have direct control over the application and operation of all drilling, boring, and probing equipment owned by their organization.
- It is the **Equipment Contractor** operator's responsibility to implement safe work practices provided by the **Contractor's** project management or supervisory staff supplemented by good judgment, safe control, and caution whenever operating drilling, boring, and probing equipment.

4.3.7 **Safety Representative**: Unless the **Contractor** has a designated **Safety Representative**, the **Contractor'**s responsible person for safety for the drill crew will be the drill rig operator. The safety person's responsibilities are to

- Consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.
- Be the leader in using proper personal protective equipment (PPE) and set an example in following the rules that are being enforced on others. See section 4.5 for PPE required by this SOP.

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- Enforce the use of proper safety equipment and take appropriate corrective action when proper PPE is not being used.
- Understand that the proper maintenance of tools and equipment and general housekeeping on the drill rig will provide an environment that promotes and enforces safety. See Sections 4.7 and 4.9 for housekeeping and maintenance requirements of this SOP.
- Ensure that the operator has had adequate training and is thoroughly familiar with the rig, its controls, and its capabilities prior to commencement of drilling activities.
- Inspect the rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and/or damaged pressure gauges and pressure relief valves.
- Check and test all safety devices such as emergency shutdown switches at least daily and preferably at the start of a work shift. Rig operation should not be permitted until all emergency shutdown and warning systems are working correctly. Wiring around, bypassing, or removing an emergency device is not permitted.
- Check that all gauges, warning lights, and control levers are functioning properly, and listen for unusual sounds on each starting of an engine.
- Ensure that all new rig workers are informed of safe operating practices on and around the rig. Provide each new rig worker with a copy of the organization's drilling operations safety procedures and, when appropriate, the rig manufacturer's operations and maintenance manual. The safety person should ensure that each new employee reads and understands the safety procedures.
- Ensure that a first aid kit and fire extinguishers are available and properly maintained on each rig and on each additional vehicle.
- Be well trained and capable of using a first aid kit, a fire extinguisher, and all other safety devices and equipment.
- Maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.), and inform other members of the drill crew of its location.
- See that new workers are instructed in rig safety, and observe the new worker's progress toward understanding safe operating practices.
- Observe the mental, emotional, and physical capability of workers to perform the assigned work in a proper and safe manner. Dismiss from the job site any worker whose mental and physical capabilities might cause injury to the worker or coworkers.
- Rig Crew and Other Field Personnel (Those employees involved in fieldwork): All personnel engaged in site activities are required to become thoroughly familiar with, and to conform to, the provisions of Resolution Consultants' safety plan, procedures, and such other safety directives as may be considered appropriate by **Project Managers**, **Safety Officers,** and **Supervisors**.
- Rig Workers: Personnel are encouraged to offer ideas, suggestions, or recommendations regarding any operational condition, procedure, or practice that may enhance the safety of site personnel or the public. Their primary responsibilities will be:
    - Perform all required work safely.
    - Familiarize themselves with and understand the plan, including proper use of personal protective equipment.
    - Report any unsafe conditions to supervisory personnel.
    - Be aware of signs and symptoms of thermal stress.

4.4 Training

4.4.1 All staff shall be provided with on-site orientation to the rig and its operator.

4.4.2 All operators and assistants shall have industry-standard safety training and be versed in the equipment to be utilized. This may include, but is not limited to, HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and others as appropriate.

4.5 Personal Protective Equipment

4.6 For most geotechnical, mineral, and/or groundwater drilling projects, PPE should include

- Hard hat: Hard hats shall be worn by everyone working at a drilling/boring site. Hats should meet the requirements of ANSI Z89 and be kept clean and in good repair with the headband and crown straps properly adjusted for the employee.
- Safety shoes: Safety shoes or boots shall be worn by all drilling personnel and all visitors to the site who observe operations within close proximity of the rig. Safety shoes or boots should meet the requirements of ANSI Z4 1.1.
- Safety glasses: All rig personnel shall wear safety glasses meeting the requirements of ANSI Z87.1.
- High Visibility Class II Safety Vest shall be worn by all **Resolution Consultants employees**. All rig personnel should attempt to wear high-visibility clothing that should be close fitting and not have large cuffs or loose material that can catch on rotating or translating components of the rig.
- Close fitting gloves and clothing: All rig personnel should wear gloves for hand protection against cuts and abrasions that could occur while handling wire rope or cable and from contact with sharp edges and burrs on drill rods and other drilling or sampling tools. Gloves should be close fitting and not have large cuffs or loose ties which can catch on rotating or translating components of the rig.
- Face shield: Face shields shall be worn by anyone perfomring battery maintenance activities where a splash hazard exists. Face shields shall meet the requirements of ANSI Z87.
- Other protective equipment: For some operations, the project may dictate use of other protective equipment. The management of the contractor and its safety person shall determine the requirements. Such equipment might include face or ear protection or reflective clothing. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client.
- Each worker should wear noise reducing ear protectors around operating equipment or during elevated noise levels.
- When drilling, boring, or probing is performed in chemically or radiological contaminated ground, special protective equipment and clothing will probably be required.
- The clothing of the individual rig worker is not generally considered protective equipment; however, clothing should be close fitting and comfortable without loose ends, straps, draw strings or belts or otherwise unfastened parts that might catch on some rotating or translating component of the rig. Rings and jewelry should not be worn during a work shift.

4.7 Housekeeping

4.7.1 A key requirement for safe field operations is that the Contractor safety person understands and fulfills the responsibility for maintenance and “housekeeping” on and around the drill rig, including the following:

- Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the crew or a visitor.
- Storage or transporting tools, materials, or supplies within or on the mast (derrick) of the rig should be avoided.
- Pipe, drill rods, probe rods, casing augers, and similar tooling should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.

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- Work areas, platforms, walkways, scaffolding and other accesses should be kept free of materials, debris and obstructions and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- All controls, control linkages, warning and operation lights, and lenses should be kept free of oil, grease, and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, red safety container with a flame arrester in the fill spout and having the word “gasoline” easily visible.

4.8 Traffic Control

4.8.1 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passerby pedestrians.

4.8.2 All traffic control devices shall be installed, placed, and maintained in accordance with the Traffic Control Plan, client specifications, and/or the Manual of Uniform Traffic Control Devices (MUTCD). Traffic control devices shall consist of and not be limited to:

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

4.9 Maintenance & Inspection

4.9.1 Good maintenance and thorough inspection will make operations safer. Maintenance tasks should be done safely by a qualified maintenance person. Inspection and maintenance tasks include but are not limited to the following requirements:

- Inspections shall be completed at the beginning of each day by the equipment operator and in the presence of an Resolution Consultants employee when the equipment is not owned and operated by Resolution Consultants.
- Safety glasses should be worn when performing maintenance on a rig or on drilling or probing tools.
- The drill rig engine should be shut down to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running).
- Precautions should be taken to prevent accidental starting of an engine during maintenance by removing or tagging the ignition key.
- Wheels or the lowering of leveling jacks or both should be blocked ("zero energy state") and hand brakes set before working under a drill rig.
- When possible and appropriate, all pressure on the hydraulic systems should be released as well as the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a “zero energy state” before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Personnel shall not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have adequate time to cool.
- Welding and cutting shall not occur on or near a fuel tank.
- Wire rope safety factors shall be in accordance with American National Standards Institute B 30.5-1968 or SAE J959-1966.
- Gasoline or other volatile or flammable liquids shall not be used as a cleaning agent on or around a rig.
- The manufacturer's recommendations should be followed for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.
- All caps, filler plugs, protective guards, panels, high-pressure hose clamps, chains, or cables that have been removed for maintenance should be replaced.

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4.10 Hand Tools

4.10.1 A large number of hand tools can be used on or around a drill or probe rig and in repair shops and more than an equal number of instructions for proper use exist. "Use the tool for its intended purpose" is the most important rule. Additionally, equipment operators and assistants should not use their hand in place of the proper tool; work shall be stopped until the correct tool can be found. The following are a few specific and some general suggestions that apply to the safe use of several hand tools that are often used on and around rigs:

- When a tool becomes damaged, either repair it before using it again or get rid of it.
- When using a hammer, any kind of hammer for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts; don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut, first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing – check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease which would otherwise build up and cause wrenches to slip. Replace hook and heel jaws when they become visibly worn.
- Avoid the use pipe wrenches in place of a rod-holding device whenever possible.
- When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

4.11 Clearing Work Areas

4.11.1 Prior to set up, adequate site clearing and leveling should be performed to accommodate the rig and supplies and provide a safe working area. Clearing the site includes clearing the intended drilling area of underground utilities in accordance with *5-417-Utilities Underground*. Drilling or probing should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

4.11.2 Start-Up

- All rig personnel and visitors should be instructed to "stand clear" of the rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the neutral-actuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

4.12 Drilling and Probing Operations

4.12.1 The following safety measures shall be taken during drilling and probing operations on-site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots and hearing protection shall be worn in the presence of a rig.
- Services shall be cleared prior to drilling or probing.
- Hands shall be kept away from moving parts (augers).
- The emergency shut-off switch on the rig should be identified to site personnel and tested on a regular basis by the operator.

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- Unauthorized personnel shall be kept clear of the rig.

4.12.2 Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *5-417-Utilities, Underground* and *5-406-Electrical Lines, Overhead*.
- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pads until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a rig should only operate a drill rig from the position of the controls. If the operator of the rig shall leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools will not be permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a rig or while on the job.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All air and water lines and pumps should be drained when not in use if freezing weather is expected.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes should be covered, protected, or backfilled adequately and according to local or state regulations on completion of the drilling project.
- “Horsing around” within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the rig is shut down.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Always use adequate fall protection and a full body harness when climbing above six feet of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool “bucket” or a safety hook to raise or lower hand tools.

4.13 Elevated Derrick Platforms

4.13.1 The following precautions should be used:

- When a rig worker first arrives at a derrick platform, the platform should immediately be inspected for broken members, loose connections, and loose tools or other loose materials.
- A derrick platform over 4 feet (1.2 m) above ground surface should have toe boards and safety railings that are in good condition.
- When climbing to a derrick platform that is higher than 6 feet (2 m), a fall arresting device shall be used. The fall arresting device should consist of a full body harness and fall protection. The harness should fit snugly but comfortably. The lifeline when attached to the derrick should be less than 6 feet (2 m) long and attached to a fall arrester. The harness and lifeline should be strong enough to withstand the dynamic force of a 250-pound (115 kg) weight (contained within the belt) falling 6 feet (2 m).

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- When a rig worker is on a derrick platform, the lifeline should be fastened to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
- Tools should be securely attached to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.
- When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
- Loose tools and similar items should not be left on the derrick platform or on structural members of the derrick.
- Workers on the ground or the drilling floor should avoid being under rig workers on elevated platforms whenever possible.

4.14 Lifting Heavy Objects

4.14.1 Before lifting any object without using a hoist, make sure that the load is within your personal lifting capacity. If it is too heavy, ask for assistance.

4.14.2 Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.

4.14.3 If a heavy object shall be moved some distance without the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.

4.14.4 Move heavy objects with the aid of handcarts or lifting devices whenever possible.

4.15 Use of Wire Line Hoists, Wire Rope, and Hoisting Hardware

4.15.1 The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron Steel Institute, Wire Rope Users Manual.

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper revving, jamming, crushing, bird caging, kinking, care protrusion, and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes that have not been used for a period of a month or more should be thoroughly inspected before being returned to service.
- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer’s instructions and loaded according to the manufacturer's specifications.
- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the swivel freely rotates under load.
- If a rod-slipping device is used to hoist drill or probe rods, do not drill through or rotate drill rods through the slipping device; do not hoist more than 1 foot (. 3 m) of the rod column above the top of the mast (derrick); and do not hoist a rod column with loose tool joints while the rod column is being supported by a rod slipping device. If rods should slip back into the hole, do not attempt to break the fall of the rods with your hands or by applying tension to the slipping device.
- Most sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should never be increased without first consulting with the manufacturer of the drill rig.
- Wire ropes shall be properly matched with each sheave. If the rope is too large, the sheave will pinch the wire rope; if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger-sized wire ropes and therefore shall be replaced.

4.15.2 The following procedures and precautions shall be understood and implemented for safe use of wire ropes and rigging hardware.

- Use tool-handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool-handling hoists to pull on objects always from the rig; however, drills may be moved

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using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.

- When struck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
- When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
- Minimize shock loading of a wire rope. Apply loads smoothly and steadily. Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Clutches and brakes of hoists should be periodically inspected and tested.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves, and pinch points while slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body, or feet of any personnel. Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement wire ropes should conform to the drill rig manufacturer's specifications.

4.16 Use of Cathead and Rope Hoists

4.16.1 The following safety procedures should be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, for rope wear grooves. If a rope groove forms to a depth greater than 1/8 inches (3 mm), the cathead should be replaced.
- Always use a clean, dry, sound rope. A wet or oily rope may “grab” the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope “grab” the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope “grabs” the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.
- The rope should always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg or any other part of your body.
- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.

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- Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum. Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator shall be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

4.17 Use of Augers

4.17.1 The following general procedures should be used when starting a boring with continuous flight of hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.
- An auger guide can facilitate the starting of a straight hole through hard ground or a pavement.
- The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnection auger sections, and inserting and removing the auger fork. The operator shall ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench, or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

4.18 Rotary and Core Drilling

4.18.1 Rotary drilling tools should be safety checked prior to drilling:

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

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4.18.2 Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting, and lowering of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.19 Site Movement of Equipment

4.19.1 The individual who transports a rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state, and local regulations.
- Know the traveling height (overhead clearance), width, length and weight of the rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with and adequate margin.
- Never move an l rig unless the vehicle brakes are in sound working order.
- Allow for mast overhand when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
- Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.
- Never travel on a street, road, or highway with the mast (derrick) of the rig in the raised or partially raised position.
- Remove all ignition keys if rig is left unattended.

4.19.2 Loading and Unloading

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the rig carrier before approaching loading ramps.
- Distribute the weight of the rig, carrier, and tools on the trailer so that the center of eight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the high of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- The rig and tools should be secured to the hauling vehicle with ties, chains, and/or load binders of adequate capacity.

4.19.3 Off-Road Movement

The following safety suggestions relate to off-road movement:

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- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts, and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Attempt to cross obstacles such as small logs and small erosion channels or ditches squarely, not at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill has been moved to a new drilling site, set all brakes and/or locks. Always block/chock the wheels.

4.20 Tires, Batteries, and Fuel

4.20.1 Tires on the rig shall be checked daily for safety and during extended travel for loss of air and they shall be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be inflated to normal pressures before movement on firm or hilly ground or on streets, roads and highways. Under-inflated tires are not as stable on firm ground as properly inflated tires. Air pressures should be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between dual or embedded in the tire casing. Damaged or poorly fitting rims or rim flanges.
- Abnormal wear, cuts, breaks, or tears in the casing.
- The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacturer’s repair manual.

4.20.2 Batteries contain strong acid. Use extreme caution when servicing batteries.

- Batteries should only be serviced in a ventilated area while wearing safety glasses (and face shield if a splash hazard exists).
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Cell caps should be loosened prior to charging to permit the escape of gas.
- Spilled battery acid can burn your skin and damage your eyes. Spilled battery acid should be immediately flushed off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte; use a flashlight (not an open flame) to check electrolyte levels and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

4.20.3 Special precautions shall be taken for handling fuel and refueling the rig or carrier. Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.

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- Do not fill fuel tanks while the engine is running. Turn off all electrical switches. Do not spill fuel on hot surfaces. Clean any spillage before starting an engine. Wipe up spilled fuel with cotton rags or cloths. Do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials, and flames or sparking equipment well away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Fuel containers and hoses should remain in contact with a metal surface during travel to prevent the buildup of static charge.

4.21 First Aid

4.21.1 At least one member of the crew (and if only one, preferably the drilling and safety supervisor) should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red Cross or a similar organization would best satisfy the requirements of first aid training for drill crews.

4.21.2 For drilling and probing operations it is particularly important that the individual responsible for first aid should be able to recognize the symptoms and be able to provide first aid for electrical shock, heart attack, stroke, broken bones, eye injury, snake bite, and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crewmembers by instructors qualified by an agency such as the American Red Cross.

4.21.3 A first aid kit should be available and well maintained on each drill site. The contents of the first aid kit shall be placed in a weatherproof container with individual sealed packages for each type of item.

4.22 Rig Utilization

4.22.1 Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc.

4.22.2 Only use the drill rig and tools for the purposes that they are intended and designed.

4.23 Rig Alterations

4.23.1 Alterations to a rig or drilling or probing tools should only be made by qualified personnel and only after consultation with the manufacturer.

5.0 Records

None.

6.0 Attachments

None.

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5-406 Electrical Lines, Overhead

1.0 Purpose and Scope

1.1 Provides the safe work requirements to be observed where overhead power lines are present on a job site.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 Types of overhead lines:

2.1.1 Overhead power lines

2.1.2 Structural cable supports

2.1.3 Guy wires

2.1.4 Cable television / communication lines

3.0 References

None.

4.0 Procedure

4.1 An appropriate distance must be kept between equipment and overhead utility lines.

4.2 Employees must contact the power line operator before work is done or before equipment is operated within 15.25 metres (50 feet) of an energized overhead power line, in order to:

- determine the voltage of the power line, and
- establish the appropriate safe limit of approach distance as identified by provincial/territorial regulations.

4.3 The safe limit of approach distances do not apply to a load, equipment, or building that is transported under energized overhead power lines if the total height, including equipment transporting it, is less than 4.15 metres (13.5 feet).

4.4 **Employers** or **CTO Managers** must formally notify (using the Overhead Electrical Lines Acknowledgement form) all subcontractors or equipment operators of an energized overhead power line before work is done or equipment is operated in the vicinity of the power line at distances less than the safe limit of approach distances and obtain the operator's assistance in protecting workers involved.

4.5 Employees must not place earth or other material under or beside an overhead power line if doing so reduces the safe clearance to less than the safe limit of approach distances.

4.6 To maintain minimum safe clearances:

4.6.1 Install warning devices and signs (hang a sign from and mark all guy wires to warn traffic of low clearance; provide warning signage for all overhead services).

4.6.2 Install telescopic, nonconductive posts and flagging across right-of-way at the minimum allowable clearance as allowed by regulations for the line voltage.

4.6.3 Position signs or other devices to determine the “Danger Zone.”

4.6.4 Inform all on-site staff with the on-site clearances required.

4.6.5 Beware of atmospheric conditions, such as temperature, humidity, and wind, that may dictate more stringent safety procedures.

4.7 Operation of heavy equipment and cranes in areas with overhead power lines represents a significant hazard to all personnel on the job site. Accidental contact with an energized line or arcing between a

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high power line and grounded equipment can cause electrocution of equipment operators or nearby ground personnel, and damage to power transmission and operating equipment. Although maintaining a safe distance from all energized lines is the preferred means for control of this hazard, site conditions may not always accommodate this. If work will (or may) occur within 50 feet of any energized line, the procedures outlined below will be observed.

4.8 Overhead power lines will be identified on each job site before the work commences. For each identified line, the Project Manager must determine whether it is energized (and the operating voltage for energized lines), and whether work operations will require that activities with heavy equipment (excavators, loaders, cranes, etc.) will occur within 50 feet (15.25 metres) of the line. Unless verified, it will be assumed that all lines are energized.

4.9 Safe working distance is the minimum distance that must be maintained between any energized electrical line and any part of the operating equipment to maintain adequate safety margins and is based on the line voltage of the power line. Figure 4-1 lists the line voltages in kilovolts and the Minimum Safe Work Distance in the United States and Figure 4-2 indicates the Nominal Phase to Phase voltage rating in kilovolts for Canada. The following safe working distance criteria will be applied for all Resolution Consultants operations:

Figure 4-1: United States Overhead Line Criteria

Line Voltage (Kilovolts)	Minimum Safe Working Distance
0 – 50	10 feet
>50 – 200	15 feet
>200 – 350	20 feet
>350 – 500	25 feet
>500 – 750	35 feet
>750 – 1,000	45 feet

Source: American National Standards Institute, Publication B30.5.

Figure 4-2: Canadian Overhead Line Criteria

Column 1	Column 2
Nominal phase-to-phase voltage rating	Minimum Distance
Over 425 to 12,000	3.0 metres
Over 12,000 to 22,000	3.0 metres
Over 22,000 to 50,000	3.0 metres
Over 50,000 to 90,000	4.5 metres
Over 90,000 to 120,000	4.5 metres
Over 120,000 to 150,000	6.0 metres
Over 150,000 to 250,000	6.0 metres
Over 250,000 to 300,000	7.5 metres
Over 300,000 to 350,000	7.5 metres
Over 350,000 to 400,000	9.0 metres

Source: Canada Occupational Health and Safety Regulations Electrical Safety- Subsection 8.5(6).

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4.10 Under no circumstances will any object pass closer than 3 metres to any energised, uninsulated electrical line.

4.11 Formally notify all subcontractors of Overhead Power lines.

4.12 Acceptable Safety Procedures

4.12.1 Where any work task will not allow the minimum safe working distance to be maintained at all times, an alternate means of protection must be identified and approved by the SH&E Department. In order of preference, acceptable procedures are

- De-energize the power line(s)/lockout by local utility authorities
- Install insulated sleeves on power lines
- Assign line spotters to assist the equipment operator

4.12.2 De-energize Power Lines

Elimination of electrical power provides the most acceptable means of ensuring safety of personnel. While temporary site power lines are under the control of the site manager (and can be de-energized locally), electrical distribution and transmission lines can be de-energized only by the owner of the line (generally the local electrical utility). Therefore, de-energizing of a line requires advance coordination with the line owner; generally, at least one week advance notice should be provided.

4.12.3 Install Insulating Sleeves

Insulating sleeves can be placed over power lines to provide a contact and arcing barrier if work must occur closer to the power lines than the accepted safe work distance. Although not as desirable as line de-energizing, the use of these sleeves can provide an acceptable alternative where electrical lines are required to remain in service.

As with de-energizing of distribution and transmission lines, placement of insulating sleeves can be performed only by the line owner. This requires advance coordination with the line owner; generally, at least one week advance notice should be provided. To install the sleeves, representatives of the line owner will require access to the job site.

4.12.4 Assign Line Spotters

A line spotter is a person located at ground level who is assigned to observe equipment operations, with the specific duty of assisting the equipment operator to ensure that no part of the equipment gets too close to an energized, unprotected electrical line.

Persons assigned to act as line spotters must meet the following requirements:

- While acting as a line spotter, no other duties may be performed (e.g., the line spotter cannot also act as the load spotter during a lifting operations).
- The spotter will have a radio or other direct means of communicating with the equipment operator at all times.
- The spotter will be positioned at a right angle to the equipment operator's line of sight to maximize the sight angles between the personnel.

Under no circumstances will any portion of a piece of equipment pass closer than 10 feet to any energized, uninsulated electrical line.

4.13 Additional Safety Measures

4.13.1 The following additional safety measures can be implemented as needed when working around energized power lines:

- Provide equipment with proximity warning devices. These provide an audible alarm if any part of the equipment gets too close to a line.
- Install ground safety stops. These prevent vehicles from accidentally entering hazardous areas.
- Equip cranes with a boom-cage guard. This prevents the boom from becoming energized if an electrical line is contacted.
- Utilize insulated links and polypropylene tag lines. These prevent the transmission of electricity to loads or tag line handlers if an electrical line is contacted.

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NOTE: These additional safeguards are intended as supplemental protection. Use of these measures is not permissible as a substitute for maintaining the safe working distance or implementation of the procedures in Section 4.1.

4.13.2 If an electrical power line is hit or an electrical arc occurs:

- All ground personnel must evacuate IMMEDIATELY to a distance of at least 50 feet (15.25 metres). DO NOT attempt to rescue any injured person until the line can be de-energized.
- The operator should remain in the cab until the line can be de-energized and should carefully try to extricate the equipment from the power line. This may not be possible where melting of insulator material or metal has occurred.
- Contact the line owner to report the line contact and request that the line be de-energized immediately.
- Once the line has been confirmed to be de-energized, the operator can safely evacuate the cab and rescue can commence for any injured personnel.
- Contact the SH&E Department to report the incident and implement any instructions provided.

If the operator must evacuate while the line is still energized (because of fire or other life-threatening condition) he/she should jump clear of the equipment (making sure to avoid touching the equipment and the ground simultaneously), and land upright and with feet together. Once on the ground, proceed in a direct line away from the equipment using a short, shuffling gait (feet touching, sliding each foot no more than 1 foot forward at a time) to minimize shock hazard from electrical energy being transmitted through the ground.

5.0 Records

None.

6.0 Attachments

None.

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5-408-Elevated Work Platforms and Aerial Lifts

1.0 Purpose and Scope

1.1 Provides the requirements to be followed when the use of elevated work platforms and aerial lift equipment are planned.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Elevating Work Platform (EWP):** Includes aerial lifts, scissor lifts, articulating boom lifts, truck platforms, and crane-suspended personnel platforms.

3.0 References

None.

4.0 Procedure

4.1 Restrictions

4.1.1 No person shall operate an elevated work platform until they have received adequate training, in accordance with manufacturer's specification.

4.1.2 The elevated work platform must be equipped with ground level controls so that in an emergency where there is no operator in the basket/bucket, the personnel lift can be operated from ground level. Personnel on the ground must be trained in how to operate the lift in the event of an emergency.

4.2 Roles and Responsibilities

4.2.1 **Project Manager (field task manager, supervisor)**

- The Resolution Consultants site management is responsible to see that sound principles of safety, training, inspection, maintenance, and operation consistent with all resource data available from the manufacturer, governing or regulatory authority is provided to the operator and users.
- The **Supervisor** has direct control over the use and operation of elevating work platforms. The **Supervisor** and the assigned operating personnel have the responsibility for proactive, safe employee behavior. Decisions about the use and operation of a EWP shall be made with due consideration that the equipment will be carrying personnel whose safety is dependent on those decisions.
- It is the operator's responsibility to implement safe work practices provided by project management, supervision or the task leader supplemented by good judgment, safe control, and caution whenever evaluating personnel in a platform, bucket or basket. The safety of all personnel in the EWP is dependent on safe use and operation by the operator.

4.2.2 **Regional SH&E Manager**

- Provides technical guidance and support about this procedure.

4.2.3 **Site Safety Coordinator**

- The **Site Safety Coordinator (SSC)** shall assist the site manager in compliance with the requirements of this procedure.

4.2.4 **Employees**

- All **employees** engaged in project field activities involving EWPs shall follow these procedures.

4.3 General Equipment Requirements

4.3.1 Fall Protection – All employees on EWP or Aerial Lift shall wear and use a full body harness, fall arrest device and lanyard and be secured to the manufacturer's provided anchorage point at all times. Employees shall not secure themselves to a handrail or the work structure.

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4.3.2 All aerial lifts shall be operated and maintained in accordance with manufacturer's specifications.

4.3.3 All aerial lifts used by Resolution Consultants must be certified by the manufacturer to meet requirements of the American National Standards Institute (ANSI) or the Canadian Standards Association (CSA) standard applicable to the device:

- For truck-mounted boom or scissor lifts – ANSI Standard 92.2.
- For manually propelled boom or scissor lifts – ANSI Standard 92.3.
- For self-propelled boom lifts – ANSI Standard 92.5.
- For self-propelled scissor lifts – ANSI Standard 92.6.
- For elevated rolling work platform – CAN3-B354.1M82.
- For self-propelled elevating work platform – CAN3-B354.2-M82 and CAN3-B354.2-M82.
- For boom type elevating work platform – CAN3-B354.4-M82.
- For vehicle-mounted aerial device – Can-CSA-C225-M88.

4.3.4 Lift controls on extendable and articulating boom platforms shall be clearly identified as to function.

4.3.5 Aerial lifts designed as personnel carriers shall have both work platform (primary) and lift mount (secondary) controls. Primary controls shall be within easy reach of the operator. Secondary controls shall be capable of overriding the upper controls. All controls shall be plainly marked to identify their function.

4.4 Personal Protective Equipment (PPE)

4.4.1 PPE required by regulation for the Construction or Industrial application

4.4.2 A Full Body Harness, meeting the requirements of ANSI/CSA, Class A, suitably sized for the body mass and shape of the worker.

4.4.3 A shock absorbing lanyard meeting the regulatory requirements and suitably sized for the body mass and shape of the worker. The lanyard should be as short as possible to allow the user to perform his/her work while anchored to the designated anchor point on the elevated work platform.

4.5 Operator Training

4.5.1 Elevated Work Platform or Aerial Lift operators shall be trained and certified by a source approved by the SH&E Department (e.g., vendor / equipment rental company or a competent staff operator). Documentation of training shall be maintained including the source, date, persons trained and outline of information.

4.5.2 A demonstration shall accompany any operator training to verify that the prospective operator possesses the actual skills to operate specific types of aerial lifts. Staff using Personal Fall Protection Equipment must be trained in Working at Heights and must be trained in the proper inspection, use, and care of the harness and lanyard that will be used in accordance with this procedure.

4.5.3 Instruction in the use and operation of the Elevated Work Platform or Aerial Lift will include typical observation and check of the Work Zone for proper marking, foreign objects, uneven or rough surfaces, and signal staff if required.

4.6 Equipment Inspection

4.6.1 **Pre-Operational Check -** The Aerial Equipment Pre-Operation Checklist (Attachment 1) shall be completed prior to each day of operation. The checklist will be submitted to the supervisor or task leader with explanation of any noticed defects.

4.6.2 NOTE: Any problems or malfunctions that affect safe operation of the equipment **shall be repaired prior to the use of the EWP.**

4.6.3 **Periodic Inspection –** Project management shall ensure that complete inspections scheduled in accordance with the manufacturer's recommendations are performed on the EWP. Periodic inspections shall be performed by the dealer or qualified mechanic familiar with such equipment designated by project management. Inspections shall include the use of the Aerial Equipment Inspection (Attachment II) or a similar inspection form provided by the vendor.

4.6.4 **Post Incident Inspection –** An inspection shall be conducted before continuing the operation of an EWP following any incident where the EWP has obvious or suspected operational damage. This post incident inspection must be supported by communications to the dealer or manufacturer of the equipment requesting any additional specific inspection, maintenance checks or repairs.

4.6.5 **Maintenance/Repairs –** All maintenance and repairs shall be made by a qualified person in conformance with the manufacturer's recommendations. Scheduled maintenance may exceed the manufacturer's minimum requirements. EWP shall be immediately removed from service until repaired and their use discontinued any time there are problems or malfunctions that affect safe operation of the EWP.

4.6.6 **Records of all inspections and maintenance on EWP shall be maintained by the project.**

4.7 Equipment Operation

4.7.1 The operator of the Elevated Work Platform equipment shall review the work to be performed with the assigned staff including the work task(s), work zone set up, client requirements, any hazards, equipment controls, safety equipment, fall prevention, emergency response plan and coordination of the operation before undertaking the work.

4.7.2 The operator must make decisions about the use and operation of the EWP with due consideration that his/her own safety as well as the safety of other personnel on the platform is dependent on those decisions.

4.7.3 During operation, the EWP shall be used in accordance with project requirements, manufacturer operation specifications and the following guidelines:

- Conduct a work area hazard evaluation prior to initiating any elevated platform work. Plan work accordingly.
- The work area below EWP must be clear or barricaded from unauthorized person's entry (e.g., project personnel, pedestrians, traffic) in case something is dropped from work platform.
- On public highways and roadways, a safe work zone must be established in compliance with appropriate local, state, provincial and federal requirements. In rail systems and airports, a safety work area shall be similarly established in conformance with client requirements and applicable standards.
- The EWP must be operated on a surface within the limits specified by the manufacturer.

4.7.4 Lift controls shall be tested each day prior to use to determine that they are in safe working condition. Controls shall be plainly marked as to their function.

4.7.5 Outriggers, stabilizers, extendible axles or other stability enhancing means are used as required by the manufacturer.

4.7.6 Guardrails must be in a safe condition and access gate(s) or openings are closed per manufacturer's instructions.

4.7.7 The load and its distribution on the platform and any platform extension(s) are in accordance with the manufacturer's rated capacity for that specific configuration. Never exceed manufacturer's rated load limits.

4.7.8 Personnel must stand firmly on the platform floor, and shall not sit or climb on the edge of the basket or use planks, ladders or other objects to gain a work position or as a climbing device.

4.7.9 Fall Protection – Each person in the platform must wear a full body harness and be secured to the manufacturer provided anchorage point at all times.

4.7.10 Adequate clearance from overhead obstructions is maintained.

4.7.11 Safe operating distances are maintained from all potentially energized (exposed or insulated) power lines and parts including temporary construction power lines/cord sets. (*See 5-406-Electrical Lines, Overhead*).

4.7.12 Safe distances are maintained from all potential hazards where a client's moving equipment may be in transit and come in contact with an EWP or its parts. All client procedures, approval, permits and accompaniments shall be secured prior to operating an EWP.

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4.7.13 Only essential materials and tools required to perform the work from the lift are in the platform and fit completely inside, taking into account total weight involved and the capacity of the equipment.

4.7.14 When operating from a barge, ensure that the EWP is positively secured to the barge deck by using tie down lines and appropriate anchorage points. Anchorage needs to ensure that wheels remain firm on the barge deck. Use four-point tie down or equivalent method. Never secure to anything loosely lying on the barge deck.

4.7.15 Never use the EWP for hoisting, towing or pulling.

4.7.16 Never place heavy objects on hand rails or come in contact with objects that could damage railings or platform.

4.7.17 Immediately report any problems or equipment malfunctions occurring during operation to the Supervisor or task leader.

4.7.18 Do not continue to operate an EWP if unsafe conditions occur during operations.

4.7.19 Never alter, disconnect or disable interlocks or other safety devices that would allow operation in violation of manufacturer's specifications.

4.7.20 Ensure care is taken to prevent entanglement in ropes, wires, cables, etc. Retract and lower the EWP to its lowest possible position before attempting to move an EWP. Ensure that the path of intended movement is clear of debris and personnel. Use a spotter attendant in congested or hazardous areas. Equipment movement speed shall be limited to surface and safe condition in accordance with the manufacturer's recommendations.

4.7.21 Shut engine off during refueling and fuel only in well-ventilated areas free of other flammable/combustible materials.

4.7.22 Should an EWP become snagged or caught on a structure preventing normal operation/motion, personnel should be removed from the platform before attempting to free the platform using ground controls.

4.7.23 Articulating boom and extendable boom platforms shall have both upper (platform level) and lower (ground level) controls. Lower controls shall override upper controls, but shall not be operated unless permission has been obtained from the employee in the lift, except in case of emergency.

4.7.24 Never attempt to operate an EWP from below (ground controls) when it is already in use, except in an emergency situation.

4.7.25 No more than two people shall be in an EWP at any one time without approval of the Supervisor. Under no circumstances shall more than two people be allowed in the EWP if the manufacturer prohibits such a practice.

4.8 Aerial Lifts

4.8.1 An aerial lift is a vehicle-mounted device used to elevate personnel to job sites above the ground. This includes extendible boom platforms, aerial ladders, articulating boom platforms, vertical towers, and combinations of these devices. It is not necessary that the device be able to rotate around a vertical axis to be classified as an aerial lift.

4.8.2 Follow all equipment operation and work area guidelines.

4.8.3 Lift controls on extensible and articulating boom platforms shall be clearly identified as to function and tested each day to verify safe working condition. An overall visual inspection shall be completed to ensure cracked welds and/or structural damage does not exist. Defective equipment shall be reported to the supervisor and not used until repairs are completed.

4.8.4 Aerial lifts shall be operated only by authorized persons.

4.8.5 Employees working in baskets shall always stand on the floor of the basket and may not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.

4.8.6 The manufacturer's boom and basket load limits must not be exceeded.

4.8.7 Brakes on aerial lifts shall be set when in use. When outriggers are used, they must be placed on pads or on solid surfaces. When using aerial lifts on inclined surfaces, wheel chocks shall be used if they can be safely installed.

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4.8.8 Aerial lift trucks shall not be moved with employees in an elevated basket unless the equipment is specifically designed for this operation.

4.8.9 Aerial lifts primarily designed as personnel carriers shall have both platform (upper) and lower controls. Upper controls shall be within easy reach of the operator. Lower controls shall override the upper controls. All controls shall be plainly marked to identify their function.

4.8.10 Lower level controls shall not be operated without permission from the employee(s) in the lift except in case of emergency.

4.8.11 Before moving an aerial lift for travel, the boom must be properly cradled and the outriggers stowed.

4.8.12 Aerial ladders on ladder trucks and tower trucks shall be secured in the lower travelling position by the locking device on top of the truck cab, and the manually operated device at the base of the ladder before the truck is moved for highway travel.

4.9 Emergency Response

4.9.1 In the rare instance where personnel fall while attached to a Powered Personnel lift, it is essential that they be rescued promptly.

4.9.2 The Project Safety Plan must include detailed instructions for the immediate recognition and prompt rescue of a fallen worker. In urban centers or in industrial settings where trained rescue specialists have confirmed their availability and capability to affect a prompt rescue, the plan may simply include instructions for summoning the designated rescue team. In remote locations where it is not possible to summon rescue specialists to extract the fallen worker within 20 minutes of the fall occurrence, a rescue team must either be mobilized and on standby at the site or accompanying employees must be trained and equipped to effect a prompt rescue in accordance with the plan.

4.9.3 The rescuers who will implement the rescue plan must be properly trained in the applicable rescue techniques and must have the rescue equipment readily available.

4.9.4 After the fall, immediately assess the condition of the casualty. If the casualty appears to be seriously injured or unconscious, summon emergency medical responders to the site before initiating the rescue so that they will be enroute during the rescue.

4.9.5 After a fall, if there is a person left in the basket/bucket who is competent to operate the controls, he/she shall carefully and slowly maneuver the basket/bucket to move the casualty until suspended over a safe area (ground or bridge deck). Take great care that the casualty does not become entangled or snagged by any structures that are adjacent to the movement.

4.9.6 After a fall, if there is no person left in the basket/bucket who is competent to operate the controls, the designated person on the ground will switch control to ground level and will carefully maneuver the basket/bucket to move the casualty until suspended over a safe area (ground or bridge deck). Take great care that the casualty does not become entangled or snagged by any structures that are adjacent to the movement.

4.9.7 Operate the lift to lower the casualty to the safe area. If the casualty is injured, unconscious, or unable to stand, call other available personnel to assist laying the casualty down as the lift is lowered. If there are no other personnel available, swing the lift as needed, after the persons feet touch the ground, while carefully lowering the person into a lying position.

4.9.8 Once the casualty is on the ground, deck or other safe platform, and there is no tension in the lanyard, immediately reassess the condition of the casualty and begin first aid if needed.

4.9.9 In all cases, whether the casualty appears to be injured or not, evacuate him or her to the nearest medical facility for medical examination and treatment of any trauma or circulatory problems.

5.0 Records

None.

6.0 Attachments

6.1 5-408-Form 1 Aerial Equipment Pre-operation & Work Zone Checklist

6.2 5-408-Form 2 Aerial Equipment Inspection

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5-408-Form 1 Aerial Equipment Pre-operation and Work Zone Checklist

CHECKLIST MUST BE COMPLETED DAILY PRIOR TO INITIAL OPERATION			
FAULTY EQUIPMENT / DEVICES WILL BE IDENTIFIED AND REPAIRED BEFORE USE			
☑ = Acceptable O = Needs Improvement ☒ = Not To Be Operated N/A = Not Applicable			
EQUIPMENT / VEHICLE ID #	**LOCATION:**		
DATE:	**OPERATOR NAME:**		
MARK CONDITION			**COMMENTS**
Parking Brake			
Brakes Adjusted			
Tires Pressure & Condition			
Fluid Levels			
Steering System			
Horn			
Seat Belts			
Muffler / Exhaust System			
Rear View Mirrors			
Belts - Fan, Alternator			
Hydraulic Lines			
Fire Extinguisher			
Ladders, Tools, Equipment			
OPERATING CONTROLS			
Turn Signals			
Brake Lights			
Emergency Lights			
Head & Tail Lights			
Gauges			
Platform Controls			
Reflectors & Labels			
Windshield Wipers			
Back-Up Alarm			
Stabilizers Positioned			
Swing / Boom / Hoist Controls			
Travel Controls and Tracks			
Traverse Controls			
Elevation Controls			
Wheels Chocked			
WORK ZONE			
Platform Completely Enclosed			
Trained Operator			
Required PPE			
Fall Protection Equipment Used			
Cones, Barricades, Signage			
Establish Clear Work Zone			
Review Work Task(s) with Staff			
Traffic Directional Lights			
NOTE: WHEN VEHICLE IS NOT REQUIRED TO HAVE SPECIFIC ITEMS, IT MUST BE SHOWN AS N/A IN BOX			
THIS FORM MUST BE MAINTAINED IN THE PROJECT FILE			

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5-408-Form 2 Aerial Equipment Inspection

TYPE EQUIPMENT:	**EQUIPMENT NUMBER:**	**SERIAL NUMBER:**
MAKE:		**MODEL NUMBER:**
MILEAGE:	**DATE CHECKED:**	**LOCATION:**
ENGINE MAKE:	**YEAR MANUFACTURED:**	**HOURS:**

	MARK ONE			COMMENTS (List percentage of wear on all wear items)
	GOOD	FAIR	REPAIR	
1. GENERAL APPEARANCE				
Hood & Panels				
Paint				
Undercarriage				
Tires – Type, Size				
2. ENGINE COMPARTMENT				
Oil Level & Condition				
Filters, Condition				
Fan / Radiator / Belts				
Gov. / Idling Device				
Exhaust System				
Fuel / Water / Oil / Lines				
Coolant – Level – Protect.				
Battery – Test Condition				
3. OPERATOR'S POSITION				
Controls				
Gauges				
Starting / Charging				
Engine Condition				
- Minor Repair				
- Major Repair				
Decals & Labels				
4. AERIAL EQUIPMENT				
Boom Condition				
Wear Pads				
Power Trac				
Hydraulic Fluid & Filter				
Emergency Lowering				
Aux. Power System				
Scissor Arms				
Safety Circuits				
Control Labels				
Basket & Door				
Platform & Railings				
Back-up Alarm				
Stabilizers				
Pads				
5. DOCUMENTATION, ETC				
Operator's Manual				
Service Manual				
Log Book				
Fire Ext.				

	MARK ONE			COMMENTS
6. OTHER COMPONENTS	GOOD	FAIR	REPAIR	
Certification **Inspected By:** **Approved By:** **Name:**				**ESTIMATED HOURS TO REPAIR:**

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5-410-Hazardous Energy Control

1.0 Purpose and Scope

1.1 Establishes the requirements for Resolution Consultants employees to perform hazardous energy control (equipment lockout and tagout (LOTO)) operations.

1.2 All Resolution Consultants work is regulated by this procedure when:

1.2.1 An unexpected energization or start-up of machines and/or equipment would result in the release of stored energy which could cause injury to an employee.

1.2.2 Any employee (or contractor) is required to remove or bypass a guard or other safety device.

1.3 Any employee (or contractor) is required to place any part of his body into the mechanism of a piece of equipment or path of hazardous energy.

2.0 Terms and Definitions

2.1 **Affected Employee:** A trained person whose job requires him/her to operate or use a machine or piece of equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed

2.2 **Authorized Employee:** A person who locks out or tags out a machine or piece of equipment in order to perform servicing or maintenance on that machine or equipment.

2.3 **Cord and Plug-connected Equipment:** Equipment where the only energy source is electrical power provided by a plug-in connection

2.4 **Energy Source:** Any electrical, mechanical, hydraulic, pneumatic, chemical, radiation, thermal, or compressed gas energy source; energy stored in springs; and potential energy from suspended objects (gravity) that may injure personnel, cause property damage, and/or cause a release of hazardous substance to the environment.

2.5 **Energized:** Connected to an energy source or containing residual or stored energy

2.6 **Energy-isolating Device:** A mechanical device that physically prevents the transmission or release of energy. This includes locks, hairpins, tongs, lockable valves, clamshell devices for valves, blank flanges for piping systems, and restraining devices to prevent movement of parts.

2.7 **Energy Source:** Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other energy.

2.8 **Isolation:** A physical activity using a device which prevents the transmission or release of energy. Examples of devices used to isolate equipment/systems include, but are not limited to restraint blocks, electrical circuit breakers, disconnect switches, fuses, slip gates, slip blinds, or double valves. Control circuit devices, motor controllers, etc., are not acceptable isolation devices.

2.9 **Locking Device:** A device that utilizes a lock, key, and identification number to hold an energy isolation device in the safe position for the purpose of protecting personnel.

2.10 **Lockout:** The use of a locking device to ensure that an energy-isolating device and the equipment it controls cannot be operated until the lockout device is removed.

2.11 **Lockout/Tagout (LOTO) Specific Procedure:** A written procedure developed specifically for each piece of machinery or equipment capable of unexpectedly releasing energy. This procedure outlines in detail how lockout/tagout will be performed.

2.12 **Normal Production Operations:** The utilization of a machine or piece of equipment to perform its intended production function.

2.13 **Servicing and/or Maintenance:** Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment, and making

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adjustments or tool changes where employees could be exposed to the unexpected energization or start-up of the equipment or a release of hazardous energy.

2.14 **Tagout:** The use of a warning device to establish that an energy-isolating device and the equipment it controls may not be operated until the tagout device is removed.

3.0 References

None.

4.0 Procedure

4.1 Regional and District operations managers

4.1.1 Provide LOTO training to employees engaged in projects covered by this procedure

4.1.2 Assure that Project Managers are preparing and implementing LOTO procedures on their projects

4.2 **Project Manager** or **Resident Engineer** on the project is responsible for administering the procedure including:

4.2.1 Determining whether client employees or Resolution Consultants employees will be responsible for implementing any required lockout/tagout of energy sources at client facilities

4.2.2 Consulting with the SH&E Department regarding project specific requirements for lockout/tagout

4.2.3 Informing the field team about the client or facility's requirements for lockout

4.2.4 Ensuring that if Resolution Consultants is responsible for lockout/tagout, that only authorized employees work on or near equipment requiring hazardous energy control

4.2.5 Assuring that the written LOTO procedure in effect on a project is audited at least annually including the observation of workers performing the procedure

4.3 Supervisors

4.3.1 Assure that all employees under their direction are fully aware of, understand, and adhere to the Lockout/Tagout procedures.

4.4 Authorized Employees

4.4.1 Verifying with the Project Manager who is responsible for LOTO at client facilities.

4.4.2 Obtaining a lock, key and tags.

4.4.3 Meeting with the facility representative and affected employees to review the LOTO activities.

4.4.4 Implementing project specific LOTO procedures.

4.5 Affected Employees

4.5.1 Assist Authorized Employees with the safe shutdown and restart of equipment.

4.5.2 Assure that no attempt is made to restart equipment without the knowledge of all employees performing work on the equipment.

4.6 All Employees

4.6.1 Refrain from making any attempt to restart equipment that is locked or tagged out.

4.6.2 Avoid areas where other employees are working on equipment.

4.7 Training

4.7.1 The supervisor must orientate all personnel to the project, the hazards associated with the work to be performed and the Lockout/ Energy Control Procedures to be followed.

4.7.2 Proof of training must be documented on the Project Safety Plan and readily available for review.

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4.8 General Procedures

4.8.1 Energy control means to neutralize and make inoperable all potential sources of energy or power in the equipment or machinery to be worked on. No part of the equipment should be capable of inadvertent activation or movement, which may lead to personal injury. Removing a fuse, closing a valve or turning a switch is not an acceptable isolation from the energy source.

4.8.2 Only staff orientated to the lockout/energy control procedure will be involved with the locking out, de-energizing and control of all potential sources of energy on energized systems.

4.8.3 Written procedures for lockout and energy control shall be developed and approved by the Site Supervisor or Client and must be implemented prior to performing work.

4.8.4 The site, project or Client specific procedures must be understood and followed for the health and safety of all workers affected by or involved with the locking out, de-energizing and control of all potential sources of energy prior to the performance of work on energized systems.

4.8.5 Be aware of all potential energy sources, such as:

- Chemical
- Hydraulic
- Radiological
- Electrical
- Mechanical
- Residual
- Gravitational
- Pneumatic
- Thermal
- X-ray testing of pipes

4.8.6 It is the responsibility of on-site supervisors to identify through meetings with Client representatives when and where their work requires the isolation and control of an energy source.

4.8.7 The supervisor must also identify and communicate to all on-site personnel how the sources of energy will be isolated, brought to a zero energy state, locked out of service and tested to verify the effectiveness of the controls.

4.8.8 Where the procedures are affected by the facilities or workers of the Client, procedures will follow the requirements of and be approved by the Client.

4.8.9 Padlocks and Danger Tags

- Where there is a danger of equipment being energized, the motor switch on all individual motor drives shall be locked in the open position.
- It shall be the responsibility of each employer to maintain an adequate supply of safety locks.
- Each worker affected shall affix their own individual lock.
- In addition, a danger tag shall also be applied to the lockout bearing: a brief description of the work being done; the company name, the worker's name, the supervisor's name, the date and emergency phone numbers.
- The tag and locks shall remain in place until the work has been completed.
- Where a lock has been abandoned or must be removed due to an emergency, the Site Supervisor or Client contact must be notified and the removal must follow the approved lock abandonment procedure.

4.8.10 LOTO of energy sources must be performed only by an Authorized Employee. If more than one employee is involved, either each individual Authorized Employee must use his/her own lock (multiple lockout), or a group lockout may be performed by the employees' supervisor/foreman.

4.8.11 The locks, tags, and equipment shall not be tampered with by any employee.

4.8.12 Only the person placing the lock and tag the equipment may remove the lock and tag.

4.8.13 If the employee who placed the lockout/tagout device/sign subsequently no longer works for the company, or cannot be located, only the authorized supervisor/foreman can remove the locks and

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tags in accordance with the procedure outlined below for Removal of Unattended Lockout/Tagout Devices.

4.9 Authorized Employees

4.9.1 Only employees that have completed training for Lockout/Tagout Authorized Employees will be permitted to perform work under Lockout/Tagout procedures.

4.9.2 Each Authorized Employee will also be responsible for reviewing any applicable equipment-specific Lockout/Tagout procedure prior to initiating work.

4.9.3 Any problems identified with the equipment-specific procedure are to be immediately reported as an incident or near miss and should be brought to the attention of the SH&E Department and all work on affected equipment halted.

4.10 Shift Change Procedures

4.10.1 If ongoing work requires carryover from shift to shift, or transfer of responsibility between employees, the following procedure will be implemented:

- The employee(s) who originally performed the lockout shall walk through the lockout/isolation steps with the new worker.
- At each isolation point the original worker shall remove his/her lockout/tagout device(s), to be immediately replaced by the new worker's device(s).
- Upon transfer of the lockout/tagout equipment, the new employee shall verify that the equipment is still isolated prior to continuation of work.

4.10.2 Under no circumstances shall the original devices remain in place and just the keys transferred.

4.10.3 For supervisor/foreman and/or group lockouts, the same procedure shall be used with the oncoming supervisor/foreman.

4.11 Removal of Unattended Lockout/Tagout devices

4.11.1 Only the person(s) who placed the lockout/tagout devices on the system can remove the devices, unless:

- The Project Manager has verified that the employee is not on site and is not available to return to the site to remove the lock.
- All reasonable efforts have been made to contact the employee to verify that the work is complete and the devices are about to be removed.
- The Project Manager inspects the locked-out/tagged-out device and ensures that the equipment is capable of being safely re-energized.

4.11.2 If all of the above apply, the locks and tags can be removed at the direction of the Project Manager. The Project Manager shall complete an 5-*410- Lock and Tag Removal Form* to document the event prior to removing the lock and file the form with the project records. A copy of the form shall be sent to the SH&E department member with oversight responsibility for the project.

4.11.3 **UNAUTHORIZED REMOVAL OF A LOCKOUT/TAGOUT DEVICE WILL RESULT IN IMMEDIATE DISMISSAL FROM THE PROJECT SITE AND POTENTIAL TERMINATION!**

4.12 Emergency Lock Removing Procedures

4.12.1 This procedure will ONLY be used in an emergency situation defined as an event that may cause injury, fire, explosion, over exposure or other hazards to the general public, the environment or personnel.

4.12.2 In an emergency event that requires a lock or tag to be removed by a person other than the person who placed the lock or tag, the following lock-removing procedure will be implemented by another Authorized Employee:

- Investigate and verify that all equipment and material in relation to the work has been completed and/or put into a safe configuration.
- Ensure all personnel have been removed from the hazardous location and Affected Employees on site are notified.
- Remove lock.

- Attempt to contact the person that originally provided LOTO to advise him that the LOTO has being removed.
- Complete the 5-*410-Emergency Lock Removal Form*. The Emergency Lock Removal Forms will be placed in the project files and send a copy to the SH&E department member with oversight responsibility for the project.
- Whenever a LOTO is removed for emergency purposes by anyone other then the employee who placed the LOTO, that person and all affected personnel must be contacted prior to the start of their next shift to inform them that the equipment/system is no longer locked out/tagged out.

4.13 Specific LOTO Procedures

4.13.1 Written procedures will be developed for the lockout and tagout of each piece of equipment that has potentially hazardous energy sources (*5-410-Equipment-Specific LOTO Procedure Template*).

4.13.2 Each procedure must be reviewed and approved by the SH&E Department prior to implementation.

4.13.3 Equipment-specific written lockout/tagout procedures are not required, if ALL of the following conditions are met:

- The equipment's only energy source is electrical; and
- The unexpected start up of the equipment is controlled by unplugging the equipment from the electrical source; and,
- The plug or switch is under the exclusive control of the person performing the work.

4.13.4 Additionally, equipment-specific Lockout/Tagout procedures are not required if ALL of the following apply:

- The machine has no potential for stored or residual energy, or re-accumulation of stored energy after shutdown (i.e. contains a capacitor to store electrical energy or pressurized tank to store air/gas); and,
- The machine has a single energy source that can be readily identified and isolated (if more than one energy source is present (e.g., gas and electric), then written procedures shall be developed); and,
- The isolation and locking out of the single energy source completely de-energizes and deactivates the equipment; and,
- Servicing of the machine requires that its energy source must previously have been locked out and tagged out in accordance with this section; and,
- A single lock-out device achieves a locked-out condition.

4.13.5 Procedure Outline. All equipment-specific Lockout/Tagout procedures will be prepared to meet the following steps:

- Identify type and magnitude of energy.
- Notify affected employees that the machine/equipment will be shut down and locked out for servicing.
- Shut down machine/equipment by normal stopping procedure.
- Identify all energy-isolating device(s) for the machine or equipment being serviced.
- Lock out each device with individual locks. Tag out only if a device is not capable of being locked out.
- Relieve or restrain stored and/or residual energy.
- Verify the isolation of equipment and its zero energy state (attempt to restart the equipment.)
- Establish that energy to the equipment being worked on was isolated.
- Complete *5-410-LOTO Verification Checklist LOTO Verification Checklist.*
- Perform work.
- Check work area to remove non-essential items and ensure equipment components are intact.
- Check work area to ensure all personnel are removed from the area.
- Verify that the controls are in neutral (off).
- Remove lockout device(s).
- Notify affected employees that the machine/equipment is ready for use.

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- Reenergize the machine or equipment.

4.14 Non-Specific LOTO Procedures

In the absence of an equipment-specific LOTO procedure, the following procedures, in combination with a completed Task Hazard Analysis (or Job Safety Analysis), can be used as an acceptable substitute.

4.14.1 Process Equipment

- Determine what energy sources are present, such as electrical, gas, pressurized systems (e.g., steam, water, and hydraulics), heated fluids or gas (e.g., steam, hot water), and gravity (e.g., presses, elevated vehicles).
- Determine which of these sources requires isolation to perform the work.
- Determine the locations where each energy source for that piece of equipment can be turned off/isolated AND be locked out. For example, if a machine has an on/off button, pushing the button to the off position is not sufficient isolation, since the button cannot be locked out. You must then either unplug the equipment or find, close, and lock out the circuit breaker or electrical switch supplying the machine.
- Make sure anyone in the area knows you are about to turn off and lock out the equipment, and then close the isolation devices. Once closed, lock out the isolation devices so they cannot be inadvertently opened.
- Place an appropriate tag on each lock out device, with the appropriate warning (e.g., Do Not Open, Do Not Start) with date and time of isolation and a means of identifying who has performed the lockout.
- Once everything is locked out, verify that the isolation was successful by following manufacturers' directions or standard trade practice. Means of determining whether isolation was successful include:
  - Try to turn the equipment on.
  - Use pressure relief valves.
  - Try to ignite the pilot light.
- Complete the *5-410-LOTO Verification Checklist LOTO Verification Checklist*
- Perform the necessary work.
- Ensure all tools and parts are removed from the work area.
- Remove the tags and locks used to isolate the various energy sources.
- Open up each isolation source. For fluid or gas systems, check for leaks at the area the work was performed as necessary.
- Inform personnel in the area that the lockout/tagout systems have been removed.
- If additional work is required (e.g., repair of leak, fine tuning of work), the lockout/tagout procedure must be re-established. Under no circumstances shall work be performed on the equipment without prior isolation of the energy sources.

4.14.2 High Voltage Electrical Systems

In general, Resolution Consultants personnel will provide lockout/tagout services in low voltage situations only (voltage is below 600 volts). For high voltage situations (above 600 volts), Resolution Consultants will either subcontract operations to an electrical subcontractor or obtain approval of the equipment-specific Lockout/Tagout procedure from the Group SH&E Manager and the Regional Manager. If an electrical subcontractor is utilized, they will be required to provide documentation of their high voltage certification.

4.14.3 Low Voltage Procedure

- Make sure the equipment to be worked on is turned off.
- Locate the source of the electrical supply and isolate the equipment. This can be accomplished by:
  - Turning the appropriate circuit breaker off.
  - Unplugging the equipment.
  - Disconnecting the source from the battery (e.g., pulling cables from automotive batteries).

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- Lock the isolation circuit in the closed position using an appropriate locking device and a unique lock and key system.
- Tag the locked-out circuit. The tag used shall warn against the hazard (e.g., Do Not Start), and include a means of identifying the employee who installed the tag and lock.
- Go back to the equipment and try to turn it on to ensure that the proper source has been isolated. If the machine turns on, reverse the above steps (b-d), and start again until the proper circuit is isolated. Report the incident to site safety coordinator as a serious near miss and do not perform the task until proper isolation is performed and verified. The site (project) manager is responsible for developing the written procedure for LOTO of this equipment prior to authorizing re-work on it.
- Complete the LOTO Verification Checklist.
- Perform the required work.
- Upon completion of the work, inspect the area to ensure all tools and parts are removed. If tools or parts are noticed after the energy source is no longer locked out, steps (a-e) MUST be performed again prior to retrieval of the tools/parts. Under no circumstances shall the items be retrieved without the equipment being locked out.
- Inform anyone in the area that work has been completed and equipment is being energized.
- Remove the tag and lock.
- Turn on the closed circuit following the appropriate procedures (or reconnect the battery cables).
- Turn the equipment on to verify operation.

4.14.4 Pressurized Water or Air/Gas

- Turn the appropriate valve upstream from the area of work to the off position (closed). Note: if steam or water can enter the pipe from the normal downstream side, either verify that the check valve is operating properly, or ensure that all necessary valves have been closed to stop all fluid or steam flow into the section to be worked. If this procedure is being used in preparation of Confined Space Entry, positive isolation (i.e. line break, blind plate, or double-block and bleed) must be established on both sides prior to authorizing confined space entry.
- Using the appropriate device, lock the valve(s) in the closed position using a unique lock and key.
- Tag the locked-out valve(s). The tag shall warn against the hazard (Do Not Open) and include date and time of isolation and a means of identifying the employee who installed the lock and tag.
- Allow the system to be worked to cool down (in the case of steam or hot water).
- Relieve the pressure in the system and then drain any fluid from the system. If the system is not equipped with a pressure relief or drain system, make sure the pipes are cool to the touch and slowly open and drain in accordance with standard trade practice.
- Once the system has been bled to atmospheric pressure, the pipes or lines shall be disconnected, blinded, or closed by a valve and locked out and/or tagged accordingly. Observe line entry procedures when first opening the line.
- Complete the *5-410-LOTO Verification Checklist*.
- Perform the necessary work.
- Ensure all sections are secure and closed.
- Remove the tag and lock.
- Slowly open the valve, stopping when water or steam flow has started. Observe the work performed to make sure no leaks are evident. If there are no leaks, then the valve can be completely opened. If leaks are observed, then re-close the valve, and follow steps 2-5 above to reapply the LOTO to the system.

4.14.5 Natural Gas Lines

- Turn off the valve upstream from the area to be worked.
- Using the appropriate device, lock the valve in the closed position using a unique lock and key.
- Ensure all spark sources in the area have been isolated or removed.
- Using non-sparking tools, remove the remaining gas in the line using standard trade practice. If in an enclosed area, make sure appropriate ventilation is present. If the flow of gas does not

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stop, then shut down the next upstream valve, or the gas main valve. Each additional valve closed must be locked out and tagged out.

- Complete the *5-410-LOTO Verification Checklist*.
- Perform the required work. If hot work is necessary (i.e. soldering, grinding, welding), make sure the line has been purged of gas and that the hot work requirements of this manual are followed, including explosivity check prior to authorizing work.
- Make sure that all connections are secure. Also, have a solution of soap and water for leak testing.
- Remove all tools and parts from the area.
- Remove the lock(s) and tag(s) from the valve(s).
- Slowly crack open the valve(s).
- Test the work area for leaks using the soap solution. If leaks are detected, the system must be locked out and tagged out following steps 1-4 above before additional repairs can be made.
- If no leaks are detected, gradually open the isolation values to their normal position.

4.15 Annual Program Review

4.15.1 At least annually (or whenever any incident or serious near miss occurs due to inadequate lockout/tagout) , an independent Authorized Employee who is not involved in the procedure being inspected must conduct and document a review and inspection of the Energy Control Program specific to the identified facility. The inspection should include a meeting with authorized employees and any other affected employees.

4.15.2 The inspection procedure must include the following elements.

- Where lockout is used, discuss the authorized employee's responsibilities under the lockout/tagout program with the inspector.
- Hold group meetings with the authorized employees who are performing the inspection and all authorized employees who implement the procedure.
- Where tagout is used, discuss the authorized employee's responsibilities under the lockout/tagout program and the limitations of the tagout system.
- Review of lockout/tagout verification checklists and other documentation to ensure procedure is being correctly followed and documented.
- If deficiencies are noted during the inspection, corrective actions and retraining of employees, as necessary, must be performed immediately.
- The inspector shall provide a copy of all inspection documentation to the applicable Resolution Consultants Manager for review and filing.

These inspections shall at least provide for a demonstration of the procedures and may be implemented through random audits and planned visual observations. These inspections are intended to ensure that the energy control procedures are being properly and consistently implemented.

4.16 Training

4.16.1 Authorized Employees

Authorized Employees involved in or affected by lock out and their Supervisors and Project Managers will be trained in the following areas before being allowed to work on equipment requiring LOTO:

- Recognition of hazardous energy sources;
- Types and magnitudes of energy sources located in the workplace;
- Procedures for energy isolation and control, including specific procedures developed for specific equipment and systems;
- Purpose and use of the energy-control (lock out/tag out) procedure, equipment, and devices;
- Prohibitions and penalties for attempting to restart or re-energize equipment which has been locked out/tagged out, or to work on equipment without following the lock out/tag out procedures.

Authorized Employees are limited to those departmental supervisors and managers, and those selected employees who have successfully completed all of the required training listed above.

4.16.2 Affected Employees

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Affected Employees will be trained in the purpose and use of the lock out/tag out procedure. All employees whose work operations may be in an area where lock out/tag out procedures may be utilized will be trained about the procedure and about the prohibition relating to attempts to restart or reenergize machines or equipment that are locked out/tagged out. These personnel are not required to be familiar with specific procedures for equipment and systems.

4.16.3 Retraining

Retraining or refresher training for Authorized and/or Affected employees will be conducted annually or whenever one of the following exists:

- The employee has a change in job assignment;
- There has been a change in the equipment or process;
- There has been a change in the energy-control procedure;
- An inspection reveals deviations from the standard procedures or inadequacies in the employee's knowledge or use of the lock out/tag out procedure;
- An incident occurs as a result of unexpected energy release.

4.16.4 Training Documentation

All employee training, including refresher training, will be documented in accordance with 5-*003-PR SH&E Training*. Employee training records will include type of training, date, and employee name. These records will be maintained for each employee for the duration of their employment.

Each office and project site shall maintain a current list of personnel trained in accordance with Authorized and Affected employees above.

5.0 Records

None.

6.0 Attachments

6.1 5-410- Lock and Tag Removal Form

6.2 5-410-LOTO Verification Checklist

6.3 5-410-Emergency Lock Removal Form

6.4 5-410- Equipment-Specific LOTO Procedure Template

5-410-Lock and Tag Removal Form

TAG NUMBER	LOCK NUMBER	LOCATION USED	COMPONENT AFFECTED	DATE/TIME ATTACHED	MANAGER / SUPERVISOR	DATE/TIME RETURNED

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5-410-LOTO Verification Checklist

Equip ID (#)/Loto Location (S)—Device Type and Number: _____ Loto Reference Number: _____	Date:

Lockout-Tagout Checklist	Yes	No	Initials
Employee Notification Have all affected employees been informed that a LOTO is necessary and the reason for the LOTO?			
Energy Source Identification Has the type and magnitude of all energy sources and the respective method of control been identified?			
Equipment Shutdown Has the machine/equipment been shut down by the normal stopping procedure (depressing the stop button, open switch, close valve, etc.)?			
Deactivating Energy-Isolating Device Have all energy-isolating devices been deactivated so that the machine/equipment is isolated from all energy sources?			
Lockout Has a lock been placed on all appropriate energy isolating devices with an assigned individual lock(s)?			
Tagout Has a tag been placed on all appropriate energy isolating devices?			
Energy Dissipation Has all stored/residual energy (such as in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, air, steam, or water pressure) been dissipated/restrained by methods such as grounding, repositioning, blocking, bleeding down, etc?			
Zero Energy State Verification Has verification been made that the equipment is disconnected from all energy sources by first checking that no personnel are exposed, then verifying the isolation of the equipment by operating the push button or other normal operating controls?			
IF SO, THE EQUIPMENT IS NOW LOCKED OUT			
Restoring Equipment to Service	DATE:		
Job Completion Verification Has the machine/equipment and immediate area been checked to make sure that nonessential items have been removed and the machine/equipment components are operationally intact?			
Personnel Verification Have all personnel been safely positioned or removed from the area and all controls are in neutral?			
Lockout Removal And Equipment Startup Has all lockout and tagout devices been removed and the machine reenergized?			
Employee Notification Have all affected been notified that the LOTO is complete and that the machine/equipment is ready for use?			

NOTES:

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5-410-Emergency Lock Removal Form

This form will only be used in an emergency situation. For this form, an emergency is defined as an event that may cause injury, fire, explosion, over exposure, or other hazards to the general public, the environment, or personnel.

1. NAME of personnel whose LOTO is to be removed:			
2. METHOD(s) used to contact personnel whose LOTO is to be removed:			
3. LOCATION of LOTO:			
4. REQUIRED CONTACTS: Contact the following Resolution Consultants personnel to locate affected contractor personnel:			
Contact Name 1:			
Office Phone #	**Home Phone #**	**Pager #**	**Cell #**
Contact Name 2:			
Office Phone #	**Home Phone #**	**Pager #**	**Cell #**
Contact Name 3:			
Office Phone #	**Home Phone #**	**Pager #**	**Cell #**
Contact Name 4:			
Office Phone #	**Home Phone #**	**Pager #**	**Cell #**
5. NOTIFICATION: A Resolution Consultants representative has been contacted. ☐ Yes ☐ No Notification verified by: (Initial) OR, the special conditions for not contacting Resolution Consultants are as follows:			
6. WALK DOWN: A walk-down of the equipment / system has been performed to ensure that all personnel are removed from hazardous locations. ☐ Yes ☐ No Notification verified by: (Initial)			

	Print Name	**Signature**	**Date**
Project Manager			
SH&E Representative			

AFTER COMPLETION OF THESE STEPS, THE LOCK AND TAG MAY BE REMOVED

This form must be provided to the Resolution Consultants Project Management Team (PM and SSO) so the affected employee can be notified that his/her Lock-Out/Tag-Out has been removed

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5-410-Equipment-Specific LOTO Procedure Template

PROCEDURE REFERENCE NUMBER:

EQUIPMENT:	
EQUIPMENT NO:	**LOCATION:**

PURPOSE

This 7-step procedure establishes the minimum requirements for the lockout of energy isolating devices whenever servicing or maintenance is done on facility equipment. This procedure will be used to ensure that the equipment is stopped, isolated from all potentially hazardous energy sources and locked out before employees perform any maintenance where the unexpected energization or startup of the equipment or release of energy could cause injury.

COMPLIANCE WITH THIS PROCEDURE
All employees are required to comply with the restrictions and limitations imposed on them during the use of this procedure. The authorized employees are required to perform the lockout in accordance with this procedure. Other employees, upon observing a piece of equipment which is locked and/or tagged out, will not attempt to start, energize, or use said equipment.

SEQUENCE OF LOCKOUT/TAGOUT

1. All affected employees will be notified that the equipment must be shut down and locked out to perform servicing or maintenance.

   Specific Instructions:

2. The authorized employee will identify the type and magnitude of the energy that the equipment utilizes, will understand the hazards of the energy, and will know the methods to control the energy.

   ENERGY

___ Electrical (440V)	___ Natural Gas	___ Spring
___ Hydraulic	___ Gravity	___ Steam
___ Chemical	___ Pneumatic	___ Thermal
___ Other:		

3. Shut down operating equipment by the normal stopping procedures (depress stop button, open switch, close valve, etc.).

   Specific Instructions:

4. Deactivate the energy isolating device(s) so that the equipment is isolated from the energy sources(s).

   Specific Instructions:

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5. Lockout and tagout the energy isolating devices(s) with assigned individual locks and tags.

   Lockout Equipment Needed:

6. Dissipate any stored or residual energy (such as that in capacitors, springs, hydraulic systems, and air, steam, or water pressure, etc.) by methods such as grounding, repositioning, blocking, bleeding down, etc.

   Specific Instructions:

7. Ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed, then verify the isolation of the equipment by operating the normal operating control(s) or by testing to make certain the equipment will not operate. CAUTION: Return controls to "OFF" after verification. THE EQUIPMENT SHOULD NOW BE LOCKED OUT AT ZERO ENERGY STATE.

   Specific Instructions:

METHODS OF VERIFICATION

Verification should be determined via start-up attempts, visual observations and testing. For electrical verification, place local on/off switch to ON position and verify equipment will not operate. Return the switch to OFF position and commence work.

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5-411-Machine Guarding

1.0 Purpose and Scope

1.1 Provides the Resolution Consultants requirements for machine guarding practices for all equipment located 7 feet or less from grade level or the floor.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

None.

3.0 References

None.

4.0 Procedure

4.1 The **Project Manager/field task manager/supervisor** shall confirm that all equipment used or worked on by Resolution Consultants personnel is properly guarded and that employees are instructed not to remove any guards to operating areas or pinch points in the absence of controlling all sources of hazardous energy.

4.2 Typically, moving parts (e.g., rotating parts) require machine guards to prevent employee injury.

4.3 Guards will be firmly fixed or secured, with no more than ½-inch-diameter openings. If work equipment does not have the proper machine guards installed, it shall be removed from service and locked out/tagged out until the proper guard is installed.

4.4 Guards will conform to the following requirements:

4.4.1. Under no circumstances shall employees remove manufacturer-installed guards (except during maintenance procedures) or use guards in a manner not consistent with the manufacturer's directions.

4.4.2. When guarding is provided by two hand-control devices, the devices shall be constructed to prevent tie-down of either of the two or to prevent bridging (i.e., using something else such as a pipe to hold down both control devices simultaneously with one hand).

4.4.3. Employees shall not place any part of their body under any vehicle or equipment that is solely supported by a jack, overhead hoist, chain fall, or other temporary supporting means. Safety stands, blocks, or other support system capable of holding the total imposed weight shall be used.

4.4.4. Under no circumstances shall equipment control interlocks or "deadman" switches be bypassed (e.g., spring trigger taped down on an abrasive blast guns or other powered tools) and will be located within reach of the operator's working position.

4.4.5. Sufficient clearance will be provided around and between machines to allow for safe operations, set up and servicing, material handling, and waste removal.

4.5 **Auto-Starting Equipment**

Some process equipment starts automatically in response to control system inputs of system sensors. Since inadvertent startup can present special worker hazards, all auto-starting equipment will be identified, and a label affixed to each reading:

CAUTION
EQUIPMENT MAY START WITHOUT WARNING
DE-ENERGIZE BEFORE SERVICING

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5.0 Records

None.

6.0 Attachments

6.1 05-411-Form 1 Machine Guarding Inspection Checklist

6.2 05-411-Form 2 Machine Guarding Safe Work Practice

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05-411-Form 1 Machine Guarding Inspection Checklist

Y	N	N/A	Equipment Markings
			1. Are all emergency stop buttons colored red?
			2. Are empty compressed gas cylinders appropriately marked and their valves closed?
			3. Are manually operated valves and switches controlling the operation of equipment and machines clearly identified and readily accessible?
			4. Are storage cabinets used to hold flammable liquids labeled "Flammable—Keep Fire Away"?
			5. Is red used to identify acetylene (and other fuel-gas) hose, green for oxygen hose, and black for inert gas and air hose?
Y	**N**	**N/A**	**Housekeeping: Maintenance**
			6. Is all machinery and equipment kept clean and properly maintained?
Y	**N**	**N/A**	**Lockout**
			7. Are appropriate employees provided with individually keyed personal safety locks?
			8. Are correct lockout/tagout procedures in use?
			9. Are equipment control valves provided with a means for locking out?
			10. Are provisions made to prevent machines from automatically starting after a shutdown?
			11. Are suspended loads or potential energy (such as compressed springs, hydraulics, or jacks) controlled to prevent hazards?
			12. Is all machinery or equipment capable of movement, required to be de-energized or disengaged and locked out during cleaning, servicing, adjusting or setting up operations, whenever required?
			13. Is the locking-out of control circuits in lieu of locking-out main power disconnects prohibited?
			14. Is there a means provided to identify employees who are working on locked-out equipment by their locks or accompanying tags?
Y	**N**	**N/A**	**Machine Guarding: General**
			15. Are all moving chains and gears properly guarded?
			16. Are machinery guards secure and so arranged that they do not offer a hazard in their use?
			17. Are rotating or moving parts of equipment guarded to prevent physical contact?
			18. Are the noncurrent-carrying metal parts of electrically operated machines bonded and grounded?
			19. Are work positions, machinery, pits or holes, and hazardous operations adequately guarded?
			20. Are workers protected from sharp objects which might pierce the feet or cut the hands (e.g., machinery, food handling and storage, sawing and cutting)?
			21. Is sufficient clearance provided around and between machines to allow for safe operations, set up and servicing, material handling, and waste removal?
Y	**N**	**N/A**	**Machine Guarding: Portable Power Tools**
			22. Are grinders, saws, and similar equipment provided with appropriate safety guards?
			23. Are power tools used with the correct shield, guard, or attachment recommended

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			by the manufacturer?
			24. Does each portable power tool have a constant pressure switch (dead man switch) that will shut off the power when pressure is released?
Y	**N**	**N/A**	**Machine Guarding: Stationary Equipment**
			25. Are all pulleys and belts that are within 7 feet of the floor or working level properly guarded?
			26. Are fan blades protected with a guard having openings no larger than 1/2 inch when operating within 7 feet of the floor?
			27. Are foot-operated switches guarded or arranged to prevent accidental actuation by personnel or falling objects?
			28. Are machines constructed so as to be free from excessive vibration when the largest size tool is mounted and run at full speed?
			29. Are radial arm saws so arranged that the cutting head will gently return to the back of the table when released?
			30. Are saws used for ripping equipped with anti-kick back devices and spreaders?
			31. Are splash guards mounted on machines that use coolant to prevent the coolant from reaching employees?
			32. Are workers protected from fixed objects that may cause injury, such as sharp machine edges?
			33. Do arbors and mandrels have firm and secure bearings and are they free from play?
			34. Is equipment and machinery securely placed and anchored, to prevent moving?
			35. Is fixed machinery provided with appropriate safety guards to prevent injuries to the operator and other employees resulting from point of operation, ingoing nip point, rotating parts, flying chip, and spark hazards?
			36. Is there a power shut-off switch within reach of the operator's position at each machine?
Y	**N**	**N/A**	**Personal Protective Equipment (PPE)**
			37. Are all employees required to use PPE when handling chemicals (gloves, eye protection, respirators, etc.)?
			38. Are all employees required to use PPE as needed?
			39. Are employees exposed to the hazards created by welding, cutting, or brazing operations protected with PPE?
			40. If machinery is properly cleaned with compressed air, is air pressure controlled and PPE or other safeguards used to protect operators and other workers from eye and body injury?
			41. Is PPE functional and in good repair?
			42. Is protective clothing and equipment provided and used when cleaning up spilled toxic or otherwise hazardous materials or liquids?
			43. Is PPE provided and are all employees required to use PPE as needed to protect against injury?
			44. Does PPE have ANSI or ASTM specifications marked on it?
Y	**N**	**N/A**	**Portable Fire Extinguishers**
			45. Are all fire extinguishers inspected and recharged regularly, and noted on the inspection tag?
			46. Are appropriate fire extinguishers mounted, located, and identified so that they are readily accessible to employees?
			47. Are portable fire extinguishers provided in adequate number and type?

United States OSHA References: 29 CFR 1910.101; 106; 144; 147;132; 157; 212; 213; 217; 218; 219; 242; 243; 252; 253

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05-411-Form 2 Machine Guarding Safe Work Practice

1.0 Why Is It Needed?

1.1 There are as many hazards created by moving machine parts as there are types of machines. Safeguards are an essential requirement for protecting workers from needless and preventable injuries.

1.2 A good rule to remember is: Any machine part, function, or process that may cause injury must be safeguarded. When the operation of a machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must be either controlled or eliminated.

2.0 Where Mechanical Hazards Occur

2.1 Dangerous moving parts in three basic areas require safeguarding:

2.1.1 The **point of operation:** That point where work is performed on the material, such as cutting, shaping, boring, or forming of stock.

2.1.2 **Power transmission apparatus:** All components of the mechanical system that transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

2.1.3 **Other moving parts:** All parts of the machine that move while the machine is working. These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

2.2 Hazardous Mechanical Motions and Actions**.** A wide variety of mechanical motions and actions may present hazards to the worker. These can include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any parts that impact or shear. These different types of hazardous mechanical motions and actions are basic in varying combinations to nearly all machines, and recognizing them is the first step toward protecting workers from the danger they present.

The basic types of hazardous mechanical motions and actions are:

2.2.1 **Motions**

- **Rotating motion** can be dangerous; even smooth, slowly rotating shafts can grip clothing and through mere skin contact force an arm or hand into a dangerous position. Injuries due to contact with rotating parts can be severe.
- Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting are some examples of common rotating mechanisms that may be hazardous. The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys or set screws are exposed on rotating parts.
- In-running nip point hazards are caused by the rotating parts on machinery. There are three main types of in-running nips:
    - Parts can rotate in opposite directions while their axes are parallel to each other. These parts may be in contact (producing a nip point) or in close proximity. In the latter case the stock fed between the rolls produces the nip points. This danger is common on machines with intermeshing gears, rolling mills, and calendars.
    - Nip points are also created between rotating and tangentially moving parts. Some examples would be: the point of contact between a power transmission belt and its pulley, a chain and a sprocket, and a rack and pinion.
    - Nip points can occur between rotating and fixed parts which create a shearing, crushing, or abrading action. Examples are spoked handwheels or flywheels, screw conveyors, or the periphery of an abrasive wheel and an incorrectly adjusted work rest.

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- **Reciprocating motions** may be hazardous because during the back-and-forth or up-and-down motion, a worker may be struck by or caught between a moving and a stationary part.
- **Traverse motion** (movement in a straight, continuous line) creates a hazard because a worker may be struck or caught in a pinch or shear point by the moving part.

2.2.2 Actions

- **Cutting action** may involve rotating, reciprocating, or traverse motions. The danger of cutting action exists at the point of operation where finger, arm and body injuries can occur and where flying chips or scrap material can strike the head, particularly in the area of the eyes or face. Such hazards are present at the point of operation in cutting wood, metal, or other materials.
  - Examples of mechanisms involving cutting hazards include band saws, circular saws, boring or drilling machines, turning machines (lathes), or milling machines.
- **Punching action** results when power is applied to a slide (ram) for the purpose of blanking, drawing, or stamping metal or other materials. The danger of this type of action occurs at the point of operation where stock is inserted, held, and withdrawn by hand.
  - Typical machines used for punching operations are power presses and iron workers.
- **Shearing action** involves applying power to a slide or knife in order to trim or shear metal or other materials. A hazard occurs at the point of operation where stock is actually inserted, held, and withdrawn.
  - Examples of machines used for shearing operations are mechanically, hydraulically, or pneumatically powered shears.
- **Bending action** results when power is applied to a slide in order to draw or stamp metal or other materials. A hazard occurs at the point of operation where stock is inserted, held, and withdrawn.
  - Equipment that uses bending action includes power presses, press brakes, and tubing benders.

2.2.3 Requirements for Safeguards

Safeguards must meet these minimum general requirements:

- **Prevent contact**: The safeguard must prevent hands, arms, and any other part of a worker's body or clothing from making contact with dangerous moving parts. A good safeguarding system eliminates the possibility of the operator or another worker placing parts of their bodies near hazardous moving parts.
- **Positioning of fixed machines:** Sufficient clearance will be provided around and between machines to allow for safe operations, set up and servicing, material handling and waste removal.
- **Secure**: Workers should not be able to easily remove or tamper with the safeguard. Guards and safety devices should be made of durable material that will withstand the conditions of normal use. They must be firmly secured to the machine.
- **Protect from falling objects:** The safeguard should ensure that no objects can fall into moving parts. A small tool which is dropped into a cycling machine could easily become a projectile that could strike and injure someone.
- **Create no new hazards**: A safeguard defeats its own purpose if it creates a hazard of its own such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration. The edges of guards, for instance, should be rolled or bolted in such a way that they eliminate sharp edges.
- **Create no interference**: Any safeguard which impedes a worker from performing the job quickly and comfortably might soon be overridden or disregarded. Proper safeguarding can actually enhance efficiency since it can relieve the worker's apprehensions about injury.
- **Allow safe lubrication**: If possible, one should be able to lubricate the machine without removing the safeguards. Locating oil reservoirs outside the guard, with a line leading to the lubrication point, will reduce the need for the operator or maintenance worker to enter the hazardous area.

2.2.4 Training

Even the most elaborate safeguarding system cannot offer effective protection unless the worker knows how to use it and why. Specific and detailed training is therefore a crucial part of any effort to

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provide safeguarding against machine-related hazards. Thorough operator training with the use of manufacturers' instructions, should involve instruction or hands-on training in the following:

- A description and identification of the hazards associated with particular machines;
- The safeguards themselves, how they provide protection, and the hazards for which they are intended;
- How to use the safeguards and why:
- How and under what circumstances safeguards can be removed, and by whom (in most cases, repair or maintenance personnel only); and
- What to do (e.g., contact the supervisor) if a safeguard is damaged, missing, or unable to provide adequate protection and take the affect machine out of service until the guard is repaired or replaced.

This kind of safety training is necessary for new operators and maintenance or setup personnel, when any new or altered safeguards are put in service, or when workers are assigned to a new machine or operation.

3.0 Guards

Method	Safeguarding Action	Advantages	Limitations
Fixed	Provides a barrier.	Can be constructed to suit many specific applications In-plant construction is often possible. Can provide maximum protection. Usually requires minimum maintenance. Can be suitable to high-production, repetitive operations.	May interfere with visibility. Can be limited to specific operations. Machine adjustment and repair often require its removal, thereby necessitating other means of protection for maintenance personnel.
Interlocked	Shuts off or disengages power and prevents starting of machine when guard is open; should require the machine to be stopped before the worker can reach into the danger area.	Can provide maximum protection. Allows access to machine for removing jams without time-consuming removal of fixed guards.	Requires careful adjustment and maintenance may be easy to disengage jams.
Adjustable	Provides a barrier that may be adjusted to facilitate a variety of production operations.	Can be constructed to suit many specific applications. Can be adjusted to admit varying sizes of stock.	Hands may enter danger area; protection may not be complete at all times. May require frequent maintenance and/or adjustment. The guard may be made ineffective by the operator may interfere with visibility.
Self-adjusting	Provides a barrier that moves according to the size of the stock entering the danger area.	Off-the-shelf guards are often commercially available.	Does not always provide maximum protection may interfere with visibility may require frequent maintenance and adjustment.

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5-417-Utilities, Underground

1.0 Purpose and Scope

1.1 Establishes requirements to ensure that underground installations are identified properly before excavation work commences.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Underground Utilities:** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

2.2 **Ground Disturbance (GD):** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

3.0 References

3.1 American Public Works Association, Excavator's Damage Prevention Guide and One-Call System Directory International 1990-1991, Utility Location and Coordination Committee.

4.0 Procedure

4.1 Ground disturbance may be a conducted for a variety of purposes, including, but not limited to, exposing existing buried lines, soil sampling, remedial excavations, or installing monitoring wells or test pits.

4.2 Improper ground disturbance may impact a buried pipeline or utility line and cause a major release of a hazardous substance, flood, or electrocution. Serious injuries and significant property damage have resulted from insufficient/inadequate identification of underground installations during the course of ground disturbance work.

4.3 To control hazards associated with coming in contact with such installations, the American Public Works Association's (APWA) guidelines for the uniform identification of underground installations has been adopted.

4.4 **CTO Managers** are responsible for ensuring that all work, including the identification, location, and access to all underground utilities, is planned and performed in accordance with contract specifications and safety requirements.

4.4.1 The planning for associated work and avoidance of contacting underground utilities shall be part of the project safety planning in the HASP.

4.5 The **CTO Manager or Site Supervisor** is responsible for the execution of work in accordance with this and other associated Resolution Consultants SOPs, including:

- The review of the HASP.
- Verification that all steps have been taken to identify existing underground utilities in the area to be disturbed.

4.6 **Regional SH&E Professional** provides guidance as needed.

4.7 **Personal Protective Equipment**

- Long sleeved shirt and pants (coveralls/Nomex LILA for upstream oil and gas)
- Safety toe boots
- Hard hat
- High-visibility clothing
- Gloves

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- Respirator with organic vapor/particulate filter cartridge (for use when the exposure exceeds the occupational exposure limit stated on the MSDS), as required
- Hydrogen Sulfide (H2S) Monitor (for areas with known or suspected H2S

4.8 Training

4.8.1 Staff shall successfully complete a Ground Disturbance training course.

4.8.2 Some clients may also have required client-based Ground Disturbance training.

4.9 Underground Utility Lines

4.9.1 To avoid injury from electrical and other utilities on site, utility lines shall be located and marked prior to conducting any drilling or digging on site. If available, refer to site drawings or client interviews for information pertaining to utilities on site.

4.9.2 Types of underground lines:

- Gas line
- Potable water line
- Raw water line
- Sewer line
- Power line
- Cable television/communication line
- Cathodic protection lines
- Grounding cable
- Process piping/flow line

4.9.3 Prior to conducting the ground disturbance, you shall locate all pipelines and utilities that pass within (30 m) of the work area. This is your search and control area. To do so, you need to do the following:

- Notify all pipeline and utility companies, and confirm that their notification requirements are fulfilled prior to conducting a ground disturbance.
- Identify pipelines, power lines, utilities, and irrigation canals in a 30-foot (9.1 m) zone of the work area with the owner of the utility.
- On private property, a properly trained and competent third party utility locator shall be used.
- Get approval for work within a right-of-way (ROW) or within 15 feet (4.6 m) of a line if there is no ROW.
- Prepare a site map identifying the search area, the ground disturbance area, and known underground utilities.
- Confirm that all pipelines, power lines, and utilities are marked.

4.9.4 Look for pipeline indicators:

- Look for warning signs where pipelines cross roads or water courses.
- Look for cut lines, wells, tanks, or valves that may indicate the presence of pipelines.
- Look for ground settling from previous work.
- Talk to nearby landowners and residents.
- Look for vegetation appearing “different” from the surrounding vegetation (e.g., greener, taller, shorter, or more brown than surrounding vegetation).

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4.9.5 When you are working within a pipeline right-of-way, you shall get written approval from the pipeline owner prior to doing your work.

4.9.6 Call the pipeline owner at least two full working days before you dig so the pipeline can be located and marked.

4.9.7 Expose the pipeline by hand/hydrovac before digging within 15 feet (4.6 m) of the pipeline with machinery (no machinery comes may come within 2 feet [60 cm] of the pipeline) with the supervision of the owner or their representative, and call the owner at least one full day before you cover the exposed line.

4.9.8 During ground disturbance:

- All underground utilities shall be hand exposed or hydrovac'd within 3.3 feet (1 m) of a mark out or within the distance required by the owner of the utility before operating any mechanized equipment.
- Make arrangements for supervision ("a Signal Person") during hand exposure.
- If for any reason these hand excavations are temporarily filled in, mark them.
- Make arrangements for supervision ("a Signal Person") during any mechanical excavation within 5 m of the underground utility.
- Make arrangements for supervision ("a Signal Person") during backfilling of utilities.
- Cutting back and shoring of excavations shall be completed to ensure that there are no cave-ins (follow *5-303-Excavation and Trenching*).
- Do not damage utilities by shovels when hand exposing and picks should not be used.
- Remember that all workers have the right and responsibility to refuse to carry out any work or procedures that they feel are unsafe.
- If the ground disturbance is deeper than 3.3 feet (1 m), all crew members shall have appropriate training for excavations and trenches and shall be protected from cave-ins or sliding/rolling materials (follow *5-303-Excavation and Trenching*).
- Remember that incidents, injuries, and near misses shall be reported immediately.
- Review the site-specific emergency response plan.

4.9.9 If you hit an underground facility, stop the work immediately and notify the owner of the facility.

- The owner shall be informed of the location of the contact and the type of damage that resulted.
- If the facility is a pipeline, the company (client) shall immediately notify the required agencies and regulatory bodies of the location of the contact and the type of damage that resulted.
- The government agencies will require a written record and the company (client) should conduct an incident investigation into the causes and make recommendations for the future prevention of this incident.

4.10 Identification of Installations

4.10.1 Various forms of underground utility lines or pipes may be encountered during Resolution Consultants deployments to field sites. Damaged utilities, in particular, can present other hazards including asbestos, explosion, electric shock, scalding, etc., and they shall be avoided. The presence of damaged utilities at any work location shall be immediately brought to the attention of the site supervisor or other member of the Resolution Consultants site management team.

4.10.2 Guidance will be provided on the appropriate action to be taken, which could include suspension of work until the responsible utility agency is contacted and the hazard is either isolated or eliminated.

4.10.3 Extreme caution shall always be exercised when attempting to locate underground utilities. The location of utilities can be in some cases not consistent as shown on drawings, as indicated by the placement of surface signage, or as described by personnel. Coordination and planning of the job shall be required with the client or owner.

- Prior to digging and drilling operations, the client shall always be informed of the potential location(s) of underground utility systems.
- If a utility permit is required from the client or owner, it shall be secured.
- The client shall explain how the utility line may be identified—e.g., red concrete encasement.

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- All underground installations shall be considered “live” and “operational” until the owner, client, or utility authority isolates any hazardous energy or deactivates the system and can demonstrate that condition.
- Where a line placement and depth is known or suspected and where there is potential for contact, hand digging, or hand auguring, instrumentation and other investigative techniques shall be used.

4.10.4 The One Call System Definition and Directory or its equivalent shall be used to prepare for excavation work in the event the identity of an underground installation(s) is unknown.

4.10.5 Line location documentation (or appropriate regional agency or company) provides a listing of companies that have registered buried facilities in the proposed work area. Some public utilities and private companies are not members of the One Call System. In order to give line operators sufficient time to respond to a request to locate, a minimum waiting period of 72 business hours is required prior to beginning work.

4.10.6 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines contained in this SOP or as contract-specified.

4.11 Surface Markings

4.11.1 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

4.11.2 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than two inches.

4.11.3 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

4.12 Uniform Color-Coding

4.12.1 The colors and corresponding installation type are as follows unless otherwise contract-specified.

4.12.2 Red: Electric Power Lines, Cables, Conduit, and Lighting Cables

4.12.3 Yellow : Gas, Oil, Stream, Petroleum, or Gaseous Materials

4.12.4 Orange :Communication, Alarm or Signal Lines, Cables, or Conduit

4.12.5 Green: Sewers and Drain Lines

4.12.6 White : Proposed Ground Disturbance area

4.12.7 Pink: Temporary Survey Markings

4.12.8 Purple: Nonpotable Water

5.0 Records

5.1 The following records on the identification of and response to underground utilities will be maintained in the project files:

5.1.1 All information regarding the identification of underground installations (this information can also be transferred to the appropriate drawings and/or prints and shall be available on site).

5.1.2 Drawings and/or prints shall be maintained for the life of this project.

5.1.3 Identifying Underground Installations Checklist.

6.0 Attachments

None.

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5-503 Blood borne Pathogen Program

1.0 Purpose and Scope

1.1 Define the Resolution Consultants Program for eliminating or controlling exposure to Bloodborne Pathogens on Resolution Consultants projects and activities.

1.2 This procedure shall be implemented on any and all projects where there is a reasonable potential for Resolution Consultants Employees and/or subcontractors to be exposed to regulated waste as defined below.

1.3 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Blood:** Human whole blood; human blood components such as plasma or platelets; and human blood products such as clotting factors.

2.2 **Bloodborne Pathogens (BBP):** Pathogenic microorganisms that are present in human blood and that can infect and cause disease in persons who are exposed to blood containing these pathogens including but not limited to hepatitis B virus (HBV), human immunodeficiency virus (HIV), hepatitis C, malaria, syphilis, babesiosis, brucellosis, leptospirosis, arboviral infections, relapsing fever, Creutzfeldt-Jakob disease, human T-lymphotrophic virus Type I, and viral hemorrhagic fever.

2.3 **Exposure Control Plan:** A plan that addresses the requirements applicable to specific Resolution Consultants projects and activities designed to eliminate or minimize employee exposure. The Exposure Control Plan may be incorporated into the project Health and Safety Plan. The Exposure Control Plan shall include:

2.3.1 Exposure determination.

2.3.2 Evaluation of circumstances surrounding exposure incidents.

2.3.3 Accessibility to all potentially affected employees.

2.3.4 Methods of compliance.

Note that in the State of California this plan shall also address exposures to airborne pathogens.

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2.4 **Health and Safety Plan (HASP):** A document prepared for a specific project that details the hazards, precautions, emergency planning, medical, and training requirements for that project.

2.5 **Occupational Exposure (Exposed):** Reasonably anticipated skin, eye mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties. Employees will be considered to be potentially exposed, even though they are using the universal precautions specified for the project.

2.6 **Other Potentially Infectious Materials:** Body fluids and tissues including: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, saliva, and any other body fluid that is visibly contaminated with blood. When it is difficult or impossible to differentiate between body fluids, all body fluids should be treated as if they are potentially infectious.

Note that in the State of California airborne pathogens are also considered infectious materials.

2.7 **Parenteral:** Refers to piercing the skin barrier (cuts, abrasions, human bites).

2.8 **Regulated Waste:** (1) liquid or semi-liquid blood or other potentially infectious materials; (2) contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; (3) items that are caked with dried blood or other potentially infectious materials and are capable of being released during handling; (4) objects contaminated with blood that can pierce the skin; and (5) pathological and microbiological wastes containing blood or other potentially infectious materials.

2.9 **Source Individual:** An individual, typically one who has been injured, whose blood or saliva has come in contact with another individual, typically one who has rendered first aid or Cardio Pulmonary Resuscitation (CPR) to the injured party.

2.10 **Universal Precautions:** All body fluids and materials potentially contaminated by body fluids will be considered to be infectious unless the fluids were from the person performing the clean up or decontamination activities. All employees coming in contact with another person's body fluids shall assume that the fluids are infectious and shall wear prescribed Personal Protective Equipment (PPE).

2.11 **Medical Director:** Resolution Consultants Medical Consultant Provider.

2.12 **SH&E Manager** – Resolution Consultants company safety and health manager who is responsible for tracking all exposure incidents that occur on Resolution Consultants jobsites.

2.13 **JV SH&E Manager –** Resolution Consultants appropriate Joint-Venture company safety and health manager (EnSafe - HS Manager or AECOM HS Manager) who is responsible for interaction with their respective employee regarding personnel medical and exposure records.

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3.0 References

3.1 United States: OSHA 29 CFR 1910.1030 "Occupational Exposure to Bloodborne Pathogens"

3.2 5-003 SH&E Training

3.3 5-209 Hazard Assessment and Project Planning

3.4 5-604 Medical Records

3.5 5-605 Medical Surveillance Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Resolution Consultants Medical Director

- Will review and maintain all medical records generated as a result of post-exposure follow-up and maintain all medical records related to the follow-up.
- Will, where appropriate, consult with Resolution Consultants' local medical providers about follow-up recommendations.

4.1.2 SH&E Manager

- Will review project-specific Exposure Control Plans (normally part of the HASP) prior to the initial project mobilization, at least annually for continuing projects, and whenever necessary to reflect modified tasks or procedures that affect occupational exposure to bloodborne pathogens.
- Will consult with the Medical Director regarding all bloodborne pathogens exposure incidents.
- Will review all incident reports and arrange for post-exposure follow-up with Resolution Consultants' local medical provider.
- Will offer recommendations on how to prevent an incident from recurring.

4.1.3 JV SH&E Manager

- Will consult with the Medical Director regarding all bloodborne pathogens exposure incidents for their respective employees.
- Will maintain training records and post-exposure follow-up information.
- Will confirm that site-specific training is conducted for all employees working at sites where regulated wastes were disposed or for employees who may be occupationally exposed while working at a facility that handles regulated wastes.
- Will confirm that either the local first aid and CPR training providers or a member of the SH&E Department conducts BBP training prior to first aid and/or CPR training.
- Will review all incident reports and arrange for post-exposure follow-up with Resolution Consultants' local medical provider.
- Will offer recommendations on how to prevent an incident from recurring.

4.1.4 Project Manager

- See that all recommendations made by the **SH&E Manager** are implemented.
- Support the **SH&E Manager** in their efforts to prevent occupational and non-occupational exposures to bloodborne pathogens.

4.1.5 Employees

- Use all PPE and universal precautions required to prevent exposure to infectious materials.
- Report potential exposure incidents to their supervisor or **Project Manager** immediately.

4.2 Potential Exposure Situations

4.2.1 Because of the nature of Resolution Consultants' work, it is very unlikely that employees will come in contact with bloodborne pathogens. However, there are a few activities within Resolution Consultants where occupational exposures to blood or other potentially infectious materials are of concern. These activities include:

- Investigations of properties that received regulated wastes.

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- Site visits or audits at Treatment Storage and Disposal facilities where medical waste is handled.
- Site visits or audits at medical or health care facilities.
- The provision of first aid or CPR to Resolution Consultants, subcontractor, or client personnel.

4.2.2 Although Resolution Consultants does offer first aid and CPR training to its employees on a regular basis, providing such aid is not a specified job duty of any Resolution Consultants employee and, as such, may not technically be considered occupational exposure within the context of the OSHA Bloodborne Pathogens Standard. However, Resolution Consultants chooses to provide training, personal protective equipment, and post-exposure medical follow-up to any first aid and/or CPR - trained employee who renders first aid in the office or during field activities.

4.3 Unforeseen Exposure Situations

4.3.1 Occasionally, potentially infectious material is encountered during a project where none was expected; when this happens, the work shall be stopped, employee training conducted, and an exposure control plan prepared prior to resuming activities with potential exposures.

4.4 Health and Safety Plan (HASP)

4.4.1 A site-specific HASP shall be developed for any work activities at sites that generate, store, or have received regulated wastes (see Definition). The HASP will specify:

- Work practice controls including isolating potentially contaminated materials and regulated wastes from other materials, labeling containers, barriers, and housekeeping in the project area;
- Universal precautions (PPE) to be used for affected activities;
- Recognition of potentially contaminated materials; and,
- Contact information for the Resolution Consultants Medical Director.

4.4.2 Resolution Consultants personnel shall also be prepared to follow any requirements related to a client's compliance program for bloodborne pathogens. This is particularly important when conducting site visits or audits at medical or health care facilities and TSD facilities where medical waste is handled.

4.5 Employee Training

4.5.1 All personnel who will work on projects which involve potential contact with regulated wastes will be required to attend a training class prior to the start of the project and annually for continuing projects.

4.5.2 Either of the following two sources of employee training will be used by Resolution Consultants to educate employees on the hazards of exposure to bloodborne pathogens:

- The local chapter of the American Red Cross or other recognized training provider.
- Resolution Consultants' in-house training program.

4.5.3 **Training sessions will review the following:**

- Requirements of OSHA's Bloodborne Pathogens Standard
- Review of Resolution Consultants' Bloodborne Pathogen Procedure (this document)
- Situations within Resolution Consultants that may involve exposure to bloodborne pathogens
- Bloodborne diseases and symptoms of disease
- Means of transmission
- Work practice controls to reduce risk
- Use of personal protective equipment to reduce risk
- Incident reporting

4.6 Resolution Consultants' post-exposure medical follow-up procedures:

4.6.1 When contracting for CPR and first-aid training sessions, Resolution Consultants will request that each session include a section on the hazards associated with exposure to bloodborne pathogens and protective measures that shall be followed when administering first aid, CPR, or other emergency medical care. At the end of the session, employees will be provided with a copy of this Procedure. The Procedure will be reviewed and a question-and-answer session will be conducted at the end of the presentation.

4.6.2 If the training provider cannot provide such training, Resolution Consultants will conduct a training session using a video, hand-out materials, lecture, and a question-and-answer session, prior to the start of the first aid or CPR class.

4.6.3 All personnel who will work on projects which involve potential contact with regulated wastes will be required to attend a training class prior to the start of the project and annually for continuing projects. The specific requirements and provisions of the project Exposure Control Plan shall be provided to each Resolution Consultants employee and Resolution Consultants subcontractor assigned to work at the project site.

4.6.4 Resolution Consultants will have little control over employees who have not received first aid or CPR training, but who choose to perform Good Samaritan acts. Any employee who does perform a Good Samaritan act that results in exposure to blood or other potentially infectious materials will, however, be provided with post-exposure medical follow-up as described in this Procedure.

4.7 Personal Protective Equipment

4.7.1 All body fluids and materials potentially contaminated by body fluids will be considered to be infectious unless the fluids were from the person performing the clean up or decontamination activities. All employees coming in contact with another person's body fluids shall assume that the fluids are infectious and shall wear prescribed PPE.

4.7.2 The use of PPE to prevent exposure is more appropriate for the types of occupational and non-occupational exposures Resolution Consultants employees might encounter than is the use of engineering or work practice controls that are more effectively instituted in medical care or laboratory facilities where employees are actually handling blood and other potentially infectious materials.

4.7.3 Personal protective equipment such as Tyvek coveralls, shoe covers, and gloves will be provided to all field team members involved in site activities where regulated wastes may be present. The specific PPE requirements will be identified in the site-specific HASP. The same type of PPE will also be available, if it is deemed necessary, for Resolution Consultants employees involved with activities at TSD facilities that handle regulated wastes.

4.7.4 PPE will be provided to affected employees at no cost to the employee.

4.8 First Aid Kits

4.8.1 All office and portable first aid kits used in the field will be equipped with several pairs of latex gloves, alcohol wipes for emergency hand washing, and a protective CPR shield. Extra supplies will be stocked in each office and in the field office or trailer for field projects that are longer than one month in duration.

4.9 Universal Precautions Kits

4.9.1 In those work areas where there is the potential for exposure to infectious materials, a universal precaution kit shall be readily available. The kit shall permit the clean up, neutralization, transportation, and disposal of up to 1 liter of blood or body fluids. The kit shall contain the following items at a minimum:

- Safety shield/mask combination
- Liquid proof apron
- Medical-grade vinyl/nitrile gloves
- Liquid solidifier/deodorizer
- Pickup scoop with scraper
- Red biohazard waste bag with tie
- Germicidal solution with dry wipe
- Antimicrobial hand wipe
- ID tag
- Instructions for use

4.10 Personal Hygiene

4.10.1 Special provisions will be made so that hand washing facilities are available on-site for sites that are known to be contaminated with regulated wastes. Alcohol wipes will be available in the event that hand washing facilities are not immediately available.

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4.10.2 To reduce the potential for infection, if skin contact with blood or other potentially infectious materials occurs, the exposed area should be washed with non-abrasive soap and water as soon as possible. Hand washing will also help to prevent the transfer of contamination from the hands to other areas of the body or other surfaces that may be contacted later. Even when protective gloves are worn, hands should be washed with non-abrasive soap and running water as soon as possible after the gloves are removed.

4.10.3 The use of an alcohol wipes should not be relied upon as the primary means of personal hygiene. Hands should be thoroughly washed with soap and running water as soon as possible.

4.10.4 If mucous membranes, such as the eyes, come in direct contact with blood or other potentially infectious materials, the area should be washed or flushed with water as soon as possible.

4.11 Reporting Exposure Incidents

4.11.1 All incidents in which an employee has been exposed to blood or other potentially infectious materials shall be reported to the employee's Supervisor and to the SH&E Manager. A Supervisors Accident/Incident Investigation Form shall also be completed by the Supervisor and returned to the SH&E Manager and JV SH&E Manager. After reviewing the report, the SH&E Manager will provide recommendations, when appropriate, for preventing recurrence of the incident.

4.11.2 The following are examples of exposure incidents that shall be brought to the attention of the SH&E Manager so that prompt and appropriate medical follow-up can be initiated:

- Injury (piercing, puncturing, or cutting of the skin) with a sharp object contaminated with blood or a potentially infectious material.
- Contact of an open cut, skin abrasion, dermatitis, and the mucous membranes of the eyes, mouth, or nose with blood or potentially infectious material. This would include providing unprotected, mouth-to-mouth CPR.
- Touching a contaminated object or surface and transferring the infectious material to your mouth, eyes, nose, or open skin.

4.12 Medical Follow-Up to Exposure Incidents

4.12.1 Once notified, the SH&E Manager will in turn discuss the incident with Resolution Consultants' Medical Director and/or medical provider and make arrangements for an evaluation. Prompt medical attention is important in the event of an exposure incident. If the incident occurs in the field, the employee will either be asked to visit the local hospital or if he/she chooses, return immediately to the office to visit Resolution Consultants' local medical provider.

4.12.2 An attempt will be made to test the affected employee, and if applicable, the source individual's blood, for bloodborne pathogens. No testing will be performed without the written consent of the exposed employee or the source individual. If initially, the exposed employee or the source individual does not consent to HIV serological testing, but does consent to HBV serological testing, Resolution Consultants will make provisions with the local medical provider to preserve the blood sample for at least 90 days in the event that after counseling efforts, the employee voluntarily consents to HIV testing.

4.12.3 Resolution Consultants will rely on the professional judgment of its Medical Director and/or local medical providers in the event of an exposure incident. Evaluations and follow-up procedures will be provided according to the recommendations of the United States Public Health Service (USPHS), current at the time these evaluations and procedures take place. Minimally, a post-exposure evaluation and follow-up will include the following elements:

- Documentation of the route(s) of exposure
- Circumstances under which the exposure incident occurred
- Identification and documentation of the source individual in the case of first aid or emergency medical treatments
- Collection and testing of source individuals and exposed employee's blood for HBV and HIV serological status as soon as feasible and upon consent
- Post-exposure vaccination when medically indicated, as recommended by the USPHS
- Counseling, if necessary
- Evaluation of reported illnesses

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4.12.4 Any and all follow-up recommendations offered by the physician will be immediately instituted by the SH&E Manager with the guidance of the Medical Director and/or the local medical provider and at no cost to the affected employee. Testing results, employee specific follow-up activies, etc. shall be considered personal in nature and will be handled according the JV specific guidelines (EnSafe specific or AECOM specific) by the respective JV SH&E Manager. Repeat testing, counselling, and follow-up, if recommended, will also be provided at no cost to the employee. Resolution Consultants will rely on the Medical Director and/or the local medical provider to provide counseling to employees concerning infection status, including results of and interpretation of medical tests and advising the employee about the protection of personal contacts.

4.12.5 All medical providers shall submit to Resolution Consultants' Medical Director and the affected employee a written opinion of the post-exposure evaluation within 15 days of the completion of the evaluation.

4.12.6 All medical records generated as a result of the post-exposure evaluation will be retained in the office of the Medical Director under lock and key and will be maintained with the strictest confidentiality.

4.13 Hepatitis Vaccination

4.13.1 Prior to performing field investigations where regulated wastes are stored, processed, or known to have been disposed of, Resolution Consultants will consult with the Medical Director and/or the local medical providers to determine if a hepatitis A or B vaccination is appropriate given the site conditions and the proposed scope of work. Where possible the first Hepatitis B vaccinations will be given prior to working at sites with known, potential exposures.

4.13.2 Although trained Resolution Consultants employees may provide first aid or CPR for injuries resulting from workplace accidents, Resolution Consultants employees do not provide medical assistance as part of their job or on a regular basis. Therefore, pre-exposure hepatitis vaccinations will not typically be performed for first-aid or CPR trained individuals.

4.13.3 Post-exposure hepatitis vaccination will be offered to employees involved in an exposure incident within 24 hours of possible exposure.

4.13.4 The vaccinations discussed above shall be provided to Resolution Consultants Employees at no cost to the employee.

4.14 Housekeeping

4.14.1 Other than through the provision of first aid or CPR, there is no potential for occupational exposure to blood or other potentially infectious materials within any of the Resolution Consultants offices. Therefore, the housekeeping requirements and requirements for warning signs and labels contained in the OSHA Bloodborne Pathogens standard are not applicable to our office operations.

4.14.2 When working at a site where regulated wastes have been disposed of, the specific housekeeping and warning sign requirements will be prescribed by the client and/or in the site-specific HASP.

4.14.3 When working at a client's facility, Resolution Consultants will assume the facility is in complete compliance with all the requirements of the Bloodborne Pathogens Standard and will observe all housekeeping requirements, wear required PPE, and acknowledge all warning signs and labels as specified in the client's plan. If the client does not have an effective plan, Resolution Consultants will prepare a plan as part of the project HASP.

4.15 Regulated Waste Generated by Resolution Consultants

4.15.1 Any regulated waste generated by Resolution Consultants as a result of first aid activities or clean up of potentially infectious material will be collected in sealed, watertight containers and disposed of according to the Host Employer's BBP program or transported to a local fire station or hospital for proper disposal.

4.16 Material Decontamination

4.16.1 Any areas or equipment that are contaminated by potentially infectious material will be decontaminated using a 10% solution of household bleach.

4.17 Procedure and Plan Review

4.17.1 This procedure will be reviewed at least annually and whenever necessary to reflect new or modified tasks and procedures within Resolution Consultants which may affect occupational exposure to bloodborne pathogens.

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4.17.2 All Exposure Control Plans for projects extending over one year shall be reviewed annually by the SH&E Manager.

5.0 Records

5.1.1 Each JV SH&E Manager will maintain records and provide copies of the records to the Medical Director, related to bloodborne pathogens in accordance with the provisions of the standard and *5-604 Medical Records.*

5.1.2 Records maintained in accordance with this Procedure will include bloodborne pathogens exposure incidents, post-exposure follow-up, vaccination status, and training for all employees with potential occupational exposure. Medical records will be maintained in the office of the Medical Director for the term of employment plus 30 years. Training and incident investigation documents shall be maintained by the JV SH&E department for the term of employment or 3 years whichever is longer.

5.1.3 Employee medical and training records required by this Procedure shall be provided upon request for examination and copying to the subject employee, to anyone having written consent of the subject employee, or to State, Province, or Federal Occupational Safety and Health regulatory agencies.

5.1.4 Employees may request and obtain copies of their medical records from the Medical Director.

5.1.5 If Resolution Consultants ceases to do business, Resolution Consultants shall notify the OSHA Area Director, at least 3 months prior to the disposal of the medical records and, if required by the Director to do so, transmit them to the OSHA Area Director within that 3-month period.

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05-505-Cold Stress Prevention

1.0 Purpose and Scope

1.1 To protect workers from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all workers can be repeatedly exposed without adverse health effects.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Cold Stress:** The production of physiological effects due to cold temperatures and\or wind chill.

2.2 **Frostbite:** Freezing of tissue, often resulting in tissue death.

2.3 **Hypothermia:** Condition of reduced core body temperature resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

2.4 **Wind Chill:** The effect of air movement on apparent temperature in a cold environment.

3.0 References

None.

4.0 Procedure

4.1 Restrictions

4.1.1 Staff working in extreme cold or snow for extended periods of time away from a shelter or vehicle shall not work alone.

4.1.2 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frost bite.

4.1.3 If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist.

4.1.4 Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure.

4.1.5 Try to schedule work for the warmest part of the day or when the wind is most calm.

4.1.6 Avoid exhaustion or fatigue because energy is needed to keep muscles warm.

4.1.7 Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.

4.2 Roles and Responsibilities

4.2.1 Project Managers/Field Task Managers:

- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign personnel physically capable of performing the assigned tasks.
- Confirm personnel are properly trained to recognize the symptoms of cold stress.

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4.2.2 Regional SH&E Managers:

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.2.3 Supervisors:

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.2.4 Employees:

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly vested condition.
- Report all suspected cold stress-related illnesses.

4.3 Training

4.3.1 Before they begin work, project staff who may be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress.

4.3.2 Personnel potentially exposed to cold stress will receive training including, but not limited to:

- Sources of cold stress, the influence of protective clothing, and the importance of acclimatization
- How the body loses heat.
- Recognition of cold-related illness symptoms.
- Preventative/corrective measures.
  - Employees will be informed of the harmful effects of excessive alcohol consumption in a cold stress environment.
- First aid procedures for symptoms related to cold stress.

4.4 Personal Protective Equipment

4.4.1 Wear multiple layers of clothing to maintain immobile layers of warm air next to the body.

4.4.2 Avoid cotton, especially blue jeans.

4.4.3 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Confirm extra blankets or sleeping bags are on-site.

4.4.6 Sunglasses and sunscreen should be used when there is a persistent combination of snow and direct sun.

4.4.7 If shelter is not readily available, confirm that staff carry fire starter materials (see the Safe Work Practice for Wilderness Isolation).

4.4.8 Pack warm, sweet drinks, and high-calorie food for snacks.

4.5 General Cold Stress Prevention Measures

4.5.1 In order to prevent hypothermia:

- Wear multiple layers of clothing to maintain immobile layers of warm air next to the body. Avoid cotton, especially blue jeans.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
- Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
- Next remove head gear and neck wrappings.
- Then coats/parkas should be opened at the waist and sleeves.
    - Finally, layers of clothing should be taken off.
    - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.
    - Garments worn to keep out rain and spray should also allow water vapor to escape.
    - Take advantage of heat from the sun and stay out of the wind as much as possible.
    - Have available emergency shelter providing protection from wind and rain and insulation from the ground.
    - Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
    - Get adequate rest; conserve energy.
    - Get adequate nutrition to replenish energy stores; rest after meals.
    - Drink adequate fluids to avoid dehydration.
    - If any project staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frostbite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine, particularly cigarettes, and alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8^{o}F (37°C) shall be provided to workers if work is performed in air temperatures below 40°F (5°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *05-505-Temperature Thresholds.* Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32°F (0° C) regardless of wind speed. However, older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

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4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25°F (-32° C) or below.

4.5.6 At air temperatures of 40°F (5°C) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.

4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

4.6 Cold Stress Prevention Measures for the Hands

4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:

- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60oF (15o C), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30oF (-1o C).
- If the air temperature falls below 60oF (15o C) for sedentary work, 40oF (5o C) for light work, or 20oF (-6o C) for moderate work, and fine manual dexterity is not required, workers should use gloves.

4.6.2 To prevent contact frostbite, workers should wear anti-contact gloves:

- When cold surfaces below 20°F (-6° C) are within reach, each worker should be warned to prevent inadvertent contact by bare skin.
- If the air temperature is 0°F (-18° C) or less, workers should protect their hands with mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40°F (5° C). The workers should wear cold protective clothing appropriate for the level of cold and physical activity.

4.6.4 Additional Cold Stress Prevention Measures. For work practices at or below 10°F (-12° C) ECT, the following will apply:

- The worker should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
- The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
- Workers should be instructed in safety and health procedures, which should address:
    - Proper rewarming procedures and appropriate first aid treatment.

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- Proper clothing practices.
- Proper eating and drinking habits.
- Recognition of impending frostbite.
- Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
- Safe work practices.

4.6.5 Eye protection for workers employed outdoors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

4.6.6 Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of “cryogenic fluids” or those liquids with a boiling point that is just above ambient temperature.

4.6.7 Trauma sustained in freezing or subzero conditions requires special attention, because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 Work-Warming Regimen

4.7.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below -15°F (–26°C), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure.

4.7.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.7.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.8 A change of dry work clothing should be provided as necessary to prevent workers from returning to the cold environment with wet clothing.

5.0 Records

None.

6.0 Attachments

6.1 05-505-Temperature Thresholds

6.2 05-505-Symptoms and Treatment

6.3 05-505-Cold Exposure

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05-505-Temperature Thresholds

1.0 Purpose and Scope

1.1 The following table gives apparent temperatures (wind chill) for various combinations of wind and air temperature, as well as guidelines to the danger of skin exposure.

Table 1. Wind Chill Chart (C)

Actual Temp (°C)	Wind Speed in km/hour									
	8	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**72**	**80**
	Ambient Temperature (°C)									
0	-2	-8	-11	-14	-16	-17	-18	-19	-19	-20
-5	-7	-14	-18	-21	-23	-25	-26	-27	-28	-28
-10	-12	-20	-25	-28	-31	-33	-34	-35	-36	-36
-15	-18	-26	-32	-35	-38	-40	-42	-43	-43	-44
-20	-23	-32	-38	-43	-46	-48	-50	-51	-52	-52
-25	-28	-38	-45	-50	-53	-56	-57	-59	-59	-60
-30	-33	-45	-52	-57	-61	-63	-65	-67	-67	-68
-35	-39	-51	-59	-64	-68	-71	-73	-75	-75	-76
-40	-44	-57	-65	-71	-75	-79	-81	-83	-83	-84
-45	-49	-63	-72	-78	-83	-86	-89	-90	-91	-92
-50	-54	-69	-79	-85	-90	-94	-96	-98	-99	-100

Note: A. Little Danger: if less than one hour of exposure to dry skin.
B. Danger: Exposed flesh freezes within one minute.
C. Great Danger: Flesh may freeze with in 30 seconds.

*Source: *Threshold Limit Values (TLV™) and Biological Exposure Indices (BEI™) booklet; published by ACGIH, Cincinnati, Ohio.*

Table 2. Equivalent Chill Temperature Chart (F)

Estimated Wind Speed (mph)	Actual Temperature Reading (°F)									
	50	**40**	**30**	**20**	**10**	**0**	**-10**	**-20**	**-30**	**-40**
	Equivalent Chill Temperature (°F)									
Calm	50	40	30	20	10	0	-10	-20	-30	-20
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-24	-33	-46	-58	-70
15	36	22	9	-5	18	-32	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-75	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	35	-51	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Wind speeds >40 mph have little additional effect	**LITTLE DANGER**				**INCREASING DANGER**			**GREAT DANGER**		
	Trenchfoot and immersion foot may occur at any point on this chart.									

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Table 3. Work-Warming Schedule Guidelines

Air Temp. (Sunny Sky) °F	No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind		25 mph Wind		Air Temp. (Sunny Sky) °C
	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	
above 5°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		above -15°
5° to –1°											100 min	2	-15° to -17°
0° to –4°									100 min	2	75 min	2	-18° to -20°
-5° to –9°							100 min	2	75 min	2	55 min	3	-21° to -22°
-10° to –14°					100 min	2	75 min	2	55 min	3	40 min	4	-23° to -25°
-15° to –19°			100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	-26° to -28°
-20° to –24°	100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	Cease Work		-29° to -31°
-25° to –29°	75 min	2	55 min	3	40 min	4	30 min	5	Cease Work				-32° to -34°
-30° to –34°	55 min	3	40 min	4	30 min	5	Cease Work						-35° to -37°
-35° to –39°	40 min	4	30 min	5	Cease Work								-38° to -39°
-40° to –44°	30 min	5	Cease Work										-40° to -42°
-44° & below	Cease Work												-43° & below

Modified from ACGIH 2002 Threshold Limit Values for Chemical Substances and Physical Agents.

Note 1: Schedule describes the maximum continuous duration of work and number of 10-15 minute breaks to be observed during any 4-hour work period and assumes that period will be followed by an extended warm-up period (e.g., lunch). Allowed breaks should be taken in a warm environment.

Note 2: Schedule applies to moderate to heavy work performed by acclimated workers wearing appropriate layered clothing. For light to moderate work apply the schedule for conditions one step lower. For unacclimated workers apply the schedule for conditions two steps lower. These modifications are additive.

Note 3: For work under 25%–50% overcast/clouds, apply the schedule for conditions one step lower. For work at night or under greater then 50% overcast/clouds, apply the schedule for conditions two steps lower. These modifications are additive with any applicable modifications from Note 2.

Note 4: For wind speeds in excess of 25 mph, cease all nonemergency work when temperatures fall below 5°F.

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05-505-Symptoms and Treatment

1.0 Cold Stress-related Illnesses

1.1 Frostbite

1.1.1 Frostbite is a localized cold injury characterized by freezing of the tissues with ice crystal formation.

1.1.2 This injury is almost always limited to the upper and lower extremities or to such appendages as the ears or nose.

1.1.3 Conditions conducive to frostbite include sub-zero temperatures, hypothermia (most important predisposing factor), dehydration, obstruction of the blood supply to the extremities (by constricting clothing, especially on the feet or at the wrists or ankles), contact with cold metal, contact with organic liquids (such as gasoline or solvents that have been left outdoors in sub-zero temperatures), use of substances that cause vasoconstriction (such as smoking tobacco), or other injury or shock.

1.1.4 Symptoms of frostbite include:

- Pain in the involved tissue is the earliest symptom.
- Sudden and complete cessation of cold or discomfort in affected fingers or toes, often followed by a pleasant feeling of warmth.
- Subsequently the only symptom may be the absence of any sensation in the frozen part.
- Paleness in the affected tissues.
- Firm or hard tissues.
- Purple tissue, if a large area, such as an entire hand or food, is frostbitten.

1.1.5 If exposure occurs in temperatures that are below freezing (32ºF or below), frostbite or trench foot (immersion foot) may accompany or complicate the symptoms of hypothermia. Frostbite is the freezing of living tissues with a resultant breakdown of cell structure. Symptoms due to frostbite may include, but is not limited to:

- Superficial redness of the skin
- Slight numbness
- Blisters
- Obstruction of blood flow (ischemia)
- Blood clots (thrombosis)
- Skin discoloration due to insufficient oxygen in the blood (cyanosis)

1.1.6 Frostbite may occur if the skin comes into contact with objects with a surface temperature below freezing, such as metal tool handles. Trench foot is caused by continuous exposure to cold combined with persistent dampness or immersion in water. Injuries in this case include permanent tissue damage due to oxygen deficiency, damage to capillary walls, severe pain, blistering, tissue death, and ulceration.

1.1.7 Additionally, cold exposures may either induce or intensify vascular abnormalities. These include chilblain (a swelling or sore), Raynaud's disease, acrocyanosis (blueness of hands and feet) and thromboangiitis (inflammation of the innermost walls of blood vessels with accompanying clot formation). Workers suffering from these ailments should take particular precautions to avoid chilling.

1.2 Hypothermia

1.2.1 Hypothermia is a lower than normal body temperature that occurs when outer cold cools the body faster than the body can produce heat to stay warm.

1.2.2 Hypothermia can be caused by exposure to wind, cold, and/or moisture. The combination of wind, cold, and moisture can be deadly.

1.2.3 Early warning signs of hypothermia:

- Feeling of being cold and tired.
- Heavier breathing and increased pulse rate.
- Tendency to keep moving (e.g., stamping feet, rubbing hands, continued walking/pacing).
- Goose bumps, holding arms tightly wrapped around the body, hunching of shoulders.

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- Shivering.

1.2.4 Hypothermia damages both the body's internal temperature mechanisms (hypothalamus) and the peripheral mechanisms to prevent heat loss (vasoconstriction and perspiration.) These effects may last up to three years after the initial hypothermia episode. Symptoms of hypothermia may include, but are not limited to:

- Pain in the extremities.
- Severe shivering and numbness.
- Low core body temperature.
- Drowsiness and muscular weakness.
- Apathy.
- Mental confusion.
- Loss of consciousness.
- Shock.
- Decreasing pulse and breathing rate.

2.0 Recommended Treatment for Cold Stress-related Illnesses

2.1 Frostbite

2.1.1 Wrap the victim in woolen blanket and keep dry until he or she can be brought inside.

2.1.2 Remove the victim from the cold environment.

2.1.3 Do not rub, chafe, or manipulate frozen parts.

2.1.4 Place the victim in warm water (102ºF to 105ºF) and make sure the water remains warm. Test the water by pouring it on the inner surface of your forearm. Never thaw affected body parts if the victim has to go back out into the cold; refreezing can cause significant tissue damage.

2.1.5 Do not use hot water bottles or a heat lamp, and do not place the victim near a hot stove.

2.1.6 Do not allow the victim to walk if his or her feet are affected.

2.1.7 Have the victim gently exercise the affected parts once they are thawed.

2.1.8 Seek immediate medical attention for thawing of serious frostbite.

2.2 Hypothermia

2.2.1 Bring the victim into a warm room or shelter as quickly as possible.

2.2.2 Give artificial respiration and stop any bleeding, if necessary.

2.2.3 If the victim cannot be moved (spinal injury, etc.), carefully place newspapers, blankets, or some other insulation between the victim and the ground.

2.2.4 Remove all wet clothing.

2.2.5 Provide an external heat source, because the body cannot generate its own heat. Wrap the victim in prewarmed blankets, place him or her in the liner of a portable hypothermia treatment unit, put the torso (not the extremities) into a tub of warm water, or use body-to-body contact to rewarm the body core. These measures will slowly reopen the peripheral circulation, minimizing the possibility of after-shock or after-drop (the flowing of cooled, stagnated blood from the limbs to the heart), which may cause ventricular fibrillation, cardiac arrest, or death.

2.2.6 Do not allow the victim to sleep.

2.2.7 Give warm, sweet drinks. Do not give alcohol or pain relievers.

2.2.8 Keep the victim still. Do not try to walk.

2.2.9 Do not rub numb skin.

2.2.10 Get medical attention as soon as possible.

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05-505-Cold Exposure

The following Occupational Health and Safety regulations apply directly to cold and snow hazards:

Jurisdiction	Regulation
United States	
OSHA	Title 29, Code of Federal Regulations, Sections 1910.1027 and 1926.1127
Canada	
Alberta	n/a
British Columbia	OHS Regulation (1997) Sect 7.33 – 7.38
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 4.12, 4.14
New Brunswick	OHS Regulation (91-191) Sect 44
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 10
Nova Scotia	n/a
NWT/NU Territories	n/a
Ontario	O. Reg. 851 Sect 39, 129
Prince Edward Island	OHS Regulations (EC180/87) Sect 42.1
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Schedule 4
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 70 Cold Conditions Guidelines for Outside Workers
Yukon Territory	Occupational Health Regulations (O.I.C. 1986/164) Sect 9

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5-507-Hazardous Materials Communication/WHMIS

1.0 Purpose and Scope

1.1 Provides a Hazard Communication Program so that Resolution employees are informed of the hazards of the chemicals to which they may be exposed in the course of their work by way of container labeling and other forms of warning, material safety data sheets (MSDS), and employee training.

1.2 This procedure applies to all Resolution JV Partner employees and operations.

1.3 The program applies to the use of any hazardous substances which are known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

2.0 Terms and Definitions

A complete list of definitions can be found in their entirety in the HMR, the TDG Regulations, and the IATA DGR.

2.1 **Acute Effect:** An adverse effect on the human body with immediate onset of symptoms.

2.2 **Article:** A manufactured item: (1) which is formed to a specific shape or design during manufacture; (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and, (3) which does not release or otherwise result in exposure to, a hazardous chemical, under normal conditions of use.

2.3 **Carcinogen:** Those chemicals appearing in any of the following reference sources are established as carcinogens for hazard communication purposes:

- National Toxicology Program (NTP) Annual Report on Carcinogens.
- International Agency for Research on Cancer (IARC) Monographs, Volumes 1-34. Note: The Registry of Toxic Effects of Chemical Substances published by NIOSH indicates whether a substance has been found by NTP or IARC to be a potential carcinogen.

2.4 **Chemical Name:** The scientific designation of a substance in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry or the system developed by the Chemical Abstracts Service.

2.5 **Chronic Effect:** An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

2.6 **Combustible Liquid:** Any liquid having a flash point at or above 100°F (37.8°C) but below 200°F (93.3°C), except any mixture having components with flash points of 200°F (93.3°C), or higher, the total volume of which makes up 99% or more of the total volume of the mixture.

2.7 **Common Name:** Any designation or identification such as code name, code number, trade name or brand name used to identify a substance other than by its chemical name.

2.8 **Container:** Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank or the like that contains a hazardous chemical. For purposes of this Safety Operating Procedure (SOP) and Occupational Safety and Health Administration (OSHA) standard, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

2.9 **Establishment:** Any separate and distinct Resolution office, laboratory or other company facility.

2.10 **Exposure:** Any situation arising from work operations where an employee may ingest, inhale, absorb through the skin or eyes or otherwise come into contact with a hazardous substance.

2.11 **Flammable:** A substance that falls into one of the following categories:

- **Flammable Aerosol**: An aerosol that when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening or flashback (a flame extending back to the valve) at any degree of valve opening;
- **Flammable Gas**: A gas that at ambient temperature and pressure:

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  - Forms a flammable mixture with air at a concentration of 13% of volume or less; or
  - Forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

- **Flammable Liquid**: Any liquid having a flash point below 100°F (37.8°C), except any mixture having components with flash points of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture.
- **Flammable Solid**: A solid, other than a blasting agent or explosive as defined in 8 CCR 5237(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard.
  - A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

2.12 **Flash Point:** Minimum temperature of a liquid at which it gives off sufficient vapors to form an ignitable mixture with the air near the surface of the liquid or within the container used.

2.13 **Hazardous Chemical:** Those chemicals appearing in any of the following reference sources are established as hazardous chemicals for hazard communication purposes.

- 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, OSHA.
- Hazardous Products Act, R.C.S. 1985, c. H-3, section 2, Canada
- For operations within the state of California, the list of hazardous substances prepared by the California Director of Industrial Relations pursuant to Labor Code Section 6382. The concentrations and footnotes, which are applicable to the list, shall be understood to modify the same substance on all other source lists or hazard determinations set forth in § 8 CCR 5194(d)(3)(B) and (d)(5)(D).

2.14 **Hazardous Substance:** A hazardous chemical or carcinogen, or a product or mixture containing a hazardous chemical or carcinogen provided that:

- The hazardous chemical is 1% or more of the mixture or product or 2% if the hazardous chemical exists as an impurity in the mixture; or
- The carcinogen is 0.1%or more of the mixture or product.
- Manufacturers, importers and distributors will be relied upon to perform the appropriate hazard determination for the substances they produce or sell.

2.15 The following materials are not covered by the Hazard Communication Standard:

- Any hazardous waste as defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901 et seq.) when subject to regulations issued under that act by the Environmental Protection Agency.
- Tobacco or tobacco products
- Wood or wood products. Note: Wood dust is not exempt since the hazards of wood dust are not “self-evident” as are the hazards of wood or wood products
- Consumer products (including pensm, pencils, adhesive tape) used in the work place under typical consumer usage
- Articles (i.e. plastic chairs)
- Foods, drugs, or cosmetics intended for personal consumption by employees while in the work place
- Foods, drugs, cosmetics in retail store packaged for retail sale
- Any drug in solid form used for direct administration to the patient (i.e., tablets or pills)

2.16 **Hazardous Substance Inventory (HSI):** A listing of all chemicals stored or used at an office or project site. Note that the HSI may be imbedded in a project Health and Safety Plan.

2.17 **Immediate Use:** Means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

2.18 **MSDS:** A material safety data sheet prepared pursuant to state and federal regulations, OSHA Form 174 and Canada regulations (Controlled Products regulations, schedule 1).

2.19 **MSDS Administrator:** The individual designated by the Office Manager to maintain the additional establishment-specific HSI and the MSDS binder required if that establishment uses or stores hazardous substances.

2.20 **NFPA:** A system of categories, colors and numbers was created to provide basic hazard information. It enables firefighters and other emergency personnel to easily decide whether or not to evacuate an area or proceed with emergency control operations. The three principal categories of identification are Health, Flammability and Instability. A numerical range of “0 to 4” indicates the severity of the hazard. A “4” indicates the most severe and a “0” indicates a minimal hazard.

2.21 **Mixture:** Any solution or intimate admixture of two or more substances which do not react chemically with each other**.**

2.22 **Reactivity:** A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

2.23 **Solubility:** The ability of substance to blend and mix uniformly with another.

2.24 **Specific Gravity (density):** Ratio of the weight of a substance to the weight of the same volume of another substance. As used in this directive, specific gravity or density refers to the weight of substance as compared to the weight of an equal volume of water.

2.25 **Vapor Density:** The weight of a vapor-air mixture resulting from the vaporization of a volatile liquid at equilibrium temperature and pressure conditions, as compared with the weight of an equal volume of air under the same conditions.

2.26 **WHMIS:** The Workplace Hazardous Materials Information System (WHMIS) is Canada's national hazard communication standard. The key elements of the system are cautionary labelling of containers of WHMIS "controlled products", the provision of material safety data sheets (MSDSs) and worker education and training programs.

3.0 References

None.

4.0 Procedure

4.1 All employees have a right to, and should, know the properties and potential hazards of substances to which they may be exposed.

4.2 Should Resolution assign employees that do not read and speak English to tasks with chemical exposures, communications will be provided in the language understood by that employee.

4.3 **Hazardous Waste Exemption**

4.3.1 In the U.S., hazardous wastes are excluded from the state and federal Hazard Communication standards. However, Resolution employees who handle or are otherwise exposed to hazardous wastes are covered by the requirements of the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 – Hazardous Waste Operations And Emergency Response. This standard requires that:

- Employees receive 40-hour initial and 8-hour annual SH&E training; and that
- Information on the hazards of hazardous wastes be documented in a site-specific Health and Safety Plan (HASP) and communicated to all employees in site-specific briefing on-site training required by the standard.

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4.3.2 Therefore, Resolution HAZWOPER projects are not required to comply with the requirements of this SOP as they relate to the hazardous wastes that are present at those project sites.

4.3.3 A Resolution's HASP requirements are specified in *5-509-Hazardous Waste Operations and Emergency Response.*

4.4 Hazardous Substance Inventory

4.4.1 Establishment-Specific HSI

- If an Resolution establishment uses or stores additional hazardous substances, an establishment-specific HSI must be maintained at that establishment.
- If it is determined that an office-specific HSI is needed, the Resolution **Office Manager** shall assure that one is developed and maintained by someone appointed as the establishment's MSDS Administrator.
- The content of the office-specific written inventory shall be updated as new hazardous substances are procured for, or removed from, the establishment and shall be verified by the **Regional SH&E Manager** through regular inspections of the establishment.
- In order to meet the 30-years-after-employment-termination record retention requirement, the office-specific HSIs shall be treated as a permanent record.

4.5 Material SAFETY Data Sheets

4.5.1 Establishment-Specific MSDS Inventory

- If it is determined that an Resolution establishment is required to maintain an establishment-specific HSI ,MSDSs for those specific hazardous substances must be maintained on file at that establishment.
- The **Regional SH&E Manager** shall audit the local office program for MSDS request and maintenance and report deficiencies to the appropriate management level, as necessary, to assure compliance with this SOP.

4.5.2 Field Project Sites and Client Facilities

- The **Project Manager** and/or the **Site Safety Officer** shall access or obtain, and maintain copies of MSDS from:
  - All Resolution subcontractors bringing chemicals onto the project site; and
  - The client, for all of the client's chemicals to which Resolution or Resolution subcontract employees are potentially exposed.

4.5.3 Employee Access to MSDSs

- MSDSs should be maintained at the local establishment that uses that hazardous substance. Copies of the MSDS should be made available to the employee upon request to the office's MSDS Administrator.

4.5.4 Field Access to MSDSs

- When hazardous substances are brought into the field, the user must assure that a copy of the MSDS for that substance accompanies it and is available at the field location where it is to be used.

4.5.5 MSDSs for Resolution Products

- It is unlikely that Resolution activities would create a chemical for which a new MSDS were needed. If such a chemical were created, the Corporate SH&E Department shall work with the appropriate operations groups to draft, review, and publish the new MSDS.

4.5.6 Content of the Material Safety Data Sheet

- As a minimum, the MSDS must contain the following information:
  - The name, address, and telephone number of the source of the product or material, preferably those of the manufacturer
  - The trade name and synonyms of the product or material

- Chemical names of hazardous ingredients, including, but not limited to, those in mixtures
- An indication of the percentage, by weight or volume, which each ingredient of a mixture bears to the whole mixture
- Physical data pertaining to the product or material, including boiling point (in °F); vapor pressure (in mm of mercury); vapor density of gas or vapor (air = 1); solubility in water (in percent by weight); specific gravity of material (water = 1); percentage volatile by volume (at 70 °F); evaporation rate for liquids (either butyl acetate or ether may be taken as 1); and appearance and odor
- Fire and explosion hazard data pertaining to the product or material, including flash point (in °F); flammable limits (in percent by volume in air); suitable extinguishing media or agents; special fire fighting procedures; and unusual fire and explosion hazard information
- Health hazard data pertaining to the product or material, including exposure limits, effects of overexposure and medical conditions aggravated by exposure, and emergency and first-aid procedures
- Reactivity data, including stability, incompatibility, hazardous decomposition products, and hazardous polymerization
- Procedures to be followed and precautions to be taken in cleaning up and disposing of materials leaked or spilled
- Special protection information, including use of personal protective equipment, such as respirators, eye protection, and protective clothing, and ventilation or other control measures
- Special precautionary information about handling and strong
- Any other general precautionary information

- MSDSs that do not contain this information shall be returned to the distributor or manufacturer to be updated.

4.5.7 Trade Secrets

- Some hazardous substance suppliers may claim the information requested on MSDSs is proprietary and not provide the information to Resolution.
- When MSDSs supplied to the Resolution Regional SH&E Manager indicate that proprietary information has been withheld, the Regional SH&E Manager will either obtain the necessary information to make a hazard assessment or reject the material for use within Resolution.

4.6 Labeling

4.6.1 Containers of hazardous substances used or stored in each Resolution establishment must be labeled, tagged or marked with the following information:

- Identification of the hazardous substance(s)
- Appropriate hazard warnings
- Name and address of the manufacturer, importer or other responsible parties
- Safe Handling Instructions
- Statement that an MSDS is available for the product

4.6.2 Labels on containers shall not be removed or defaced. Labels or other forms of warning shall be legible, in English and French (Canada), and prominently displayed on the container.

4.6.3 Any failure to have the appropriate labeling information on a container at any time will be cause to suspend use of the product until the container is properly labeled.

4.6.4 Carcinogen Labeling

- Chemicals which have been indicated as positive or suspect carcinogens by either OSHA, ACGIH, the International Agency for Research on Cancer (IARC) (World Health Organization), or the National Toxicology Program (NTP) will be considered to be carcinogenic for purpose of the HCS. Those chemicals identified as being “known to be carcinogenic” by NTP must have carcinogen warnings on the label and information on the MSDSs.

4.6.5 Stationary Process Containers

- If there is stationary process equipment within a work area, signs, placards, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of fixed labels on the containers, as long as the alternative method conveys the appropriate hazard information. The written materials shall be readily accessible to the employees in the work area.

4.6.6 Portable Containers

- Portable containers of hazardous substances need not be labeled when the substance is transferred from labeled containers and is intended for immediate use of the employee who performs the transfer.
- Containers of hazardous substances transferred from labeled containers and not intended for the immediate use of the employee performing the transfer shall be labeled with the chemical name and a hazard warning label in accordance with the National Fire Protection Association's (NFPA) 704M Hazard Identification System shall be attached.

4.7 Chemical Storage

4.7.1 Hazardous chemicals are to be stored in their original, labeled containers with the lids securely closed and taped if possible. Flammable and combustible materials must be stored in fire impervious cabinets in designated stockroom areas. Chemicals must be stored in compliance with instructions provided on their labels, MSDS, or the manufacturer's specifications.

4.7.2 All hazardous chemicals must be stored in a manner that prevents spillage and leakage from exposing people or the environment to the chemical.

4.7.3 Hazardous chemicals shall not be stored with foods or beverages. Food and beverages shall not be consumed in areas where hazardous chemicals are used or stored.

4.8 Chemical Use in Offices

4.8.1 In general, hazardous substances should not be taken into office areas, conference rooms, or break areas. If this general requirement is infeasible, contact the SH&E Department for guidance.

4.8.2 General exceptions to this rule are the following:

- Liquid paper
- Toner
- Cleaners
- Isobutylene calibration gas
- pH calibration solutions for instruments

4.9 Employee Information and Training

4.9.1 Each Resolution employee who handles or is exposed to hazardous substances must be provided information and training on hazardous substances in their work area.

- At the time of their initial assignment
- Whenever a new hazard is introduced into their work area

4.9.2 As a minimum, the training requirements apply to Resolution personnel in the following job categories:

- All personnel who perform field work that involves the use of, or potential exposure to, hazardous substances
- Laboratory Employees

4.10 Initial Training Content

4.10.1 The Initial Training will provide instruction in the following:

- Methods and observations that may be used to detect the presence or release of a hazardous substance in the work area (such as personal monitoring, visual appearance or odor of hazardous substances being released, etc.);

- The physical and health hazards of substances in the work area and measures and procedures Resolution has implemented to protect employees; and
- The details of this hazard communication program (SOP), including an explanation of the labeling system and the MSDS, and how he/she can obtain and use appropriate hazard information.

4.10.2 The Initial Training will also inform the employee of the following:

- Any operations in their work area in which hazardous substances are present
- Location and availability of this written hazard communications program (SOP)
- Their right to personally receive information regarding hazardous substances to which they may be exposed
- Their right to have their physician receive information regarding hazardous substances to which they may be exposed
- Their right against discharge or other discrimination (in California) due to the employee's exercise of rights afforded pursuant to provisions of the California Hazardous Substances Information and Training Act

4.11 Periodic Training and Training for Non-Routine Tasks

4.11.1 Additional training will be provided to employees who have received initial training whenever:

- A new hazardous substance is introduced into their work area
- A new or revised MSDS is received, which indicates significantly increased risks to employee health as compared to those stated on the previous MSDS
- Non-routine tasks are performed, which will potentially result in exposure to hazardous substances, or exposure under circumstances, which were not addressed during initial training

4.11.2 Supervisors, in coordination with their **Regional SH&E Manager**, shall provide such training through an explanation of the information on the contents of the MSDS for that substance.

4.11.3 When training their employees, supervisors shall explain:

- Any health hazards associated with use of the substance or mixture
- Proper precautions for handling
- Necessary personal protective equipment or other safety precautions to prevent or minimize exposure
- Emergency procedures for spills, fire, disposal, and first aid

4.11.4 For most projects involving field work, this periodic training requirement will be facilitated through the implementation of the site specific HASP that has been developed for the project.

4.12 Documentation of Initial and Periodic Training

4.12.1 All training required by this SOP shall be documented at the time it is performed by having the employee sign a copy of a training attendance sheet.

4.13 Chemical Usage

4.13.1 Prior to using any chemical, a Task Hazard Analysis (THA) shall be completed by the employees assigned to use the chemical. The analysis will identify the hazards associated with the tasks to be performed and prescribe the Personal Protective Equipment (PPE) to be used.

4.14 Office Specific Written Program

4.14.1 Each office or location using or storing hazardous materials will develop a written office/ location-specific Hazard Communication/WHMIS Program. If the local office decides to implement the requirements of the standard in any way that differs from this procedure, they shall verify the changes with the SH&E department, document the changes, and communicate the differences to all affected employees.

4.14.2 For Canadian operations, all relevant MSDS must be current (no more than 3 years) and readily available (in French and English) for all hazardous materials.

4.15 Canada-specific

4.15.1 Consumer products are exempt from supplier labels and MSDS requirements. Some cleaning solvents may be packaged as consumer products and these must be labelled in accordance with the Consumer Product Act requirements.

4.15.2 In addition to the labelling of storage containers in the workplace, the contents of process piping (including valves), process vessels and reaction vessels are required to be identified through the use of colour coding, labels, placards or other modes of identifications that must be communicated to workers through training programs. It is very important for employees to be aware of and understand Client labelling requirements for these types of process systems.

4.16 Roles and Responsibilities

4.16.1 **Regional SH&E Managers** will:

- Audit their regional offices to assure that they maintain an establishment-specific Hazardous Substance Inventory (HSI).
- Audit their regional offices to assure that if an establishment-specific HSI is required, that MSDSs are available for each substance listed on the HSI.
- Provide interpretation of MSDSs and hazard information for HMIS labels/NFPA labels and other information to assist in training employees.
- Provide hazard communication training to Resolution employees and file documents of this training in the Corporate SH&E office.
- Review MSDS for adequacy of completion to meet the OSHA and Canadian standard and returning them to supplier, if necessary.

4.16.2 **Office Managers** will:

- Have an operations-specific, written hazard communication program which at least describes how the requirements of this Procedure and the US OSHA and Canadian Hazard Communication requirements for labels and other forms of warning, material safety data sheets, and employee information and training will be met.
- Appoint an MSDS administrator for their establishment if they store or use hazardous substances.
- Confirm, if required, that the MSDS Administrator maintains an HSI for their establishment.
- Confirm that MSDS are available for all substances listed on their establishment's HSI.
- Confirm that a copy of this Procedure and the site-specific MSDS are available to all employees. Employees shall be instructed in the location of this Procedure and the MSDS.
- Confirm that all employees in their office affected by the HAZCOM standard are provided with the appropriate training, including new employees.

4.16.3 **Project Managers (field task managers, supervisors)** will:

- Confirm that all employees under their supervision have received the initial and periodic training required by this SOP prior to assigning employees to tasks involve the use of, or potential exposure to, hazardous substances.
- Notify employees of hazardous substances covered by this SOP that are used in their work area.
- Determine the potential fire, toxic, or reactivity hazards which are likely to be encountered in the handling or utilization of a hazardous substance and will communicate this information to their affected employees, before any are permitted to work with it.
- Confirm that an MSDS is available for each hazardous substance used, or potentially encountered, in the work areas or on the projects that are under their supervision.
- Notify subcontractors (working for Resolution) of any hazardous substances that are used or stored by Resolution to which the subcontractor's employees may be exposed.
- Notify clients or property owner/operators of chemicals brought onto their property by Resolution or Resolution's subcontractors.
- Request MSDSs from all subcontractor organization for the relevant chemicals they bring onto an Resolution controlled site.

4.16.4 **Employees** will:

- Confirm that they have received appropriate hazard communication training prior to working with materials that fall under the standard.
- Only work with materials for which they have been instructed on how to find an MSDS and how to work with that material safely.
- Provide a copy of all MSDSs received to the MSDS Administrator at their facility.
- Verify that an MSDS is available in their work area for each hazardous substance that they use.
- Confirm that containers of hazardous substances that they use are properly labeled.

5.0 Records

None.

6.0 Attachments

None.

5-510-Hearing Conservation Program

1.0 Purpose and Scope

1.1 Establishes procedures to confirm that personal noise exposure remains within acceptable limits and establishes the requirements of an acceptable hearing conservation program.

1.2 This procedure applies to all Resolution Consultants North America-based employees and operations.

2.0 Terms and Definitions

2.1 **Decibel (dB):** Logarithmic unit of measurement of sound level.

2.2 **Action Level:** An eight-hour, time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently; a noise dose of 50 percent.

2.3 **Standard Threshold Shift (STS):** When one's hearing threshold has changed (relative to the baseline audiogram) an average of 10 dB or more at 2000, 3000, or 4000 Hz in either ear).

2.4 **Noise Reduction Rating (NRR):** The measure, in decibels, of how well a hearing protector reduces noise, as specified by the Environmental Protection Agency.

3.0 References

None.

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Regional SH&E Managers** or their designate

- Provide access to initial and refresher hearing conservation training.
- Inform employees of noise monitoring results when full-shift noise exposure is at or above the action level.
- Designate areas and tasks where employees' exposure is at or above the action level.
- Conduct noise monitoring, as applicable, and support hazardous noise assessment/evaluation efforts.

4.1.2 **Project or Office Managers**

- Implement the hearing conservation program.
- Confirm that a hazardous noise assessment/evaluation has been conducted.
- Confirm that a hazardous noise assessment/evaluation is conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Implement engineering controls to reduce noise levels when such measures are considered feasible and when required by regulation.
- Purchase, monitor, and replenish for employees' use a supply of hearing protection devices with a minimum Noise Reduction Rating (NRR) of 26 dBA.
- Confirm that individuals included in the program receive training and that the training meets the criteria outlined in this program.
- Investigate and implement corrective action to all reports of nonconformance with this procedure, including reports of standard threshold shifts or employees' failure to wear hearing protectors in designated areas.

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4.1.3 **Supervisors**

- Maintain an awareness of the noise levels in work areas for which he/she is responsible.
- Place warning signs in areas where sound levels would require the use of hearing protectors.
- Request that a hazardous noise assessment/evaluation be conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Confirm that all employees are aware of the requirements for hearing protection for any designated area or task.
- Enforce the use of hearing protection by employees in designated areas and for designated tasks.

4.1.4 **Employees**

- Comply with the requirements of the Hearing Conservation program.
- Wear hearing protection devices in designated areas or for designated tasks.
- Inspect and maintain hearing protection devices.
- Report any suspected change in noise levels of work area to supervisor.
- Report any signs or symptoms experienced that could be the result of overexposure to noise to supervisor.
- Participate in audiometric testing and hearing protection training when required.

4.2 Requirements

4.2.1 The requirements of this procedure apply to all locations/facilities/projects where employee noise exposure may equal or exceed 50 percent of the allowable noise dose or Permissible Exposure Limit (PEL). Table 1 provides information relative to the current PEL for noise exposure expressed as a time-weighted average.

Table 1. Permissible Exposure Limit

SOUND LEVEL (dBA)	TIME (hours)
85	8
90	4
95	2
100	1
105	0.5
110	0.25
115	0.125

4.2.2 Table 2 provides information relative to the Action Level (or 50 percent allowable noise dose) expressed as a time-weighted average. The action levels outlined in the table below and PELs described in Table 1 are calculated without regard to the protection afforded by the use of hearing protectors.

Table 2. Action Levels for Hearing Conservation Program

SOUND LEVEL (dBA)	TIME (hours)
85	4
90	2
95	1
100	0.5
105	0.25

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4.3

110	0.125
115	0.0625

Training Program

4.3.1 All employees with potential exposure above the action levels established in Table 2 of this procedure or who otherwise utilize any type of hearing protector will participate in a hearing conservation training program.

4.3.2 Training Objectives

4.3.3 The initial and subsequent annual hearing conservation training will address, at a minimum, the following topics:

- The effects of noise on hearing, recognizing hazardous noise, and symptoms of overexposure to hazardous noise.
- When and/or where hearing protectors are required to be worn.
- The purpose of hearing protectors.
- The advantages, disadvantages, and effectiveness of various types of protectors.
- Instructions on how to select, use, fit, and care for hearing protectors.
- The purpose of audiometric testing, including an explanation of the test procedures.
- Hearing Conservation Program requirements and responsibilities.

4.3.4 Hearing protection training is conducted biannually for all affected employees or more frequently for employees who do not properly use hearing protectors or otherwise fail to comply with this policy.

4.4 Audiometric Testing

4.4.1 All Resolution Consultants personnel with exposure greater than the action level may be enrolled in the medical surveillance program and undergo a baseline audiogram. Thereafter, annual audiograms will be compared with the baseline exam.

4.4.2 Enrolled employees will receive audiograms during their exit physicals.

4.4.3 When a Standard Threshold Shift (STS), as identified by the Resolution Consultants Medical Consultant, is noted between the last valid baseline and the annual audiogram, the following steps will be taken:

- A retest will be conducted within 30 days to confirm the STS. The employee will not be exposed to workplace/hobby noise for 14 hours or will be provided with adequate hearing protection prior to testing.
- If the STS persists, ear protection will be upgraded to one with a greater NRR. The minimum NRR will be 26 dBA.
- The employee will be counseled and Resolution Consultants will obtain information regarding the employee's possible noise exposure away from the workplace or existing ear pathology.
- Qualified medical personnel will review the audiograms. This group will determine the need for a medical referral.
- The employee will be notified in writing by either the SH&E Department or the Resolution Consultants Medical Provider of the STS, within 21 days of determination, as required by regulation.
- The employee's supervisor will be notified of the shift in hearing threshold.

4.4.4 If the employee who has experienced an STS is exposed to 85 dBA for eight hours or 80 dBA for 12 hours, mandatory use of ear protection is required.

4.5 Monitoring of Noise Levels

4.5.1 As deemed necessary by an SH&E Professional, or a Project Health and Safety Plan, Resolution Consultants will periodically monitor personal and area noise levels using noise dosimetry and/or sound level meters.

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4.6 Hearing Protectors

4.6.1 Selection of appropriate hearing protectors must be based on actual or anticipated exposure levels. At a minimum, hearing protectors must provide a level of protection that brings actual or anticipated exposure below the PEL established for the time period shown in the table above. Additional information relative to hearing protector use is as follows:

- Hearing protection will be mandatory for all employees exposed to 85 dBA for eight hours.
- Hearing protection will be mandatory for all employees working in any area that has not been evaluated for noise exposure and the ambient noise level in the area is such that you must raise your voice to have a normal conversation with someone less than four feet from you and/or when within 25 feet of an operating piece of heavy equipment.
- Hearing protection will be mandatory for all employees who work on or near heavy equipment unless personal dosimetry or other techniques have been used to document actual exposure.
- Hearing protectors will be made available to all employees who may be exposed to 85 dBA for eight hours.
- Hearing protection will be mandatory for all employees exposed to 85 dBA for any period of time and who have experienced an STS.

5.0 Records

5.1.1 Noise exposure measurement records will be retained for three years at the project/facility.

5.1.2 Audiogram records will be retained in the employee's medical records as per Resolution Consultants' Medical Surveillance Procedure for a period as directed by regulation or Resolution Consultants' Medical Provider.

5.1.3 Employee training session documentation will be retained for the duration of employment.

6.0 Attachments

6.1 5-510-Specific Hearing Conservation Program

6.2 5-510-Hearing Protection Guidelines

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5-510-Hearing Protection Guidelines

1.0 Comparison

Comparison of Hearing Protection	
Ear Plugs	**Ear Muffs**
Advantages: • small and easily carried • convenient to use with other personal protection equipment (can be worn with ear muffs) • more comfortable for long-term wear in hot, humid work areas • convenient for use in confined work areas	***Advantages:*** • less attenuation variability among users • designed so that one size fits most head sizes • easily seen at a distance to assist in the monitoring of their use • not easily misplaced or lost • may be worn with minor ear infections
Disadvantages: • requires more time to fit • more difficult to insert and remove • require good hygiene practices • may irritate the ear canal • easily misplaced • more difficult to see and monitor usage	***Disadvantages:*** • less portable and heavier • more inconvenient for use with other personal protective equipment • more uncomfortable in hot, humid work area • more inconvenient for use in confined work areas • may interfere with the wearing of safety or prescription glasses; wearing glasses results in breaking the seal between the ear muff and the skin and results in decreased hearing protection

2.0 Care and Use

2.1 Follow the manufacturer's instructions.

2.2 Check hearing protection regularly for wear and tear.

2.3 Replace ear cushions or plugs that are no longer pliable.

2.4 Replace a unit when head bands are so stretched that they do not keep ear cushions snugly against the head.

2.5 Disassemble ear muffs to clean.

2.6 Wash ear muffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Sound-attenuating material inside the ear cushions must not get wet.

2.7 Use a soft brush to remove skin oil and dirt that can harden ear cushions.

2.8 Squeeze excess moisture from the plugs or cushions and then place them on a clean surface to air dry.

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5-510-Site-Specific Hearing Conservation Program

Site (Project)

1.0 Monitoring

As per regulation, noise monitoring will be conducted by the following procedure:

Such monitoring will consist of (*check those that apply*):

☐ Noise Dosimetry ☐ Sound Level Meter Survey

Specific instrumentation to be used is (make/model):

Make	Model

and will be calibrated at a frequency of and documented in the .

Monitoring strategy is as follows (*list all equipment and activities on site that may involve sound pressure levels above 80 dBA and an explanation of the strategy to document actual exposures*):

Area/Equipment	Monitoring Strategy

Where areas or equipment are not clearly identified, all monitoring will be documented utilizing an illustrated layout (*attach form developed for the specific site*). Monitoring frequency will be in accordance with the strategy outlined above and when the following changes in site conditions/activities occur:

1.
2.
3.
4.
5.

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2.0 Employee Notification

All site employees exposed above the regulated action level (85 dBA – 8 hour TWA) will be notified of the monitoring results by (*insert name/title*) at an interval not to exceed after completion of monitoring.

Notification shall be written, with a copy to the SH&E Department. Documentation of employee notifications and corresponding signatures of notified employees will be kept in the site health and safety logbook/files.

3.0 Observation of Monitoring

All employees affected by the monitoring, or a designated employee representative, shall be given the opportunity to observe noise monitoring procedures. This will be achieved by:

4.0 Audiometric Testing Program and Requirements

Resolution Consultants personnel who perform field activities where noise exposure above action levels is expected are required to participate in an audiometric testing program. Additionally, any subcontractors performing work on Resolution Consultants projects where noise levels exceeding action level will be required to provide documentation that they participate in an audiometric testing program that meets the applicable regulations. Documentation of participation in the testing program will be maintained by and will be located at .

5.0 Hearing Protectors and Estimating Attenuation

A selection of suitable hearing protectors will be made available to all employees who are expected to have 8-hour TWA noise exposures above 85 dBA. The types anticipated to be available include:

Protection Type	Attenuation

Hearing protector attenuation will be evaluated by for specific noise environments according to the following method prior to determining their suitability for use:

1.
2.
3.

The following site personnel will be required to wear hearing protectors during specific activities and the results of site-specific monitoring conducted in accordance with this procedure. (*This section can be completed after monitoring, if necessary*).

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Employee Name	Activity Type	Type of Protection

Hearing protectors will be properly fitted by upon initial distribution to site workers.

Training in the use and care of hearing protectors shall be conducted by during the initial site-specific health and safety training. Training contents shall meet the requirements set forth in this procedure and the applicable regulations.

Hearing protectors will be distributed by from the storage location at the .

6.0 Access to Information and Training Materials

All information required by regulation to be made available to the employees will be posted by (*insert name/title*) at the .

Local Occupational Health and Safety Regulations will also be kept on site.

7.0 Recordkeeping

Records required by Resolution Consultants' Hearing Conservation Program and Regulations shall be completed by and shall be maintained at the and placed on permanent file at the for the minimum duration required by the standard. Employees can access their individual records by contacting .

All records required by this section will be transferred to any employee's successive employer if Resolution Consultants ceases to do business.

8.0 Approvals

Project Manager: Date:

SH&E Representative: Date:

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5-511 Heat Stress Prevention

1.0 Purpose and Scope

1.1 Establishes a heat stress prevention program to help ensure that employees know and recognize the symptoms of heat stress-related illnesses and are prepared to take appropriate corrective action.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Acclimated**: Workers who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC):** Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the worker with potentially hazardous materials in the workplace. Such materials include: Tyvek® coveralls (all types) and polyvinyl chloride (PVC) coveralls and rain suits.

2.3 **Unacclimated**: Workers who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

2.4 **Heat Cramps**: A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.5 **Heat Exhaustion**: A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.6 **Heat Rash**: A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.7 **Heat Stress.** The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.8 **Heat Stroke**: The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.9 **Sunburn**: Is caused by unprotected exposure to ultraviolet light that is damaging to the skin. The injury is characterized by red painful skin, blisters, and/or peeling.

3.0 References

3.1 5-003-SH&E Training

3.2 5-208-Personal Protective Equipment

3.3 5-314-Working Alone and Remote Travel

4.0 Procedures

4.1 Restrictions

4.1.1 Staff working in extreme heat or sun for extended periods of time away from a shelter or vehicle must not work alone.

4.1.2 Staff shall not be exposed to levels that exceed those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

4.1.3 Clothing corrections shall be applied in accordance with the heat stress and strain section of the ACGIH Standard.

4.2 Roles and Responsibilities

4.2.1 Project Managers'/field task managers' responsibilities:

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- Evaluate the need for heat stress prevention measures and incorporate as appropriate into the Health and Safety Plan.
- Implement heat stress prevention measures, as applicable, at each work site.
- Develop/coordinate a work-rest schedule, as applicable.
- Ensure heat stress hazard assessments/evaluations were completed for the planned activities.
- Assign personnel physically capable of performing the assigned tasks.
- Ensure that personnel are properly trained in the recognition of heat stress-related symptoms.

4.2.2 SH&E Managers' responsibilities:

- Provide heat stress awareness training.
- Assist project teams develop appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.2.3 Site Supervisors' responsibilities:

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned employees.
- Ensure that employees have been trained on the recognition of heat stress-related illness.
- Ensure that adequate supplies of appropriate fluids are readily available to employees.
- Ensure that a proper rest area is available.
- Conduct heat stress monitoring, as applicable.
- Implement the work-rest schedule.
- Ensure that first aid measures are implemented once heat stress symptoms are identified.
- Ensure personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat stress-related illnesses.

4.2.4 Employees' responsibilities:

- Observe each other for the early symptoms of heat stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.3 Controls

4.3.1 If staff are or may be exposed, the supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of workers, and
- Develop and implement a heat stress exposure control plan.

4.3.2 If staff are or may be exposed, the supervisor shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of staff to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

4.3.3 If engineering controls are not practicable, the supervisor shall reduce the exposure of workers to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If staff are or may be exposed, the supervisor shall provide and maintain an adequate supply of cool, potable water close to the work area for the use of a heat exposed worker.

4.3.5 If a staff person shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant, if available, or by a physician.

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4.3.6 Heat stress can be a significant field site hazard, especially for workers wearing CPC. The workforce will gradually work up to a full workload under potentially stressful conditions to allow for proper acclimation.

4.3.7 Site personnel shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Workers must be encouraged to immediately report any heat stress that they may experience or observe in fellow workers. Supervisors must use such information to adjust the work-rest schedule to accommodate such problems.

4.3.8 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow workers to loosen or remove protective clothing, and sufficient seating should be available for all personnel. During breaks, workers must be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.4 Symptoms and Treatment

4.4.1 Workers who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin), shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.4.2 Anyone exhibiting symptoms of heat stroke (red, dry skin, or unconsciousness) must be taken immediately to the nearest medical facility, taking steps to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.4.3 Severe heat stress (heat stroke) is a life-threatening condition that must be treated by a competent medical authority.

4.5 Prevention

4.5.1 All staff working in extreme heat or sun should understand the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- If you experience heat exhaustion or heat stroke you must immediately seek shelter and water.
- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.

4.5.2 Prevention of heat-related illnesses:

- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Avoid sudden changes of temperature. Air out a hot vehicle before getting into it.
- If you take diuretics, ask your doctor about taking a lower dose during hot weather.
- Drink 8 to 10 glasses of water per day. Drink even more if you are working or exercising in hot weather.
- Avoid caffeine and alcohol as they increase dehydration.
- If you exercise strenuously in hot weather, drink more liquid than your thirst seems to require.

4.6 Personal Protective Equipment

- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 Work-Rest Schedule Practices

- Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.
- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 oz. per hour during the work shift; fluid replacement at frequent intervals is most effective.

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- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.
- Additional salt is usually not needed and salt tablets should not be taken.
- Replacement fluids should be cool, but not cold.
- Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.
- Dry clothing or towels will be available to minimize chills when taking breaks.
- Manual labor will not be performed during breaks, other than paperwork or similar light tasks.
- Other controls that may be used include:
  - Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
  - Erecting a cover or partition to shade the work area.
  - Wearing cooling devices such as vortex tubes or cooling vests beneath protective garments. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the work supervisor must continually evaluate its effectiveness through observation of workers for signs/symptoms of heart stress. Measurement of each worker's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate, and is accomplished as follows:

4.8.2 At the start of the workday each worker's baseline pulse rate (in beats per minute – bpm) is determined by taking a pulse count for 15 seconds and multiplying the result by four or an automated pulse count device may be utilized. Worker pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- Each worker's maximum heart rate at the start of any break should be less than [180 minus worker's age] bpm. If this value is exceeded for any worker, the duration of the following work period will be decreased by at least 10 minutes.
- At the end of each work period all workers' heart rates must have returned to within +10% of the baseline pulse rate. If any worker's pulse rate exceeds this value the break period will be extended for at least 5 minutes, at the end of which pulse rates will be remeasured and the end-of-break criteria again applied.

4.8.3 Use a clinical thermometer or similar device to measure the oral/ear temperature at the beginning (before drinking liquids) and end of each break period and apply the following criteria:

- If the oral temperature exceeds 99.6^{o}F, shorten the next work cycle by one-third without changing the rest period.
- If the oral temperature still exceeds 99.6^{o}F (36.6^{o}C) at the beginning of the next rest period, shorten the following work cycle by one-third.

4.8.4 Use of an automated or similar blood pressure device will be used to assess each employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an employee is outside of 90/60 to 150/90, then the employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be remeasured and the end-of-break criteria again applied.

4.8.5 All physiological monitoring of heat stress will be documented using *5-511-Heat/Cold Stress Monitoring Log*.

4.9 Training

4.9.1 Project staff and their supervisors that may be exposed to the hazard will be oriented to the hazard and the controls prior to work commencing.

4.9.2 Those personnel potentially exposed to heat stress will receive training including, but not limited to

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- Sources of heat stress, influence of protective clothing, and importance of acclimatization.
- How the body handles heat.
- Recognition of heat-related illness symptoms.
- Preventative/corrective measures.
    - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
    - All employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses.

5.0 Records

None.

6.0 Attachments

6.1 5-511-FM Heat/Cold Stress Monitoring Log

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5-511 Form 1 Heat Stress Monitoring Log

The purpose of this form is to track entry into hot zones wearing chemically protective clothing and monitor employees for heat stress-related illness. It is the responsibility of the foreman or supervisor-in-charge to ensure that each person entering the hot zone completes the required information. Vital signs must be taken by a competent person.

Project Name:			**Foreman/Supervisor:**									**Work/Rest Schedule1:** IN *(min)* OUT *(min)*				
Date:	**Water Provided[2]**		**Acclimated[3]**		**Initial Vitals[3]**	**Vital Signs and Time In/Out[4]**										
Employee Name	Yes	No	Yes	No	**Vitals**	In	Out	**Vitals**	In	Out	**Vitals**	In	Out	**Vitals**	In	Out
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
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					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
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					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		

1. Please refer to 5-511 Heat Stress. Section 6.3 provides specific details on how to develop a work-rest schedule.
2. Each employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.
3. A worker is "acclimated" if he/she has worked in a hot environment for at least 7 to 10 consecutive days. If a worker is acclimated, check "Yes." If a worker is not acclimated, check "No" and reduce the "Min In" by 50 percent for that employee until the 7- to 10-day period is reached.
4. "Vitals" refers to employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work operations in the hot zone. Each time the employee exits the hot zone, vitals must be taken and evaluated for heat stress criteria. Section 6.4 of 5-511 Heat Stress provides specific instructions for taking and evaluating employee vital signs.
5. Body temperature vital signs will be recorded in °F.

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5-514-MEC/UXO Response Procedures for Non-MEC Operations

1.0 Introduction

1.1 The potential presence of MEC/UXO at a site presents hazards to personnel performing site assessment operations both on the ground surface while conducting surface operations and in the subsurface while conducting intrusive operations, such as excavating, trenching, soil boring or drilling. For all sites where it has been determined that there is alow probability of encountering MEC/UXO, the following Response Procedures should be followed.

1.2 The basic policy to be observed regarding MEC/UXO is:

1.3 *DO NOT TOUCH IT*. Follow the 3Rs: RECOGNIZE, RETREAT AND REPORT. In addition, use the following information to minimize the hazards to personnel from MEC/UXO.

1.4 All personnel must be briefed concerning the potential MEC/UXO hazards in surface areas when a low probability of encountering MEC/UXO exists at a site.

2.0 MEC/UXO in Surface Areas

2.1 During field activities, MEC/UXO items may be present on the ground surface and present a potential hazard to employees. When moving about the site personnel should remain alert for any MEC/UXO items which might be present. Each work site should be thoroughly checked for the presence of MEC/UXO before any other activities commence.

2.2 In the event that any MEC/UXO item is observed or expected, the following will requirements will be observed:

2.2.1 Personnel should mark the location of the MEC/UXO item with highly visible marking tape and alert all other personnel in the area to its presence. If possible, use GPS to record the waypoint of the suspect item.

2.2.2 Any non-MEC Resolution Consultants work operations occurring in the area will cease and all Resolution Consultants and subcontractor employees will evacuate the area.

2.2.3 Under no circumstances will any Resolution Consultants or subcontractor employee attempt to move or otherwise handle any MEC/UXO orsuspected MEC/UXO item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.

2.2.4 The client representative will be immediately informed about the MEC/UXO discovery and provided the location of the suspected item.

3.0 Excavating and Trenching Activities

Excavation activities may expose subsurface MEC/UXO items. Throughout the excavation work a member of the site team will be posted as an observer, with the responsibility to monitor the trench conditions and observe if any suspected MEC/UXO items may be present. In the event that any MEC/UXO item is encountered during excavation, the following procedures will be observed.

3.1 **MEC/UXO Item Observed in the Trench**

3.1.1 The work operation will cease **immediately**. Personnel will evacuate to a safe area/distance.

3.1.2 The area will be delineated using yellow CAUTION tape or bright paint. No stakes or rods will be driven into the ground to support the tape.

3.1.3 Responsibility for the work location will be transferred to the installation or client.

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3.2 **MEC/UXO Item Observed in the Spoils**

3.2.1 The work operation will cease immediately and all personnel will evacuate to a safe area/distance. The equipment will be left in place.

3.2.2 Delineate MEC/UXO with yellow caution tape or bright paint.

3.2.3 All Resolution Consultants and subcontractor employees will evacuate this area.

3.2.4 Under no circumstances will any Resolution Consultants or subcontractor employee attempt to move or otherwise handle any MEC/UXO/suspected MEC/UXO item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.

3.2.5 The operations manager or safety officer will be alerted as to the location of the suspected item, and responsibility for the work location will be transferred to the installation or client.

3.3 **MEC/UXO Item Encountered and Detonation Occurs**

3.3.1 The work operation will cease immediately. Personnel will evacuate to a safe area/distance, upwind, minimum 1,250 feet.

3.3.2 If injuries have occurred, the Emergency Action Plan will be activated.

3.3.3 Equipment will be left in place.

3.3.4 Responsibility for the work location will be transferred to the installation or client.

3.3.5 Once equipment is recovered it will be thoroughly inspected for damage before being put back into service.

4.0 Drilling Activities

In the event that any MEC/UXO item is encountered during drilling, the following procedures apply.

4.1 **MEC/UXO Item Believed to be Encountered Downhole but No Detonation Occurs**

4.1.1 The work operation will cease immediately.

4.1.2 If drilling, the drilling auger will be blocked in place and disconnected from the drill rig. The equipment (drill rig, backhoe, etc.) will be withdrawn from the site and the area will be delineated using yellow CAUTION tape.

4.1.3 Responsibility for the work location will be transferred to the installation or client.

4.2 **MEC/UXO Item Observed in the Spoils**

4.2.1 The work operation will cease immediately and all personnel will evacuate the area. The equipment will be left in place.

4.2.2 Delineate MEC/UXO with yellow caution tape or bright paint.

4.2.3 All Resolution Consultants and subcontractor employees will evacuate this area.

4.2.4 Under no circumstances will an Resolution Consultants or subcontractor employee attempt to move or otherwise handle any MEC/UXO or suspected item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.

4.2.5 The operations manager or safety officer will be alerted as to the location of the suspected item, and responsibility for the work location will be transferred to the installation or client.

4.3 **MEC/UXO Item Encountered Downhole and Detonation Occurs**

4.3.1 The work operation will cease immediately.

4.3.2 If injuries have occurred the Emergency Action Plan will be activated. Once any necessary immediate response actions have been completed, the drilling auger will be blocked in place and disconnected from the drill rig. The drill rig will then be withdrawn from the site and the area will be delineated using yellow CAUTION tape.

4.3.3 Responsibility for the work location will be transferred to the installation or client.

4.3.4 The drill rig will be thoroughly inspected for damage before being put back into service.

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5-514-Munitions and Explosives of Concern/ Unexploded Ordnance (MEC/UXO)

1.0 Purpose and Scope

1.1 This SOP presents procedures for obtaining Munitions and Explosives of Concern (MEC) support during the planning or performance of environmental practice-based projects such as Hazardous, Toxic, and Radioactive Waste (HTRW) investigations and remedial construction activities. MEC support activities include anomaly avoidance and surface and subsurface removal activities.

1.2 This SOP was developed to provide Resolution Consultants personnel guidance on the procedures and requirements involved in recognizing and mitigating the potential hazards associated with MEC and Material Potentially Presenting an Explosive Hazard (MPPEH) that may be encountered during field operations.

2.0 Terms and Definitions

2.1 **Anomaly**: Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity would deviate from the expected subsurface ferrous and non-ferrous material at a site (i.e., pipes, power lines, etc.).

2.2 **Anomaly Avoidance**: Techniques employed on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), and munitions constituents in high enough concentrations to pose an explosive hazard (regardless of configuration), in an effort to avoid contact with potential surface or subsurface explosive hazards, thus allowing entry to the area for the performance of required operations.

2.3 **Construction Support**: Assistance provided by UXO-qualified personnel and/or by personnel trained and qualified for operations involving MEC during intrusive construction activities on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, regardless of configuration, to ensure the safety of personnel or resources from any potential explosive hazards.

2.4 **Discarded Military Munitions (DMM):** Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations (10 U.S.C. 2710(e)(2)).

2.5 **Exclusion Zone**: Safety zone established around the MEC work area. Only essential project personnel and authorized escorted visitors are allowed within the exclusion zone. Those authorized to be in the exclusion zone are primarily the personnel performing the MEC removal tasks and those overseeing such personnel. Examples of exclusion zones are safety zones around MEC intrusive activities and safety zones where MEC is intentionally detonated.

2.6 **Explosive Hazard:** A condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) in a mishap with potential unacceptable effects (e.g., death, injury, damage) to people, property, operational capability, or the environment.

2.7 **Explosives or Munitions Emergency Response**: All immediate response activities to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render-safe procedures, treatment or destruction of the explosives or munitions, and/or transporting those items to another location to be rendered safe, treated, or destroyed. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities (Military Munitions Rule, 40 CFR 260.10).

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2.8 **Geophysical Techniques**: Techniques utilized for the detection and measurement of buried anomalies (e.g., ferromagnetic indicators and ground penetrating radar) to investigate the presence of munitions.

2.9 **Hazardous, Toxic, and Radioactive Waste (HTRW) Activities**: HTRW activities include those activities undertaken for the Environmental Protection Agency's Superfund program, the Defense Environmental Restoration Program (DERP), including Formerly Used Defense Sites (FUDS), and Installation Restoration Program (IRP) sites at active DoD facilities, HTRW actions associated with Civil Works projects, and any other mission or non-mission work performed for others at HTRW sites.

2.10 **Material Documented as Safe (MDAS**): MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

2.11 **Material Documented as an Explosive Hazard (MDEH):** MPPEH that cannot be documented as MDAS, for which the maximum explosive hazards the material is known or suspected to present has been assessed and documented, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH. (The MDEH characterization only addresses the explosives safety status of the material.)

2.12 **Material Potentially Presenting an Explosive Hazard (MPPEH**): MPPEH is material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris), or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations).

2.13 **Military Munitions**: Ammunition products and components produced for or used by the armed forces for national defense and security. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, riot control agents, smokes, incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

2.14 **Minimum Separation Distance (MSD):** MSD is the distance at which personnel in the open (unprotected) shall be from an intentional or unintentional detonation based on the Munition with the Greatest Fragmentation Distance (MGFD).

2.15 **Munition with the Greatest Fragmentation Distance (MGFD):** The munition with the greatest fragment distance that is reasonably expected (based on research or characterization) to be encountered in any particular area.

2.16 **Munitions and Explosives of Concern (MEC):** This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means: (a) Unexploded ordnance (UXO), as defined in 10 U.S.C. 101(e)(5); (b) discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (c) munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

2.17 **Munitions Response**: Response actions, including investigation, surface and subsurface removal actions and remedial actions to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.

2.18 **Munitions Response Area (MRA):** An area, located on a defense site, that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area may be comprised of one or more munitions response sites.

2.19 **Munitions Response Site (MRS):** A discrete location within an MRA that is known to require a munitions response.

2.20 **Unexploded Ordnance (UXO):** Military munitions that (a) have been primed, fuzed, armed, or otherwise prepared for action; (b) have been fired, dropped, launched, projected, or placed in such a

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manner as to constitute a hazard to operations, installations, personnel, or material; and (c) remain unexploded either by malfunction, design, or any other cause (10 U.S.C. 101(e)(5)(A) through (C)).

2.21 **UXO Qualified Personnel**: Personnel who have performed successfully in military EOD positions or are qualified to perform in the following Department of Labor, Service Contract Act, or Directory of Occupations contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist or Senior UXO Supervisor (DDESB TP-18).

3.0 References

3.1 Applicable sections and paragraphs in the documents listed below are primarily used as references for the planning and execution of UXO operations:

3.1.1 OSHA General Industry Standards, 29 CFR 1910;

3.1.2 OSHA Construction Standards, 29 CFR 1926;

3.1.3 USACE EM 385-1-1, Safety and Health Requirements Manual;

3.1.4 DoD 4160.21-M, Defense Reutilization and Marketing Manual;

3.1.5 Applicable sections of 49 CFR Parts 100 to 199.

3.1.6 DoD 6055.9-STD, DOD Ammunition and Explosives Safety Standards;

3.1.7 DA PAM 385-64, Ammunition and Explosives Safety Standards;

3.1.8 TM 9-1300-200, Ammunition General;

3.1.9 TM 9-1300-214, Military Explosives;

3.1.10 USACE EP 385-1a, Basic Safety Concepts and Considerations for Ordnance and Explosives Operations;

3.1.11 USACE EP 75-1-2, MEC Support During HTRW and Construction Activities;

3.1.12 USACE EM 385-1-97, Explosives Safety and Health Manual;

3.1.13 USACE EM 1110-1-4009, Military Response Actions; and

3.1.14 DDESB TP 18, Minimum Qualifications for UXO Technicians and Personnel

4.0 Procedure

4.1 EC hazards are generally encountered on land surfaces, subsurface, and within bodies of water formerly occupied and/or used by the Department of Defense (DoD). Despite efforts to remove and cleanup potential MEC hazards prior to releasing the land from DoD control, some MEC items may remain.

4.2 Even though evidence of MEC is not observable on the ground surface at a site, MEC hazards may be present on former DoD property.

4.3 MEC hazards may be present underground from remaining impacted items or may have been pushed into depressions and covered with dirt, water, or intentionally buried in pits.

4.4 General Requirements

4.4.1 Prior to beginning any activities on a site suspected of former DoD munitions use, every effort shall be made to determine whether munitions-related activities ever occurred on the specific work area or within waters on which Resolution Consultants operations/activities will take place. Normally the client, based on available historical documents or prior environmental response actions, will make an assessment determination for encountering MEC. This determination should be documented and provided to the Resolution Consultants project managers and used to plan the appropriate level of MEC/UXO support required (e.g., no support, standby or on-call support, or a removal action within the work site footprint).

4.4.2 All Munitions and Explosives of Concern (MEC) or Material Presenting a Potential Explosive Hazard (MPPEH) encountered on Resolution Consultants jobsites shall be treated as extremely dangerous and shall be reported immediately. MEC or MPPEH, regardless of age or condition, shall be handled by UXO-qualified personnel only as defined by DDESB TP 18.

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4.4.3 Resolution Consultants has established an Military Munitions Response Group at the 4840 Cox Road Glen Allen, Virginia, office. This group is staffed with UXO-qualified personnel and serves as the company's technical center of expertise for work activities involving the detection, evaluation, handling, and remediation of MEC. For Resolution Consultants activities where the known or suspected presence of MEC may impact work activities (non-MEC procedures), the MEC Group will provide technical support, including worker familiarization training and on-site support as needed.

4.4.4 On sites that have not been identified as having MEC or explosives contamination where Resolution Consultants personnel have been contracted to perform environmental practice-based tasks, the following actions should be taken if suspect items are encountered.

4.5 Response Actions

4.5.1 If MEC or MPPEH is encountered or suspected to have been encountered, *DO NOT TOUCH IT*. Follow the 3Rs: RECOGNIZE, RETREAT, AND REPORT.

4.5.2 Identify the location, notify other team members, keep all unnecessary personnel out of the area and report the finding to your supervisor. The site is now considered a potential munitions response site (MRS). *Note: The general location of the MEC hazard should be marked with tape, colored cloth, or colored ribbon. If available, attach the marker to a branch, structure, or other existing object so that it is about 3 ft (.9 m) off the ground and visible from all approaches. Place the marker no closer than the point where you first recognized the MEC hazard, and do not drive stakes into the ground or otherwise disturb the surface. If possible, use GPS to record the waypoint of the suspect item.*

4.5.3 Any time suspected MEC is encountered while working on a non-DoD installation, immediately call the local emergency response authority (e.g., local police, sheriff, or 911) to report the finding.

4.5.4 If encountered on an active DoD installation, immediately notify your supervisor, Government Designated Authority (GDA), and installation Point of Contact (POC), who will contact and facilitate military EOD response.

4.5.5 Ensure that the Resolution Consultants SH&E Department is notified of the presence of known or suspected MEC or MPPEH items on any work site prior to initiating field activities. This type of finding represents a potential change in scope, and the appropriate hazard analysis shall be completed prior to beginning any operations involving the MEC or MPPEH. An outline of Response Procedures for non-MEC operations is included as an attachment to this document.

4.6 Probability Assessment

4.6.1 If the site has a minimal probability of encountering MEC (e.g., current or previous land use leads to an initial determination that MEC or MPPEH is not present), no UXO support is required.

4.6.2 If the site has a low probability of encountering MEC (e.g., current or previous land use leads to an initial determination that MEC or MPPEH *may* potentially be present), only MEC standby support will be required.

4.6.3 If the probability of encountering MEC is moderate to high (e.g., current or previous land use leads to a determination that MEC was employed or disposed of within the work site or area of concern), UXO-qualified personnel shall conduct a surface clearance/removal for all areas within the proposed limits of disturbance for the planned site activities and subsurface clearance/removal any areas where intrusive type activities are to occur (i.e., sampling locations, well installation, construction footprint and access routes).

4.6.4 If MEC or MPPEH is discovered at any point in time by site personnel, the response actions in Section 4.2 should be followed (RECOGNIZE, RETREAT, REPORT) and the probability assessment will be re-evaluated.

4.7 Resolution Consultants MEC/UXO Avoidance Support

4.7.1 During the investigative/design phase of any project on a site known or suspected to contain MEC, a probability assessment will be conducted and provisions for MEC support (if necessary) will be included in the project planning phase. For sites requiring investigation activities other than the identification and removal of MEC/UXO, MEC support refers to MEC/UXO or anomaly avoidance techniques implemented to avoid any potential encounter with surface and/or subsurface MEC items or anomalies. Intrusive activities for anomaly investigations are not authorized during anomaly avoidance activities. The appropriate level of support for these sites will be determined on a case-by-case basis by the project delivery team (PDT).

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4.7.2 During MEC/UXO or anomaly avoidance activities, Resolution Consultants will provide a UXO team consisting of a minimum of two personnel, one of whom shall be a UXO Technician III. This individual will be the UXO team leader. The UXO team shall be on site during all sampling activities. The UXO team may include additional UXO-qualified personnel, geophysicists, or any other team member, depending on site- and task-specific conditions/requirements.

4.8 Standby Support

4.8.1 If the probability of encountering MEC is low (e.g., current or previous land use leads to an initial determination that MEC may be present), only MEC standby support will be required.

4.8.2 The UXO team will meet with on-site management and construction personnel and conduct a general work and safety briefing, including:

- Probable site hazards and site-specific safety considerations.
- MEC standby support procedures.
- Responsibilities and lines of authority for any MEC response.
- Emergency response procedures.

4.8.3 The UXO team will physically preview the actual construction footprint with the onsite management of the construction team and discuss visual observations and potential areas of concern. In the event that surface MEC is discovered, the UXO team will place flagging adjacent to the discovery for subsequent visual reference, select a course around the item, and lead any on-site personnel out of the area. The UXO team will assess the condition of the MEC to determine if a disposal action is required.

4.8.4 When MEC is found on the surface, the PDT will perform a detailed assessment of the site to determine if the potential for encountering MEC is still low. If the potential for encountering MEC is raised to moderate to high, a subsurface removal for the construction footprint will be required.

4.9 Anomaly Avoidance

4.9.1 This paragraph discusses anomaly avoidance procedures during the investigative/design phase of any project on a site with known or suspected MEC on HTRW sites. Procedures are implemented to include, but are not limited to, surveying and mapping, environmental and natural resource assessments, surface and subsurface sampling, boring and drilling, and groundwater monitoring.

4.9.2 The purpose of anomaly avoidance is to avoid any potential surface MEC and MPPEH and subsurface anomalies during sampling activities. *Intrusive anomaly investigation is not authorized during anomaly avoidance operations.*

4.9.3 The Resolution Consultants Military Munitions Response Group will prepare a Work Plan detailing MEC procedures to supplement the HTRW Work Plan/Site Plan and provide additional safety precautions specific to the tasks to be performed to be included in the safety documents.

4.9.4 The UXO team members have the following responsibilities for anomaly avoidance procedures during an HTRW investigation project on a site with known or suspected MEC:

- Provide the MEC recognition, location, and safety functions for the HTRW personnel during HTRW field activities;
- Conduct MEC safety briefings for all site personnel and visitors.

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4.9.5 The senior UXO qualified person has final on-site authority on MEC procedures and explosive safety issues.

4.10 Access Surveys

4.10.1 HTRW sampling personnel shall be escorted by UXO-qualified personnel at all times in areas potentially containing MEC until the UXO team has completed the access surveys and the cleared areas have been marked. Escorted HTRW personnel will follow behind the UXO escort. If anomalies or MEC are detected, the UXO escort will halt escorted personnel in place, select a course around the item, and instruct personnel to follow.

4.10.2 The UXO team shall conduct a surface access survey and a subsurface survey for anomalies before any type of activities commence, including foot and vehicular traffic. Typically, the access route will be at least twice as wide as the widest vehicle that will use the route.

4.10.3 The UXO team shall also complete an access survey of an area around the proposed investigation site that is large enough to support all planned operations. The size of the surveyed area will be site-specific and will take into account, for example, maneuverability of required equipment (e.g., drill rigs, excavation equipment), parking of support vehicles, and establishment of decontamination stations. As a minimum, the surveyed area will have a dimension in all directions equal to twice the length of the longest vehicle or piece of equipment to be brought on site.

4.10.4 Geophysical instrumentation capable of detecting the smallest known or anticipated military munition will be used to locate anomalies just below the surface that may be encountered through erosion from rain or continual vehicular traffic.

4.10.5 If anomalies or surface MEC are encountered, they will be marked with flagging and the investigation area will be relocated to avoid contact. The UXO team will clearly mark the boundaries of the surveyed area using survey flagging and pin flags. The UXO team will establish a system of flagging colors that will distinguish anomalies, surface MEC, and route boundaries from each other as well as from any utility markings that have been used at the site.

4.10.6 If surface MEC is encountered, the UXO team will assess the condition of the MEC to determine if a disposal action is required. No personnel will be allowed outside the surveyed areas.

4.11 Subsurface Geophysical Survey

4.11.1 The UXO team shall complete a subsurface geophysical survey of the subsurface sampling locations or well installation. If an anomaly is detected, HTRW sampling personnel shall select a new sampling location. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance.

4.11.2 If the subsurface sampling or well installation depth is greater than the geophysical instrument's detection capabilities, the UXO team shall incrementally complete the geophysical survey as outlined below.

4.11.3 Once an access survey has been completed, the UXO team will install a pilot hole at each proposed drill hole location, using a hand auger. While the UXO team is completing the geophysical survey, the remaining project personnel shall withdraw out of the immediate area to a distance determined by the senior UXO personnel. If an anomaly is detected, the pilot hole will be backfilled in accordance with site-specific procedures and HTRW sampling personnel shall select a new drill hole location. As long as no anomalies are detected, the pilot hole will be advanced to the maximum reach of the auger or to the maximum depth of the proposed drill hole, whichever is less.

4.11.4 During the excavation of the pilot hole, the auger will be withdrawn and the hole checked for anomalies every 12 inches. The pilot hole will also be inspected upon reaching the final depth, providing a total clearance depth equal to the pilot hole depth plus 12 inches.

4.11.5 In cases where the pilot hole does not reach the full depth of the proposed boring (e.g., the proposed depth of the drill hole is more than the maximum depth of the auger, or the UXO team cannot penetrate the soils using the auger), the drill rig may be brought on-site and advanced in 12-inch increments beyond the clearance depth of the pilot hole. At the end of each 12-inch increment, the drill rig's auger shall be withdrawn from the hole so that the UXO team may screen for anomalies as described above. As necessary with loose soils, a polyvinyl chloride (PVC) pipe (minimum 3 inches inner diameter) will be inserted to keep the hole open and to allow for incremental geophysical screening.

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4.11.6 When working in ordnance impact areas, the UXO team may discontinue incremental screening once the drilling has extended to depths of 30 feet below ground surface, the depth of penetration of the MEC has been exceeded, or the planned depth of drilling has been reached.

4.11.7 For all other areas, incremental screening will be determined based on an assessment of the site's characteristics and history.

4.12 Recovered Chemical Warfare Materials (RCWM)

4.12.1 Any time that RCWM or munitions with unknown fillers are encountered during MEC support, all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of a minimum of two personnel will secure the area to prevent unauthorized access. Personnel will position themselves as far upwind as possible while still maintaining the security of the area.

4.13 Notification

4.13.1 When RCWM or munitions with unknown fillers are identified on formerly used defense site (FUDS) project sites, the UXO team will notify the local POC designated in the Work Plan. The local POC will facilitate the military EOD unit's response, and two Resolution Consultants personnel will secure the site until the EOD unit's arrival. If the local POC designated in the Work Plan is not the local law enforcement agency, the local POC will inform the local law enforcement agency of the discovery.

4.13.2 The EOD unit will notify the U.S. Army Technical Escort Unit (TEU) and secure the area until arrival of TEU.

4.13.3 On active installations, the UXO team will normally notify the Range Control Officer, the Facility Engineer, Post Headquarters, or the POC designated in the Work Plan.

4.14 SH&E Department Requirements

4.14.1 The **Military Munitions Response Group** and **SH&E Department** provides support to project managers in the management of the safety responsibilities associated with work locations where MEC items are known or suspected to be present. The Military Munitions Response Group and SH&E Department will:

- Review and approve site-specific MEC hazard assessment for each work site where the presence of MEC is known or suspected.
- Review and approve the Accident Prevention Plan (APP) and Site Health and Safety Plan (SSHP) to be implemented to control the potential hazards associated with the performance of planned work activities in areas of known or suspected MEC.
- Investigate any reported unsafe acts or conditions.
- Ensure that the **Resolution Consultants** MEC Group is involved in all projects with a known or suspected presence of MEC.

4.15 Training

4.15.1 UXO Personnel Training Requirements

- **Resolution Consultants** personnel working through the Military Munitions Response Group who inspect, process, or document material as safe or hazardous will be trained in the recognition and safe handling of used and unused military munitions and specific types of MPPEH and procedures that apply to MPPEH, MDEH, and MDAS that are to be released. Personnel will meet the qualification requirements of Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 18 and will demonstrate training and experience in the recognition and safe handling of military munitions and other MPPEH and processing of material.
- These individuals shall be certified, in writing, as being technically qualified according to the standards provided in DoDI 4140.62, November 25, 2008, and USACE guidance on the management of MPPEH and be certified in conformance with contract requirements.
- The UXO technicians will receive operational briefings and training on their duties and responsibilities for each task to be performed.

4.15.2 Non-UXO Personnel Training Requirements

- Site-specific UXO awareness training will be provided for all personnel assigned to each work site. The purpose of this training is to ensure that all personnel fully understand the procedures and methods that will be used to perform operations at the project site, their individual duties and

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responsibilities, and any and all safety and environmental practices/procedures associated with operations. All personnel will be trained before they are allowed to work on site and will receive ordnance recognition and UXO safety precautions provided by the SUXOS or UXOSO. Training topics/issues and responsibilities are detailed in the site specific work/safety plans.

- All personnel will receive additional training on the specific equipment they will operate while on site. A tailgate safety briefing is required at the start of each work shift to review current work operations, current site conditions, operational safety procedures, and other pertinent safety issues.

5.0 Records

None.

6.0 Attachments

6.1 5-514-MEC/UXO Response Procedures for Non-MEC Operations

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5-520-Spill Response, Incidental

1.0 Purpose and Scope

1.1 This procedure defines the role of Resolution Consultants employees in the event of a chemical spill in Resolution Consultants offices, laboratories, or storage areas and during field investigations, including the appropriate containment procedures that Resolution Consultants employees will follow.

1.2 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Emergency Response**: A response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrolled release of a hazardous substance or whenever a release requires that a federal or state agency be notified, such as:

2.1.1 A release at or above a reportable quantity (RQ) of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance (40 CFR 302.8) is required to be reported to the National Response Center (NRC).

2.1.2 A hazardous chemical release at or above an RQ under the Emergency Planning and Community Right-to-Know Act (EPCRA) (Title III under the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 350-372) is required to be reported to state and local officials.

2.1.3 A release in violation of a facilities Spill Prevention, Control, and Countermeasure (SPCC) Plan (40 CFR 112).

2.2 **Incidental Releases**: A response to a spill or release of a hazardous substance (in quantities below its RQ) where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area using equipment and materials available to them at the time or the spill or release. Any spill or release that cannot be managed with the personnel, materials, and equipment at the site shall be considered an Emergency Response.

2.2.1 Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses. Handling of incidental releases shall be in accordance with applicable standard operating procedures.

3.0 References

3.1 40 CFR 302.8

3.2 40 CFR 350-372

3.3 40 CFR 112

3.4 5-101-Emergency Response Planning, Office

3.5 5-203-Emergency Response Planning, Field

3.6 5-208-Personal Protective Equipment Program

3.7 5-509-Hazardous Waste Operations and Emergency Response

3.8 5-605-Medical Surveillance Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Supervisor/Project Manager** shall become the individual in charge at the incident until relieved by more qualified personnel. All Resolution Consultants emergency responders and their communications shall be coordinated and controlled through this individual. The individual in charge shall implement the Incident Command System (ICS) and shall be responsible for the following tasks:

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- Designate a safety officer who is knowledgeable about the operations being implemented at the emergency response site and who will have specific responsibility to identify and evaluate hazards and to provide direction on the safety of operations for the emergency at hand. If the safety officer judges activities to be an Immediately Dangerous to Life or Health (IDLH) and/or to involve an imminent danger condition, the safety officer shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.
- Identify all hazardous substances or conditions present and address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance, and handling procedures.
- Implement appropriate emergency operations.
- Limit the number of emergency response personnel at the emergency site.
- Implement the buddy system in groups of two or more.
- Provide standby, backup personnel with equipment ready to provide assistance or rescue. Qualified basic life support personnel, as a minimum, shall also be standing by with medical equipment and transportation as necessary.
- Verify that personal protective equipment (PPE) meets, at a minimum; the criteria contained in 29 CFR 1910.156(e) when worn while performing firefighting operations beyond the incipient stage for any incident.
- Determine if employees, who are engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard, wear positive pressure self-contained breathing apparatus, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection is appropriate.
- When deemed necessary for meeting the tasks at hand, an approved, self-contained, compressed air breathing apparatus may be used with approved cylinders from other approved, self-contained, compressed air breathing apparatuses provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatuses shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.
- Ensure that the PPE worn is appropriate for the hazards to be encountered.
- Implement appropriate decontamination procedures after emergency operations have terminated.
- Responsibility for the emergency response shall be transferred upon arrival of a more qualified Resolution Consultants Incident Commander or a Public Service Incident Commander.

4.1.2 **Safety, Health and Environmental Manager** is responsible for the following:

- Provide technical assistance to the Incident Commander regarding the correct way to respond to the spill.
- Decide whether Resolution Consultants or an outside emergency response company will clean up the spill.
- Prepare project-specific Spill Response Plans when required.
- Report spills, as necessary, to state/provincial environmental agencies.
- Review the incident report and facilitate the post-response discussion.
- Review and revise this SOP as necessary based on recommendations from post-response discussions.

4.1.3 **Resolution Consultants Employees** are responsible for the following:

- Follow precautions and safe handling practices to avoid spills.

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- Alert Supervisor/Project Manager to any deteriorating hazardous materials containers within the office or project area.
- Report all spills and leaks to the Supervisor/Project Manager immediately.
- Secure the spill area as quickly as possible and prevent the migration of exterior spilled materials or substances to drains or other openings.

4.1.4 **First Responder Awareness Level** are those employees who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response by notifying the proper authorities of the release. They take no further action beyond notifying the authorities of the release.

First responders at the awareness level shall have sufficient training or experience to demonstrate competency in the following areas:

- An understanding of what hazardous substances are and the risks associated with them in an incident.
- An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.
- The ability to recognize the presence of hazardous substances in an emergency.
- The ability to identify the hazardous substances, if possible.
- An understanding of the role of the first responder awareness individual in the employer's emergency response plan, including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.
- The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.1.5 **First Responder Operations Level** are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures.

First responders at the operational level shall receive at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level:

- Knowledge of the basic hazard and risk assessment techniques.
- Know how to select and use proper PPE provided to the first responder operational level.
- An understanding of basic hazardous materials terms.
- Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and PPE available with their unit.
- Know how to implement basic decontamination procedures.
- An understanding of the relevant standard operating procedures and termination procedures.

4.1.6 **Hazardous Materials Technicians** are employees who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.

Hazardous materials technicians shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas:

- Know how to implement the employer's emergency response plan.
- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment.
- Be able to function within an assigned role in the Incident Command System.

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- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician.
- Understand hazard and risk assessment techniques.
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and PPE available with the unit.
- Understand and implement decontamination procedures.
- Understand termination procedures.
- Understand basic chemical and toxicological terminology and behavior.

4.1.7 **Hazardous Materials Specialists** are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities.

Hazardous materials specialists shall receive at least 24 hours of training equal to the technician level and in addition have competency in the following areas:

- Know how to implement the local emergency response plan.
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment.
- Know the state emergency response plan.
- Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist.
- Understand in-depth hazard and risk techniques.
- Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and PPE available.
- Be able to determine and implement decontamination procedures.
- Have the ability to develop a site safety and control plan.
- Understand chemical, radiological, and toxicological terminology and behavior.

4.1.8 **On Scene Incident Commander,** who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas:

- Know and be able to implement the employer's incident command system.
- Know how to implement the employer's emergency response plan.
- Know and understand the hazards and risks associated with employees working in chemical protective clothing.
- Know how to implement the local emergency response plan.
- Know the state emergency response plan and of the Federal Regional Response Team.
- Know and understand the importance of decontamination procedures.

4.1.9 **Skilled Support Personnel** who are skilled in the operation of certain equipment (such as mechanized earth moving or digging equipment or crane and hoisting equipment), who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by Resolution Consultants' employees, and who will be or may be exposed to the hazards at an emergency response scene are not required to meet the training required. However, these Skilled Support Personnel shall be provided an initial briefing at the site prior to their participation in the emergency response. At a minimum, the initial briefing shall include instruction in the wearing of appropriate PPE, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety

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and health precautions provided to Resolution Consultants' own employees shall also be provided to any Skilled Support Personnel.

4.1.10 **Specialist Employees** are Resolution Consultants employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge shall receive training or demonstrate competency in the area of their specialization annually.

4.2 Emergency Response Plan

4.2.1 An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to performing emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, and OSHA personnel. The plan shall be reviewed and approved by the SH&E Manager prior to issue.

4.2.2 If contract does not require Resolution Consultants to provide emergency response services, then Resolution Consultants' SH&E Procedures found in the site specific Health and Safety Plan shall apply and employees shall evacuate from the danger area whenever an emergency occurs.

4.2.3 Upon completion of the emergency response, all followup remediation work shall be done in accordance with Resolution Consultants SH&E Procedure *5-509-Hazardous Waste Operations and Emergency Response.*

4.2.4 At a minimum, the emergency response plan shall address the following:

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

4.2.5 (Note: Local and state emergency response plans may need to be review and incorporated into the plan.)

4.3 Training

4.3.1 Training for responders shall be provided by Resolution Consultants' SH&E Manager or by individuals who have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach. Employees who receive responder training shall also receive annual refresher training if their responding responsibilities continue.

4.3.2 Employees receiving initial and refresher responder training shall be issued a certificate indicating training competency. Copies of all training records shall be maintained by the Site Safety Officer.

4.4 Medical Surveillance

4.4.1 All employees participating in an emergency response shall participate in their respective employers Medical Surveillance and Monitoring Program.

4.5 Chemical Protective Clothing

4.5.1 Chemical protective clothing shall be worn in accordance with Resolution Consultants' *5-208-Personal Protective Equipment Program*.

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4.6 Spill Response Equipment

4.6.1 All Resolution Consultant offices that store chemicals at their facility shall have the appropriate spill response equipment. Such equipment may include the following:

- Overpack containers of varying capacities
- Absorbent material such as vermiculite or commercially prepared, absorbent containing pillows, rolls, sheets, or booms
- Acid and base neutralizing agents
- Chemically resistant gloves for solvents, alcohols, and acids
- Polycoated Tyvek coveralls
- Safety goggles
- Respiratory protection

4.6.2 Spill response equipment shall be placed adjacent to areas where chemicals are routinely handled, stored, and/or where shipments are received. Similar types of spill response equipment shall also be available in any Resolution Consultants vehicle or rented vehicle in which chemicals are being transported. Access to the spill response equipment shall be designed to avoid likely spill locations.

4.7 Spill Response Equipment for Field Programs

4.7.1 The amount of chemicals being used during a field program will dictate the types and quantity of spill response equipment that is brought to the site. If several squirt bottles of decontamination solutions are all that is being brought to a site, a few spill pillows and a one-gallon bucket may be sufficient to respond to a spill of these materials. If gallons of chemicals are being delivered to the site in drums or bulk tanks, a greater variety of spill response equipment will be needed. As indicated previously, during these types of field programs, a separate spill plan will be incorporated into the project health and safety plan (HASP) and will provide a greater level of detail regarding the specific spill response effort for that field program.

4.8 Immediate Response

4.8.1 Evacuate all personnel that will not be involved in the clean up from the immediate area of the spill or release.

4.8.2 Take all reasonable measures to confine, repair, and remedy the effects of the spill; cleanup must be done by knowledgeable personnel and is in accordance with the product label and MSDS.

4.8.3 Use the appropriate equipment and PPE so that you do not expose yourself to any chemicals or hazardous substances.

4.8.4 Clean up teams shall be organized outside the spill area and re-enter for cleanup activities.

4.8.5 If it is not practicable to maintain the airborne concentration of a flammable gas or vapour below the applicable exposure limit, for example, in a temporary situation or an emergency,

- Only the minimum number of workers necessary for the work may be exposed,
- Every worker exposed must be adequately trained and equipped to safely perform the required duties,
- The concentration of the flammable gas or vapor must not exceed 20% of the lower explosive limit (LEL), and
- In a life-threatening emergency only, exposure of emergency response workers is permitted above 20% of the LEL, provided that only those qualified and properly trained and equipped workers necessary to correct the unsafe condition are exposed to the hazard and every possible effort is made to control the hazard while this is being done.

4.9 First Aid

4.9.1 In the event of an incident, refer to the MSDS labels to ensure proper first aid is administered for the hazardous material and call the nearest Poison Control Center or 911.

4.9.2 The American National Standards Institute (ANSI) Standard for Emergency Eyewash and Shower Equipment (ANSI Z358.1-1998) recommends that the affected body part must be flushed immediately and thoroughly for at least 15 minutes using a large supply of clean fluid under low pressure. However,

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other references recommend a minimum 20-minute flushing period if the nature of the contaminant is not known. The flushing or rinsing time can be modified if the identity and properties of the chemical are known. For example, at least

- 5 minutes flushing time for mild irritants.
- 20 minutes for moderate to severe irritants.
- 20 minutes for nonpenetrating corrosives.
- 60 minutes for penetrating corrosives.
- If irritation persists, repeat the flushing procedure.

4.9.3 It is important to note that ingestion of any chemical is not likely to occur in the workplace. If ingestion does occur, evidence indicates that inducing vomiting is not necessary in most situations where there has been an occupational chemical ingestion. Induction of vomiting should only be recommended if the chemical has very high, short-term (acute) toxicity, and medical follow-up is not readily available. In these cases, first aiders should receive special training on how to safely and effectively induce vomiting in the appropriate circumstances.

4.9.4 In the unlikely event that there is an on-site release of a hazardous substance (e.g., H2S):

- Get out of the area (in an upwind direction).
- Sound an alarm.
- Assess situation.
- Put on a breathing apparatus.
- Rescue victim(s).
- Revive victim(s).
- Get medical aid.

4.10 Reporting

4.10.1 Should there be a spill or leak involving a hazardous product, employees shall immediately notify the Supervisor. The supervisor shall then make the appropriate notifications to both client and Resolution Consultants management.

4.10.2 “Dangerous occurrences” must be reported immediately to the police, employer, vehicle owner/leaser and the dangerous goods owner. Such events would include spills, bulk container damage, fire, explosion, and transportation accidents involving dangerous goods.

4.10.3 Confirm and seek direction on external reporting requirements.

- A major release of a hazardous substance must be reported to the appropriate provincial or territorial governing body for Occupational Health and Safety.
- All spills and releases must be reported to the governing regulatory body. Each jurisdiction has regulations governing the minimum quantities for reporting based on the type of product spilled or released.

4.10.4 If you have knowledge of spill, release, or unlawful discharge, notify authorities immediately. Reporting does not imply guilt or assign blame. You will need to report the following details.

- Location and time of spill.
- Description of circumstances leading to spill.
- Type and quantity of material or substance spilled.
- Details of any action taken at the site of the spill.
- Description of location of spill and immediately surrounding the area.
- Any additional information in respect of the spill that the Minister, environmental protection officer or person designated by regulations requires.

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5.0 Records

None.

6.0 Attachments

None.

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5-601-Recordkeeping

1.0 Purpose and Scope

1.1 Provide the process for compliance with Resolution Consultants internal recordkeeping and reporting requirements of occupational injuries and illnesses, outside the scope of Workers Compensation reporting requirements.

1.2 Applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 Resolution Consultants – A joint venture between AECOM and EnSafe to provide services as specified in contract number, N62470-11-D-8013.

3.0 References

None

4.0 Procedure

4.1 All recordkeeping and reporting requirements shall follow the appropriate requriements as specified by the JV member company's existing protocol.

5.0 Records

None

6.0 Attachments

None

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5-603-Incident Investigation and Review

1.0 Purpose and Scope

1.1 Provide that all SH&E incidents are investigated in a timely and thorough manner. For all recordable, serious and fatalities, provide a formal incident investigation process.

1.2 Additionally, ensure that appropriate Lessons Learned are gathered from all SH&E incidents and that information is shared regarding lessons learned throughout the organization.

1.3 This procedure applies to all Resolution Consultants employees and operations.

2.0 Terms and Definitions

2.1 **Responsible Lead Investigator (RLI):** Manager responsible for the incident investigation.

2.2 **SRI:** Supervisor's Report of Incident .

2.3 **SH&E Incidents**: A potientially work-related event which is unplanned, possibly harmful or damaging, and which may result in personal injury, environmental impact, or loss or may impact the reputation of Resolution Consultants or its clients or may result in an investigation by a regulatory agency or insurer.

3.0 References

3.1 5-004-Incident Reporting

4.0 Procedure

4.1 Initial post-incident response procedure by office/project team as it relates to an incident investigation and review

4.1.1 Immediate steps to be taken by local field/office personnel:

- Confirm corrective actions that have been put in place to eliminate or control identified hazards at the scene.

4.1.2 Secure the area. Do not disturb the scene until relevant facts are obtained unless an immediate hazard exists.

4.1.3 Prepare appropriate sketches and or obtain photographs of the incident scene and gather relevant information from the scene (Who, What, Where, When and other "environmental factors" that may have had an influence on the incident).

4.1.4 Interview witnesses and document responses as soon as possible at the scene of the incident.

4.2 Follow–up Investigation

4.2.1 **Identify Responsible Lead Investigator and Formation of Team.**

- The **Responsible Lead Investigator (RLI)** An appropriate team member will be designated to be the RLI for any investigation covered by this procedure. That determination will be made based off of technical capabilities, relevant work experience, and the ability to demonstrate critical thinking skills.
- The **RLI** shall contact Resolution Consultants SH&E Manager to ask if legal counsel will be needed in the investigation. If so, the incident investigation report will be marked as "Attorney Privileged Communication."

The RLI will appoint an appropriate team to conduct and document the required investigation.

4.2.2 **Investigation Team Procedures**

- The team will follow an appropriate investigation technique (as agreed to by the **RLI, Resolution Consultants SH&E Manager** and Resolution Consultants in-house counsel) to determine the following:
  - Sequence of events leading up to the incident and steps followed immediately following the incident that may have had an impact on the final outcome.
  - Identification of the People, Parts/Equipment, Position and Paper/Documentation factors involved in the incident.
  - Determination of direct cause(s) and root causes using techniques agreed to by the **RLI** and **Resolution Consultants SH&E Manager.** (Note: Example root cause investigation tools include "5 Why's", TapRoot, Fishbone Diagram, etc.).
- The Investigation Team will prepare a preliminary report, signed by the **RLI**, documenting all findings and recommended corrective actions within 10 business days following the incident. If necessary, the report shall be prepared at the direction of in-house counsel and shall be marked "Attorney Privileged Communication".
- An Investigation Review Call will be held to review the preliminary investigation report. Required participants for the call will include:
  - **Responsible Lead Investigator**.
  - Responsible Supervisor or **Project Manager** of the injured/involved employee.
  - Resolution Consultants **SH&E Manager**.
  - Resolution Consultants **Legal Counsel**, when required.
  - Additional personnel as deemed necessary by the Resolution Consultants Management Committee.
- Note: Incident Review Calls are designed to summarize the preliminary investigation findings and come to agreement on contributing factors, root causes and appropriate corrective actions.
- The **RLI** will extend an invitation to the **Program Manager** at least 5 days prior to the scheduled review date. The **Program Manager** will extend an invitation to other senior and executive management members based on a preliminary assessment of the incident:
  - Final investigation reports (following incident review call where required) are to be forwarded to the **Resolution Consultants SH&E Manager** for inclusion in the permanent incident files.

4.2.3 **Communication of Investigation Results**

- **Any and all written investigation reports must first be reviewed by** Program Manager**, or the Chief Counsel's designee. All drafts shall include "Attorney-Client Work-Product Privilege" at the top of such reports.**
- Where appropriate based on the type, severity and/or scope of the incident, a formal Alert will be prepared by the **RLI** and **Resolution Consultants SH&E Manager**. The Alert will be communicated to the most appropriate audience (i.e. regional, national, business line only, etc.).
- Action items and corrective actions identified by the **RLI** and investigation teams will be tracked to completion by the **Resolution Consultants SH&E Manager**. Additionally, the results will be utilized by the SH&E department to develop appropriate regional, national and business line level reports and to improve existing procedures.

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4.3 Roles and Responsibilities

4.3.1 **Office Managers, Project Managers, Field Task Managers** are responsible to:

- Lead/participate in the formal Incident Investigation process as required by this procedure. Managers should consult with the appropriate Resolution Consultants in-house counsel before conducting any formal investigation of a serious SH&E incident or engaging in any discussion outside of Resolution Consultants.
- Schedule and conduct Incident Review calls as required by this procedure.

4.3.2 **Supervisors** are responsible for the following:

- Lead/Participate in formal Incident Investigation as required by this procedure.

4.3.3 **Resolution Consultants SH&E Manager** is responsible for the following:

- Provide training on incident investigation techniques and tools to selected investigation teams.
- Initiate an investigation for all incidents by contacting the **RLI** and establishing the team, report format, and deadlines.
- Participate (following consultation with Resolution Consultants in-house counsel) on investigation teams and Incident Review Calls when requested by the **Responsible Lead Investigator.**
- Track and report on the status of all action items identified within final Incident Investigation Reports.
- Provide final Incident Investigation Report to the Program Manager prior to inclusion in permanent incident files.

4.3.4 **Employees** involved in an SH&E incident must assist supervisor in completing/ conducting appropriate incident investigations.

5.0 Records

None.

6.0 Attachments

None.

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5-605-Medical Surveillance Program

1.0 Purpose and Scope

1.1 The Medical Surveillance Program provides a consistent process to determine if employees meet physical requirements to perform assigned duties as defined by applicable OSHA and/or provincial/territorial regulations.

1.2 The program is also designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

1.3 This procedure applies to all Resolution Consultants operations and employees whose work assignments involve potential exposure to harmful chemical and/or physical agents.

2.0 Terms and Definitions

2.1 **Modified Duty:** Modified duty (or temporary transitional duty) work is defined as a temporary job task adjustment or alternate job assignment other than the employee's normal essential duties, in response to physical activity restrictions or limitations established by Resolution Consultants's Contracted Medical Director, a designated clinical physician, or the employee's medical doctor.

2.2 **Medical Director:** The Medical Director is a physician, board-certified in occupational medicine, employed by the Medical Services Contractor. The Medical Director manages the services provided by the Corporate Medical Provider and provides to Resolution Consultants guidance on medical matters.

2.3 **Medical Services Contractor/Human Resource Manager:** The Corporate Medical Provider (AECOM) or Human Resource Manager (EnSafe) manages all occupational medical services, including medical surveillance programs, substance abuse prevention programs, and care for workers with occupational injuries or illness.

2.4 **PEL:** OSHA Permissible Exposure Limit.

2.5 **OEL:** Occupational Exposure Limit.

2.6 **Physical Activity Restriction:** To prevent aggravation of an existing condition, the Medical Doctor recommends a physical activity restriction to limit exposure to a chemical or class of chemicals (such as benzene), a physical agent (such as noise or radiation), or an activity (such as lifting more than 40 pounds).

2.7 **PPE:** Personal Protective Equipment.

2.8 **Safety Sensitive:** A task or position is designated as safety sensitive when the task or position is such that an action would endanger the lives of others. Examples, but not a complete list, of positions that have been designated "safety-critical" by regulations include:

- Drivers of commercial vehicles
- Workers on pipelines carrying fuels or toxic or corrosive substances
- Workers at nuclear power plants
- Employees that operate Nuclear Regulatory Commission (NRC)-regulated devices (nuclear density gauges)
- Operators of industrial mobile equipment, including: cranes of more than 6,000-pound capacity, forklifts, loaders, etc.
- Operators of drill/boring rigs
- Laboratory technicians

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3.0 References

None.

4.0 Procedure

4.1 All Resolution Consultants employees whose work assignments involve potential exposure to harmful chemical and/or physical agents should participate in the medical surveillance program.

4.2 In addition, employees may be requested to participate in the medical surveillance program if they perform a task that requires an assessment for fitness for duty (e.g. lifting, climbing, etc.). The **Office/Project Manager** and **SH&E Manager** will identify activities/tasks that will require fit-for-duty assessments.

4.3 The medical surveillance program consists of the following types of examinations:

- Baseline (initial)
- Periodic (annual or biennial)
- Special exposure-specific
- Contractual requirement
- Exit/termination
- Fit-for-duty
- Client specific

4.4 Types of Medical Examinations

4.4.1 Baseline/Pre-Placement/Pre-Employment

- The baseline medical examination is used to identify physical capabilities and medical limitations that may have an impact on the candidate's ability to perform in the position for which he/she is being considered and to provide a baseline against which periodic or project-specific monitoring can be compared. The baseline medical examination is used to determine the suitability of an existing employee for a new assignment (pre-placement) or a candidate's suitability to be hired (pre-employment) for a particular position.

4.4.2 Periodic/Annual/Biennial

- The periodic medical examination is used to evaluate an employee's continued fitness for duty and to assess any impact occupational exposures may have on his/her health status. The periodic examination includes an update to the medical and work history, results of any occupational exposure assessments and a detailed medical examination tailored to the job description.
- The **SH&E Manager** determines the frequency of the periodic medical examinations based on recommendation from the company medical provider, regulatory requirements, the position held by the employee, and the level of exposure to physical, chemical, and biological agents.

4.4.3 Exposure/Activity/Project-Specific

- The exposure-specific examination consists of medical tests to assess the impact of occupational exposures associated with a particular activity or project. The Medical Director or **SH&E Manager** will require an exposure-specific examination when he/she has reason to believe occupational exposures are impacting or may be impacting the health of an employee.

4.4.4 Client Specific

- Clients may recommend exposure-specific examinations for persons working on their projects. A client recommendation for an exposure-specific examination will be forwarded to the **SH&E**

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Manager who will evaluate the request, and if appropriate, forward the recommendation to the Medical Director, who will determine the frequency of the exposure-specific medical examinations for each employee designated to participate based on sound medical practice and regulatory requirements.

4.4.5 Exit from the Program

- An exit medical examination is given when an employee leaves the medical surveillance program, either because of termination of employment with Resolution Consultants or because of reassignment to a position not designated to participate in the medical surveillance program. The exit examination assesses any impact occupational exposures may have had on the employee's health status.

4.5 Participating Employees

4.5.1 Required Participation

- Participation in the medical surveillance program is required for employees who are or may be:
  - Exposed to substances at or above the PEL/OEL.
  - Required to participate by regulatory provisions (e.g., asbestos, lead OSHA standards).
  - Fit-tested for or wearing a respirator in the field.
  - Exposed above PELs OELs in accidents or emergency situations.
  - Working on sites/projects with specific state, provincial/territorial or federal medical surveillance requirements.
  - Driving a commercial motor vehicle.
  - Performing safety sensitive tasks.
- Employees may be required to participate in a fit-for-duty examination under the following scenarios:
  - Perform extensive physical activities (e.g. bending, lifting, climbing, pulling/pushing, etc.).
  - Experience a non-work related injury or illness.
  - Return to work after extended absence.
- Those employees required to participate will be identified by the **Project Manager** and **SH&E Manager**.

4.5.2 Employee

- When designated to participate in the medical surveillance program, the employee completes and signs the following documents:
  - Medical and Work History Questionnaire.
  - Medical records release authorizing Medical Services Contractor to receive the medical clearance certificate.

4.5.3 The **SH&E Administrator** (AECOM) or Human Resource Manager (EnSafe) is responsible for providing the Corporate Medical Provider with the following services:

- Facilitate the management and exchange of documentation regarding the medical surveillance program between Resolution Consultants (typically employee's line manager) and the Corporate Medical Provider using the *5-605 Form 1 Scheduling Request form*.
- Schedule the initial exam for newly hired or re-assigned employees.
- Assist employees with scheduling examinations as necessary.

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- Coordinate medical surveillance program information exchange between Human Resources and the Medical Resource Contractor as necessary.
- Provide information from previous examinations that may not be readily available.

4.6 Scheduling Pre-Employment Medical Examination

4.6.1 **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)**

- The SH&E Administrator coordinating a medical examination will:
  - Provide the candidate or **Human Resource Representative** with a baseline medical and work history questionnaire to include in the job offer package. The Medical Resource Contractor and **SH&E Administrator** may also provide the questionnaire to the candidate.
  - Work with the candidate to identify the clinic location that is convenient for the candidate's medical examination.
  - Contact the Corporate Medical Provider to obtain the name, address, telephone number, and contact person for the contract medical clinic in that geographical location.
  - Coordinate the scheduling of the examination and ensure the scheduling information is provided to the Medical Services Contractor.
  - Notify the candidate's manager and **Human Resources Representative** upon receipt of the medical clearance certificate from the Medical Services Contractor.

4.6.2 Hiring Manager

- When necessary based on the position being filled, the Hiring Manager/**Human Resources Representative** informs the candidate that the offer of employment is contingent on the candidate being physically and medically qualified to perform the duties of the position for which he/she is being hired. The Hiring Manager/**Human Resources Representative** may not allow the candidate to begin employment until the conditions of the offer letter have been satisfied.

4.6.3 **SH&E Manager**

- The **SH&E Manager** provides such assistance as is requested by the Hiring Manager to ensure the job description for the position being filled adequately describes the physical, chemical, and biological stresses of the position, and the PPE used or which may be used, including respiratory protection. The **SH&E Manager** provides all necessary assistance to ensure that required and appropriate information is provided with the request and authorization for medical examination.
- The **SH&E Manager** provides assistance to the Hiring Manager to interpret physical activity restrictions if such restrictions are noted on the medical clearance certificate.

4.7 Scheduling Periodic and Exposure Specific Medical Examinations

4.7.1 Medical Services Contractor

- After the initial baseline is complete, the Corporate Medical Provider provides notification to the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** approximately 30 days before subsequent periodic or exposure-specific medical examination is due. The Corporate Medical Provider will also notify the employee 30 days before the periodic or exposure-specific medical examination is due.
- The Corporate Medical Provider provides notification of delinquent medical examinations to the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)**, who ensures the notification of examination due is forwarded to the employee.
- Any employee that has not completed the required medical evaluation within 30 days of an expiration date will be issued a non-qualified statement. The employee is not permitted to perform the associated task and/or work until the required medical evaluation is completed and a qualified statement is issued by the Medical Director.

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4.7.2 Employee's Manager

- The employee's manager arranges work assignments so that the employee is available to take the medical examination before the medical clearance certificate expires. In the event that an employee has not completed the medical examination before the medical clearance certificate expires, the manager shall remove the employee from the work assignment until the medical evaluation is completed and a qualified statement is issued by the Medical Director.

4.7.3 **SH&E Manager**

- The **SH&E Manager** will confirm that all relevant exposure assessments have been appropriately annotated to show the applicability to the employee and forwarded to the Medical Services Contractor. The **SH&E Manager** also confirms that employees on the delinquent medical examination list have been removed from designated assignments.

4.8 Scheduling Exit Medical Examinations

4.8.1 **Human Resources Manager/SH&E Administrator**

- Upon notification of termination or impending termination, the employee's manager working with the **Human Resources Manager** notifies the **SH&E Administrator** to arrange for exit medical examination. If the employee declines the opportunity to take the exit examination the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** will send a waiver memorandum to the employee on behalf of the employee's manager. Once the employee signs the waiver the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** will place the original in the employee's Human Resources personnel file and copy the Medical Services Contractor.

4.8.2 Manager

- Upon notification of termination or reassignment, the manager contacts the **Human Resources Representative.**
- The manager releases the terminating or reassigned employee from duties as necessary to complete the exit medical examination.

4.8.3 **SH&E Manager**

- The **SH&E Manager** provides assistance to ensure that terminating and reassigned employees are offered the opportunity to take an exit medical examination.

4.9 Reports

4.9.1 Report of Examination

- The Corporate Medical Provider provides the employee with a confidential report of findings of the examination and a medical clearance certificate. Resolution Consultants requires the employee to preserve the medical clearance certificate in a safe place and provide copies of it to project managers and clients.
- The Corporate Medical Provider provides the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** with a copy of the medical clearance certificate.

4.9.2 Examinations Due Report

- The Corporate Medical Provider (AECOM) / Human Resource Manager (EnSafe) produces a list by organization code of employees due to be examined 30 days before the expiration of their medical clearance certificate. This list ensures each manager is notified of the employees in his/her charge who are due examinations so they may be scheduled appropriately.
- The Corporate Medical Provider (AECOM) / Human Resource Manager (EnSafe) notifies each employee via email or phone to the office of record 30 to 60 days before the periodic or exposure-specific medical examination is due.

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4.9.3 Delinquent Examinations Report

- The Corporate Medical Provider distributes a report of delinquent medical examinations to the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)**.
- When an employee's name appears on the delinquent examination report for two consecutive months, the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)**.must notify the **SH&E Manager**, who will bring this to the attention of the employee's direct supervisor for resolution. If the delinquency issue is not resolved, the employee's **Project Manager** will be notified for final resolution.

4.9.4 Physical Activity Restriction Report

- The **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** maintains a list of employees who have physical activity restrictions. The **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** provides each manager in his/her area of responsibility with a list of the employees with physical activity restrictions who are assigned to their project/location.
- The **SH&E Manager** shall audit locations and projects periodically to ensure employees with physical activity restrictions are not exceeding their limitations. Concerns of an employee exceeding his/her physical activity restriction is brought to the attention of the employee's manager/ supervisor for resolution.

4.9.5 Annual Reports

- The Corporate Medical Provider provides annual reports of utilization, medical trends, and statistical analyses. These reports are prepared to improve the service, manage trends, and reduce the cost of the medical surveillance program.

4.9.6 Cost Accounting

- The Corporate Medical Provider submits invoices directly to the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe).**. Each examination and service invoiced includes the organization code of the employee examined or receiving the service. Departments with employees who participate in the medical surveillance program are responsible for the cost of administering the program. In addition, if special monitoring (e.g., for lead exposure) is to be conducted for a project, the **Project Manager** must inform the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** of that project's charge code.

4.10 Roles and Responsibilities

4.10.1 **Employees** – **Mandatory Participation** are responsible for the following:

- All employees designated to participate in the medical surveillance program as a condition of employment or participate voluntarily. Will be notified in advance if they will be assigned to a location, project or client which requires a Medical Surveillance Program. Employees whose duties fall within the categories listed will be included in the medical surveillance program. Each employee is individually responsible for ensuring that he/she maintains a current medical clearance as required for the performance of assigned work duties.

4.10.2 **Office and Project Managers** are responsible for the following:

- Operations managers and employee supervisors must evaluate the duties of each employee and prospective employee reporting to him or her. If the employee's position meets the criteria for required participation in the medical surveillance program, the manager is responsible for ensuring that the employee is enrolled in the program.
- Candidates for positions that require medical surveillance in order to meet their job description may not be on site until they have satisfactorily completed the baseline or pre-employment medical examination.

4.10.3 **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** is responsible for the following administrative activities for the medical surveillance program relative to the employees they support**:**

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- Serves as the primary point of contact between the employee, employee's manager, the Medical Services Contractor, and the SH&E Department.
- Provides information regarding medical surveillance documentation, forms, and scheduling of services.
- Maintains a medical surveillance database and other associated documents.
- Assists employees with scheduling of exams with the Medical Surveillance Contractor.
- Participates in initial SH&E Administrator (AECOM) / Human Resource Manager (EnSafe) training and subsequent reviews and updates that will provide guidance on exam protocols.

4.10.4 **SH&E Manager** is responsible for the following:

- Reviews employee assignments with managers to ensure that all employees who should be participating in the medical surveillance program have been enrolled.
- Provides all assistance necessary to ensure all required information is provided to the Medical Director (e.g., a copy of Resolution Consultants' Medical Surveillance Policy, OSHA/state regulations, etc.).
- Report any change in requirements, protocols or concerns with the contracted Medical Provider to the **Project Manager, SH&E Administrator (AECOM) / Human Resource Manager (EnSafe).**

5.0 Records

5.1.1 Medical Records

- Medical records must be preserved and protected in accordance with applicable legislative requirements for the duration of employment plus 30 years. Medical records contain information that is protected by the Privacy Act. To meet the obligations of preserving the medical records and protecting the information they contain, Resolution Consultants has arranged for the Corporate Medical Provider to manage the medical records.

5.1.2 Access to Records

- An employee or designated representative may request to review his/her medical and exposure records. Such a request must be in writing, signed and dated, and include the employee's Social Security/Insurance Number. The **SH&E Manager** or the **SH&E Administrator (AECOM) / Human Resource Manager (EnSafe)** will forward the request to the Medical Services Contractor, who will provide the employee with a copy of the medical record.
- The Corporate Medical Provider will supply the copy within 15 days after the request has been submitted by the employee or designated representative.

5.1.3 Quality Control and Quality Assurance

- The Corporate Medical Provider performs quality control checks on all medical records to ensure examining physicians appropriately record the findings of the examination and tests.
- The Corporate Medical Provider has access to all medical records to perform quality assurance checks to ensure proper recording and preservation.

6.0 Attachments

6.1 5-605 Form 1 Scheduling Request Form

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5-605 Form 1 Scheduling Request Form

Submit to:

Phone:

Email:

REQUEST INFORMATION:			**Date:**	
1.	**Requested By:**		**Email:**	
	Phone #:		**Locator:**	
	Office Location Code: Name		**Department No.:**	
EMPLOYEE INFORMATION:			**Billing Charge No.:**	
2.	**Employee Name:**		**Email (if applicable):**	
	Social Security No.:		**Work Phone #:**	
	Home Phone #:		**Cell Phone #:**	
	City, State, Zip for the Exam:			
3.	**New Hire/Transfer?**	☐ **Yes** ☐ **No**		
	Rehire?	☐ **Yes** ☐ **No**		
	Existing Employee?	☐ **Yes** ☐ **No**		
REQUEST DETAILS:				
4.	**Schedule by (date):**		**Rush**: (check one of these)	☐ **Yes** ☐ **No**
	Social Security No.:		**Work Phone #:**	
	Home Phone #:		**Cell Phone #:**	
	Please list three dates of availability:			
5.	**Drug Screen Needed:**	☐ **Yes** ☐ **No (If No, skip to #6)**		
	Reason for Drug Screen:	☐ **DOT Clearance** ☐ **Client/Contract Requirement**	☐ **Post Accident** ☐ **For Cause**	
	Drug Screen Type:	☐ **Non-DOT Type** ☐ **Federal DOT Type (Required for DOT Clearance)**		
6.	**Employee working in remote locations in high stress conditions** (subject to temperature/weather extremes) and limited access to emergency services?		☐ **Yes** ☐ **No**	

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7.	**Medical Protocol(s)?** ☐ **Yes** ☐ **No**	
	A. Commercial Motor Vehicles (>10,000 lbs but < 26,001 lbs) (CMV-01)	☐ Baseline ☐ Renewal
	B. Commercial Motor Vehicles (over 26,000 lbs.) (DOT-01)	☐ Baseline ☐ Renewal (plus enrollment in random drug pool)
	C. HAZWOPER	☐ Baseline ☐ Annual ☐ Biennial ☐ Exit
	D. Laboratory Technician	☐ Baseline ☐ 3 Year Protocol ☐ Exit
	D. BOTH Commercial Motor Vehicles (over 26,000 lbs.) AND Hazardous Waste Site Work (COM-01)	☐ Baseline ☐ Renewal ☐ Exit
	E. Respiratory Protection Clearance – (Questionnaire Only) (RES-01)	☐ Questionnaire (Initial) ☐ Annual
	F. Respiratory Protection Clearance (Requiring Examination) (RES-02)	☐ Baseline ☐ Annual
	G. Fit-for-Duty	☐ Pre-employment (FFD-01) ☐ Admin/Office Worker **(**Back fit test not required) ☐ Post-Incident/Illness (FFD-02) ☐ Back Fit Test ☐ Stress Test
	H. Hearing Conservation (HC-01)	☐ Baseline ☐ Annual
	I. Immunizations/vaccinations	☐ Tetanus (T)/Diphtheria(d) (Td) ☐ Td Booster (required every 10 years) ☐ Hepatitis A Vaccination (only) (2 shot series) ☐ Hepatitis B Vaccination (only) (3 shot series) ☐ Twinrix (combination Hep A & B) (3 shot series) ☐ Other
	J. Lead ZPP	☐ Baseline ☐ Annual
	K. Asbestos	☐ Baseline ☐ Annual
	L. Diver	☐ Baseline ☐ Annual
	M. Records Review	☐ Change Frequency of Physicals ☐ Other (specify in item 8)
8.	**Other (ex. Stand Alone Tests/Exams:**	

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Appendix D
Site Safety and Health Officer Resume

William P. Duffy

Project Geologist

Professional History

Education

BS, Geology, University of Tennessee, Knoxville, 1995

Professional Registrations

Florida, Professional Geologist, 2011, No. 2710

Professional Affiliations

Training and Certifications

DOT Level 1 Shipper/(TDG) Canada
Fall Protection Awareness Training
FEMA Public Assistance Operations 1
FEMA Public Assistance Operations 2
Fire Extinguisher Training
First Aid
General Excavation Safety
Hazard Communication (US)/WHMIS (Canada)
HAZWOPER 40-Hour Training
HAZWOPER 8-Hour Refresher Training
HAZWOPER 8-Hour Supervisor Training
HAZWOPER Medical Exam
Hearing Protection
Lockout/Tagout
Office Ergonomics
Project Management – Basic
Radiation Safety Officer
Reasonable Suspicion - Alcohol and Substance Abuse
Respirator Fit Test
Respiratory Protection
Safety Orientation
The Groundwater Pollution and Hydrology Course
Trench/Excavation Safety
10-Hour Construction Outreach Training
4-Hour Defensive Driving Course
8-Hour Hazardous Waste Managers Training
8-Hour Radiation Worker Safety Course
Bloodborne Pathogen Training Course
Confined Space – Entrant
CPR
Defensive Driving Awareness Training

Publications

Awards

Mr. Duffy is an environmental manager with fifteen years of diverse environmental experience. He's experienced as a project and site manager, geologist, and safety and health officer for environmental investigation and remediation work for federal and commercial clients. Responsible for implementing removal and upgrading of fuel systems, contaminated soil removal and site restoration, sheet pile installation, installation and operation of nutrient injection (PHOSter), air-sparge and soil vapor extraction remediation systems, wetland remediation and restoration, and oversight for construction/remediation projects. Duties performed as a project manager include client interactions, development of site specific scope of work, work plan and report scheduling and development, the management of personnel performing assessment, remediation and construction activities, subcontract procurement, selection and oversight of subcontractors, scheduling personnel, cost tracking and projecting, change order cost estimating and contracting modifications, and coordinating with clients, client representatives, and regulators. Responsibilities as a geologist include groundwater investigations and regulatory report preparation for petroleum and organic solvent contaminated industrial sites. Prepared underground storage tanks closure reports, site assessment reports, remedial action plans, monitoring only reports, remedial work plans, phase two site assessments, and health and safety plans. Skilled in Microsoft Office and Project, RACER Cost Estimating Software, and AutoCAD.

Experience

Panama City Airport and Industrial District, Panama City-Bay County International Airport Cleanup, Panama City, Florida. (2009 – Present)
Role: Project Geologist
Project geologist supervising field activities associated with two fuel system removals, soil, sediment, and groundwater investigations, wetland remediation and restoration, and impacted soil removals at 20 sites on the airport property. =

Air Force Center for Engineering and Environment, 4PAE, Tyndall AFB, Florida (2009 – Present)
Role: Field Operations Manager
Field Operations Manager for organizing and supervising field efforts required to perform supplemental remedial investigations and baseline risk assessment for three sites on Tyndall AFB. Ensures field work is performed in accordance with EPA methodologies and manages the work performance of subcontractors (drillers, surveyors, and waste haulers).

Air Force Center for Engineering and Environment, 4PAE, Tyndall AFB, Florida (2009 – 2011)
Role: Project Manager
Project Manager for completion of a comprehensive inventory of groundwater monitoring wells, drinking water wells, and remediation wells on Tyndall AFB. Also managed

the well maintenance performed on over 700 wells identified in the inventory.

US Army Corps of Engineers - Omaha District, Stripping and Painting of Water Tanks, Eglin AFB, Florida. (2006 – 2009)
Role: Project supervisor for the sandblasting and painting of ten elevated water tanks, two ground water tanks, and the historic Cape San Blas lighthouse for Eglin AFB, FL. This project was the annual winner of the 2009 US Army Corps of Engineers Safety Award for a construction project in the one to seven million dollar range.

Federal Emergency Management Agency, Hurricane Katrina Response, New Orleans, Louisiana. (2005-2006)
Role: Project officer
Responsible for preparing project worksheet detailing damaged incurred by Hurricane Katrina to the Louisiana school system.

The KEVRIC Company, Site Assessments, Remedial Action Plans, and Environmental Support, Tyndall AFB, Florida. (2003 – 2004)
Role: Project Technical Manager and Geologist
Project technical manager and geologist providing direction and support for field activities investigating multiple sites including: petroleum, oils, and lubricants storage areas; underground and aboveground storage tanks, and chlorinated solvent impacted sites.

US Army Corps of Engineers - Omaha and Mobile Districts, POL Compliance Site Assessments and Remedial Action Plans, Tyndall AFB, Florida. (2001 – 2004)
Role: Project Manager
Project manager responsible for the performance of site assessments (Buildings 110, 249, 280, 2894, 9310 and Facility 411 and 413) and site assessment addenda (Hangar 26, Buildings 560, 1280, 7002, 182 and 239) directing and assisting in soil sampling, well installation, groundwater gauging and groundwater sampling.

US Army Corps of Engineers - Omaha District, Soil Capping, Eglin AFB, Florida. (2001)
Role: Site Manager
Site manager for the asphalt capping of dioxin contaminated soil. Directed field efforts including sub-base preparation, coordinating the placement of 1200 tons of asphalt, and installation of erosion control measures.

US Army Corps of Engineers - Mobile District, Pesticide Contaminated Soil Removal, Eglin AFB, Florida. (2001)
Role: Site Supervisor and Site Health and Safety Officer
Site supervisor and site health and safety officer responsible for the site supervision for the removal of pesticide- and arsenic-contaminated soil.

US Army Corps of Engineers - Mobile District, Arsenic-Contaminated Soil Removal, Eglin AFB, Florida. (2001)
Role: Site Supervisor and Site Health and Safety Officer
Site supervisor and site health and safety officer for verification of personal and perimeter air monitoring and completing associated health and safety documentation during the removal of arsenic-contaminated soil around three cattle dipping vats. .

Lockheed Martin Energy Systems, Inc., Biotreatment Facility Construction, Advanced Infrastructure Management Technologies (AIMTech), Fort Benning, Georgia. (1999-2000)
Role: Site supervisor
Design, construction, and operation of a biotreatment facility for the bioremediation of petroleum contaminated soil originating from the cleanout of vehicle wash areas and grit chambers.

Confidential Railway, UST/AST Removal, Alabama, Mississippi, Georgia, and South Carolina. (1999)
Role: Staff scientist
Responsible for the removal of underground storage tanks ranging from 500 to 25,000 gallon capacity with ASTs ranging from 10,000 to 24,000 gallon capacity

Firth Construction, UST/AST Removal and Replacement, Fort Benning, Georgia. (1997-1998)
Role: Staff scientist
Responsible for the supervising the removal of 30 underground storage tanks. Conducted sampling of soil and water from excavations, documented tank removal actions, and completed all Georgia Underground Storage Tank Closure reports in accordance with state and federal regulations.

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CERTIFICATE OF TRAINING

This Certifies That

Bill Duffy

has successfully completed 8 hours of instruction in
OSHA Hazardous Waste Operations and Emergency Response Supervisor Training

Prepared and conducted on January 22, 1999
by EARTH TECH Health and Safety Department
to Comply with OSHA 29 CFR 1910.120(e)(4)

Dale M. Prokopchak

Dale M. Prokopchak, CIH, CSP
Industrial Hygiene and Safety Programs
Director

John C. Clauson

Scientist

Professional History

Education

BS, Environmental Studies/Geography, GIS Certificate, University of West Florida, 2005

Professional Registrations

Professional Affiliations

Choctawatchee Basin Alliance
Florida Society of Geographers

Training and Certifications

10-Hour Construction Outreach Training
4-Hour Defensive Driving Course
Basic Trailer Loading & Towing Awareness
Confined Space – Entrant
CPR
Defensive Driving Awareness Training
DOT Level 1 Shipper/(TDG) Canada
Fall Protection Awareness Training
Fire Extinguisher Training
First Aid
General Excavation Safety
GIS Certificate
Hazard Communication (US)/WHMIS (Canada)
HAZWOPER 40-Hour Training
HAZWOPER 8-Hour Refresher Training
HAZWOPER 8-Hour Supervisor Training
HAZWOPER Medical Exam
Hearing Protection
Lockout/Tagout
Office Ergonomics
Reasonable Suspicion - Alcohol and Substance Abuse
Respiratory Protection
Safety Orientation
Scaffolding Training
Trench/Excavation Safety

Publications

Awards

Celebrate Safety Award and 2009 Celebrate Safety Contractor of the Year, (Alaska District Army Corp of Engineers)
2009 Environmental Restoration Team Award (Office of the Secretary of the Army)
Honorable Mention 2010 AECOM Excellence and Core Values Awards for Best Large Project.
USACE Mobile District 2009: 1) Celebrate Safety Award for 2nd Quarter FY09 for CONUS Medium category, and 2) 2009 Safe Contractor of the Year.

Mr. Clauson has over 6 years of technical experience as an environmental scientist with experience in site assessments, site investigations, remedial investigations, feasibility studies, interim corrective measures, treatability studies, remedial actions, RCRA Closures, and remedial process optimization (RPO). This work has been performed under contract work for the US Air Force Center for Engineering and the Environment (AFCEE), the US Army Corps of Engineers (USACE), Florida Department of Environmental Protection (FDEP), and through other commercial contracts on federal, state, and private industrial and residential land. These efforts included soil boring, geophysical surveying, GPS surveying, utilities surveying, interim measure removal actions, hazardous material/hazardous waste surveying, piezometer and well installation, bioventing, soil vapor and groundwater remediation system installation, operation, monitoring and effectiveness evaluation, petroleum removal, surface and subsurface soil sampling, air sampling, surface water, sediment, groundwater sampling and fish tissue sampling. He has a thorough knowledge of Florida Department of Environmental Protection standard operating procedures and US EPA standards for environmental field activities. He also has experience interpreting geological, hydrogeological, analytical, and geophysical data, performing statistical evaluation, preparing cross-sectional maps, and assisting with Phases I/II ESAs, SAs, SIs, RI/FS, APARs, RCRA clean closure, CERCLA documents, UFP QAPP-compliant work plans, treatability study work plans, health and safety plans, and reports.

Mr. Clauson has worked at multiple sites that have included munitions responses sites, test ranges, small arms firing ranges, skeet ranges, low-level radioactive materials sites, former surface and/or subsurface disposal areas, drainage basins, fuel or solvent spill locations, oil/water separators, cattle dipping vats, and water towers. Contaminants addressed include munitions constituents, metals (particularly lead and arsenic), chlorinated solvents, and pesticides. He has been involved with many phases of the work, including the preliminary assessment and investigative fieldwork, remediation fieldwork, data management, interpretation, reporting and regulatory interaction.

One of Mr. Clauson's main duties has been to manage the geospatial data and figure development on the majority of the projects he has worked on. This has created a broad understanding of GIS related software including Arc Map, Arc Catalog, Arc toolbox, Arc Scene, Arc Pad, Terra Sync, Pathfinder office, Cad, and other mapping programs. He also has experience with a range of surveying products and field data collection techniques along with the ability to cooperate with clients and federal, state, local, and private agencies to obtain and deliver geospatial data and products.

Experience

The Air Force Center of Engineering and the Environment (AFCEE) Investigation of Oil Water Separators (OWS) to Determine Defense Environmental Restoration Account Eligibility. (2011 – Present)
Role: Project Support
Project support of the investigation of Oil Water Separator's (OWS's) and to identify new sites for potential inclusion in the Compliance Restoration Program (CRP) at 48 military bases. Activities include site investigation, sampling, and reporting of recommendations as to whether the sites qualify for investigation and/or cleanup under the Defense Environmental Restoration Account (DERA) for validation by AFCEE and the installation. The draft update requires that all DERA-eligible OWS and newly identified sites be inventoried and loaded into a central database. The inclusion of potential sites into the DERP is the basis for this project. Provided updates for Tyndall's GIS layer of OWS sites.

AFCEE, 4PAE08 - Remedial Action Support (TO 093), Tyndall AFB, Florida. (2009 – Present)
Role: Project Support
Project support for Environmental Restoration Program at Tyndall AFB. Activities include site-specific and basewide UFP QAPP development support, CSM development support, and basewide well inspection/maintenance. CSM support focuses on direction of groundwater flow; the types and distribution of contaminants; the migration pathways; and the potential risks posed to human health and the environment. Based on this understanding, the remedial approach alternatives and monitoring programs are being evaluated to determine their effectiveness and efficiencies at meeting the remediation goals. Upon completion of the federal facility agreement, additional investigations will be completed to fill data gaps and assist with development of site-specific remedial alternatives and exit strategies. Historical data will be reviewed and remedial approaches prioritized. The selected remedial approaches will also include performance goals to ensure that the remedial action is proceeding in a well defined manner toward site closure. Providing project field support as well as updates to the project and Tyndall's GIS.

Panama City Airport and Industrial District, Panama City-Bay County International Airport Cleanup, Panama City, Florida. (2008 – Present)
Role: Project Support
Project support for oversight of cleanup of eight identified sites at the airport requiring cleanup, including dioxin-impacted soil spoil pile, underground storage tanks, petroleum-impacted sites, arsenic-impacted sites, and stormwater run-off sites. Impacted media are soil and groundwater. Managing data review and evaluation; development of the site-specific conceptual approaches and GIS-related mapping activities. Site cleanup results within an aggressive remedial timeline and negotiations with state regulators have resulted in remedial cost savings of over $5 million to the client and increased the sales price of the current Airport property by over $6 million.

Florida Department of Environmental Protection, C&C Pawn Shop Site Excavation, Blountstown, Florida. (2006 – Present)
Role: Project Support
Project support for a former gas station site involving soil excavation and the removal of abandoned underground storage tanks, followed by reinstallation of monitor wells and post-active remediation monitoring.

US Army Corps of Engineers - Omaha District, ERSC DO 36 - Hurricane Katrina Damage Assessments and Soil Monitoring, Eglin AFB, Florida. (2006 – Present)
Role: Project Support
Project support for preliminary assessment and preparing a site investigation work plan and ecological preliminary risk evaluation for POI 512 SI, POI 514 SI, and POI 514. Managing LTM and LUC at LF-51, OT-89, DP-261, OT-269, OT-270, and OT-271; groundwater sampling at Site SS-85; a statement of basis and LUCIP for Site SS-278; sediment and soil sampling at Site DP-257; short-term monitoring of the sediment cap and site for Site DP-261; and hydric soil and surface water sampling for Site DP-268.

Florida Department of Environmental Protection, City of Parker Maintenance Yard Remediation, Parker, Florida. (2005 – Present)
Assisting in assessment activities to define the extent of a large contaminant plume emanating from the municipal maintenance yard and extending downgradient to the Pratt Bayou to a depth of 125 feet below land surface. Assisted in construction of in-situ air sparge, soil vapor extraction via vertical wells and associated trenching and equipment compounds.

Florida Department of Environmental Protection, Okaloosa County Road Department Remediation, Fort Walton Beach, Florida. (2005 – Present)
Assisted in assessment activities to define the extent of a large soil and groundwater plume extending off-site and implement a remedial action plan to address the source area while completing off-site assessment activities. Assisted in construction of in-situ air sparge, soil vapor extraction via vertical wells and associated trenching and equipment compounds.

Appendix E
Competent/Qualified Persons Proof of Competency

OSHA 000242913

U.S. Department of Labor
Occupational Safety and Health Administration

Bill Duffy

has successfully completed a 10-hour Occupational Safety and Health Training Course in

Construction Safety & Health

Ron Bruce 11/28/03

(Trainer) Ron Bruce 63214 (Date)

Appendix F
HAZWOPER Training and Medical Monitoring Documentation

HAZWOPER Training and Medical Monitoring Documentation has been intentionally omitted herein; this documentation will be maintained on site and is available upon request.

Appendix F.1
8-Hour Certificates

8-Hour Certificates have been intentionally omitted herein; this documentation will be maintained on site and is available upon request.

Appendix F.2
40-Hour Certificates

40-Hour Certificates have been intentionally omitted herein; this documentation will be maintained on site and is available upon request

Appendix F.3
Medical Monitoring

Medical Monitoring documentation has been intentionally omitted herein; this documentation will be maintained on site and is available upon request

Appendix F.4
Supervisor Certificates

Supervisor Certificates have been intentionally omitted herein; this documentation will be maintained on site and is available upon request

Appendix G
First Aid and CPR Trained Individuals

First Aid and CPR Trained Individuals have been intentionally omitted herein; this documentation will be maintained on site and is available upon request

Appendix H
Site Safety and Health Plan

APPENDIX H
SITE SAFETY AND HEALTH PLAN

SITE 4 AND SITE 40
NAVAL AIR STATION WHITING FIELD (NASWF)
MILTON, FLORIDA

Revision 1

Prepared for:

Naval Facilities Engineering Command Southeast
Building 135 North, P.O. Box 30
Jacksonville, Florida 32212-0030

Prepared by:

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

Contract Number: N62470-11-D-8013
Delivery Order Number: JM44 and JM57

October 2013

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Attachment 4 Activity Hazard Analyses
Attachment 5 Resolution Consultants Safety Standard Operating Procedures (See Appendix C of the APP)
Attachment 6 Route Map to Emergency Medical Facility

LIST OF ACRONYMS

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIH	Certified Industrial Hygienist
COPCs	chemicals of potential concern
CRZ	Contaminant Reduction Zone
CSP	Certified Safety Professional
EAP	Emergency Action Plan
EC	Emergency Coordinator
EZ	Exclusion Zone
FDEP	Florida Department of Environmental Protection
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDLH	immediate danger to life or health
MSDS	Material Safety Data Sheet
NASWF	Naval Air Station Whiting Field
PID	photo ionization detector
PPE	Personal Protective Equipment
ppm	parts per million
RI	Remedial Investigation
SAR	Site Assessment Report
SH&E	Safety, Health, and Environmental
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SSHO	Site Safety Health Officer
SZ	Support Zone
TBD	To be determined
TLV	Threshold Limit Value
TO	Task Order
TOM	Task Order Manager
UST	underground storage tank
VOC	volatile organic compound

SIGNATURE SHEET

This Site Safety and Health Plan (SSHP) was prepared for employees performing field activities at Site 4 and Site 40, Naval Air Station Whiting Field (NASWF), Milton, Florida. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present at the project sites. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of the project, adherence to the safety and health program requirements of this SSHP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve this SSHP for the field activities at Site 4 and Site 40, NASWF, Milton, Florida. This SSHP has been written for exclusive use by Resolution Consultants employees and its subcontractors. This SSHP was written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Plan Preparer:

_____ Date:_____

1.a. Bill Duffy, P.G.
Geologist
Resolution Consultants

Plan Review:

_____ Date: _____

1.b. Alex Eddington, P.G.
Task Order Manager
Resolution Consultants

Plan Concurrence:

_____ Date: _____

1.c. Harold McDaniel, CSP
Safety, Health, & Environmental Representative
Resolution Consultants

Plan Concurrence:

_____ Date: _____

1.d. John Knopf, CSP
Safety, Health, & Environmental Manager

SIGNATURE SHEET

This Site Safety and Health Plan (SSHP) was prepared for employees performing field activities at Site 4 and Site 40, Naval Air Station Whiting Field (NASWF), Milton, Florida. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present at the project sites. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of the project, adherence to the safety and health program requirements of this SSHP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve this SSHP for the field activities at Site 4 and Site 40, NASWF, Milton, Florida. This SSHP has been written for exclusive use by Resolution Consultants employees and its subcontractors. This SSHP was written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Plan Preparer:

Date: 10/08/13

1.a. Bill Duffy, P.G.
Geologist
Resolution Consultants

Plan Review:

Date: 10/8/13

1.b. Alex Eddington, P.G.
Task Order Manager
Resolution Consultants

Plan Concurrence:

Date: October 10, 2013

1.c. Harold McDaniel, CSP
Safety, Health, & Environmental Representative
Resolution Consultants

Plan Concurrence:

jknopf@ensafe.com Digitally signed by jknopf@ensafe.com DN: cn=jknopf@ensafe.com Date: 2013.10.10 14:26:38 -05'00'

Date:

1.d. John Knopf, CSP
Safety, Health, & Environmental Manager

H.1 INTRODUCTION

The provisions of this Site Safety and Health Plan (SSHP) are mandatory for all Resolution Consultants personnel (including both AECOM and EnSafe employees, as applicable) engaged in fieldwork associated with the environmental services being conducted at the subject site. For the purposes of this SSHP, the term "Resolution Consultants" means an employee of either of the two firms. A copy of this SSHP and any applicable SSHP supplements shall be accessible on site and available for review at all times. Recordkeeping will be maintained in accordance with this SSHP and the applicable Standard Operating Procedures (SOPs) referenced throughout this document and the Accident Prevention Plan (APP). In the event of a conflict between this SSHP, the SOPs and federal, provincial, state, and local regulations, workers shall follow the most stringent/protective requirements. Concurrence with the provisions of this SSHP is mandatory for all personnel covered by this SSHP and personnel must sign the acknowledgement page in Attachment 1 to indicate they have read and understand the SSHP. All changes to this SSHP must be documented using the form in Attachment 2.

H.2 SITE DESCRIPTION AND CONTAMINANT CHARACTERIZATION

H.2.1 General Description

Resolution Consultants will conduct an environmental investigation at Site 4 and Site 40. Investigation activities will be performed in accordance with the Work Plan (Resolution Consultants, 2012). Deviations from the Work Plan that include tasks not covered by this SSHP will require that the Resolution Consultants Health and Safety Manager or designee review and update this SSHP to ensure that personnel and other property are protected. All changes to this SSHP will be documented in Attachment 2.

This section provides a general description and historical information associated with the sites.

H.2.2 Site Background and History

Site 4 and Site 40 are located on NASWF, which is located in Santa Rosa County, in Florida's northwest coastal area, and includes the region occupied by the groundwater aquifer. NASWF has an area of approximately 3,842 acres. NASWF was constructed in the early 1940s as a naval aviation training facility. The field's mission has been to train student naval aviators in the use of basic instruments, formation and tactic phases of fixed-wing and propeller-driven aircraft, and in the basic and advanced portions of helicopter training. Currently, the North Field is used for fixed-wing aircraft training, while the South Field is used for helicopter training.

Site 4 was known as Site 1467 prior to 1992. The underground storage tank (UST) site was renamed when it moved from the UST Program to the Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA) Program, as a result of chlorinated compound detection. Site 4 is identified as the AVGAS Tank Sludge Disposal Area, based upon UST cleaning practices used during the operational period. The former underground storage tank (designated as UST Site 1467) facility contained eight 25,000-gallon steel USTs, and one 15,000-gallon steel UST. AVGAS was piped from the storage system (Site 4 USTs) to the dispensing or delivery location (hydrant area). According to historical documents, nine USTs were installed in 1943. Seven USTs were excavated and removed in 1992, and a Discharge Reporting Form was submitted to the Florida Department of Environmental Protection (FDEP) for each of the USTs removed.

Site 40 was established in 1999 and includes the surficial groundwater aquifer underlying NASWF and was designated as a single site in order to reduce complexity and quantify the extent, locations, and sources of groundwater contamination at NASWF. As part of the Site 40 Remedial Investigation (RI; Tetra Tech, 2012), surface and subsurface soil leachate was evaluated to identify potential sources of groundwater contamination. Task Order (TO) JM44 focuses on the identification and verification of potential source areas resulting in impacts to subsurface soil and the surficial aquifer.

H.2.3 Previous Investigations

Previous investigations of these sites are documented in the Site Assessment Report (SAR) for Site 4 (CH2MHILL, 2013) and the RI Report for Site 40 (Tetra Tech, 2012).

H.2.4 Potential Chemical Exposure

Based on the findings documented in the SAR for Site 4 (CH2MHILL, 2013) and the RI Report for Site 40 (Tetra Tech, 2012), chemicals presented in Table H-1 and Table H-2 are identified as chemicals of potential concern (COPCs).

Table H-1
Site 4 Previous Investigation Data

Site 4 Subsurface Soil from 2004 to 2011 (mg/kg)	Frequency of Detections	Residential SCTL	Maximum Concentration
Benzene	9/267	1.2	24.6J, April 2008
Toluene	0/267	7,500	445, 2008
Ethylbenzene	0/267	1,500	937, 2008
Total Xylenes	3/267	130	74.7, 2011
Chloroethane	1/267	3.9	6.6J 2008
Bromomethane	0/267	3.1	1.2 J, 2008
Ethylene dibromide	0/267	0.1	0.0019 J, 2004
Isopropylbenzene	0/267	220	0.06, 2004
4-Methylphenol	0/267	300	0.081, 2004
1-Methylnapthalene	0/267	200	6.4, 2008
2-Methylnapthalene	0/267	210	8.7, 2008
Napthalene	0/267	55	3.0, 2008
Benzo(a)pyrene	1/267	0.1	0.23 J 2011
TPH	2/267	460	5,780, 2008
Site 4 Upper Perched Aquifer Groundwater (µg/L)	**Frequency of GCTL Exceedances**	**GCTL**	**Maximum Concentration**
Benzene	6/6	1	3,600
Ethylbenzene	5/6	30	3,460
Toluene	4/6	40	71,700
Xylenes, total	5/6	20	11,900
Isopropylbenzene	2/3	0.8	12.7
Trichlorothene	3/3	3	41.8
Lead	3/3	15	92.4 J
Site 4 Lower Perched Aquifer Groundwater (µg/L)	**Frequency of GCTL Exceedances**	**GCTL**	**Maximum Concentration**
Benzene	7/7	1	6,610
Ethylbenzene	6/7	30	2,170
Toluene	6/7	40	25,400
Xylenes, total	6/7	20	5,340
Lead	6/7	15	270
Benzo(a)fluoranthene	2/7	0.05	0.84
Napthalene	1/7	14	16.8

µg/L = micrograms per liter
J = estimated value

Table H-2
Site 40 Previous Investigation Data

Analyte	Frequency of Detection	Minimum Concentration	Maximum Concentration
North Central Area Groundwater (µg/L)			
Benzene	18/34	4.42	3,580
Cis-1,2-DCE	12/34	0.612 J	636
Ethylbenzene	19/34	0.254 J	2,690
Tetrachloroethene	3/34	0.559 J	1.98 J
Toluene	18/34	0.2.61 J	35,000 J
Total Xylenes	15/34	3.07	8,060
Trichloroethene	19/34	0.364 J	376
Iron	19/34	289 J	34,200
Manganese	26/34	8.666 J	2,940
South Central Area Groundwater (µg/L)			
Benzene	9/42	0.258 J	1,010
Cis-1,2-DCE	24/42	0.26 J	37.2
Ethylbenzene	11/42	0.394 J	1,840
Tetrachloroethene	2/42	0.26 J	0.468 J
Toluene	15/42	0.251 J	7,510
Total Xylenes	9/42	0.757 J	3,470
Trichloroethene	34/42	0.274 J	522
Iron	10/42	313 J	17,600
Manganese	33/42	3.27 J	598
Other Sites Groundwater (µg/L)			
1,1-Dichloroethane	1/68	9 J	9 J
Carbon Tetrachloride	1/67	1 J	1 J
Chloroform	2/67	3 J	3 J
Tetrachloroethene	1/67	1 J	1 J
Trichloroethene	7/67	0.97 J	17
Vinyl Chloride	1/67	1.1	1.1
Metals total (µg/L)			
Aluminum	43/68	24.7 J	49,400
Antimony	1/68	13.9 J	13.9 J
Arsenic	5/68	1.1 J	5.6 J
Cadmium	7/68	1.2 J	8.1
Iron	40/68	41.6 J	104,000
Lead	19/68	0.6 J	32.4
Manganese	54/68	1.3 J	385
Mercury	6/68	0.11 J	1.2
Thallium	3/68	0.6 J	0.7 J
Metals filtered (µg/L)			
Aluminum	6/12	50.7 J	1,930
Arsenic	1/12	1.1 J	1.1 J
Cobalt	2/12	1.6 J	3.4 J
Iron	8/12	7.4 J	2,150

µg/L = micrograms per liter
J = estimated value

Material Safety Data Sheets (MSDSs) will be included for all chemicals that are brought onto the site. MSDSs are included in Attachment 3.

H.3 ACTIVITY HAZARD ANALYSIS

Activity Hazard Analysis (AHA) is a technique used to identify hazards and hazard controls associated with a specific job function. AHAs focus on the relationship between the workers, the task, resources required to complete the task, and the work environment. These variables must be evaluated to identify the potential hazards associated with the task. Once identified, the tasks and associated hazards can be evaluated to eliminate or reduce injuries or losses.

Tasks that require an AHA include:

- Drilling
- Well Installation and Development
- Groundwater Sampling
- Equipment Decontamination and IDW Management and Sampling

In the event of unanticipated work activities or changing conditions, additional AHAs may be required. All additional AHAs will be reviewed and approved by the Resolution Consultants Health and Safety Manager or designee before use.

AHAs for all work tasks that will be conducted during this phase of work are included in Attachment 4.

H.4 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

H.4.1 Program Manager (Mr. Ken Vinson)

The Resolution Consultants Program Manager is responsible for supporting the establishment and oversight of the overall health and safety program presented in the APP.

H.4.2 Resolution Consultants Safety, Health, and Environmental Manager (John Knopf, CSP)

The Safety, Health, and Environmental (SH&E) Manager is assigned to provide guidance and technical support for the project. Duties include the following:

- Approving this SSHP and any required changes
- Approving the designated Site Safety Health Officer (SSHO)

- Reviewing all personal exposure monitoring results
- Investigating any reported unsafe acts or conditions

The SH&E Manager may designate another safety professional as the direct liaison for this project; if that is the case, he will remain available for any or all of the tasks listed here or elsewhere in this SSHP in lieu of the designee.

H.4.3 Task Order Manager (Alex Eddington)

The Task Order Manager (TOM) has overall management authority and responsibility for all site operations, including safety. The TOM will provide the Site Supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations.

H.4.4 Site Supervisor (Bill Duffy)

The Site Supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans. The TOM may act as the Site Supervisor while on site.

H.4.4.1 Responsibilities

The Site Supervisor is responsible to:

- Discuss deviations from the work plan with the SSHO and TOM.
- Discuss safety issues with the TOM, SSHO, and field personnel.
- Assist the SSHO with the development and implementation of corrective actions for site safety deficiencies.
- Assist the SSHO with the implementation of this SSHP and ensuring compliance.
- Assist the SSHO with inspections of the site for compliance with this SSHP and applicable Standard Operating Procedures (SOPs).

H.4.4.2 Authority

The Site Supervisor has authority to:

- Verify that all operations are in compliance with the requirements of this SSHP, and halt any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspend individuals from field activities for infractions against the SSHP pending consideration by the SSHO, the SH&E Manager or designee, and the TOM.

H.4.4.3 Qualifications

In addition to being Hazardous Waste Operations and Emergency Response (HAZWOPER)-qualified (see Section 4.1), the Site Supervisor is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 Code of Federal Regulation 1910.120 (e)(4).

H.4.5 Site Safety Health Officer (Bill Duffy)

H.4.5.1 Responsibilities

The SSHO is responsible to:

- Update the site-specific SSHP to reflect changes in site conditions or the scope of work. SSHP updates must be reviewed and approved by the SH&E Manager or designee. Updates must be documented using the Revision History in Attachment 2.
- Be aware of changes in Resolution Consultants Safety Policies, Programmatic Health and Safety Plan, or SOPs.
- Monitor the lost time incidence rate for this project and work toward improving it.
- Inspect the site for compliance with this SSHP and the SOPs using the appropriate audit inspection checklist provided by the SH&E Manager or designee.
- Work with the Site Supervisor and TOM to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contact the SH&E Manager or designee for technical advice regarding safety issues.
- Provide a means for employees to communicate safety issues to management in a discreet manner (e.g., suggestion box, etc.).
- Determine emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Check that all site personnel and visitors have received the proper training and medical clearance prior to entering the site.
- Establish any necessary controlled work areas (as designated in this SSHP or other safety documentation).
- Present tailgate safety meetings and maintain attendance logs and records in accordance with SH&E SOP *5-210-Tailgate Safety Meeting Log* (Attachment 5).
- Discuss potential health and safety hazards with the Site Supervisor, the SH&E Manager or designee, and the TOM.

- Select an alternate SSHO by name and inform him/her of their duties, in the event that the SSHO must leave or is absent from the site. The alternate SSHO must be approved by the TOM.

H.4.5.2 Authority

The SSHO has authority to:

- Verify that all operations are in compliance with the requirements of this SSHP.
- Issue a "Stop Work Order" under the conditions set forth in this SSHP.
- Temporarily suspend individuals from field activities for infractions against the SSHP pending consideration by the SH&E Manager or designee and the TOM.

H.4.5.3 Qualifications

In addition to being HAZWOPER-qualified, the SSHO is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 Code of Federal Regulation 1910.120 (e)(4).

H.4.6 Employees

H.4.6.1 Employee Responsibilities

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the policies and procedures specified in the SSHP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to health and safety management relating to omissions and modifications in the SSHP or other safety policies.
- Notifying the SSHO, in writing, of unsafe conditions and acts.

H.4.6.2 Employee Authority

The health and safety authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work authority when the employee feels that the work is unsafe (including subcontractors or team contractors), or where specified safety precautions are not adequate or fully understood.
- The right to refuse to work on any site or operation where the safety procedures specified in this SSHP or other safety policies are not being followed.
- The right to contact the SSHO or the SH&E Manager or designee at any time to discuss potential concerns.
- The right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions.

H.5 TRAINING, GENERAL AND PROJECT SPECIFIC

H.5.1 HAZWOPER Qualifications

Personnel performing work at the job site must be qualified as HAZWOPER workers (unless otherwise noted in specific AHAs or by the SSHO), and must meet the medical monitoring and training requirements specified in the Resolution Consultants SH&E SOPs.

If site monitoring procedures indicate that a possible hazardous material exposure has occurred above the Occupational Safety and Health Administration permissible exposure limit, employees may be required to receive supplemental medical testing to document any symptoms that may be specific to the particular materials present.

H.5.2 Site-Specific Safety Training

All Resolution Consultants personnel performing activities at the site will be trained in accordance with SH&E SOP *5-003-SH&E Training* (Attachment 5). All personnel are required to remain current in all of their required training and evaluate their need for additional training when there is a change in work. In addition to the general health and safety training programs, personnel will be required to complete any supplemental task-specific training developed for the tasks to be performed. Administration and compliance with the requirements for additional task-specific training will be the responsibility of the project or lead manager. Any additional required training that is completed will be documented and tracked in the project files.

H.5.3 Competent Person Training Requirements

Work requiring a task specific competent person may be required on this site. If competent person tasks are identified, the SSHO/Site Supervisor will be responsible for identifying the appropriate employee/subcontractor and area of competency. Table H-3 contains the required information for task-specific competencies on this job site.

Table H-3
Task-Specific Competent Persons

Employee Name	Organization	Area of Competency (Task)
Lead Driller	TBD	Drill Rig and Support Vehicles

Notes:
TBD = To be determined
The training requirements for competent persons are specified in the indicated SOPs and/or SH&E SOP 5-202-Competent Person Designation (refer to Appendix C of the APP). By identifying an employee as a "competent person", that person has now been authorized to take prompt corrective measures to eliminate hazards.

H.6 PERSONAL PROTECTIVE EQUIPMENT

The purpose of personal protective equipment (PPE) is to provide a barrier, which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. SH&E SOP *5-208-Personal Protective Equipment Program* (Attachment 5) lists the general requirements for selection and usage of PPE.

H.6.1 Minimum PPE Requirements

Table H-4 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual AHAs. By signing this SSHP the employee agrees having been trained in the use, limitations, care, and maintenance of the protective equipment to be used by the employee at this project. If training has not been provided, request same of the TOM/SSHO for the proper training before signing.

Table H-4
Personal Protective Equipment

PPE	Type	Additional Information
Minimum PPE		
Boots	Leather	ANSI approved safety toe
Safety Glasses	ANSI Z87.1	ANSI Approved; ≥98% UV protection
Hard Hat	ANSI Z89.1	ANSI Approved; recommended wide-brim
Work Uniform		No shorts/cut-off jeans or sleeveless shirts
Additional PPE		
Leather Gloves		If working with sharp objects or powered equipment.
Protective Chemical Gloves	Inner: Chemical resistant	Use during handling of all potentially impacted media.
Level C Respiratory Protection	Upgrade to Half Face based on SSHO recommendations	Upgrade based on air monitoring requirements established in Section H.8

H.6.2 PPE Doffing and Donning (UTILIZATION) Information

The following information is to provide field personnel with helpful hints that, when applied, make donning and doffing of PPE a more safe and manageable task:

- Never cut disposable booties from your feet with basic utility knives. This has resulted in workers cutting through the booty and the underlying sturdy leather work boot, resulting in significant cuts to the legs/ankles. Use a pair of scissors or a package/letter opener (cut above and parallel with the work boot) to start a cut in the edge of the booty, then manually tear the material down to the sole of the booty for easy removal.

- When applying duct tape to PPE interfaces (wrist, lower leg, around respirator, etc.) and zippers, leave approximately one inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small handle to grab while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Have a "buddy" check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.
- Never perform personal decontamination with a pressure washer.

H.7 MEDICAL SURVEILLANCE

Medical Records for Resolutions Consultants employees working on the Site 4 and 40 are included in Appendix F.3 of the APP.

H.8 EXPOSURE MONITORING AND AIR SAMPLING PROGRAM

Monitoring shall be performed where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices, and PPE. Employees should not be exposed to levels, which exceed permissible exposure limits, or published exposure levels, without the use of acceptable protective measures.

Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site. Periodic monitoring shall be conducted when the possibility of an immediate danger to life or health (IDLH) condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

- When work begins on a different portion of the site.
- When contaminants other than those previously identified are being handled.
- When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).
- When employees are handling leaking drums or containers or working in areas with obvious liquid contamination.

Table H-5 contains monitoring instruments, manufacturer information, and the substances that each instrument detects.

Table H-5
Monitoring Parameters and Equipment

Instrument	Manufacturer/Model*	Substances Detected
PID *	TBD	VOCs and petroleum hydrocarbons

Notes:
PID = photo ionization detector
VOCs = volatile organic compounds
*Or similar unit, as approved by the Resolution Consultants Safety Health and Environmental Manager or designee

H.8.1 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone. Action levels are based upon sound scientific principles as expressed by various regulatory agencies or industry groups.

If ambient levels are measured, which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (removal from area, barricades, warning signs, and mitigative actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of SSHO or the SH&E Manager or designee.

Reasons to upgrade:

- Known or suspected presence of dermal hazards.
- Occurrence or likely occurrence of gas, vapor, or dust emission.
- Change in work task that will increase the exposure or potential exposure to hazardous materials.

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally suspected.
- Change in site conditions that decrease the potential hazard.
- Change in work task that will reduce exposure to hazardous materials.

H.8.2 Monitoring Procedures

The SSHO will assess the atmosphere for acceptable concentrations/levels using the prescribed hand-held direct read instrumentation (or other approved alternative) prior to any personnel entering into the area, and continuously thereafter. The monitoring devices may then be assigned to individual personnel working within the Exclusion Zone (EZ). Care should be taken to apply all necessary correction factors to your monitoring results (volatile organic compounds and Explosive Atmosphere channels) specific to the contaminants of concern.

Table H-6 lists the monitoring procedures and action levels.

Table H-6
Monitoring Procedures and Action Levels

Parameter	Location and Interval	Action Level (Meter Units/ppm Above Background)	Response if Action Level is Met
VOCs (Total by PID)	Continuous in the worker's breathing zone or in the immediate work area. Response based on sustained readings at least 1 minute in duration.	< 1.0 ppm	Continue Level D or Modified Level D work and continue monitoring.
		≥ 1 ppm and < 5 ppm	Collect Drager Tube for benzene; if benzene concentration is less than 1 ppm, continue work. If benzene is greater than 1ppm, cease work, exit the area, contact the Resolution Consultants SSHO or designee.
		≥ 50 ppm	Cease work, exit the area, contact the Resolution Consultants SSHO or designee.

Notes:
ppm = parts per million

H.8.3 Monitoring Equipment Calibration

All instruments used will be calibrated to the appropriate level at the beginning of each work shift, in accordance with the manufacturer's recommendations (bump test, span gas calibration). If the

owner's manual is not available, the personnel operating the equipment will contact the applicable office representative, rental agency, or manufacturer for technical guidance for proper calibration. If equipment cannot be pre-calibrated to specifications, site operations requiring monitoring for worker exposure or off-site migration of contaminants will be postponed or temporarily ceased until this requirement is completed.

H.8.4 Personal Sampling

Should site activities warrant performing personal sampling (breathing zone) to better assess chemical exposures experienced by Resolution Consultants employees, the SSHO, under the direction of a Certified Industrial Hygienist (CIH) or a Certified Safety Professional (CSP) will be responsible for specifying the monitoring required. Within five working days after the receipt of monitoring results, the Certified Industrial Hygienist or Certified Safety Professional will notify each employee, in writing, of the results that represent that employee's exposure. Copies of air sampling results will be maintained in the SSHO project files.

If the site activities warrant, the subcontractor will ensure its employees' exposures are quantified via the use of appropriate sampling techniques. The subcontractor shall notify the employees sampled in accordance with health and safety regulations, and provide the results to the SSHO for use in determining the potential for other employees' exposure.

H.9 HEAT AND COLD STRESS

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress.

H.9.1 Responding to Heat-Related Illness

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties. Work-rest cycles will be determined and the appropriate measures taken to prevent heat stress as outlined in SH&E SOP *5-511-Heat Stress Prevention* (Attachment 5). The guidance presented in Table H-7 will be used in identifying and treating heat-related illness.

Table H-7
Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • If an air-conditioned spot is available, this is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (*avoid drafts or sudden chilling*). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (*Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing*). • If the victim is conscious, it may be helpful to give him/her sips of water. • Transport victim to a medical facility as soon as possible.
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool/shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his/her back w/the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide on-site treatment of the victim and proper transport to a medical facility.

H.9.2 Responding to Cold-Related Illness

If work on this project is conducted in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Work will cease under unusually hazardous conditions (e.g., wind chill less than 0°F, or wind-chill less than 10°F with precipitation). Systemic cold exposure is referred to as hypothermia. Localized cold exposure is generally labeled frostbite. Recognition of the symptoms of cold related illness will be discussed during the health and safety briefing

conducted prior to the onset of site activities. Refer to the 2003 American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLV) for Chemical Substances and Physical Agents for additional information on cold stress prevention, monitoring, and work-warming regimens. Work-rest cycles will be determined and the appropriate measures taken to prevent cold stress as outlined in SH&E SOP *5-505-Cold Stress* (Attachment 5).

H.9.2.1 Hypothermia

Hypothermia is a life-threatening condition in which the core body temperature falls below 95°F. Hypothermia can occur at temperatures above freezing particularly, when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe. Symptoms and warning signs progressively worsen and range from sluggishness and slurred speech to disorientation and eventually unconsciousness (see Table H-8).

Table H-8
Progressive Clinical Symptoms of Hypothermia

Core Temperature (°F)	Clinical Signs
95°	Maximum shivering
87° — 89°	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated
84° — 86°	Progressive loss of consciousness; muscular rigidity; respiratory rate decreases
79°	Victim rarely conscious
70° — 72°	Maximum risk of ventricular fibrillation

The ability to sustain metabolic rate and to reduce skin blood flow is diminished by fatigue. Thus, fatigue increases the risk of severe hypothermia by decreasing metabolic heat. Additionally, because blood flow through the skin is reduced to conserve heat, the skin and underlying tissues become more susceptible to frostbite.

H.9.2.2 Frostbite

Frostbite is both the general and medical term given to areas of cold injury. Unlike hypothermia, frostbite rarely occurs unless environmental temperatures are less than freezing and usually less than 20°F. Frostbite injuries occur most commonly on the distal parts of the body (nose, earlobes, hands, and feet) that are subject to intense vasoconstriction.

The three general categories of frostbite are:

- Frostnip — A whitened area of the skin, which is slightly burning or painful.
- Superficial frostbite — Waxy, white skin with a firm sensation but with some resiliency. Symptomatically feels "warm" to the victim with a notable cessation of pain.
- Deep frostbite — Tissue damage deeper than the skin, at times, down to the bone. The skin is cold, numb, and hard.

H.9.2.3 Preventing Cold Related Illness

The following are precautions that will be taken to prevent illness relating to cold stress:

- Educate worker to recognize the symptoms of frostbite and hypothermia.
- Ensure the availability of an enclosed, heated environment within the vehicles. The nearest heated environment will be the interior of the vehicles at the site.
- Ensure the availability of dry changes of clothes.
- Record temperature readings.
- Ensure the availability of warm beverages, preferably non-caffeinated.

H.9.2.4 Monitoring for Cold Exposure

Cold stress monitoring will be conducted in accordance with the American Conference of Governmental Industrial Hygienists cold stress TLV. The TLV objective is to prevent the deep body core temperature from falling below 96.8°F and to prevent cold injury to body extremities. Temperature monitoring and recording will be initiated in the following situations:

- At the SSHO discretion when suspicion is based on changes in worker's performance or mental status
- At worker's request
- As a screening measure whenever any one worker on the site develops hypothermia
- Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours

H.10 STANDARD OPERATING PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

H.10.1 Site Rules and Prohibitions

All site personnel shall conduct themselves in a safe manner and maintain a working environment that is free of additional hazards, in adherence to SH&E SOPs *5-001-Safe Work Standards and Rules* and *5-307-Housekeeping, Worksite* (Attachment 5).

H.10.1.1 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

H.10.1.2 Smoking, Eating, or Drinking

Smoking, eating, and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any Resolution Consultants site. Smoking, eating, or drinking must be in an approved area.

H.10.1.3 Personal Hygiene

The following personal hygiene requirements will be observed:

Water Supply: A water supply meeting the following requirements will be utilized:

Potable Water — An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as adequate disposal containers. Staff sharing a potables cooler shall not introduce individually opened containers into the team cooler in an effort to minimize concerns for indirect contamination. Additionally, each potable cooler will be sealed to protect the water quality.

Potable water containers will be properly identified in order to distinguish them from non-potable water sources. All containers of potable water will be marked with a label stating:

Potable Water ONLY
Not Intended for Sample Storage

Non-Potable Water — Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating:

Non-Potable Water
Not Intended for Drinking Water Consumption

Toilet Facilities: A minimum of one toilet will be provided for every 20 personnel on site, with separate toilets maintained for each sex except where there are less than 5 total personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities, on-site facilities are not required.

Washing Facilities: Employees will be provided washing facilities (e.g., buckets with water and Alconox, waterless hand sanitizers) at each work location. The use of water and hand soap (or similar substance) will be required by all employees following exit from the EZ, prior to breaks, and at the end of daily work activities.

H.10.1.4 Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on site can serve as "buddies" for Resolution Consultants personnel. Under no circumstances will any employee be present alone in a controlled work area.

H.10.1.5 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions as outlined in SH&E SOP *5-002-Stop Work Authority* (refer to Appendix C in the APP). Whenever the SSHO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the SSHO is authorized and required to stop work, which shall be immediately binding on all affected Resolution Consultants employees and subcontractors.

Upon issuing the stop work order, the SSHO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the SH&E Manager or designee has concurred that workplace conditions meet acceptable safety standards.

H.10.1.6 Client-Specific Safety Requirements

Not applicable based on the scope of work.

H.10.2 Work Permit Requirements

Not applicable based on the scope of work.

H.10.3 Material Handling Procedures

Manual Material Handling Procedures are included in *SH&E SOP 5-308-Manual Lifting Field* (Attachment 5) Standard Operating Procedures.

H.10.4 Drum, Container, Tank Handling

Not applicable based on the scope of work.

H.10.5 Comprehensive AHA of Treatment Technologies

Not applicable based on the scope of work.

H.11 SITE CONTROL MEASURES

H.11.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from site hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community.

Controlled work areas will be established at each work location, and if required, will be established directly prior to the work being conducted. Diagrams designating specific controlled work areas will be drawn on site maps, posted in the support vehicle or trailer, and discussed during the daily safety meetings. If the site layout changes, the new areas and their potential hazards will be discussed immediately after the changes are made.

H.11.2 Controlled Work Areas

The scope of this project may require the implementation of HAZWOPER work zones. The SSHO shall determine the applicability and breadth of this requirement.

Each HAZWOPER controlled work area will consist of the following three zones:

- *EZ:* Contaminated work area.
- *Contamination Reduction Zone (CRZ):* Decontamination area.
- *Support Zone (SZ):* Uncontaminated or "clean area" where personnel should not be exposed to hazardous conditions.

Each zone will be periodically monitored in accordance with the air monitoring requirements established in this SSHP. The EZ and the CRZ are considered work areas. The SZ is accessible to the public (e.g., visitors, vendors, inspectors).

H.11.2.1 Exclusion Zone

The EZ is the area where primary activities occur, such as sampling, remediation operations, installation of wells, cleanup work, etc. This area must be clearly marked with hazard tape, barricades or cones, or enclosed by fences or ropes. Only personnel involved in work activities, and meeting the requirements specified in the applicable AHA and this SSHP will be allowed in an EZ. The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with sample collection activities.

All personnel should be alert to prevent unauthorized, accidental entrance into controlled-access areas (the EZ and CRZ). If such an entry should occur, the trespasser should be immediately escorted outside the area, or all HAZWOPER-related work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated or containerized as waste prior to leaving (through the CRZ only).

H.11.2.2 Contamination Reduction Zone

The CRZ is the transition area between the contaminated area and the clean area. Decontamination is the main focus in this area. The decontamination of workers and equipment limits the physical transfer of hazardous substances into the clean area. This area must also be clearly marked with hazard tape and access limited to personnel involved in decontamination. This area will clearly show the entrance and exit lanes for access to the EZ.

H.11.2.3 Support Zone

The SZ is an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located. The SZ shall have minimal potential for significant exposure to contaminants (i.e., background levels).

Employees will establish a SZ (if necessary) at the site before the commencement of site activities. The SZ would also serve as the entry point for controlling site access.

H.11.3 Site Access Documentation

If implemented by the TOM or SSHO, all personnel entering the site shall complete the "Site Entry/Exit Log" located at the site trailer or primary site support vehicle.

H.11.4 Site Security

Depending upon the job site location and the proximity to unauthorized pedestrian traffic and other areas of interest site security may be necessary. The TOM or SSHO shall determine if site security is necessary for the job site.

Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards.
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the site.
- Prevent theft.
- Avoid interference with safe working procedures.

To maintain site security during working hours:

1. Maintain security in the SZ and at access control points.
2. Establish an identification system to identify authorized persons and limitations to their approved activities.
3. Assign responsibility for enforcing authority for entry and exit requirements.
4. When feasible, install fencing or other physical barrier around the site.
5. If the site is not fenced, post signs around the perimeter and whenever possible, use guards to patrol the perimeter. Guards must be fully apprised of the hazards involved and trained in emergency procedures.
6. Have the TOM approve all visitors to the site. Make sure they have a valid purpose for entering the site. Have trained site personnel accompany visitors at all times and require them to wear the appropriate protective equipment.

To maintain site security during off-duty hours:

1. If possible, assign trained, in-house technicians for site surveillance. They will be familiar with the site, the nature of the work, the site's hazards, and respiratory protection techniques.
2. If necessary, use security guards to patrol the site boundary. Such personnel may be less expensive than trained technicians, but will be more difficult to train in safety procedures and will be less confident in reacting to problems around hazardous substances.
3. Enlist public enforcement agencies, such as the local police department, if the site presents a significant risk to local health and safety.
4. Secure the equipment.

H.12 EQUIPMENT DECONTAMINATION

H.12.1 General Requirements

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials, etc.).

All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the EZ but shall be no lower than 1 step below the EZ PPE ensemble (ex: EZ is Level B, Decon is Level C).

All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the SZ.

Decontamination procedures may vary based on site conditions and nature of the contaminant(s). If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The applicable MSDS must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

All contaminated PPE and decontamination materials shall be contained, stored, and disposed of in accordance with site-specific requirements determined by site management.

H.12.2 Decontamination Equipment

The equipment required to perform decontamination may vary based on site-specific conditions and the nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants.
- Hoses, buckets of water, or garden sprayers for rinsing.
- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions.

- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment.
- Metal or plastic cans or drums for the temporary storage of contaminated liquids.
- Paper or cloth towels for drying protective clothing and equipment.

H.12.3 Personal/Equipment Decontamination

All equipment leaving the EZ shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to sampling tools, heavy equipment, vehicles, PPE, support devices (e.g., hoses, cylinders, etc.), and various handheld tools.

All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

PPE used on site may be considered disposable and if so, can be removed and containerized in the CRZ during decontamination activities. Suits and booties will be removed first, and gloves last.

For glove removal:

- Grasp the cuff of the dominant hand and pull glove over the bulk of the hand, leaving the fingers inside the glove.
- Use the dominant hand to grasp the cuff of the non-dominant hand and pull the glove completely off (inside-out) and place inside of the dominant hand glove.
- Once removed, employee should only touch the inside material of the dominant hand glove.
- Thoroughly wash hands.

For larger equipment (not personnel), a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination. Before heavy equipment and trucks are taken off site, the SS and/or SSHO will visually inspect them for signs of contamination. If contamination is present, the equipment must be returned to the decontamination process.

For equipment, use the following steps for decontamination:

1. Remove majority of visible gross contamination in EZ (use shovels, scrapers, brooms, etc.).
2. Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment.
3. Rinse equipment.
4. Visually inspect for remaining contamination.
5. Follow appropriate personal decontamination steps outlined above.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the CRZ. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

H.13 EMERGENCY EQUIPMENT AND FIRST AID

A first aid kit will be available at all times while work is being conducted at the site.

H.14 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES (ERP)

H.14.1 Pre-Emergency Planning

Prior to the start of site operations, the Emergency Coordinator* (EC) will complete Table H-9 with any site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

Table H-9 Emergency Planning		
Emergency	**Evacuation Route**	**Muster Location**
Chemical Spill	• Upwind	• Site vehicles
Fire/Explosion	• Upwind	• Site vehicles
Tornado/Severe Weather	• Closest available tornado shelter	• Building # (TBD by SSHO)
Lightning	• Closest available shelter	• Vehicle/Site Trailer
Additional Information		
Communication Procedures	Direct verbal communications. Must be supplemented when voices cannot be clearly perceived above ambient noise levels and when a clear line-of-sight cannot be maintained by personnel. Personnel will bring a mobile phone to the site to ensure that communications with local emergency responders is maintained, when necessary.	
CPR/First Aid Trained Personnel	Bill Duffy, Anne Kakai, Angela Friar, John Clauson	
Site-Specific Spill Response Procedures	Chemicals brought on site will be limited to fuel for vehicles and small quantities of laboratory preservatives. In the event of a minor spill, sorbent material will be placed on the spill and then transferred to a container for disposal. Field personnel will immediately notify the TOM who in turn will notify the account manager and the Department project representative.	

Note:
* EC is usually the SSHO or designee

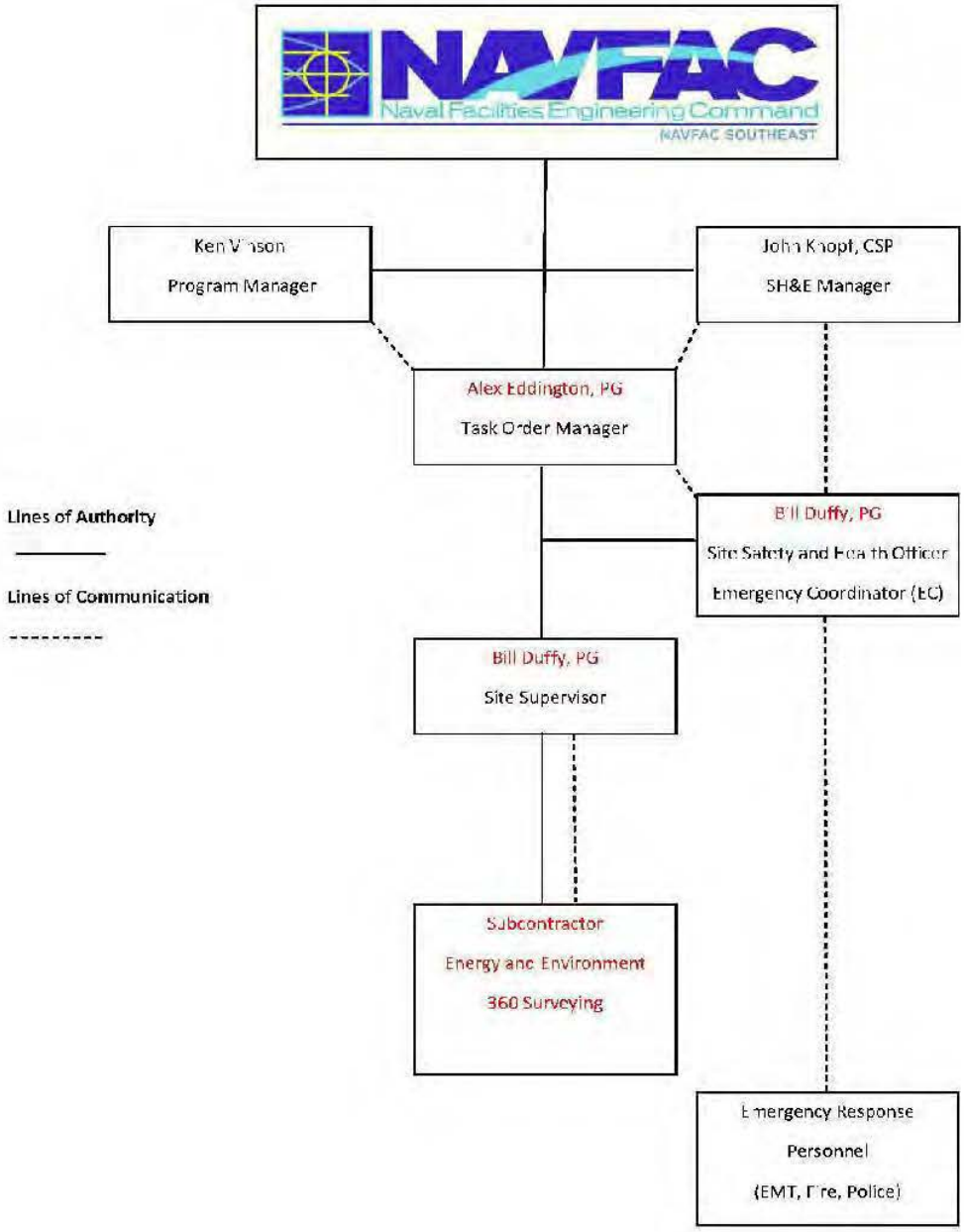


Figure H-1 — Personnel and Lines of Authority for Emergency Situations

The duties of the EC include:

- Implement the Emergency Action Plan (EAP) based on the identified emergency condition.
- Notify the appropriate project and SH&E Department personnel of the emergency (Table H-10).
- Verify emergency evacuation routes and muster points are accessible.
- Conduct routine EAP drills and evaluate compliance with the EAP.

H.14.2 Criteria and Procedures for Emergency Recognition and Site Evacuation

Although the potential for an emergency to occur is remote, an emergency action plan has been prepared for this project should such critical situations arise. The EAP will be reviewed by all personnel prior to the start of field activities. On long term sites, a test of the EAP will be performed within the first three (3) days of the project field operations. This test will be evaluated and documented in the project records.

Four major categories of emergencies could occur during site operations:

1. Illnesses and physical injuries (including injury-causing chemical exposure)
2. Catastrophic events (fire, explosion, earthquake, or chemical)
3. Workplace Violence, Bomb Threat
4. Safety equipment problems

H.14.3 Decontamination and Medical Treatment of Injured Personnel

Personnel who may become injured on site will require an appropriate level of decontamination to ensure that medical personnel or emergency service workers are not exposed to chemical hazards posed on site. We expect our employees to encounter very low levels of chemical contaminants that should not pose a hazard to medical or emergency response personnel; however, we will still provide personal hygiene supplies and appropriate levels of emergency decontamination. If clothing is heavily soiled and/or exhibits chemical odors, personnel shall have their clothing removed and provided temporary covering. Personnel will practice acceptable hygienic steps before being transported for medical treatment. If an injured employee is incapacitated, site personnel will perform this task for them.

H.14.4 Route Map to Emergency Medical Facilities and Phone Numbers for Emergency Responders

The route map to the nearest emergency medical facility is included as Attachment 6. Table H-10 lists the emergency contacts and their phone numbers.

Table H-10
Emergency Contacts

Emergency Coordinators/Key Personnel			
Name	**Title/Workstation**	**Telephone Number**	**Mobile Phone**
Arne Olsen	Navy RPM/NAVFAC SE	TBD	TBD
Alex Eddington	Task Order Manager	850-269-2200	850-461-3869
Bill Duffy	Site Supervisor	850-269-2200	850-375-2116
Bill Duffy	Site Safety Health Officer	850-269-2200	850-375-2116
Bill Duffy	Emergency Coordinator	850-269-2200	850-375-2116
John Knopf, CSP	Resolution Consultants Safety Health and Environmental Manager	901-372-7962	901-451-9064
Eric Allen, ASP	EnSafe CLEAN H&S contact	901-372-7962	901-359-6698
Harold E. McDaniel, Jr., CSP	Resolution Consultants Regional SH&E Manager	256-366-7650	256-366-7650
Russ Reynolds, CSP	Resolution Consultants District SH&E Manager	864-234-3042	864-906-7309
Incident Reporting	**AECOM Personnel**	**800-348-5046 John Knopf**	
	EnSafe Personnel	**Call John Knopf**	
Ann-Alyssa Hill	AECOM TDG/IATA Shipping Expert	804-515-8506	804-640-4815
Kevin Arick	Resolution Consultants Transportation of Dangerous Goods /International Air Transport Association Shipping Expert	901-372-7962	901-356-3525
Eric Olson	Resolution Consultants Department of Transportation/International Air Transport Association Shipping Expert	864-297-3102	864-918-2302

Organization/Agency	
Name	**Telephone Number**
Police Department (Base Security)	911
Fire Department (Base Fire)	911
Ambulance Service *(EMT will determine appropriate hospital for treatment)*	911
Emergency Hospital *(Use by site personnel is only for emergency cases)*	
Santa Rosa Medical Center 6002 Berryhill Road Milton, Florida 32570 Emergency Hospital Route: See Attachment 6	850-626-7762
Poison Control Center	800-222-1222
Pollution Emergency	800-292-4706
National Response Center	800-424-8802
Title 3 Hotline	800-424-9346

Public Utilities	
Name	**Telephone Number**
Call Before You Dig	811

H.14.5 Criteria for Alerting the Local Community Responders

Base emergency alerting phone numbers are expressed in the Table H-10 and should be followed in the event of an emergency.

Attachment 1

SSHP Acknowledgement Form

SSHP Acknowledgement Form
Contract Number: N62470-11-D-8013
Site 4 and Site 40
NAS Whiting Field – Milton, Florida

Print Name	Signature	Organization	Date

Attachment 2

SSHP Revision Table

Site Health and Safety Plan
Revision History
Site 4 and Site 40
NAS Whiting Field – Milton, Florida

Revision No.	Revision Date	Approved By (Initials)	Changes, Discussion
0			

Attachment 3

Material Safety Data Sheets

MATERIAL SAFETY DATA SHEET

I. PRODUCT & COMPANY IDENTIFICATION

Product Name: **Banana Boat® Sport Performance® Sunscreen Stick SPF 50**

Product Code(s): **41-00160**

Product Type: **Sunscreen**

Supplier Address: **Playtex Manufacturing Inc.**
6 Research Dr.
Shelton, CT 06484
USA
Phone: 888-999-6736
Emergency Phone: 888-879-3798

Company Emergency Phone Number: 1-888-879-3798 (Medical Emergency)
1-800-424-9300 (24 hrs. Transportation Information or Spills)
1-703-527-3887 (International Transportation Information or Spills)

II. HAZARDS IDENTIFICATION

Appearance Pale beige **Physical State** Wax **Odor** Characteristic

Emergency Overview

May cause eye irritation

Potential Health Effects: None
Principle Routes of Exposure: Skin contact.

Acute Toxicity

Eyes: May cause irritation.
Skin: Does not pose a potential of skin irritation and sensitization.
Inhalation: No known effect.
Ingestion: No known effect. Ingestion may cause irritation to mucous membranes.

Chronic Effects No known effect.

Aggravated Medical Conditions None known.
Environmental Hazard See Section 12 for additional Ecological Information

III. COMPOSTION INFORMATION

This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

IV. FIRST AID MEASURES

Eye Contact: Rinse thoroughly with plenty of water, also under the eyelids. If irritation persists, call a physician.

Skin Contact: None under normal use

Inhalation: None under normal use

Ingestion: Rinse mouth with water and afterwards drink plenty of water or milk

Notes to Physician: Treat symptomatically.

V. FIRE-FIGHTING MEASURES

Flash Point: Not Applicable

Suitable Extinguishing Media: Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Sensitivity to Static Discharge: Not sensitive to static discharge.

Protective Equipment and Precautions for Firefighters As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA: **Health Hazard** 0 **Flammability** 0 **Stability** 0 **Physical and Chemical Hazards** –

VI. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Avoid contact with eyes.

Environmental Precautions: Prevent entry into waterways, sewers basements, or confined areas. Do not flush into surface water or sanitary system.

Methods for Containment: Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up: Keep in suitable and closed containers for disposal

VII. HANDLING & STORAGE

Handling: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with eyes.

Storage: Keep containers tightly.

VIII. EXPOSURE CONTROLS & PERSONAL PROTECTION

Exposure Guidelines:

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
BHT 128-37-0	TWA: 2 mg/m^3	(vacated) TWA: 10 mg/m^3	TWA: 10 mg/m^3

Engineering Measures: Showers, eyewash stations, and ventilation systems.

Personal Protective Equipment

Eye/Face Protection: No special protective equipment required.

Skin and Body Protection: No special protective equipment required.

Respiratory Protection: No protective equipment is needed under normal use conditions

Hygiene Measures: Handle in accordance with good industrial hygiene and safety practice.

IX. PHYSICAL & CHEMICAL PROPERTIES

Physical State:	Wax		
Appearance:	Pale beige	**Odor:**	Characteristic
pH:	No data available		
Flash Point:	None	**Boiling Point/Range:**	No data available
Melting Point/Range:	No data available	**Specific Gravity:**	No data available
Solubility:	No data available	**VOC Content (%):**	Not applicable

Partition Coefficient: n-octanol/water No data available

X. STABILITY & REACTIVITY

Stability: Stable

Incompatible Products: None known.

Conditions to Avoid: Heat, flames and sparks.

Hazardous Decomposition Products: None known

Hazardous Polymerization: Hazardous polymerization does not occur.

XI. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information: Product is safe for its intended use based on the formulation, testing results, and the long history of safe consumer use.

Chronic Toxicity

Chronic Toxicity: No known effect.

Target Organ Effects: None known.

XII. ECOLOGICAL INFORMATION

Ecotoxicity: The environmental impact of this product has not been fully investigated.

XIII. DISPOSAL CONSIDERATIONS

Waste Disposal Methods: This material, as supplied, is a not hazardous waste according to federal regulations (40 CFR 261). The material could become hazardous of it is mixed with or otherwise comes into contact with a hazardous waste, If chemical additions are made to this material or if the material is processed or otherwise altered. Consult 40 CFR 251 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional or local regulations for additional requirements.

Contaminated Packaging: Dispose of in accordance with local regulations.

XIV. TRANSPORTATION INFORMATION

DOT	Not Regulated
TDG	Not Regulated
MEX	Not Regulated
ICAO	Not Regulated
IATA	Not Regulated
IMDG/IMO	Not Regulated
RID	Not Regulated
ADR	Not Regulated
ADN	Not Regulated

XV. REGULATORY INFORMATION

U.S. Regulations

SARA 311/312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No
California Proposition 65	This product does not contain any Proposition 65 chemicals.

International Regulations

Mexico - Grade Serious risk, Grade 0

WHMIS Hazard Class

Not regulated under CEPA

International Inventories

TSCA	Exempt
DSL	Complies

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

XVI. OTHER INFORMATION

Prepared By	**Global Regulatory Affairs/Product Safety** 75 Commerce Dr. Allendale, NJ 07401 USA
Issuing Date	**13-May-10**
Revision Date	**N/A**
Revision Note	**N/A**

Disclaimer

The information provided on this MSDS is correct to the best of our knowledge, information and belief at the date of its publication. The Information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

Material Safety Data Sheet

24 Hour Assistance:
1-847-367-7700
Rust-Oleum Corp.
www.rustoleum.com

Section 1 - Chemical Product / Company Information

Product Name:	PRO LSPR 6PK MARK FLUORESCENT ORANGE	Revision Date:	08/13/2009
Identification Number:	2554838		
Product Use/Class:	Topcoat/Aerosols		
Supplier:	Rust-Oleum Corporation 11 Hawthorn Parkway Vernon Hills, IL 60061 USA	Manufacturer:	Rust-Oleum Corporation 11 Hawthorn Parkway Vernon Hills, IL 60061 USA
Preparer:	Regulatory Department		

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL CEILING
Liquefied Petroleum Gas	68476-86-8	30.0	N.E.	N.E.	N.E.	N.E.
Aliphatic Hydrocarbon	64742-89-8	20.0	N.E.	N.E.	300 ppm	N.E.
Toluene	108-88-3	15.0	20 ppm	N.E.	200 ppm	300 ppm
Magnesium Silicate	14807-96-6	10.0	2 mg/m3	N.E.	0.1 mg/m3 (Respirable)	N.E.
Hydrotreated Light Distillate	64742-47-8	5.0	200 mg/m3	N.E.	N.E.	N.E.
Naphtha	8032-32-4	5.0	N.E.	N.E.	N.E.	N.E.
Xylene	1330-20-7	5.0	100 ppm	150 ppm	100 ppm	N.E.
Ethylbenzene	100-41-4	1.0	100 ppm	125 ppm	100 ppm	N.E.
Quartz (Crystalline Silica)	14808-60-7	1.0	0.025 mg/m3	N.E.	2.4 mppcf (Respirable)	N.E.

Section 3 - Hazards Identification

*** Emergency Overview ***: Contents Under Pressure. Harmful if inhaled. May affect the brain or nervous system causing dizziness, headache or nausea. Vapors may cause flash fire or explosion. Harmful if swallowed. Extremely flammable liquid and vapor.

Effects Of Overexposure - Eye Contact: Causes eye irritation.

Effects Of Overexposure - Skin Contact: Prolonged or repeated contact may cause skin irritation. Substance may cause slight skin irritation.

Effects Of Overexposure - Inhalation: High vapor concentrations are irritating to the eyes, nose, throat and lungs. Avoid breathing vapors or mists. High gas, vapor, mist or dust concentrations may be harmful if inhaled. Harmful if inhaled.

Effects Of Overexposure - Ingestion: Aspiration hazard if swallowed; can enter lungs and cause damage. Substance may be harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: IARC lists Ethylbenzene as a possible human carcinogen (group 2B).

May cause central nervous system disorder (e.g., narcosis involving a loss of coordination, weakness, fatigue, mental confusion, and blurred vision) and/or damage. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Overexposure to xylene in laboratory animals has been associated with liver abnormalities, kidney, lung, spleen, eye and blood damage as well as reproductive disorders. Effects in humans, due to chronic overexposure, have included liver, cardiac abnormalities and nervous system damage. Overexposure to toluene in laboratory animals has been associated with liver abnormalities, kidney, lung and spleen damage. Effects in humans have included liver and cardiac abnormalities.

Contains crystalline silica as silicon dioxide. Excessive inhalation of respirable crystalline silica dust may cause lung disease, silicosis or lung cancer. Significant exposure is not anticipated during brush or trowel application or drying. Risk of overexposure depends on the duration and level of exposure to dust from repeated sanding of surfaces, mechanical abrasion or spray mist and actual concentration of crystalline silica in the formula. Crystalline silica is listed as Group 1 "carcinogenic to humans" by the International Agency for Research on Cancer (IARC), and Group 2 "reasonably anticipated to be a carcinogen" by the National Toxicology Program (NTP).

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Section 4 - First Aid Measures

First Aid - Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes holding eyelids open. Get medical attention. Do NOT allow rubbing of eyes or keeping eyes closed.

First Aid - Skin Contact: Wash with soap and water. Get medical attention if irritation develops or persists.

First Aid - Inhalation: If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, get medical assistance immediately.

First Aid - Ingestion: Aspiration hazard: Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe lung damage. Get immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point: -156 F
(Setaflash)

LOWER EXPLOSIVE LIMIT: 0.9 %
UPPER EXPLOSIVE LIMIT : 32.5 %

Extinguishing Media: Alcohol Film Forming Foam, Carbon Dioxide, Dry Chemical, Water Fog

Unusual Fire And Explosion Hazards: Water spray may be ineffective. Closed containers may explode when exposed to extreme heat. Vapors may form explosive mixtures with air. Vapors can travel to a source of ignition and flash back. FLASH POINT IS LESS THAN 20 °. F. - EXTREMELY FLAMMABLE LIQUID AND VAPOR! Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame. Perforation of the pressurized container may cause bursting of the can.

Special Firefighting Procedures: Evacuate area and fight fire from a safe distance.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Contain spilled liquid with sand or earth. DO NOT use combustible materials such as sawdust. Dispose of according to local, state (provincial) and federal regulations. Do not incinerate closed containers. Remove all sources of ignition, ventilate area and remove with inert absorbent and non-sparking tools.

Section 7 - Handling And Storage

Handling: Wash thoroughly after handling. Follow all MSDS/label precautions even after container is emptied because it may retain product residues. Use only in a well-ventilated area. Avoid breathing vapor or mist. Wash hands before eating.

Storage: Contents under pressure. Do not expose to heat or store above 120 ° F. Do not store above 120 ° F. Store large quantities in buildings designed and protected for storage of NFPA Class I flammable liquids. Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Prevent build-up of vapors by opening all doors and windows to achieve cross-ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof ventilation equipment.

Respiratory Protection: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. A NIOSH/MSHA approved air purifying respirator with an organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.

Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or in any other circumstances where air purifying respirators may not provide adequate protection.

Skin Protection: Nitrile or Neoprene gloves may afford adequate skin protection. Use impervious gloves to prevent skin contact and absorption of this material through the skin.

Eye Protection: Use safety eyewear designed to protect against splash of liquids.

Other protective equipment: Refer to safety supervisor or industrial hygienist for further information regarding personal protective equipment and its application.

Hygienic Practices: Wash thoroughly with soap and water before eating, drinking or smoking.

Section 9 - Physical And Chemical Properties

Boiling Range:	-34 - 468 F	Vapor Density:	Heavier than Air
Odor:	Solvent Like	Odor Threshold:	N.E.
Appearance:	Aerosolized Mist	Evaporation Rate:	Faster than Ether
Solubility in H2O:	None		
Freeze Point:	N.D.	Specific Gravity:	0.874
Vapor Pressure:	N.D.	PH:	N.A.
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Avoid temperatures above 120 ° F. Avoid all possible sources of ignition.

Incompatibility: Incompatible with strong oxidizing agents, strong acids and strong alkalies.

Hazardous Decomposition: When heated to decomposition, it emits acrid smoke and irritating fumes. By open flame, carbon monoxide and carbon dioxide.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N.D.

Product LC50: N.D.

Chemical Name	LD50	LC50
Liquefied Petroleum Gas	N.E.	N.E.
Aliphatic Hydrocarbon	>5000 mg/kg (Rat, Oral)	N.E.
Toluene	636 mg/kg (Rat, Oral)	>26700 ppm (Rat, Inhalation, 1Hr)
Magnesium Silicate	N.E.	TCLo: 11 mg/m3 (Inhalation)
Hydrotreated Light Distillate	>3160 mg/kg (Skin)	N.E.
Naphtha	>5000 mg/kg (Rat, Oral)	N.E.
Xylene	4300 mg/kg (Rat, Oral)	5000 ppm (Rat, Inhalation, 4Hr)
Ethylbenzene	3500 mg/kg (Rat, Oral)	N.E.
Quartz (Crystalline Silica)	N.E.	N.E.

Section 12 - Ecological Information

Ecological Information: Product is a mixture of listed components.

Section 13 - Disposal Information

Disposal Information: Dispose of material in accordance to local, state and federal regulations and ordinances. Do not allow to enter storm drains or sewer systems.

Section 14 - Transportation Information

DOT Proper Shipping Name:	ORM-D, Consumer Commodity	Packing Group:	N.A.
DOT Technical Name:	N.A.	Hazard Subclass:	N.A.
DOT Hazard Class:	2.1	Resp. Guide Page:	126
DOT UN/NA Number:	UN1950		

Section 15 - Regulatory Information

CERCLA - SARA Hazard Category

This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD, PRESSURIZED GAS HAZARD

SARA Section 313:

Listed below are the substances (if any) contained in this product that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS Number
Toluene	108-88-3
Xylene	1330-20-7
Ethylbenzene	100-41-4

Toxic Substances Control Act:

Listed below are the substances (if any) contained in this product that are subject to the reporting requirements of TSCA 12(B) if exported from the United States:

It is the policy of Rust-Oleum Corporation to use only TSCA compliant materials in its products.

U.S. State Regulations: As follows -

New Jersey Right-to-Know:

The following materials are non-hazardous, but are among the top five components in this product.

Chemical Name	CAS Number
Calcium Carbonate	1317-65-3

Pennsylvania Right-to-Know:

The following non-hazardous ingredients are present in the product at greater than 3%.

Chemical Name	CAS Number
Calcium Carbonate	1317-65-3
Polymer Anchored Orange Dye Dispersion	MIXTURE
Modified Alkyd	PROPRIETARY

California Proposition 65:

WARNING! This product contains a chemical(s) known by the State of California to cause cancer.

WARNING! This product contains a chemical(s) known to the State of California to cause birth defects or other reproductive harm.

International Regulations: As follows -

CANADIAN WHMIS:

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: AB5 D2A D2B

Section 16 - Other Information

HMIS Ratings:

Health: 2* Flammability: 4 Reactivity: 0 Personal Protection: X

REASON FOR REVISION: Regulatory Update

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

Rust-Oleum Corporation believes, to the best of its knowledge, information and belief, the information contained herein to be accurate and reliable as of the date of this material safety data sheet. However, because the conditions of handling, use, and storage of these materials are beyond our control, we assume no responsibility or liability for personal injury or property damage incurred by the use of these materials. Rust-Oleum Corporation makes no warranty, expressed or implied, regarding the accuracy or reliability of the data or results obtained from their use. All materials may present unknown hazards and should be used with caution. The information and recommendations in this material safety data sheet are offered for the users' consideration and examination. It is the responsibility of the user to determine the final suitability of this information and to comply with all applicable international, federal, state, and local laws and regulations.

Material Safety Data Sheet

according to ANSI Z400.1- 2004 and 29 CFR 1910.1200

OFF!® DEEP WOODS® INSECT REPELLENT V

Version *1.*

Print Date 04/23/2009

Revision Date 04/22/2009

MSDS Number 350000004807

1. PRODUCT AND COMPANY IDENTIFICATION

Product information

Trade name	:	OFF!® DEEP WOODS® INSECT REPELLENT V
Use of the Substance/Preparation	:	Insect Repellent
Company	:	S.C. Johnson & Son, Inc. 1525 Howe Street Racine WI 53403-2236
Emergency telephone	:	24 Hour Transport & Medical Emergency Phone (866) 231-5406 24 Hour International Emergency Phone (952) 852-4647

2. HAZARDS IDENTIFICATION

Emergency Overview

Appearance / Odor	:	clear / aerosol / characteristic
Immediate Concerns	:	Caution CAUSES EYE IRRITATION. FLAMMABLE: CONTENTS UNDER PRESSURE. Do not puncture or incinerate. Do not store at temperatures above 120 Deg. F (50 Deg C), as container may burst. May be harmful if swallowed. Avoid contact with eyes and lips.

Potential Health Effects

Routes of exposure	:	Eye, Skin, Inhalation, Ingestion.
Eyes	:	May cause: Moderate eye irritation
Skin	:	May cause skin reactions in rare cases.
Inhalation	:	Inhalation may cause central nervous system effects.
Ingestion	:	May be harmful if swallowed. May cause irritation to mouth, throat and stomach. Causes headache, drowsiness or other effects to the central nervous system.
Aggravated Medical Condition	:	None known.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No.	Weight %
Ethyl alcohol	64-17-5	30.00 - 60.00
N,N-Diethyl-m-toluamide	134-62-3	25.00
Water	7732-18-5	7.00 - 13.00
Butane	106-97-8	1.00 - 5.00
Propane	74-98-6	1.00 - 5.00
Isobutane	75-28-5	1.00 - 5.00

4. FIRST AID MEASURES

Eye contact : Flush immediately with plenty of water for at least 15 to 20 minutes. Get medical attention if irritation develops and persists.

Skin contact : Wash off with soap and water. Get medical attention if irritation develops and persists.

Inhalation : If breathing is affected, get medical attention. Remove to fresh air.

Ingestion : Do NOT induce vomiting. Drink 1 or 2 glasses of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : Alcohol foam, carbon dioxide, dry chemical, water fog,

Specific hazards during fire fighting : Aerosol Product - Containers may rocket or explode in heat of fire.

Further information : Wear full protective clothing and positive pressure self-contained breathing apparatus. Fight fire from maximum distance or protected area. Cool and use caution when approaching or handling fire-exposed containers.

Flash point : < 20 °F
Method: Tag Closed Cup (TCC)
Note: Propellant

Lower explosion limit : Note: no data available

Upper explosion limit : Note: no data available

NFPA Classification	:	NFPA Level 2 Aerosol

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	:	Remove all sources of ignition.
Environmental precautions	:	Use appropriate containment to avoid environmental contamination.
Methods for cleaning up	:	Soak up with inert absorbent material. Sweep up and shovel into suitable containers for disposal. Dike large spills.

7. HANDLING AND STORAGE

Handling

Advice on safe handling	:	Use only as directed. KEEP OUT OF REACH OF CHILDREN AND PETS. Avoid contact with eyes and lips. Do not puncture or incinerate.
Advice on protection against fire and explosion	:	Keep away from heat and sources of ignition.

Storage

Requirements for storage areas and containers	:	Keep in a dry, cool and well-ventilated place. Do not store at temperatures above 120 Deg. F (50 Deg C), as container may burst.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Components	CAS-No.	mg/m3	ppm	Basis
Ethyl alcohol	64-17-5	-	1,000 ppm	ACGIH TWA
Ethyl alcohol	64-17-5	1,900 mg/m3	1,000 ppm	OSHA TWA
Butane	106-97-8	-	1,000 ppm	ACGIH TWA
Propane	74-98-6	-	1,000 ppm	ACGIH TWA
Propane	74-98-6	1,800 mg/m3	1,000 ppm	OSHA TWA
Isobutane	75-28-5	-	1,000 ppm	ACGIH TWA

Personal protective equipment

Respiratory protection

Industrial setting : Substantial amounts of mist/vapors can be controlled with local exhaust ventilation or respiratory protection.

Household setting : No personal respiratory protective equipment normally required.

Hand protection

Industrial setting : For prolonged or repeated contact use protective gloves.

Household setting : not required under normal use

Eye protection

Industrial setting : If prolonged or repeated contact is possible:
Safety glasses with side-shields

Household setting : No special requirements.

Hygiene measures : Use only with adequate ventilation. Wash thoroughly after handling. Wear suitable protective clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form : aerosol

Color	:	clear
Odor	:	characteristic
pH	:	not applicable
Boiling point	:	no data available
Freezing point	:	not applicable
Flash point	:	< 20 °F Method: Tag Closed Cup (TCC) Propellant
Evaporation rate	:	no data available
Autoignition temperature	:	no data available
Lower explosion limit	:	no data available
Upper explosion limit	:	no data available
Vapour pressure	:	no data available
Water solubility	:	soluble
Partition coefficient: n-octanol/water	:	no data available
Specific Gravity	:	0.840
Percent volatile	:	no data available

10. STABILITY AND REACTIVITY

Conditions to avoid	:	Heat, flames and sparks.
Materials to avoid	:	Do not mix with oxidizing agents.
Hazardous decomposition products	:	When exposed to fire, produces normal products of combustion.
Hazardous reactions	:	Stable

11. TOXICOLOGICAL INFORMATION

Acute oral toxicity	:	rat

Dose: 3,735 mg/kg

Acute inhalation toxicity : rat
Dose: > 2.18 mg/l

Acute dermal toxicity : rabbit
Dose: > 2,000 mg/kg

Chronic effects

Carcinogenicity : no data available

Mutagenicity : no data available

Reproductive effects : no data available

Teratogenicity : no data available

Sensitisation : Not known to be a sensitizer.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects : Not Available

13. DISPOSAL CONSIDERATIONS

Industrial setting : Observe all applicable Federal, Provincial and State regulations and Local/Municipal ordinances regarding disposal.

Household setting : Consumer may discard empty container in trash, or recycle where facilities exist.

RCRA waste class : D001 (Ignitable Waste)

SCJ product category : AF: Aerosol Flammable

14. TRANSPORT INFORMATION

Land transport

- **U.S. DOT and Canadian TDG Surface Transportation:**

UN-Number 1950

Proper shipping name	Aerosols, flammable
Class:	2.1
Packaging group:	None.
Note:	SC Johnson ships this product as Consumer Commodity ORM-D (non-bulk packages)

Sea transport

- *IMDG:*

Class:	2.1
Packaging group:	None.
Proper shipping name	Aerosols, flammable
UN-Number:	1950
Note:	SC Johnson ships this product as "Limited Quantity" when the container quantity value is 1 Liter or less.

Air transport

- *ICAO/IATA:*

Class:	2.1
Packaging group:	None.
Proper shipping name	Aerosols, flammable
UN/ID No.:	UN 1950
Note:	SC Johnson typically does not ship products via air, therefore it has not been determined if the product container meets current IATA/ICAO package criteria. Refer to IATA/ICAO Dangerous Goods Regulations for detailed instructions when shipping this item by air.

15. REGULATORY INFORMATION

Global Chemical Inventories

Notification status	:	All ingredients of this product are listed or are excluded from listing on the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.
	:	All ingredients of this product comply with the New Substances Notification requirements under the Canadian Environmental Protection Act (CEPA).

California Prop. 65	:	This product is not subject to the reporting requirements under California's Proposition 65.
	:	This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.
EPA Registration Number	:	4822-167, P.C.P. REG. NO. 24723

16. OTHER INFORMATION

HMIS Ratings

Health	2
Flammability	4
Reactivity	0

NFPA Ratings

Health	2
Fire	4
Reactivity	0
Special	

Further information

This document has been prepared using data from sources considered to be technically reliable. It does not constitute a warranty, expressed or implied, as to the accuracy of the information contained herein. Actual conditions of use are beyond the seller's control. User is responsible to evaluate all available information when using product for any particular use and to comply with all Federal, State, Provincial and Local laws and regulations.

Prepared by:	SC Johnson Global Safety Assessment & Regulatory Affairs (GSARA)

March 11, 2004

Material Safety Data Sheet

Product Name: Gordon's Wasp & Hornet Spray

MSDS No.: 612-5 **Version No.:** 001 **EPA Registration No.:** 67603-11-2217

1. Basic Information:

Manufacturer: PBI/Gordon Corporation
Address: 1217 West 12th Street
City, State Zip: Kansas City, MO 64101-1407
Information Contact: Environmental, Health, & Safety Dept.
Information Telephone Number: (816)421-4070
Emergency Contact: Chemtrec
Emergency Telephone Number: (800)424-9300

1	Health
2	Flammability
0	Reactivity
B	Pers. Protection

Last Update: 1/9/2004

Chemical State: ☐ Liquid ☒ Gas ☐ Solid
Chemical Type: ☐ Pure ☒ Mixture

2. Ingredients:

☐ Trade Secret *(ND = Not Disclosed)*

CAS No.	Chemical Name	% Range	EHS	NTP	IARC	SUB Z	SARA 313	OSHA PEL	ACGIH TLV	Other Limits
124389	Carbon dioxide	3.00%	N	N	N	Y	N	5000 ppm	5000 ppm	5000 ppm
67630	Isopropyl alcohol	5.00%	N	N	N	Y	N	400 ppm	400 ppm	400 ppm
64742478	Light hydrotreated petroleum distillate	91.00%	N	N	N	N	N	NI	NI	NI
52645531	Permethrin (3-Phenoxyphenyl)methyl(+)cis/trans-3-(2,2-dichloroethenyl) 2,2-dimethylcyclopropanecarboxylate	0.25%	N	N	N	N	Y	NI	NI	NI
51036	Piperonyl butoxide, tech.	0.50%	N	N	N	N	N	NI	NI	NI
7696120	Tetramethrin	0.10%	N	N	N	N	Y	NI	NI	NI

3. Hazardous Identification:

Hazard Catagory:
☒ Acute ☒ Chronic ☒ Fire ☐ Pressure ☐ Reactive

Hazardous Identification Information:
Clear mist; pyrethroid odor

4. First Aid Measures:

Route(s) of Entry:
Contact, inhalation, ingestion

Health Hazards (Acute and Chronic):
EYES: Causes moderate eye irritation. Avoid contact with eyes or clothing.

Signs and Symptoms:
Repeated or prolonged overexposure may cause headache, weakness, nausea, dizziness.

Medical Conditions Generally Aggravated by Exposure:
NI

Emergency First Aid Procedure:
IF IN EYES:
--Hold eye open and rinse slowly and gently with water for 15-20 minutes.
--Remove contact lens, if present, after the first 5 minutes, then continue rinsing eye.
--Call a poison control center or doctor for treatment information.

IF INGESTED: Call a physician or Poison Control Center for assistance. Do not induce vomiting--Contains petroleum distillates. Do not induce vomiting or give anything by mouth to an unconscious person.

First Aid Measures (Continued)

IF INHALED: Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN: Remove contaminated clothing and wash affected areas with soap and water.

Other Health Warnings:
NI

5. Fire Fighting Measures:

Flash Point: 165°F **F.P. Method:** PM Closed Cup
Lower Explosive Limit: 0.7 %
Upper Explosive Limit: 12.7 %

Fire Extinguishing Media:
Water fog, carbon dioxide, dry chemical.

Special Fire Fighting Procedures:
Wear positive pressure breathing apparatus and full protective clothing Keep containers cool. Use equipment or shielding to protect personnel against venting, bursting or rupturing containers.

Unusual Fire and Explosion:
Containers may burst at temperatures above 130°F. Burning product may product irritating gasses. Prevent fire control runoff from contaminating surface water.

6. Accidental Release Measures:

Material Safety Data Sheet

Product Name: Gordon's Wasp & Hornet Spray

MSDS No.: 612-5 **Version No.:** 001 **EPA Registration No.:** 67603-11-2217

Accidental Release Measures (Continued)

Steps to be Taken in Case Material is Released or Spilled:
See Section 8 for Personal Protective Equipment. Contain and collect the spilled material with inert absorbent. Place the contaminated absorbent into containers for disposal. Cover and label the containers. Ventilate the area.

7. Handling and Storage:

Precautions to be Taken:
Do not contaminate water, food or feed by storage or disposal. Do not store near heat or open flame. Store in cool dry area away from children.

Other Precautions:
Contents under pressure. Exposure to temperatures above 130°F may cause bursting.

8. Exposure Controls/Personal Protection:

Ventilation Requirements:
Provide local ventilation.

Personal Protective Equipment:
PROTECTIVE CLOTHING: Wear long sleeve shirt, long pants, shoes with socks, and chemical-resistant gloves.

EYE PROTECTION: Safety glasses with side shields or safety goggles.

RESPIRATORY PROTECTION: If exposure limits may be exceeded, wear a respirator with an organic-vapor removing cartridge with a prefilter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or a NIOSH approved respirator with any R, P or HE filter.

9. Physical and Chemical Properties:

Boiling Point: NI **Melting Point:** NI

Evaporation Rate (Butyl Acetate = 1) : NI

Vapor Pressure (mm Hg.): NI

Vapor Density (Air = 1): NI

Specific Gravity (H20 = 1): 0.79000

Solubility in Water: NI

Appearance and Odor: NI

Other Information:
Density: 6.54 pounds/gallon

10. Stability and Reactivity:

Stability:
Stable.

Incompatibility (Materials to Avoid):
No incompatible materials are known. Avoid temperatures above 130°F.

Decomposition/By-Products:
Carbon dioxide, carbon monoxide

Hazardous Polymerization:
Will not occur.

11. Toxicological Information:

No toxicological data available.

12. Ecological Information:

This product is toxic to fish and aquatic invertebrates. Do not apply directly to water.

13. Disposal Considerations:

PESTICIDE DISPOSAL: Wrap container in several layers of newspaper and dispose of in trash.

CONTAINER DISPOSAL: Wrap empty container in several layers of newspaper and dispose of in trash. Do not incinerate or puncture. Can may be disposed of with other recylables where local law permits.

14. Transport Information:

The following guidlines apply for domestic ground transport. If shipping by air or ocean, please contact our Transportation Department.

Freight Class: Insecticides, NOI - NMFC Class #102120

In our currently available sizes, this product must be labeled and shipped as:

CONSUMER COMMODITY, ORM-D

15. Regulatory Information:

OSHA STATUS: This product is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200.

TSCA STATUS: This product is exempt from TSCA Regulation under FIFRA Section 3(2)(B)(ii) when used as a pesticide.

CERCLA REPORTABLE QUANTITY: None

SARA TITLE III:
SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES: None
SECTION 311/312 HAZARD CATEGORIES: Immediate Health Hazard, Delayed Health Hazard, Fire Hazard
SECTION 313 TOXIC CHEMICALS: Tetramethrin CAS# 7696-12-0, Permethrin CAS# 52645-53-1

RCRA STATUS: If discarded in its purchased form, this product would not be a hazardous waste either by listing or by characteristic. However, under RCRA it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste. (40 CFR 261.20-24)

16. Other Information:

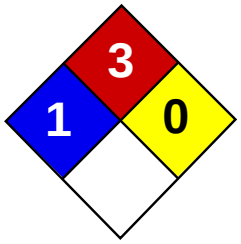
REASON FOR ISSUE: New MSDS in the ANSI Z400.1-1998 format.

NOTE: NI means not indicated.

The information and statements in this Material Safety Data Sheet are believed to accurately reflect the scientific evidence used in making the hazard determination, but is not to be construed as a warranty or representation for which we assume legal responsibility. Additional information may be necessary or desirable depending on particular, exceptional or variable conditions or circumstances of use or storage or because of locally applicable laws or government regulations. Therefore, you should use this information only as a supplement to other information available to you and must make independent determinations of the suitability of the information for your particular circumstances or conditions and of the completeness of the information available from all sources to assure both the proper use of the material described herein and the safety and health of employees.

Gordon's Wasp & Hornet Killer – MSDS

http://pbigordon.com/pdfs/WaspHornetKiller-MSDS.pdf



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Isopropyl alcohol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Isopropyl alcohol

Catalog Codes: SLI1153, SLI1579, SLI1906, SLI1246, SLI1432

CAS#: 67-63-0

RTECS: NT8050000

TSCA: TSCA 8(b) inventory: Isopropyl alcohol

CI#: Not available.

Synonym: 2-Propanol

Chemical Name: isopropanol

Chemical Formula: C3-H8-O

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Isopropyl alcohol	67-63-0	100

Toxicological Data on Ingredients: Isopropyl alcohol: ORAL (LD50): Acute: 5045 mg/kg [Rat]. 3600 mg/kg [Mouse]. 6410 mg/kg [Rabbit]. DERMAL (LD50): Acute: 12800 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Development toxin [POSSIBLE]. The substance may be toxic to kidneys, liver, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:
Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops. Cold water may be used.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 399°C (750.2°F)

Flash Points: CLOSED CUP: 11.667°C (53°F) - 12.778 deg. C (55 deg. F) (TAG)

Flammable Limits: LOWER: 2% UPPER: 12.7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME. Hydrogen peroxide sharply reduces the autoignition temperature of Isopropyl alcohol. After a delay, Isopropyl alcohol ignites on contact with dioxgenyl tetrafluorborate, chromium trioxide, and potassium tert-butoxide. When heated to decomposition it emits acrid smoke and fumes.

Special Remarks on Explosion Hazards:
Secondary alcohols are readily autooxidized in contact with oxygen or air, forming ketones and hydrogen peroxide. It can become potentially explosive. It reacts with oxygen to form dangerously unstable peroxides which can concentrate and explode during distillation or evaporation. The presence of 2-butanone increases the reaction rate for peroxide formation. Explosive in the form of vapor when exposed to heat or flame. May form explosive mixtures with air. Isopropyl alcohol + phosgene forms isopropyl chloroformate and hydrogen chloride. In the presence of iron salts, thermal decompositon can occur, whicn in some cases can become explosive. A homogeneous mixture of concentrated peroxides + isopropyl alcohol are capable of detonation by shock or heat. Barium perchlorate + isopropyl alcohol gives the highly explosive alkyl perchlorates.

It forms explosive mixtures with trinitormethane and hydrogen peroxide. It produces a violent explosive reaction when heated with aluminum isopropoxide + crotonaldehyde. Mixtures of isopropyl alcohol + nitroform are explosive.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 983 STEL: 1230 (mg/m3) [Australia] TWA: 200 STEL: 400 (ppm) from ACGIH (TLV) [United States] [1999] TWA: 980 STEL: 1225 (mg/m3) from NIOSH TWA: 400 STEL: 500 (ppm) from NIOSH TWA: 400 STEL: 500 (ppm) [United Kingdom (UK)] TWA: 999 STEL: 1259 (mg/m3) [United Kingdom (UK)] TWA: 400 STEL: 500 (ppm) from OSHA (PEL) [United States] TWA: 980 STEL: 1225 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Pleasant. Odor resembling that of a mixture of ethanol and acetone.

Taste: Bitter. (Slight.)

Molecular Weight: 60.1 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 82.5°C (180.5°F)

Melting Point: -88.5°C (-127.3°F)

Critical Temperature: 235°C (455°F)

Specific Gravity: 0.78505 (Water = 1)

Vapor Pressure: 4.4 kPa (@ 20°C)

Vapor Density: 2.07 (Air = 1)

Volatility: Not available.

Odor Threshold:
22 ppm (Sittig, 1991) 700 ppm for unadapted panelists (Verschuren, 1983).

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:
Easily soluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone. Insoluble in salt solution. Soluble in benzene. Miscible with most organic solvents including alcohol, ethyl alcohol, chloroform.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, Ignition sources, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts violently with hydrogen + palladium combination, nitroform, oleum, COCl2, aluminum triisopropoxide, oxidants Incompatible with acetaldehyde, chlorine, ethylene oxide, isocyanates, acids, alkaline earth, alkali metals, caustics, amines, crotonaldehyde, phosgene, ammonia. Isopropyl alcohol reacts with metallic aluminum at high temperatures. Isopropyl alcohol attacks some plastics, rubber, and coatings. Vigorous reaction with sodium dichromate + sulfuric acid.

Special Remarks on Corrosivity: May attack some forms of plastic, rubber and coating

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 3600 mg/kg [Mouse]. Acute dermal toxicity (LD50): 12800 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 16000 8 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Development toxin [POSSIBLE]. May cause damage to the following organs: kidneys, liver, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive/teratogenic effects (fertility, fetoxicity, developmental abnormalities(developmental toxin)) based on animal studies. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause mild skin irritation, and sensitization. Eyes: Can cause eye irritation. Inhalation: Breathing in small amounts of this material during normal handling is not likely to cause harmful effects. However, breathing large amounts may be harmful and may affect the respiratory system and mucous membranes (irritation), behavior and brain (Central nervous system depression - headache, dizziness, drowsiness, stupor, incoordination, unconciousness, coma and possible death), peripheral nerve and senstation, blood, urinary system, and liver. Ingestion: Swallowing small amouts during normal handling is not likely to cause harmful effects. Swallowing large amounts may be harmful. Swallowing large amounts may cause gastrointestinal tract irritation with nausea, vomiting and diarrhea, abdominal pain. It also may affect the urinary system, cardiovascular system, sense organs, behavior or central nervous system (somnolence, generally depressed activity, irritability, headache, dizziness, drowsiness), liver, and respiratory system (breathing difficulty). Chronic Potential Health Effects: May cause defatting of the skin and dermatitis and allergic reaction. May cause adverse reproductive effects based on animal data (studies).

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 100000 mg/l 96 hours [Fathead Minnow]. 64000 mg/l 96 hours [Fathead Minnow].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Isopropyl Alcohol UNNA: 1219 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Isopropyl alcohol Illinois toxic substances disclosure to employee act: Isopropyl alcohol Rhode Island RTK hazardous substances: Isopropyl alcohol Pennsylvania RTK: Isopropyl alcohol Florida: Isopropyl alcohol Minnesota: Isopropyl alcohol Massachusetts RTK: Isopropyl alcohol New Jersey: Isopropyl alcohol New Jersey spill list: Isopropyl alcohol Director's list of Hazardous Substances: Isopropyl alcohol Tennesee: Isopropyl alcohol TSCA 8(b) inventory: Isopropyl alcohol TSCA 4(a) final testing order: Isopropyl alcohol TSCA 8(a) IUR: Isopropyl alcohol TSCA 8(d) H

and S data reporting: Isopropyl alcohol: Effective date: 12/15/86 Sunset Date: 12/15/96 TSCA 12(b) one time export: Isopropyl alcohol SARA 313 toxic chemical notification and release reporting: Isopropyl alcohol

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R36- Irritating to eyes. S7- Keep container tightly closed. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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ALCONOX MSDS

Section 1 : MANUFACTURER INFORMATION

Product name: Alconox

Supplier: Same as manufacturer.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Supplier MSDS date: 2009/04/20

D.O.T. Classification: Not regulated.

Section 2 : HAZARDOUS INGREDIENTS

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE
497-19-8	7-13	SODIUM CARBONATE	NOT AVAILABLE	4090 MG/KG RAT ORAL 6600 MG/KG MOUSE ORAL	2300 MG/M3/2H RAT INHALATION 1200 MG/M3/2H MOUSE INHALATION
7722-88-5	10-30	TETRASODIUM PYROPHOSPHATE	5 MG/M3	4000 MG/KG RAT ORAL 2980 MG/KG MOUSE ORAL	NOT AVAILABLE
7758-29-4	10-30	SODIUM PHOSPHATE	NOT AVAILABLE	3120 MG/KG RAT ORAL 3100 MG/KG MOUSE ORAL >4640 MG/KG RABBIT DERMAL	NOT AVAILABLE

Section 2A : ADDITIONAL INGREDIENT INFORMATION

Note: (supplier).
CAS# 497-19-8: LD50 4020 mg/kg - rat oral.
CAS# 7758-29-4: LD50 3100 mg/kg - rat oral.

Section 3 : PHYSICAL / CHEMICAL CHARACTERISTICS

Physical state: Solid

Appearance & odor: Almost odourless.
White granular powder.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): Not applicable.

Vapour density (air=1): Not applicable.

By weight: Not available.

Evaporation rate (butyl acetate = 1): Not applicable.

Boiling point (°C): Not applicable.

Freezing point (°C): Not applicable.

pH: (1% aqueous solution).
9.5

Specific gravity @ 20 °C: (water = 1).
0.85 - 1.10

Solubility in water (%): 100 - > 10% w/w

Coefficient of water\oil dist.: Not available.

VOC: None

Section 4 : FIRE AND EXPLOSION HAZARD DATA

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Not available.

Sensitivity to mechanical impact: Not applicable.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: None

Section 5 : REACTIVITY DATA

Chemical stability: Stable under normal conditions.

Conditions of instability: None known.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizers.

Hazardous decomposition products: See hazardous combustion products.

Section 6 : HEALTH HAZARD DATA

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of Acute Exposure

Eye contact: May cause irritation.

Skin contact: Prolonged contact may cause irritation.

Inhalation: Airborne particles may cause irritation.

Ingestion: May cause vomiting and diarrhea.
May cause abdominal pain.
May cause gastric distress.

Effects of chronic exposure: Contains an ingredient which may be corrosive.

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available for mixture, see the ingredients section.

Exposure limit of material: Not available for mixture, see the ingredients section.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Medical conditions aggravated by exposure: Not available.

First Aid

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
Seek medical attention if symptoms persist.

Ingestion: Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.
Do not induce vomiting, seek immediate medical attention.

Section 7 : PRECAUTIONS FOR SAFE HANDLING AND USE

Leak / Spill: Contain the spill.
Recover uncontaminated material for re-use.
Wear appropriate protective equipment.
Contaminated material should be swept or shoveled into appropriate waste container for disposal.

Waste disposal: In accordance with municipal, provincial and federal regulations.

Handling procedures and equipment: Protect against physical damage.
Avoid breathing dust.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Launder contaminated clothing prior to reuse.

Storage requirements: Keep containers closed when not in use.
Store away from strong acids or oxidizers.
Store in a cool, dry and well ventilated area.

Section 8 : CONTROL MEASURES

Precautionary Measures

Gloves / Type:

Neoprene or rubber gloves.

Respiratory / Type:

If exposure limit is exceeded, wear a NIOSH approved respirator.

Eye / Type:

Safety glasses with side-shields.

Footwear / Type: Safety shoes per local regulations.

Clothing / Type: As required to prevent skin contact.

Other / Type: Eye wash capability should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

MATERIAL SAFETY DATA SHEET

Revision Number A96008E
6/2/08

1. IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND THE COMPANY / UNDERTAKING

Product name	YSI 3682 Zobell Solution
Synonyms	None
Chemical characterization	White powder
Manufacturer, importer, supplier	YSI Inc. 1725 Brannum Lane Yellow Springs, OH 45387 USA
EMERGENCY TELEPHONE NUMBER	(937) 767-7241

2. COMPOSITION / INFORMATION ON INGREDIENTS

CAS	Chemical Name	% Weight	ACGIH TWA	Acute Toxicity	IARC*	NTP*	OSHA*
7447-40-7	Potassium chloride	72-78	None	N/A	N/A	N/A	N/A
14459-95-1	Potassium ferrocyanide	10-15			N/A	N/A	N/A
13746-66-2	Potassium ferrocyanide	10-15			N/A	N/A	N/A

* IARC - Group 1 (Carcinogenic to humans)
* NTP - Report on Carcinogens - Known Carcinogens
* OSHA - Regulated Carcinogens

3. HAZARDS IDENTIFICATION

Emergency Overview

- Use all necessary personal protection when handling this material.

Eye Contact	• Contact with eyes may cause irritation • Wear safety glasses with side shields, • In the event of exposure, flush eyes with water for at least 15 minutes. • Remove contacts and continue to flush eyes, including under the eye lids.
Skin Contact	• Exposure can cause skin irritation. • Wash exposed areas with soap and water for at least 15 minutes. • Remove contaminated clothing, laundry before re-using.
Inhalation	• Dust from this product may cause respiratory irritation • Use with adequate ventilation.
Ingestion	• No effects expected from normal use of this product. Ingestion may cause digestive system upset.
General Advice	• Users with skin conditions (eczema, psoriasis, etc) respiratory conditions (asthma, bronchitis, emphysema, etc) or with chemical sensitivities should take protective precautions
Principle Routes of Exposure	Eyes, absorption, ingestion

4. FIRST AID MEASURES

General Advice	• If exposure symptoms persist, seek medical attention.
Skin Contact	• Wash exposed area with soap and plenty of water. • If skin irritation develops, seek medical attention.
Eye Contact	• Immediately flush with plenty of water after initial flushing, remove any contact lenses and continue flushing for at least 15 minutes • Keep eyes wide open while rinsing

	• If eye irritation persists, seek medical attention
Inhalation	• Move to fresh air in case of accidental inhalation • If a person feels unwell or symptoms of respiratory irritation persist, consult a physician
Ingestion	• Do not swallow. Rinse mouth with water and afterwards drink plenty of water. • For ingestion of large amounts induce vomiting if person is conscious. If conditions persist, seek medical attention.
Notes to Physician	• Treat symptomatically
Protection of First-Aiders	• Use necessary personal protective equipment
Aggravated Medical Conditions	• Users with skin conditions, respiratory conditions, or with chemical sensitivities should take protective precautions.

5. FIRE-FIGHTING MEASURES

Flash Point	NA
Suitable Extinguishing Media	• Not applicable to this product
Extinguishing media which must not be used for safety reasons	• Not applicable to this product

Specific Hazards

Special exposure hazards rising from the substance or preparation itself, its combustion products, or released gases	• Material is not combustible. It may emit toxic fumes when heated, such as hydrogen cyanide, and hydrochloric acid.
Special protective equipment for firefighters	• As in any fire, wear self contained breathing apparatus and full protective gear

NFPA (National Fire Protection Association)	Health=3	Reactivity=2	Fire=0	Special=0 (none)
HMIS (Hazardous Material Information System)	Health=3	Reactivity=2	Fire=0	Special=0 (none)

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	• Use necessary personal protective equipment
Environmental precautions	• No information available
Methods for cleaning up	• Sweep up and collect in suitable container for disposal • Avoid formation of dust

7. HANDLING AND STORAGE

Handling

Technical Measures / Precautions	• Use only in areas provided with adequate ventilation
Safe Handling Advice	• Wear personal protective equipment • Avoid contact with skin and eyes. Take necessary personal protective precautions before using this product.

Storage

Technical Measures / Precautions	• Store in a tightly closed container. Store in a cool, dry, well ventilated area away from incompatible substances. • Store in properly labeled container
Incompatible Products	• Avoid strong acids, oxidizing agents

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures	• Ensure adequate ventilation, especially in confined areas • Ensure eyewash station is readily available

Personal protective equipment

Hand Protection	• Wear appropriate protective gloves
Eye protection	• Avoid contact with eyes • Wear safety glasses with side-shields or full face shield.
Respiratory Protection	• Ensure adequate ventilation is available before handling any chemical
Skin and Body Protection	• Lightweight protective clothing • Boots • Apron
Hygiene measures	• Handle in accordance with good industrial hygiene and safety practice • Keep away from food, drink and animal feeding material
Environmental exposure controls	• No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

General Information

Form	Powder
Appearance	White
Odor	unknown

Important Health Safety and Environmental Information

pH	No information
Boiling Point / Range	No information
Flash Point	None
Water Solubility	Infinitely soluble
Specific Gravity	No information

10. STABILITY AND REACTIVITY

Stability	• Stable under normal conditions
Materials to Avoid	• Acids, oxidizing agents
Hazardous Decomposition Products	• When heated, possibly nitrogen oxides and hydrogen cyanide
Polymerization	• Polymerization does not occur

11. TOXICOLOGICAL INFORMATION

Local Effects

Skin Irritation	• May cause skin irritation
Eye Irritation	• Dust may cause eye irritation
Inhalation	• Inhalation of dust may cause irritation of respiratory tissue
Ingestion	• Ingestion of large amounts may cause digestive system upset

Specific Effects

Carcinogenic Effects	• No information available
Mutagenic Effects	• No information available
Reproductive Toxicity	• No information available
Target Organ Effects	• No information available

12. ECOLOGICAL INFORMATION

Component information

CAS	Chemical Name	% Weight	ACGIH*
7447-40-7	Potassium chloride	72-78	N/A
14459-95-1	Potassium ferrocyanide	10-15	N/A
13746-66-2	Potassium ferrocyanide	10-15	N/A

* ACGIH - Occupational Exposure Limits - TWA's
* OSHA - PELs

Product Information

Aquatic Toxicity	No information available.

Other Information

Ozone Depletion Potential; ODP; (R-11=1)	No information available.
Global Warming Potential (GWP)	No information available.
Additional Ecological Information	No information available
Mobility	No information available.
Bioaccumulative Potential	No information available.
Ecotoxicity Effects	No information available
Aquatic Toxicity	No information available.

13. DISPOSAL CONSIDERATIONS

Waste From Residues / Unused Products	Dispose of in accordance with local and state regulations
Contaminated Packaging	Empty containers should be rinsed and disposed of as appropriate for glass and plastic containers.

14. TRANSPORT INFORMATION

DOT Not regulated
UN-No
Proper shipping name
Packing group
Subsidiary Risk
Description

15. REGULATORY INFORMATION

U.S. Inventories

CAS	Chemical Name	% Weight	ACGIH*
7447-40-7	Potassium chloride	72-78	N/A
14459-95-1	Potassium ferrocyanide	10-15	N/A
13746-66-2	Potassium ferrocyanide	10-15	N/A

* ACGIH - Occupational Exposure Limits - TWA's

International Inventories

CAS	Chemical Name	% Weight	EUOED*
7447-40-7	Potassium chloride	72-78	N/A
14459-95-1	Potassium ferrocyanide	10-15	N/A
13746-66-2	Potassium ferrocyanide	10-15	N/A

* EUOED - EU Occupational Exposure Directive (98/24/EC) Indicative Occupational Exposure Limit Values (IOELV)

16. OTHER INFORMATION

Literary Reference	None.
Prepared By	YSI, Inc.

End of Safety Data Sheet.

----- MATERIAL SAFETY DATA SHEET -----

AURICAL COMPANY 383 BEACH ROAD BURLINGAME, CA 94010-2005
Factory Telephone: (650)-872-2800 fax: (650) 872-2227 Toll Free (800) 615-8870
Prepared: November 20, 1994. Revised: July 1, 2008.

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-----SUBSTANCE IDENTIFICATION-----

SUBSTANCE: Auto Cal Solution Calibrating Buffer Solution
Trade names/synonyms: This material is also known by various catalog numbers.
Cercla ratings (scale 0-3): health=0 fire=0 reactivity=0 persistence=0
Nfpa ratings (scale 0-4): health=0 fire=0 reactivity=0

-----COMPONENTS AND CONTAMINANTS---

Component: potassium hydrogen phthalate CAS# 877-24-7 Percent: <2.0
Component: water CAS# 7732-18-5 percent: >98
Other contaminants: none

Exposure limits:
No occupational exposure limits established by osha, acgih or niosh.

-----PHYSICAL DATA-----

Description: clear, colorless liquid.
Approx. boiling point: 212°F (100°C). Approx. melting point: 32°F (0°C)
Vapor pressure: 14 torr @20°C Evap. Rate: (ether=1) >1
pH: 4.0 Solubility in water: complete Vapor density: 0.7 (H_2O)

-----FIRE AND EXPLOSION DATA-----

Fire and explosion hazard: No fire hazard when exposed to heat or flame.
Flash point: not applicable
Fire fighting media: dry chemical, carbon dioxide, water spray or regular foam. (1990 emergency response guidebook, dot p-5800.5) For larger fires, use water spray, fog or regular foam. (1990 emergency response guidebook, dot p-5800.5)
Fire fighting: Move container from fire area if it can be done without risk. Do not scatter spilled material with high-pressure water streams. Dike fire-control water for later disposal . (1990 emergency response guidebook, dot p-5800.5 Pg. 31) Use agents suitable for the type of surrounding fire. Avoid breathing hazardous vapors, stay upwind of the fire.

-----TOXICITY-----

potassium hydrogen phthalate:
Carcinogen status: none.
Local effects: irritant - inhalation, skin, eye.
Acute toxicity level: no data available.
Target effects: no data available.

-----HEALTH EFFECTS AND FIRST AID-----

INHALATION:
POTASSIUM HYDROGEN PHTHALATE:IRRITANT.
ACUTE EXPOSURE - MAY CAUSE IRRITATION.
CHRONIC EXPOSURE - REPEATED OR PROLONGED EXPOSURE MAY CAUSE IRRITATION.
FIRST AID - REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
POTASSIUM HYDROGEN PHTHALATE:IRRITANT.
ACUTE EXPOSURE - MAY CAUSE IRRITATION.
CHRONIC EXPOSURE - REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
FIRST AID - REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY, WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
POTASSIUM HYDROGEN PHTHALATE: IRRITANT.
ACUTE EXPOSURE-DIRECT CONTACT MAY CAUSE IRRITATION, REDNESS AND PAIN.
CRONIC EXPOSURE-REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS
FIRST AID - WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION
POTASSIUM HYDROGEN PHTHALATE: IRRITANT.
ACUTE EXPOSURE - MAY CAUSE NAUSEA, VOMITING AND DIARRHEA.
CRONIC EXPOSURE - NOT REPORTED TO OCCUR IN HUMANS
FIRST AID - IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2-4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT, GET MEDICAL ATTENTION IMMEDIATELY.

-----REACTIVITY-----

Reactivity: stable under normal temperatures and pressures.
Incompatibilities: AFFECTED BY STRONG OXIDIZERS WHEN DRY.
Decomposition: NONE KNOWN WHILE IN SOLUTION.
Polymerization: NONE KNOWN WHILE IN SOLUTION.

-----STORAGE AND DISPOSAL-----

Observe all federal, state and local regulations when storing or disposing of this substance. for assistance, contact the district director of the environmental protection agency.

-----PROTECTIVE EQUIPMENT-----

When using, wear eye protection to prevent contact.

Material Safety Data Sheet
Instant FAME/Instant Anaerobe Methods
Methanol

SECTION 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MSDS Name: Methanol
MSDS Preparation Date: 06/19/2009
Synonyms or Generic ID for Methanol: Carbinol; Methyl alcohol; Methyl hydroxide; Monohydroxymethane; Wood alcohol; Wood naptha; Wood spirits; Columbian spirits; Methanol.
Chemical Family: Methanol Family
Formula: CH_3OH
Molecular Weight: N/A
PIN (UN#/ NA#): UN1230
Company Identification:
Microbial ID.
125 Sandy Drive
Newark, DE 19713
For Information, call: (800)276-8068, (302)737-4297
For Domestic CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

SECTION 2 – COMPOSITION, INFORMATION ON INGREDIENTS

67-56-1	Methanol	<99%	200-659-6	Irritant, Flammable

NFPA Rating: (estimated) Health: 1; Flammability: 3; Instability: 0

State: Liquid	Appearance: colorless	Odor: Alcohol-like, weak odor
Boiling Point: 64.7°C@760mmHg	pH: Not available	Specific Gravity: 7910g/cm3@20°C
Vapor Pressure (mm Hg): 128mmHg @20°C	Vapor Density (AIR=1): 1.11	
Flash Point: 12°C	Solubility in Water: miscible	

SECTION 3 – HAZARDS IDENTIFICATION

Appearance: Colorless liquid, Flash Point: 12°C, 53.6°F.

Danger! Poison! May be fatal or cause blindness if swallowed. Vapor harmful. **Flammable liquid and vapor.** Harmful if swallowed, inhaled, or absorbed through the skin. Causes eye, skin, and respiratory tract irritation. May cause central nervous system depression. Cannot be made non-poisonous.
Target Organs: Eyes, nervous system, optic nerve.

Potential Health Effects
Eye: May cause painful sensitization to light. Methanol is a mild to moderate eye irritant. Inhalation, ingestion or skin absorption of methanol can cause significant disturbance in vision, including blindness.
Skin: Causes moderate skin irritation. May be absorbed through the skin in harmful amounts. Prolonged and or repeated contact may cause defatting of skin and dermatitis. Methanol can be absorbed through the skin, producing systemic effects that include visual disturbances.
Ingestion: May be fatal or cause blindness if swallowed. Aspiration hazard. Cannot be made non-poisonous. May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause systematic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma, and possible death due to failed respiratory failure. May cause cardiopulmonary system effects.

Inhalation: Methanol is toxic and can very readily form extremely high vapor concentrations at room temperature. Inhalation is the most common route of occupational exposure. At first, methanol causes CNS depression with nausea, headache, vomiting, dizziness and incoordination. A time period with no obvious symptoms follows (typically 8-24 hrs). This latent period is followed by metabolic acidosis and severe visual effects which may include reduced reactivity and/or increased sensitivity to light, blurred, doubl and/or snowy vision, and blindness. Depending on the severity of exposure and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects.
Chronic: Prolonged or repeated skin contact may cause dermatitis. Chronic exposure may cause effects similar to those of acute exposure. Methanol is only very slowly eliminated from the body. Because of this slow elimination, methanol should be regarded as a cumulative poison. Though a single exposure may cause no effect, daily exposures may result in the accumulation of a harmful amount. Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations that did not produce significant maternal toxicity.

SECTION 4 – FIRST AID MEASURES

Eyes: In case of contact, immediately flush eyes with plenty of water for a t least 15 minutes. Get medical aid.
Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.
Ingestion: Potential for aspiration if swallowed. Get medical aid immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If vomiting occurs naturally, have victim lean forward.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Effects may be delayed.
Antidote: Ethanol may inhibit methanol metabolism.

SECTION 5 – FIRE FIGHTING MEASURES

General Information: Ethanol may inhibit methanol metabolism. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Water may be ineffective. Material is lighter than water and a fire may be spread by the use of water. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas.
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Water may be ineffective. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water.
Flash Point: 12 deg C (53.60 deg F)
Autoignition Temperature: 455 deg C (851.00 deg F)
Explosion Limits, Lower:6.0 vol %
Upper: 31.00 vol %
NFPA Rating: (estimated) Health: 1; Flammability: 3; Instability: 0

SECTION 6 – ACCIDENTAL RELEASE MEASURES

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Use water spray to disperse the gas/vapor. Remove all sources of ignition. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite. Do not use combustible materials such as sawdust. Use a spark-proof tool. Provide ventilation. A vapor suppressing foam may be used to reduce vapors. Water spray may reduce vapor but may not prevent ignition in closed spaces.

SECTION 7-HANDLING AND STORAGE

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Do not ingest or inhale. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames. Use only with adequate ventilation. Keep away from heat, sparks and flame. Avoid use in confined spaces.
Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed.

SECTION 8 – EXPOSURE CONTROL/ PERSONAL PROTECTION

Engineering Controls: Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Chemical Name	ACGIH	NIOSH	OSHA – Final PELs
Methanol	200 ppm TWA; 250 ppm STEL; Skin - potential significant contribution to overall exposure by the cutaneous route	200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m3 TWA

OSHA Vacated PELs: Methanol: 200 ppm TWA; 260 mg/m3 TWA
Personal Protective Equipment
Eyes: Wear chemical splash goggles.
Skin: Wear butyl rubber gloves, apron, and/or clothing.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Clear liquid
Appearance: clear, colorless - APHA: 10 max
Odor: alcohol-like - weak odor
pH: Not available.
Vapor Pressure: 128 mm Hg @ 20 deg C
Vapor Density: 1.11 (Air=1)
Evaporation Rate:5.2 (Ether=1)
Viscosity: 0.55 cP 20 deg C
Boiling Point: 64.7 deg C @ 760 mmHg
Freezing/Melting Point:-98 deg C
Decomposition Temperature: Not available.
Solubility: miscible
Specific Gravity/Density:.7910 g/cm3 @ 20°C
Molecular Formula:CH4O
Molecular Weight:32.04

SECTON 10 – STABILITY AND REACTIVITY

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: High temperatures, ignition sources, confined spaces.
Incompatibilities with Other Materials: Oxidizing agents, reducing agents, acids, alkali metals, potassium, sodium, metals as powders (e.g. hafnium, raney nickel), acid anhydrides, acid chlorides, powdered aluminum, powdered magnesium.
Hazardous Decomposition Products: Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide, formaldehyde.
Hazardous Polymerization: Will not occur.

SECTION 11 – TOXICOLOGICAL INFORMATION

RTECS#:
CAS# 67-56-1: PC1400000
LD50/LC50:
CAS# 67-56-1:

Draize test, rabbit, eye: 40 mg Moderate;
Draize test, rabbit, eye: 100 mg/24H Moderate;
Draize test, rabbit, skin: 20 mg/24H Moderate;
Inhalation, rabbit: LC50 = 81000 mg/m3/14H;
Inhalation, rat: LC50 = 64000 ppm/4H;
Oral, mouse: LD50 = 7300 mg/kg;
Oral, rabbit: LD50 = 14200 mg/kg;
Oral, rat: LD50 = 5600 mg/kg;
Skin, rabbit: LD50 = 15800 mg/kg;

Human LDLo Oral: 143 mg/kg; Human LDLo Oral: 428 mg/kg; Human TCLo Inhalation; 300 ppm caused visual field changes & headache; Monkey LDLo Skin: 393 mg/kg. Methanol is significantly less toxic to most experimental animals than humans, because most animal species metabolize methanol differently. Non-primate species do not ordinarily show symptoms of metabolic acidosis or the visual effects which have been observed in primates and humans.
Carcinogenicity:
CAS# 67-56-1: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information found
Teratogenicity: There is no human information available. Methanol is considered to be a potential developmental hazard based on animal data. In animal experiments, methanol has caused fetotoxic or teratogenic effects without maternal toxicity.
Reproductive Effects: See actual entry in RTECS for complete information.
Mutagenicity: See actual entry in RTECS for complete information.
Neurotoxicity: ACGIH cites neuropathy, vision and CNS under TLV basis.

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicity: Fish: Fathead Minnow: 29.4 g/L; 96 Hr; LC50 (unspecified)Fish: Goldfish: 250 ppm; 11 Hr; resulted in deathFish: Rainbow trout: 8000 mg/L; 48 Hr; LC50 (unspecified)Fish: Rainbow trout: LC50 = 13-68 mg/L; 96 Hr.; 12 degrees CFish: Fathead Minnow: LC50 = 29400 mg/L; 96 Hr.; 25 degrees C, pH 7.63Fish: Rainbow trout: LC50 = 8000 mg/L; 48 Hr.; UnspecifiedBacteria: Phytobacterium phosphoreum: EC50 = 51,000-320,000 mg/L; 30 minutes; Microtox test No data available.
Environmental: Dangerous to aquatic life in high concentrations. Aquatic toxicity rating: TLm 96>1000 ppm. May be dangerous if it enters water intakes. Methyl alcohol is expected to biodegrade in soil and water very rapidly. This product will show high soil mobility and will be degraded from the ambient atmosphere by the reaction with photochemically produced hyroxyl radicals with an estimated half-life of 17.8 days. Bioconcentration factor for fish (golden ide) < 10. Based on a log Kow of -0.77, the BCF value for methanol can be estimated to be 0.2.
Physical: No information available.
Other: No information available.

SECTION 13 – DISPOSAL CONSIDERATIONS

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 67-56-1: waste number U154 (Ignitable waste).

SECTION 14 – TRANSPORT INFORMATION

	US DOT	CANADA TDG
Shipping Name:	Methanol	Methanol
Hazard Class:	3	3
UN Number:	UN1230	UN1230
Packing Group:	II	II
Additional Information		Flash Point 12°C

SECTION 15 – REGULATORY INFORMATION

US FEDERAL

TSCA
CAS# 67-56-1 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 67-56-1: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 67-56-1: immediate, fire.
Section 313
This material contains Methanol (CAS# 67-56-1, > 99%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
CAS# 67-56-1 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 67-56-1 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
T F
Risk Phrases:
R 11 Highly flammable.
R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed.
R 39/23/24/25 Toxic : danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.

Safety Phrases:
S 16 Keep away from sources of ignition - No smoking.
S 36/37 Wear suitable protective clothing and gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 7 Keep container tightly closed.

WGK (Water Danger/Protection)
CAS# 67-56-1: 1
Canada - DSL/NDSL
CAS# 67-56-1 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of B2, D1B, D2B.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 67-56-1 is listed on the Canadian Ingredient Disclosure List.

SECTION 16 – Other Information

This Material Safety Data Sheet has been prepared in accordance with 29 CFR 1910.1200 and contains information believed to be accurate and complete at the date of preparation. The statements contained herein are offered for informational purposes only and are based upon technical data. MIDI Inc. believes them to be accurate but does not purport to be all-inclusive. The above-stated product is intended for use only by persons having the necessary technical skills and facilities for handling the product at their discretion and risk. Since conditions and manner of use are outside our control, we (MIDI Inc.) make no warranty of merchantability or any such warranty, express or implied with respect to information and we assume no liability resulting from the above product or its use. Users should make their own investigations to determine suitability of information and product for their particular purposes.

Material Safety Data Sheet

NCL of Wisconsin, Inc.
PO Box 8
Birnamwood, WI 54414
Emergency Telephone No: 800-424-9300 (Chemtrec)

Date of this revision: 11-02-2004

Product Identification

Product Name: YSI 3822 Buffer Solution, pH = 7.00
Synonyms: None. Molecular Weight: NA
Chemical Name: NA Chemical Family: NA
Product CAS#: NA Formula: NA

Ingredients

1. Potassium Phosphate Monobasic CAS# 7778-77-0
   Percent: <1 SARA: Not Listed.
   TLV: Not established. PEL: Not Established
   Hazard: Moderately toxic - May cause Irritation.

2. Sodium Hydroxide CAS# 1310-73-2.
   Percent: <1 SARA: Not listed
   TLV: 2 mg/m³ PEL: 2 mg/m³

3. Yellow Food Coloring CAS# Not listed.
   Percent: <0.02 SARA: Not listed.
   TLV: Not established. PEL: Not established.
   Hazard: None Known.

4. Deionized Water CAS# 7732-18-5
   Percent: >98 SARA: Not listed.
   TLV: Not applicable PEL: Not applicable
   Hazard: None.

Precautionary Measures

Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling. Minimal contact, as with all chemicals, is a good policy to follow.

Emergency/First Aid

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, give two glasses of water or milk to dilute. Call a physician.

DOT Hazard Class: Not Regulated

Physical Data Section One

Appearance: Clear yellow solution
Odor: Odorless
Solubility: Infinitely soluble in water.
Boiling Point: 100° C (212° F)
Melting Point: 0° C (32° F)
Specific Gravity: 1.0

Vapor Density (Air=1): Essentially the same as water.
Vapor Pressure (mm Hg): Essentially the same as water.
Evaporation Rate: Essentially the same as water.

Fire and Explosion Information — Section Two

Fire: Not considered to be a fire hazard.
Explosion: Not considered to be and explosion hazard
Fire Extinguishing Media: Use any suitable means for extinguishing surrounding fire.

Reactivity Data — Section Three

Stability: Stable under ordinary conditions of use and storage
Hazardous Decomposition Products: None known.
Hazardous Polymerization: This substance does not polymerize.
Incompatibilities: None known.

Leak/Spill/Disposal Information — Section Four

Flush to sewer with large amounts of water.
Ensure compliance with Federal, State, and local regulations
Reportable Quantity: 5000 lbs.

Health Hazard Information — Section Five

A. Exposure/Health Effects

Inhalation: No information found.
Ingestion: Large doses may cause diarrhea.
Skin Contact: Prolonged contact may cause irritation.
Eye Contact: May cause irritation and damage.
Chronic Exposure: Potassium phosphate, one of the ingredients, may sequester calcium and cause calcium phosphate deposits in the kidneys.
Cancer information: No information found for any ingredient
Aggravation of Pre-existing Conditions: No information found

B. First Aid

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion: If swallowed, give two glasses of water to dilute. Give medical attention immediately.
Skin Exposure: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing. Get medical attention if irritation develops or persists.
Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attentions immediately.

Occupational Control Measures — Section Six

Ventilation System: In general, dilution ventilation is a satisfactory health hazard control for this material. However, if conditions of use create discomfort to a worker, a local exhaust should be considered.

Personal Respirators (NIOSH Approved): For conditions of use where exposure to mist exists, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection: Rubber gloves and lab coat, apron or overalls.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material.

Maintain eye-wash fountain and quick-drench facilities in work areas.

Storage and Special Information — Section Seven

Keep in a tightly closed container. Protect container from physical damage.

The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, NCL of Wisconsin, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, NCL of Wisconsin, Inc will not be responsible for damages of any kind resulting from the use of or reliance upon such information. NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.

END OF MATERIAL SAFETY DATA SHEET

Material Safety Data Sheet

NCL of Wisconsin, Inc.
PO Box 8
Birnamwood, WI 54414
Emergency Telephone No: 800-424-9300 (Chemtrec)

Date of this revision: 11-02-2004

Product Identification

Product Name: YSI 3823 Buffer Solution, PH = 10.00
Synonyms: None. Molecular Weight: NA
Chemical Name: NA Chemical Family: NA
Product CAS#: NA Formula: NA

Ingredients

1. Disodium EDTA dehydrate CAS# 6381-92-6
   Percent: 1 SARA: Not Listed.
   TLV: Not established. PEL: Not Established
   Hazard: Slight. May cause irritation. Moderately toxic by ingestion.

2. Potassium Carbonate CAS# 584-08-7
   Percent: <1 SARA: Not listed
   TLV: Not established. PEL: Not established
   Hazard: Slight. Causes irritation.

3. Potassium Borate CAS# 12228-88-5.
   Percent: <1 SARA: Not listed.
   TLV: Not established. PEL: Not established.
   Hazard: Unknown

4. Potassium Hydroxide CAS# 1310-58-3
   Percent: <1 SARA: Listed.
   TLV: 2 mg/m³ PEL: 2 mg/m³
   Hazard: Moderate. May cause burns.

5. Blue Food Coloring CAS# Not listed.
   Percent: <0.02 SARA: Not listed.
   TLV: Not established. PEL: Not established.
   Hazard: None known.

6. Deionized water CAS# 7732-18-5
   Percent: >98 SARA: Not listed
   TLV: Not applicable. PEL: Not applicable.
   Hazard: None.

Precautionary Measures

Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling. Minimal contact, as with all chemicals, is a good policy to follow.

Emergency/First Aid

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, give two glasses of water or milk to dilute. Call a physician.

DOT Hazard Class: Not Regulated

Physical Data — Section One

Appearance: Clear blue solution.
Odor: Odorless
Solubility: Infinitely soluble in water.
Boiling Point: 100° C (212° F)
Melting Point: 0° C (32° F)
Specific Gravity: 1.0
Vapor Density (Air=1): Essentially the same as water.
Vapor Pressure (mm Hg): Essentially the same as water.
Evaporation Rate: Essentially the same as water.

Fire and Explosion Information — Section Two

Fire: Not considered to be a fire hazard.
Explosion: Not considered to be and explosion hazard
Fire Extinguishing Media: Use any suitable means for extinguishing surrounding fire.

Reactivity Data — Section Three

Stability: Stable under ordinary conditions of use and storage
Hazardous Decomposition Products: None known.
Hazardous Polymerization: This substance does not polymerize.
Incompatibilities: None known.

Leak/Spill/Disposal Information — Section Four

Flush to sewer with large amounts of water.
Ensure compliance with Federal, State, and local regulations
Reportable Quantity: 5000 lbs.

Health Hazard Information — Section Five

A. Exposure/Health Effects

Inhalation: May cause sore throat and irritation to mucous membranes.
Ingestion: If sufficient amounts are ingested, systemic poisoning may occur.
Skin Contact: Prolonged contact may cause irritation.
Eye Contact: May cause irritation.
Chronic Exposure: No information found for any ingredient.
Cancer information: No information found for any ingredient
Aggravation of Pre-existing Conditions: No information found

B. First Aid

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion: If swallowed, give two glasses of water to dilute. Give medical attention immediately.
Skin Exposure: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing. Get medical attention if irritation develops or persists.
Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attentions immediately.

Occupational Control Measures — Section Six

Ventilation System: In general, dilution ventilation is a satisfactory health hazard control for this material. However, if conditions of use create discomfort to a worker, a local exhaust should be considered.

Personal Respirators (NIOSH Approved): For conditions of use where exposure to mist exists, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection: Rubber gloves and lab coat, apron or overalls.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material.

Maintain eye-wash fountain and quick-drench facilities in work areas.

Storage and Special Information — Section Seven

Keep in a tightly closed container. Protect container from physical damage.

The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, NCL of Wisconsin, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, NCL of Wisconsin, Inc will not be responsible for damages of any kind resulting from the use of or reliance upon such information. NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.

END OF MATERIAL SAFETY DATA SHEET

Material Safety Data Sheet

NCL of Wisconsin, Inc.
PO Box 8
Birnamwood, WI 54414
Emergency Telephone No: 800-424-9300 (Chemtrec)

Date of this revision: 11-02-2004

Product Identification

Product Name: YSI 3821 Buffer Solution, PH = 4.0
Synonyms: None. Molecular Weight: NA
Chemical Name: NA Chemical Family: NA
Product CAS#: NA Formula: NA

Ingredients

1. Potassium Acid Phthalate CAS# 877-24-7
   Percent: <2 SARA: Not Listed.
   TLV: Not established. PEL: Not Established
   Hazard: May cause eye and respiratory tract irritation.

2. Red Food Coloring CAS# Not listed.
   Percent: <0.02 SARA: Not listed
   TLV: Not established. PEL: Not established
   Hazard: None known.

3. Deionized Water CAS# 7732-18-5
   Percent: >98 SARA: Not listed.
   TLV: Not applicable PEL: Not applicable
   Hazard: None.

Precautionary Measures

Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling. Minimal contact, as with all chemicals, is a good policy to follow.

Emergency/First Aid

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, give two glasses of water or milk to dilute. Call a physician.

DOT Hazard Class: Not Regulated

Physical Data Section One

Appearance: Clear Pink solution
Odor: Odorless
Solubility: Infinitely soluble in water.
Boiling Point: 100° C (212° F)
Melting Point: 0° C (32° F)
Specific Gravity: 1.0
Vapor Density (Air=1): Essentially the same as water.
Vapor Pressure (mm Hg): Essentially the same as water.
Evaporation Rate: Essentially the same as water.

Fire and Explosion Information — Section Two

Fire: Not considered to be a fire hazard.
Explosion: Not considered to be and explosion hazard
Fire Extinguishing Media: Use any suitable means for extinguishing surrounding fire.

Reactivity Data — Section Three

Stability: Stable under ordinary conditions of use and storage
Hazardous Decomposition Products: May emit toxic fumes of carbon monoxide, carbon dioxide, and potassium oxide if involved in a fire.
Hazardous Polymerization: This substance does not polymerize.
Incompatibilities: Strong solutions of nitric acid.

Leak/Spill/Disposal Information — Section Four

Flush to sewer with large amounts of water.
Ensure compliance with Federal, State, and local regulations
Reportable Quantity: 5000 lbs.

Health Hazard Information — Section Five

A. Exposure/Health Effects

Inhalation: May cause irritation to mucous membranes due to slight acidity.
Ingestion: Large doses may cause nausea, vomiting and abnormal sensations in hands and feet. Because of slight acidity, may cause irritation to mucous membranes.
Skin Contact: May cause irritation, redness, and pain.
Eye Contact: May cause irritation and damage.
Chronic Exposure: No information found.
Cancer information: No information found for any ingredient
Aggravation of Pre-existing Conditions: No information found

B. First Aid

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion: If swallowed, give two glasses of water to dilute. Give medical attention immediately.
Skin Exposure: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing. Get medical attention if irritation develops or persists.
Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attentions immediately.

Occupational Control Measures — Section Six

Ventilation System: In general, dilution ventilation is a satisfactory health hazard control for this material. However, if conditions of use create discomfort to a worker, a local exhaust should be considered.

Personal Respirators (NIOSH Approved): For conditions of use where exposure to mist exists, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection: Rubber gloves and lab coat, apron or overalls.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material.

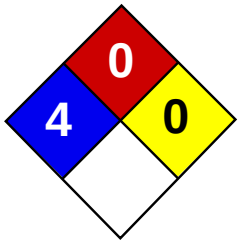
Maintain eye-wash fountain and quick-drench facilities in work areas.

Storage and Special Information — Section Seven

Keep in a tightly closed container. Protect container from physical damage.

The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, NCL of Wisconsin, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, NCL of Wisconsin, Inc will not be responsible for damages of any kind resulting from the use of or reliance upon such information. NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.

END OF MATERIAL SAFETY DATA SHEET



Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet

Nitric acid, 65% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric acid, 65%

Catalog Codes: SLN2161

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Nitric acid, fuming

CI#: Not applicable.

Synonym: Nitric Acid, 65%

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	35
Nitric acid, fuming	7697-37-2	65

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 244 ppm 0.5 hours [Rat]. 344 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, mucous membranes, upper respiratory

tract, skin, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of combustible materials

Explosion Hazards in Presence of Various Substances:
Explosive in presence of reducing materials, of organic materials, of metals, of alkalis. Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Flammable in presence of cellulose or other combustible materials. Phosphine, hydrogen sulfide, selenide all ignite when fuming nitric acid is dripped into gas. (Nitric Acid, fuming)

Special Remarks on Explosion Hazards:
Reacts exlposively with metallic powders, carbides, cyanides, sulfides, alkalies and turpentine. Can react explosively with many reducing agents. Arsine, phosphine, tetraborane all oxidized explosively in presence of nitric acid. Cesium and rubidium

acetylides explode in contact with nitric acid. Explosive reaction with Nitric Acid + Nitrobenzene + water. Detonation with Nitric Acid + 4-Methylcyclohexane. (Nitric acid, fuming)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Oxidizing material. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 2 STEL: 4 (ppm) from ACGIH (TLV) [United States] TWA: 2 STEL: 4 from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Acrid. Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point: 121°C (249.8°F)

Melting Point: -41.6°C (-42.9°F)

Critical Temperature: Not available.

Specific Gravity: 1.408 (Water = 1)

Vapor Pressure: 6 kPa (@ 20°C)

Vapor Density: 2.5 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.29 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in cold water, hot water. Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances:
Highly reactive with alkalis. Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper. Non-corrosive in presence of glass, of stainless steel(304), of stainless steel(316), of brass.

Special Remarks on Reactivity:
A strong oxidizer. Reacts violently with alcohol, organic material, turpene, charcoal. Violent reaction with Nitric acid + Acetone and Sulfuric acid. Nitric Acid will react with water or steam to produce heat and toxic, corrosive and flammable vapors. (Nitric acid, fuming)

Special Remarks on Corrosivity:
In presence of traces of oxides, it attacks all base metals except aluminum and special chromium steels. It will attack some forms of plastics, rubber, and coatings. No corrosive effect on bronze. No corrosivity data for zinc, and steel

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:

Contains material which may cause damage to the following organs: lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: LDL - Lowest Published Lethal Dose [Human] - Route: Oral; Dose: 430 mg/kg (Nitric acid, fuming)

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (effects on newborn and fetotoxicity) based on animal data. (Nitric acid, fuming)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Severely irritates skin. Causes skin burns and may cause deep and penetrating ulcers of the skin with a characteristic yellow to brownish discoloration. May be fatal if absorbed through skin. Eyes: Severely irritates eyes. Causes eye burns. May cause irreversible eye injury. Ingestion: May be fatal if swallowed. Causes serious gastrointestinal tract irritation or burns with nausea, vomiting, severe abdominal pain, and possible "coffee grounds" appearance of the vomitus . May cause perforation of the digestive tract. Inhalation: May be fatal if inhaled. Vapor is extremely hazardous. Vapor may cause nitrous gas poisoning. Effects may be delayed. May cause irritation of the mucous membranes and respiratory tract with burning pain in the nose and throat, coughing, sneezing, wheezing, shortness of breath and pulmonary edema. Other symptoms may include nausea, and vomiting. Chronic Potential Health Effects: Repeated inhalation may produce changes in pulmonary function and/or chronic bronchitis. It may also affect behavior (headache, dizziness, drowsiness, muscle contaction or spasticity, weakness, loss of coordinaton, mental confusion), and urinary system (kidney faillure, decreased urinary output after several hours of

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Nitric acid UNNA: 2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Nitric acid, fuming Rhode Island RTK hazardous substances: Nitric acid, fuming Pennsylvania RTK: Nitric acid, fuming Florida: Nitric acid, fuming Minnesota: Nitric acid, fuming Massachusetts RTK: Nitric acid, fuming

New Jersey: Nitric acid, fuming TSCA 8(b) inventory: Water; Nitric acid, fuming SARA 302/304/311/312 extremely hazardous substances: Nitric acid, fuming SARA 313 toxic chemical notification and release reporting: Nitric acid, fuming 65% CERCLA: Hazardous substances.: Nitric acid, fuming: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R8- Contact with combustible material may cause fire. R35- Causes severe burns. S23- Do not breathe gas/fumes/vapour/spray [***] S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S36- Wear suitable protective clothing. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 4

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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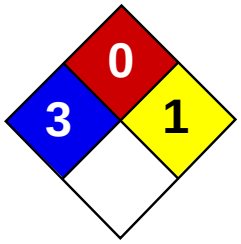

Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet
Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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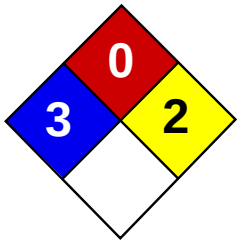

Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet

Sulfuric Acid 50% (w/w) Solution MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sulfuric Acid 50% (w/w) Solution

Catalog Codes: SLS1573

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Sulfuric acid; Water

CI#: Not applicable.

Synonym: Sulfuric Acid, 50% (w/w) Solution

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	50
Water	7732-18-5	50

Toxicological Data on Ingredients: Sulfuric acid: ORAL (LD50): Acute: 2140 mg/kg [Rat.]. VAPOR (LC50): Acute: 510 mg/m 2 hours [Rat]. 320 mg/m 2 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Non-corrosive for skin. Non-irritant for skin. Non-sensitizer for skin. Non-permeator by skin. Non-irritating to the eyes. Non-hazardous in case of ingestion. Non-hazardous in case of inhalation. Non-irritant for lungs. Non-sensitizer for lungs.

CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA [Sulfuric acid]. Classified A2 (Suspected for human.) by ACGIH [Sulfuric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED] [Sulfuric Acid 50% (w/w) Solution]. The substance may be toxic to the reproductive system, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Slightly explosive in presence of oxidizing materials. Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:

M i x t u r e s o f s u l f u r i c a c i d a n d a n y o f t h e f o l l o w i n g c a n e x p l o d e : p - n i t r o t o l u e n e , p e n t a s i l v e r trihydroxydiaminophosphate, perchlorates, alcohols with strong hydrogen peroxide, ammonium tetraperoxychromate, mercuric nitrite, potassium chlorate, potassium permanganate with potassium chloride. Nitramide decomposes explosively on contact with concentrated sulfuric acid. 1,3,5-Trinitrosohexahydro-1,3,5-triazine + sulfuric acid causes explosive decompositon. (Sulfuric acid)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Sulfuric acid TWA: 1 STEL: 3 (mg/m3) [Australia] Inhalation TWA: 1 (mg/m3) from OSHA (PEL) [United States] Inhalation TWA: 1 STEL: 3 (mg/m3) from ACGIH (TLV) [United States] [1999] Inhalation TWA: 1 (mg/m3) from NIOSH [United States] Inhalation TWA: 1 (mg/m3) [United Kingdom (UK)]3 Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Odorless.

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless. Clear

pH (1% soln/water): Acidic.

Boiling Point: The lowest known value is 100°C (212°F) (Water). Weighted average: 195°C (383°F)

Melting Point: May start to solidify at 10.36°C (50.6°F) based on data for: Sulfuric acid.

Critical Temperature: Not available.

Specific Gravity: Weighted average: 1.3 (Water = 1)

Vapor Pressure: The highest known value is 2.3 kPa (@ 20°C) (Water).

Vapor Density: The highest known value is 3.4 (Air = 1) (Sulfuric acid). Weighted average: 2.01 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, organic materials, metals, acids, alkalis.

Corrosivity:
Extremely corrosive in presence of aluminum, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with the following materials: potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals as non powders(yields hydrogen gas), metal compounds, metals as powders, strong oxidizing and reducing agents. Concentrated solutions react violently with water, spattering and liberating heat.

Special Remarks on Corrosivity:
Concentrated acid is non-corrosive to lead and mild steel, but diluted acid attacks most metals. Attacks and corrodes many metals releasing hydrogen. Minor corrosive on bronze. No data for copper, zinc or brass.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact.

Toxicity to Animals: Acute oral toxicity (LD50): 4280 mg/kg (Rat.) (Calculated value for the mixture).

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA [Sulfuric acid]. Classified A2 (Suspected for human.) by ACGIH [Sulfuric acid]. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/

female, Reproductive system/toxin/male [SUSPECTED] [Sulfuric Acid 50% (w/w) Solution]. May cause damage to the following organs: the reproductive system, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects and Cancer.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sulfuric Acid, Solution (Sulfuric acid) UNNA: 2796 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sulfuric acid New York release reporting list: Sulfuric acid Rhode Island RTK hazardous substances: Sulfuric acid Pennsylvania RTK: Sulfuric acid Minnesota: Sulfuric acid Massachusetts RTK: Sulfuric acid New Jersey: Sulfuric acid TSCA 8(b) inventory: Sulfuric acid; Water SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid SARA 313 toxic chemical notification and release reporting: Sulfuric acid 50% CERCLA: Hazardous substances.: Sulfuric acid: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R35- Causes severe burns. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S30- Never add water to this product. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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Emergency Contact: Chemtrec (800) 424-9300
Or Norco (208) 336-1643

1125 West Amity Road
Boise, ID 83705
(208) 336-1643

Isobutylene 0.0001% to 0.9% in Air

MATERIAL SAFETY DATA SHEET

Identification

Product Name: Isobutylene 0.0001% to 0.9% in Air
CAS Number: N/A
Chemical Family: Gas Mixture
Chemical Formula: C_4H_8 0.0001% to 0.9% in Air
Common Names/Synonyms: None
TDG (Canada) Classification: 2.2
WHMIS Classification: A, B1
MSDS Identification Code/Number: 2110
Prepared By: Corporate Production

Revision Date: 01/04/00
Last Review Date: 02/09/07

Composition/Information on Ingredients

Exposure Limits[1]:

INGREDIENT	% VOLUME	PEL-OSHA[2]	TlV-ACGIH[3]	LD_{50} OR LC_{50} Route/Species
Air FORMULA: Not Applicable CAS #: Not Applicable RTECS #: Not Applicable	99.1 – 100	Not Applicable	Not Applicable	Not Applicable
Isobutylene FORMULA: C_4H_8 CAS #: 115-11-7 RTECS # UDO890000	00.0001% - 0.9%	Simple Asphyxiant	Simple Asphyxiant	LC_{50} 620 mg/m^3/3Hr. (rat)

[1] Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.
[2] As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)
[3] As stated in the ACGIH 2006 Threshold Limit Values for Chemical Substances and Physical Agents

Hazards Identification

Emergency Overview:
Isobutylene is a simple hydrocarbon and can cause irritation and central nervous system depression at high concentrations. Use only with adequate ventilation. Contents under pressure. Avoid heat and flames. Protect containers from physical damage. This mixture is non-flammable.

Route of Entry:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
Yes	No	Yes	Yes	No

Health Effects:

Exposure Limits No	Irritant Yes	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen No
Synergistic Effects None Reported		

Hazards Identification Continued

Carcinogenicity: NTP: No IARC: No OSHA: No

Eye Effects:
Irritation may occur. Contact with rapidly expanding gas near the point of release may cause frostbite.

Skin Effects:
Contact with rapidly expanding gas near the point of release may cause frostbite with redness, skin color change to gray or white, and blistering.

Ingestion Effects:
Ingestion is unlikely.

Inhalation Effects:
Product is relatively nontoxic. Simple hydrocarbons can irritate the eyes, mucous membranes and respiratory system at high concentrations.

Inhalation of high concentrations of Isobutylene may cause dizziness, disorientation, incoordination, narcosis, nausea or narcotic effects.

NFPA Hazard Codes		**HMIS Hazard Codes**		**Ratings System**
Health:	1	Health:	1	0 = No Hazard
Flammability:	0	Flammability:	0	1 = Slight Hazard
Reactivity:	0	Physical Hazard:	3	2 = Moderate Hazard
				3 = Serious Hazard
				4 = Severe Hazard

Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in *CGA P-19 2004, CGA Recommended Hazard Ratings for Compressed Gases, Second Edition.*

First Aid Measures

Eyes:
Never introduce oil or ointment into the eyes without medical advice! Flush eyes with cool water for 15 minutes. If pain is present, or frostbite is suspected refer the victim to an ophthalmologist for further treatment and follow up.

Skin:
Remove contaminated clothing and wash affected area with soap and water. For frostbite, immerse skin in lukewarm water. DO NOT USE HOT WATER. If irritation persists or frostbite is suspected, seek medical attention.

Ingestion:
Not normally required. Product is a gas at room temperature.

Inhalation:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO PRODUCT. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted (artificial) respiration and supplemental oxygen. Further treatment should be symptomatic and supportive.

Fire Fighting Measures

Conditions of Flammability: Not flammable		
Flash Point: None	Method: Not Applicable	Autoignition Temperature: None
LEL (%): None	UEL (%): None	
Hazardous combustion products: Carbon Monoxide, Carbon Dioxide		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: None		

Fire and Explosion Hazards:
The majority of this product constitutes air. Isobutylene is present in concentrations below the Lower Explosive Limits (LEL). Containers may explode when exposed to heat or flames.

Extinguishing Media:
Water spray to keep cylinders cool. Extinguishing agent appropriate for the combustible material.

Fire Fighting Instructions:
Continue to cool heat or flame exposed containers until well after the flames are extinguished.

Accidental Release Measures

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest Norco location.

Handling and Storage

Electrical Classification:
Non-hazardous

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous backflow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125° F. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Use a "first in, first out" inventory system to prevent full cylinders being stored for excessive period of time.

For additional recommendations, consult Compressed Gas Association's Pamphlets P-1 and G-2.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

Exposure Controls, Personal Protection

Engineering Controls:
Use local exhaust ventilation as necessary to maintain atmospheric oxygen levels above 19.5% and control air contaminants to below acceptable exposure guidelines.

Eye/Face Protection:
Goggles should be worn.

Exposure Controls, Personal Protection Continued

Skin Protection:
Protective gloves made of suitable material appropriate for the job.

Other/General Protection:
Safety shoes, emergency eyewash station.

Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure	: Above critical temp.	
Vapor density (Air = 1)	: Not Available	
Evaporation point	: Not Available	
Boiling point	: -194.3	^{O}C
Freezing point	: Not Available	
pH	: Not Available	
Specific gravity at STP	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H_2O)	: Negligible	
Odor threshold	: Not Available	
Odor and appearance	: Colorless gas with a slight odor of burning coal.	

Stability and Reactivity

Stability:
Stable

Incompatible Materials:
None

Hazardous Decomposition Products:
Carbon Monoxide

Hazardous Polymerization:
Will not occur.

Toxicological Information

No chronic effects data for Isobutylene is given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

Ecological Information

Product does not contain Class I or Class II ozone depleting substances. Not toxic. Will not bioconcentrate.

Disposal Considerations

Do not attempt to dispose of waste or unused quantities. Return in the shipping container *properly labeled with any valve outlet plugs or caps secure and valve protection cap in place* to Norco for proper disposal.

Transport Information

PARAMETER	United States DOT	Canada TDG
Proper Shipping Name:	Compressed Gas, N.O.S., (Air, Isobutylene)	Compressed Gas, N.O.S., (Air, Isobutylene)
Hazard Class:	2.2	2.2
Identification Number	1956	1956
Shipping label:	Non-flammable gas	Non-flammable gas

Regulatory Information

SARA Title III Notifications and Information
Isobutylene is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

SARA Title III-Section 313 Supplier Notification
This product Does not contain ingredients subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372.

SARA Title III – Hazard Classes:
Acute Health Hazard
Sudden Release of Pressure Hazard

California Proposition 65: This product does not contain ingredient(s) known to the State of California to cause cancer or reproductive toxicity.

Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

Disclaimer of Expressed and Implied Warranties:
Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

MATERIAL SAFETY DATA SHEET (MSDS) FOR PORTLAND CEMENT

(Complies with OSHA and MSHA Hazard Communication Standards,
29 CFR 1910.1200and 30 CFR Part 47)

CEMEX, INC.
CEMEX CALIFORNIA CEMENT LLC
VICTORVILLE CEMENT PLANT
16888 NORTH "E" STREET
VICTORVILLE, CALIFORNIA 92394-2999

Section 1 - IDENTIFICATION

Supplier/Manufacturer

CEMEX, Inc.
CEMEX California Cement LLC
Victorville Cement Plant
16888 North "E" Street
Victorville, California 92394-2999

Emergency Contact Information

(619) 381-7600

Chemical name and synonyms

Portland Cement (CAS #65997-15-1)

Product name

"CEMEX Type I/II"
"CEMEX Type III"
“CEMEX Type II/V”
"CEMEX Type V"
"CEMEX Block"
"CEMEX Class G"

Chemical family	Formula	
Calcium salts.	$3CaO.SiO_2$	(CAS #12168-85-3)
	$2CaO.SiO_2$	(CAS #10034-77-2)
	$3CaO.Al_2O_2$	(CAS #12042-78-3)
	$4CaO..Al_2O_3Fe_2O_3$	(CAS #12068-35-8)
	$CaSO_2.2H_2O$	(CAS #13397-24-5)

Other salts: Small amounts of MgO, and trace amounts of K_2SO_4 and Na_2SO_4 may also be present.

Section 2 - COMPONENTS

Hazardous Ingredients

Portland cement clinker (CAS# 65997-15- 1) - approximately - 93.5-96.0 % by weight
ACGIH TLV-TWA (2000) = 10 mg total dust/m^3
OSHA PEL (8-hour TWA) = 50 million particles/ft^3

Gypsum (CAS# 7778-18-9) - approximately - 4.0-6.5 % by weight
ACGIH TLV-TWA (2000) = 10 mg total dust/m^3
OSHA PEL (8-hour TWA) = 15 mg total dust/m^3
OSHA PEL (8-hour TWA) = 5 mg respirable dust/m^3

Respirable quartz (CAS# 14808-60-7) – greater than 0.1% by weight
ACGIH TLV-TWA (2000) = 0.05 mg respirable quartz dust/m^3
OSHA PEL (8-hour TWA) = (10 mg respirable dust/$m^{3)}$/(percent silica + 2)

Trace Ingredients

Trace amounts of naturally occurring chemicals might be detected during chemical analysis. Trace constituents may include up to 0.75% insoluble residue, some of which may be free crystalline silica, calcium oxide (Also known as lime or quick lime), magnesium oxide, potassium sulfate, sodium sulfate, chromium compounds, and nickel compounds.

Section 3 - HAZARD IDENTIFICATION

Emergency Overview

Portland cement is a light gray powder that poses little immediate hazard. A single short-term exposure to the dry powder is not likely to cause serious harm. However, exposure of sufficient duration to wet portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns. The same type of tissue destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry portland cement.

Potential Health Effects

Relevant Routes of Exposure:
Eye contact, skin contact, inhalation, and ingestion.

Effects Resulting from Eye Contact:
Exposure to airborne dust may cause immediate or delayed irritation or inflammation. Eye contact by large amounts of dry powder or splashes of wet portland cement may cause effects ranging from moderate eye irritation to chemical burns or blindness. Such exposures require immediate first aid (see Section 4) and medical attention to prevent significant damage to the eye.

Effects Resulting from Skin Contact:
Discomfort or pain cannot be relied upon to alert a person to hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing skin contact, particularly with wet cement. Exposed persons may not feel discomfort until hours after the exposure has ended and significant injury has occurred.

Dry portland cement contacting wet skin or exposure to moist or wet portland cement may cause more severe skin effects including thickening, cracking or fissuring of the skin. Prolonged exposure can cause severe skin damage in the form of (alkali) chemical burns.

Some individuals may exhibit an allergic response upon exposure to portland cement, possibly due to trace elements of chromium. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may first experience this effect after years of contact with portland cement products.

Effects Resulting from Inhalation:
Portland cement may contain trace amounts of free crystalline silica. Prolonged exposure to respirable free silica can aggravate other lung conditions and cause silicosis, a disabling and potentially fatal lung disease.

Exposure to portland cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.

Effects Resulting from Ingestion:
Although small quantities of dust are not known to be harmful, ill effects are possible if larger quantities are consumed. Portland cement should not be eaten.

Carcinogenic potential:
Portland cement is **not** listed as a carcinogen by NTP, OSHA, or IARC. It may however, contain trace amounts of substances listed as carcinogens by these organizations.

Crystalline silica, a potential trace level contaminate in Portland cement, is now classified by IARC as known human carcinogen (Group I). NTP has characterized respirable silica as "reasonably anticipated to be [a] carcinogen".

Medical conditions which may be aggravated be, inhalation or dermal exposure:
Pre-existing upper respiratory and lung diseases.
Unusual (hyper) sensitivity to hexavalent chromium (chromium^{+6}) salts.

Section 4 - FIRST AID

Eyes

Immediately flush eyes thoroughly with water. Continue flushing eye for at least 15 minutes, including under lids, to remove all particles. Call physician immediately.

Skin

Wash skin with cool water and pH-neutral soap or a mild detergent. Seek medical treatment in all cases of prolonged exposure to wet cement, cement mixtures, liquids from fresh cement products, or prolonged wet skin exposure to dry cement.

Inhalation of Airborne Dust

Remove to fresh air. Seek medical help if coughing and other symptoms do not subside.

Ingestion

Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

Section 5 - FIRE AND EXPLOSION DATA

Flash point .....None
Lower Explosive Limit.....None
Upper Explosive Limit.....None
Auto ignition temperature.....Not Combustible
Extinguishing media.....Not Combustible
Special fire fighting Procedures.....None
Hazardous combustion products.....None
Unusual fire and explosion hazards...None

Section 6 - ACCIDENTAL RELEASE MEASURES

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Wear appropriate personal protective equipment as described in Section 8.

Scrape up wet material and place in an appropriate container. Allow the material to "dry" before disposal. Do not attempt to wash portland cement down drains.

Dispose of waste material according to local, state and federal regulations.

Section 7 - HANDLING AND STORAGE

Keep portland cement dry until used. Normal temperatures and pressures do not affect the material.

Promptly remove dusty clothing or clothing which is wet with cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet cement mixtures or fluids.

Section 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Skin Protection

Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened portland cement. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened portland cement products might occur, wear impervious clothing and gloves to eliminate skin contact. Wear sturdy boots that are impervious to water to eliminate foot and ankle exposure.

Do not rely on barrier creams: barrier creams should not be used in place of gloves.

Periodically wash areas contacted by dry portland cement or by wet cement or concrete fluids with a pH neutral soap. Wash again at the end of work. If irritation occurs, immediately wash the affected area and seek treatment. If clothing becomes saturated with wet concrete, it should be removed and replaced with clean dry clothing.

Respiratory Protection

Avoid actions that cause dust to become airborne. Use local or general exhaust ventilation to control exposures below applicable exposure limits.

Use NIOSH/MSHA approved (under 30 CFR 11) or NIOSH approved (under 42 CFR 84) respirators in poorly ventilated areas, if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. (Advisory: Respirators and filters purchased after June 10, 1998 must be certified under 42 CFR 84.)

Ventilation

Use local exhaust or general dilution ventilation to control exposure within applicable limits.

Eye Protection

Where potentially subject to splashes or puffs of cement, wear safety glasses with side shields or goggles. In extremely dusty environments and unpredictable environments wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with portland cement or fresh cement products.

Section 9 - PHYSICAL AND CHEMICAL, PROPERTIES

Appearance.....Gray Powder
Physical state.....Solid (powder)
Solubility in water...Slightly soluble (0.1 to 1.0%)
Vapor density.....Not applicable
Melting point.....Not applicable
Evaporation rate.....Not applicable

Odor.....No distinct odor
pH (in water).....12 to 13
Vapor pressure.....Not applicable
Boiling point.....Not applicable (i.e., > 1000 C)
Specific gravity (H20 = 1.0).....3.15

Section 10 - STABILITY AND REACTIVITY

Stability

Stable.

Conditions to avoid

Unintentional contact with water.

Incompatibility

Wet Portland cement is alkaline. As such it is incompatible with acids, ammonium salts and phosphorous.

Hazardous decomposition

Will not spontaneously occur. Adding water produces (caustic) calcium hydroxide

Hazardous Polymerization

Will not occur.

Section 11 - TOXICOLOGICAL INFORMATION

For a description of available, more detailed toxicological information contact the supplier or manufacturer.

Section 12 - ECOLOGICAL INFORMATION

Ecotoxicity

No recognized unusual toxicity to plants or animals

Relevant physical and chemical properties

(See Sections 9 and 10.)

Section 13 - DISPOSAL

Dispose of waste material according to local, state and federal regulations. (Since portland cement is stable, uncontaminated material may be saved for future use.

Dispose of bags in an approved landfill or incinerator.

Section 14 - TRANSPORTATION DATA

Hazardous materials description/proper shipping name

Portland is cement is not hazardous under U.S. Department of Transportation (DOT) regulations.

Hazard class

Not applicable

Identification number

Not applicable.

Required label text

Not applicable.

Hazardous substances/reportable quantities (RQ)

Not applicable.

Section 15 - OTHER REGULATORY INFORMATION

Status under USDOL-OSHA Hazard Communication Rule, 29 CFR 1910.1200

Portland cement is considered a "hazardous chemical" under this regulation, and should be part of any hazard communication program.

Status under CERCLA/SUPERFUND 40 CFR 117 and 302

Not listed.

Hazard Category under SARA(Title III), Sections 311 and 312

Portland cement qualifies as a "hazardous substance" with delayed health effects.

Status under SARA (Title III), Section 313

Not subject to reporting requirements under Section 313.

Status under TSCA (as of May 1997)

Some substances in portland cement are on the TSCA inventory list.

Status under the Federal Hazardous Substances Act

Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.

Status under California Proposition 65

This product contains up to 0.05 percent of chemicals (trace elements) known to the State of California to cause cancer, birth defects or other reproductive harm. California law requires the manufacturer to give the above warning in the absence of definitive testing to prove that the defined risks do not exist.

Section 16 - OTHER INFORMATION

Prepared by

Kevin Keegan
Director - Health and Safety
CEMEX, Inc.
Houston, Texas

Approval date or Revision date

Approved: August, 1997
Revised: March, 2001

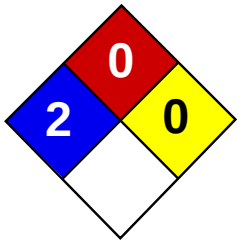
Other important information

Portland cement should only be used by knowledgeable persons. A key to using the product safely requires the user to recognize that portland cement chemically reacts with water, and that some of the intermediate products of this reaction (that is those present while a portland cement product is "setting") pose a more severe hazard than does dry portland cement itself.

While the information provided in this material safety data sheet is believed to provide a useful summary of the hazards of portland cement as it is commonly used, the sheet cannot anticipate and provide the all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

SELLER MAKES NO WARRANTY, EXPRESSED OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY CEMEX, Inc. except that the product shall conform to contracted specifications. The information provided herein was believed by CEMEX, Inc. to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information to comply with all laws and procedures applicable to the safe handling and use of product and to determine the suitability of the product for its intended use. Buyer's exclusive remedy shall be for damages and no claim of any kind, whether as to product delivered or for non-delivery of product, and whether based on contract, breach of warranty, negligence, or otherwise shall be greater in amount than the purchase price of the quantity of product in respect of which damages are claimed. In no event shall Seller be liable for incidental or consequential damages, whether Buyer's claim is based on contract, breach of warranty, negligence or otherwise.

In particular, the data furnished in this sheet do not address hazards that may be posed by other materials mixed with portland cement to produce portland cement products. Users should review other relevant material safety data sheets before working with this portland cement or working on portland cement products, for example, portland cement concrete.



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Bentonite MSDS

Section 1: Chemical Product and Company Identification

Product Name: Bentonite

Catalog Codes: SLB1441, SLB2935, SLB4435

CAS#: 1302-78-9

RTECS: CT9450000

TSCA: TSCA 8(b) inventory: Bentonite

CI#: Not applicable.

Synonym: Montmorillonite;

Chemical Name: Not available.

Chemical Formula:
(Al,Fe1.67Mg.33)Si10(OH)2Na(+)Ca(++)/2.33

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Bentonite	1302-78-9	100

Toxicological Data on Ingredients: Bentonite LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.

Potential Chronic Health Effects:
Hazardous in case of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not breathe dust. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 10 from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Odorless.

Taste: Not available.

Molecular Weight: Not available.

Color: Beige. (Light.)

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: Decomposes.

Critical Temperature: Not available.

Specific Gravity: 2.5 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Very slightly soluble in cold water, hot water. Insoluble in methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Not available.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Causes damage to the following organs: lungs.

Other Toxic Effects on Humans:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Bentonite

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 06/09/2012 12:00 PM

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AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours): Corporate Safety (732)750-6000
MSDS Internet Website www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES
Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN
Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 “Low Expansion Foam - 1994 Edition.”

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product

vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******

******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	TWA (ppm)	STEL (ppm)	Note
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Note
		Exposure Limits		
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O): Non-oxygenated gasoline - negligible (< 0.1% @ 77 ^oF). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 ^oF); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg
Acute Oral LD50 (rat): 18.75 ml/kg
Primary dermal irritation (rabbits): slightly irritating
Draize eye irritation (rabbits): non-irritating
Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

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Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types) **MSDS No. 9909**

EMERGENCY OVERVIEW
CAUTION!
OSHA/NFPA COMBUSTIBLE LIQUID - SLIGHT TO MODERATE IRRITANT
EFFECTS CENTRAL NERVOUS SYSTEM
HARMFUL OR FATAL IF SWALLOWED

Moderate fire hazard. Avoid breathing vapors or mists. May cause dizziness and drowsiness. May cause moderate eye irritation and skin irritation (rash). Long-term, repeated exposure may cause skin cancer.
If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

NFPA 704 (Section 16)

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800) 424-9300**
COMPANY CONTACT (business hours): Corporate Safety (732) 750-6000
MSDS INTERNET WEBSITE: www.hess.com (See Environment, Health, Safety & Social Responsibility)

SYNONYMS: Ultra Low Sulfur Diesel (ULSD); Low Sulfur Diesel; Motor Vehicle Diesel Fuel; Diesel Fuel #2; Dyed Diesel Fuel; Non-Road, Locomotive and Marine Diesel Fuel; Tax-exempt Diesel Fuel

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and CHEMICAL INFORMATION ON INGREDIENTS

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Diesel Fuel (68476-34-6)	100
Naphthalene (91-20-3)	Typically < 0.01

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher. Diesel fuel may be dyed (red) for tax purposes. May contain a multifunctional additive.

3. HAZARDS IDENTIFICATION

EYES
Contact with liquid or vapor may cause mild irritation.

SKIN
May cause skin irritation with prolonged or repeated contact. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Similar products produced skin cancer and systemic toxicity in laboratory animals following repeated applications. The significance of these results to human exposures has not been determined - see Section 11 Toxicological Information.

IARC classifies whole diesel fuel exhaust particulates as probably carcinogenic to humans (Group 2A). NIOSH regards whole diesel fuel exhaust particulates as a potential cause of occupational lung cancer based on animal studies and limited evidence in humans.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash).

4. FIRST AID MEASURES

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT:	> 125 ^{o}F (> 52 ^{o}C) minimum PMCC
AUTOIGNITION POINT:	494 ^{o}F (257 ^{o}C)
OSHA/NFPA FLAMMABILITY CLASS:	2 (COMBUSTIBLE)
LOWER EXPLOSIVE LIMIT (%):	0.6
UPPER EXPLOSIVE LIMIT (%):	7.5

FIRE AND EXPLOSION HAZARDS
Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA
SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY'S SPILL CONTINGENCY OR EMERGENCY RESPONSE PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE

HANDLING PRECAUTIONS

Handle as a combustible liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Diesel fuel, and in particular low and ultra low sulfur diesel fuel, has the capability of accumulating a static electrical charge of sufficient energy to cause a fire/explosion in the presence of lower flashpoint products such as gasoline. The accumulation of such a static charge occurs as the diesel flows through pipelines, filters, nozzles and various work tasks such as tank/container filling, splash loading, tank cleaning; product sampling; tank gauging; cleaning, mixing, vacuum truck operations, switch loading, and product agitation. There is a greater potential for static charge accumulation in cold temperature, low humidity conditions.

Documents such as 29 CFR OSHA 1910.106 "Flammable and Combustible Liquids, NFPA 77 Recommended Practice on Static Electricity, API 2003 "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents and ASTM D4865 "Standard Guide for Generation and Dissipation of Static

Electricity in Petroleum Fuel Systems" address special precautions and design requirements involving loading rates, grounding, bonding, filter installation, conductivity additives and especially the hazards associated with "switch loading." ["Switch Loading" is when a higher flash point product (such as diesel) is loaded into tanks previously containing a low flash point product (such as gasoline) and the electrical charge generated during loading of the diesel results in a static ignition of the vapor from the previous cargo (gasoline).]

Note: When conductivity additives are used or are necessary the product should achieve 25 picosiemens/meter or greater at the handling temperature.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

EXPOSURE LIMITS

Components (CAS No.)	Source	Exposure Limits TWA/STEL	Note
Diesel Fuel: (68476-34-6)	OSHA	5 mg/m, as mineral oil mist	
	ACGIH	100 mg/m^3 (as totally hydrocarbon vapor) TWA	A3, skin
Naphthalene (91-20-3)	OSHA	10 ppm TWA	
	ACGIH	10 ppm TWA / 15 ppm STEL	A4, Skin

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile, neoprene, or PVC are recommended. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION
A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE
Clear, straw-yellow liquid. Dyed fuel oil will be red or reddish-colored.

ODOR
Mild, petroleum distillate odor

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	320 to 690 oF (160 to 366 ^{o}C)
VAPOR PRESSURE:	0.009 psia @ 70 ^{o}F (21 ^{o}C)
VAPOR DENSITY (air = 1):	> 1.0
SPECIFIC GRAVITY (H_2O = 1):	0.83 to 0.88 @ 60 ^{o}F (16 ^{o}C)
PERCENT VOLATILES:	100 %
EVAPORATION RATE:	Slow; varies with conditions
SOLUBILITY (H_2O):	Negligible

10. STABILITY and REACTIVITY

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS
Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers; Viton ®; Fluorel ®

HAZARDOUS DECOMPOSITION PRODUCTS
Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY
Acute dermal LD50 (rabbits): > 5 ml/kg
Acute oral LD50 (rats): 9 ml/kg
Primary dermal irritation: extremely irritating (rabbits)
Draize eye irritation: non-irritating (rabbits)
Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY
Carcinogenic: OSHA: NO IARC: NO NTP: NO ACGIH: A3

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

MUTAGENICITY (genetic effects)
This material has been positive in a mutagenicity study.

12. ECOLOGICAL INFORMATION

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Diesel Fuel	Placard (International Only):
HAZARD CLASS and PACKING GROUP:	3, PG III	
DOT IDENTIFICATION NUMBER:	NA 1993 (Domestic) UN 1202 (International)	
DOT SHIPPING LABEL:	None	
		Use Combustible Placard if shipping in bulk domestically

15. REGULATORY INFORMATION

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the state and/or local level. Consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the *de minimis* levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

CALIFORNIA PROPOSITON 65 LIST OF CHEMICALS

This product contains the following chemicals that are included on the Proposition 65 "List of Chemicals" required by the California Safe Drinking Water and Toxic Enforcement Act of 1986:

INGREDIENT NAME (CAS NUMBER)	Date Listed
Diesel Engine Exhaust (no CAS Number listed)	10/01/1990

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 3 (Combustible Liquid) and Class D, Division 2, Subdivision B (Toxic by other means)

16. OTHER INFORMATION

NFPA® HAZARD RATING	HEALTH:	0	
	FIRE:	2	
	REACTIVITY:	0	

Refer to NFPA 704 "Identification of the Fire Hazards of Materials" for further information

HMIS® HAZARD RATING	HEALTH:	1 *	* Chronic
	FIRE:	2	
	PHYSICAL:	0	

SUPERSEDES MSDS DATED: 02/28/2001

ABBREVIATIONS:

AP = Approximately	< = Less than	> = Greater than
N/A = Not Applicable	N/D = Not Determined	ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212) 642-4900
API	American Petroleum Institute (202) 682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

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Additional Material Safety Data Sheets will be inserted into this document as needed.

Attachment 4

Activity Hazard Analyses

Activity Hazard Analysis (AHA)

Activity/Work Task: **Equipment Decontamination and IDW Management and Sampling**	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: Site 40, NAS Whiting Field	**Risk Assessment Code (RAC) Matrix**	
Project Number: 60268998		
Date Prepared: 8/21/2012		
Prepared by (Name/Title): Trent Sims/Environmental Engineer		
Reviewed by (Name/Title): Katie Broom/Senior Environmental Scientist		
Notes: (Field Notes, Review Comments, etc.)		

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart
E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Job Steps	Hazards	Controls	RAC
General Physical Hazards	• Uneven or slippery ground surface (i.e. slips/trips/falls) • Biological Hazards • Sharp objects (i.e. cuts and abrasions) • Heavy or unbalanced loads (i.e. manual lifting)	• Wear appropriate PPE (see HASP, Section 6.0) • Maintain a clean and organized work area. • Watch your step and ensure proper footing. • Provide a first aid kit. • Assess work area for poisonous plants and animals and communicate observations to avoid them. • Wear appropriate work gloves for task • Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 50 lbs without assistance)	**L**
	• Adverse Weather Conditions • Cold/Heat Stress	• Be aware of changing weather conditions and provide appropriate weather gear. • Wear appropriate clothing for weather conditions. • Implement a work-rest regime • Provide drinking water or other fluids for hydration • When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP)	

Job Steps	Hazards	Controls	RAC
Erection of a decontamination pad and drum staging area	• Sharp objects • Pinch points	• Wear leather gloves when erecting a decontamination pad, moving pallets, or using hand-held tools	L
	• Heavy or unbalanced loads	• Implement proper lifting techniques when moving supplies and materials.	
Decontaminating Equipment and Materials	• Chemical exposure	• Wear appropriate PPE (see HASP, Section 6.0) • Decontaminate in a well-ventilated area	L
	• Sharp objects • Pinch points • Pressurized equipment and hoses (if steam or pressure washing) • Potential airborne materials (if steam or pressure washing)	• Wear appropriate PPE (see HASP, Section 6.0) • Use proper hand-held tools for decontaminating equipment and materials • Inspect hoses, valves, and pump prior to use • Establish an EZ around the decontamination pad and drum staging area	
	• Heavy or unbalanced loads	• Implement proper lifting techniques when moving equipment and materials to be decontaminated	
	• Chemical release	• Collect decontamination fluids in drums • Place drums in secondary containment	
Moving Drums	• Pinch points	• Wear leather gloves when moving drums	M
	• Moving vehicles • Striking hazard	• Support vehicle must be equipped with backup alarms • Buddy system is required to direct driver while backing vehicle up. Spotter must maintain eye contact with the driver at all times and will not be in the pathway of the moving vehicle.	
	• Unsecure loads • Suspended loads • Lift gate or crane operations	• Ensure that drums are secure prior to lifting or transport. Drums should be secured with straps or other supportive bracing. • Only the qualified person may operate a lift gate or crane. The qualified person will not operate a lift gate or crane while personnel are in the immediate vicinity. Personnel will not walk beneath any suspended load.	
	• Heavy or unbalanced loads	• Implement proper lifting techniques when moving supplies and materials. • Avoid moving drums that are heavy. If heavy drums are to be moved, secure the drum lid and use a drum dolly in accordance with manufacturer's operating instructions and use a minimum of two personnel.	
Opening/Closing Drums	• Pinch points	• Wear leather gloves and appropriate tools (socket wrench) when opening/closing drums	L
	• Chemical exposure	• Wear appropriate PPE (see HASP, Section 6.0) • If warranted, monitor the breathing zone for volatiles after opening drums in accordance with the HASP	
	• Biological Hazards	• Inspect the drum storage area for biological organisms that can cause bodily harm (wasp/bee nests, spiders, snakes,	

Job Steps	Hazards	Controls	RAC
		etc.)	
Collecting and Managing IDW	• Chemical exposure	• Wear appropriate PPE (see HASP, Section 6.0)	L
	• Heavy or unbalanced loads	• Implement proper lifting techniques when transferring IDW to drums.	
Drum Sampling and Sample Packaging	• Chemical exposure	• Wear appropriate PPE (see HASP, Section 6.0)	L
	• Sharp objects • Pinch points	• Wear appropriate PPE (see HASP, Section 6.0) • Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar)	

Chemical Hazards and Monitoring Procedures	
Chemical Hazard(s) (list):	**PAHs, PCB Aroclors, and metals**
Applicable HASP Section(s):	**Section 5.0**
Monitoring Instrument(s):	**Not required**

Additional Safety Considerations

1. Ensure all personnel have read and signed the HASP.
2. Ensure that vehicles and heavy equipment are equipped with a fire extinguisher (≥5 lbs ABC).
3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time by using maps and known construction zones. Consult with the other team members before making any changes to the travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment whenever possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to lift heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting heavy or unbalanced loads.
8. Wear nitrile gloves when collecting environmental samples to avoid dermal contact with chemicals. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

Additional Operational Safety Procedures	PPE
SOP 5-208, Personal Protective Equipment Program SOP 5-305, Hand & Power Tools SOP 5-307, Housekeeping, Worksite SOP 5-308, Manual Lifting SOP 5-313, Wildlife, Plants and Insects SOP 5-511, Heat Stress Prevention	LEVEL D • ANSI approved hard hat • ANSI approved safety glasses • Shirts with sleeves and full-length pants. • ANSI approved steel safety-toe boots or approved equivalent. • High visibility reflective traffic vest • Nitrile Gloves • Leather work gloves • First aid kit (located in vehicle). • Fire extinguisher (located in vehicle). Modified LEVEL D (biohazard avoidance) • Tyvek suit LEVEL C (upgrade per Air Monitoring Requirements) • APR with OV/P100 cartridges ; change cartridges daily

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
IDW sampling tools and drum dolly, crane, or lift game (if required) and steam/pressure washer (if required)	To be performed by qualified person.	Equipment will be inspected prior to use. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made.

Acknowledgement

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By signing this form, Resolution Consultants employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

Print Name & Company	Date	Signature

Activity Hazard Analysis (AHA)

Activity/Work Task: **Groundwater Sampling**	Overall Risk Assessment Code (RAC) (Use highest code) **M**
Project Location: NAS Whiting Field	**Risk Assessment Code (RAC) Matrix**
Project Number: 60268998	
Date Prepared: 10/3/2013	
Prepared by (Name/Title): Bill Duffy, PG/ Geologist	
Reviewed by (Name/Title): Harold McDaniel, CSP/ Safety, Health, & Environmental Representative	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
General Physical Hazards	• Uneven or slippery ground surface (i.e. slips/trips/falls) • Biological Hazards • Sharp objects (i.e. cuts and abrasions) • Heavy or uneven loads (i.e. manual lifting)	• Wear appropriate PPE (see SSHP, Section 6.0) • Maintain a clean and organized work area. • Watch your step and ensure proper footing. • Provide a first aid kit. • Assess work area for poisonous plants and animals and communicate observations to avoid them. • Wear appropriate work gloves for task • Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 50 lbs without assistance)	L
	• Adverse Weather Conditions • Cold/Heat Stress	• Be aware of changing weather conditions and provide appropriate weather gear. • Wear appropriate clothing for weather conditions. • Implement a work-rest regime • Provide drinking water or other fluids for hydration • When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP)	

Job Steps	Hazards	Controls	RAC
Establish EZ around well and unload/set-up equipment	• Traffic in roadways and parking lots	• Use combination of vehicles, cones, traffic barriers and caution tape. • A traffic plan may be necessary depending on location.	L
	• Sharp objects	• Wear leather gloves.	
	• Stacking heights	• Avoid stacking equipment and boxes.	
Open/Close well vault	• Sharp objects • Pinch points	• Wear leather gloves when removing/tightening well cover bolts and removing/placing well cover • Pry well cover with a crowbar or screwdriver, do not attempt to pry well cover with hands and avoid placing hands between the well cover and well vault	L
	• Chemical exposure	• Wear appropriate PPE (see SSHP, Section H.6.0) • Monitor the breathing zone for volatiles as directed by SSHP • Upgrade level of PPE (i.e. respirator) based on breathing zone measurements	
	• Heavy or uneven loads	• Implement proper lifting techniques when removing/placing well covers.	
	• Biological Hazards	• Inspect the area around and within the well vault for biological organisms that can cause bodily harm (wasp/bee nests, spiders, snakes, etc.)	
Water level measurements	• Striking hazard	• Lower the probe into the well by turning the reel in a controlled manner. Do not allow the tape to unreel itself.	L
Purging and groundwater sampling	• Chemical exposure	• Wear appropriate PPE (see SSHP, Section H.6.0) • Monitor the breathing zone for volatiles as directed by SSHP • Upgrade level of PPE (i.e. respirator) based on breathing zone measurements	M
	• Sharp objects • Pinch points	• Use appropriate cutting devices (scissors, etc.) for pump tubing. Fix blade knives or razor blades are not permitted. • Use proper tools for equipment repairs/maintenance.	
	• Pressurized lines and equipment • Energized equipment	• Ensure employees are properly trained in the use of the compressors, e.g., use correct contacts for 12 volt batteries and avoid arcing situations • Inspect tubing, sampling equipment, and power sources prior to use	
	• Chemical release	• Place plastic sheeting around the well vault to prevent releases of groundwater to surface soil • Containerize and appropriately manage well purge water	
Sample collection and packaging	• Chemical exposure	• Wear appropriate PPE (see SSHP, Section H.6.0)	L
	• Sharp objects • Pinch points	• Wear appropriate PPE (see SSHP, Section H.6.0) • Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar)	

Chemical Hazards and Monitoring Procedures	
Chemical Hazard(s) (list):	**VOCs, SVOCS, and metals**
Applicable HASP Section(s):	
Monitoring Instrument(s):	**Photoionization detector (PID)**

Additional Safety Considerations

1. Ensure all personnel have read and signed the SSHP and AHA's.
2. Ensure that vehicles and heavy equipment are equipped with a fire extinguisher (≥5 lbs ABC).
3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time by using maps and known construction zones. Consult with the other team members before making any changes to the travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment whenever possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to lift heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting heavy or unbalanced loads.
8. Wear nitrile gloves when collecting environmental samples to avoid dermal contact with chemicals. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

Additional Operational Safety Procedures	PPE
SOP 5-208, Personal Protective Equipment Program SOP 5-305, Hand & Power Tools SOP 5-307, Housekeeping, Worksite SOP 5-308, Manual Lifting SOP 5-313, Wildlife, Plants and Insects SOP 5-511, Heat Stress Prevention	LEVEL D • ANSI approved hard hat • ANSI approved safety glasses • Shirts with sleeves and full-length pants. • ANSI approved steel safety-toe boots or approved equivalent. • High visibility reflective traffic vest if near moving vehicles • Nitrile Gloves • Leather work gloves • First aid kit (located in vehicle). • Fire extinguisher (located in vehicle). Modified LEVEL D (biohazard avoidance) • Tyvek suit LEVEL C (upgrade per Air Monitoring Requirements) • APR with OV/P100 cartridges ; change cartridges daily

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Groundwater Sampling and Purging Equipment	Sampling and purging tasks to be performed by qualified person.	Equipment will be inspected prior to use. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made.

Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, Resolution Consultants employees agree that:

- I have read this Task Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

Print Name & Company	Date	Signature

Activity Hazard Analysis (AHA)

Activity/Work Task: **HSA and DPT Drilling**	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: NAS Whiting Field	**Risk Assessment Code (RAC) Matrix**	
Project Number: 60268998		
Date Prepared: 10/3/2013		
Prepared by (Name/Title): Bill Duffy, PG/ Geologist		
Reviewed by (Name/Title): Harold McDaniel, CSP/ Safety, Health, & Environmental Representative		
Notes: (Field Notes, Review Comments, etc.)		

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
General Physical Hazards	• Uneven or slippery ground surface (i.e., slips/trips/falls) • Biological Hazards • Sharp objects (i.e., cuts and abrasions) • Heavy or uneven loads (i.e., manual lifting)	• Wear appropriate PPE (see HASP, Section 6.0) • Maintain a clean and organized work area. • Watch your step and ensure proper footing. • Provide a first aid kit. • Assess work area for poisonous plants and animals and communicate observations to avoid them. • Wear appropriate work gloves for task • Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 50 lbs without assistance)	**L**
	• Adverse Weather Conditions • Cold/Heat Stress	• Be aware of changing weather conditions and provide appropriate weather gear. • Wear appropriate clothing for weather conditions. • Implement a work-rest regime • Provide drinking water or other fluids for hydration • When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP)	

Job Steps	Hazards	Controls	RAC
Establish EZ around borehole location and unload/set-up equipment	• Uneven or slippery ground surface • Protruding objects	• Wear appropriate PPE (see HASP, Section 6.0) • Clear trees, roots, weeds, limbs, and other ground hazards from the drilling location. • Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment, and other tripping hazards. • Use caution when working on uneven and wet ground surfaces. • Maintain clean and organized work area.	**L**
	• Overhead and underground utilities • Striking hazard • Pinch points • Equipment malfunction	• Wear appropriate PPE (see HASP, Section 6.0) • Move the drill rig with the mast down. Ensure the sampling site foundation is stable and as level as possible. • Use the buddy system along with a functioning back-up alarm to position the drill rig. • Use hand signals, keep clear of moving equipment, and ensure eye contact with operator prior to approaching. • Confirm drilling locations are a safe distance away from aboveground and underground utilities • Inspect vehicles and equipment daily (Checklists provided in HASP) • Position the drill rig and personnel up wind of drilling location	
	• Traffic in adjacent roadway	• Use combination of vehicles, cones, traffic barriers, and caution tape. • A traffic plan may be necessary depending on location.	
Drilling	• Sharp objects • Pinch points	• Wear appropriate work gloves to prevent cuts and lacerations • Place an auger guard around the rig	**M**
	• Chemical and noise exposure	• Wear appropriate PPE (see HASP, Section 6.0) • Monitor the breathing zone for volatiles and dusts as directed by HASP • Upgrade level of PPE (i.e. respirator) based on breathing zone measurements • Wear appropriate hearing protection	
	• Pressurized lines and equipment • Energized equipment • Moving/Twisting components	• Place a guard around augurs to prevent contact • Ensure that personnel are familiar with the location of emergency shut off switches on the drill rig • Drill rig operator to inspect rig and complete drill rig inspection form daily • Use a long handled flat head shovel when removing auger cuttings. Stay away from the augers when rotating. Prevent shovel from lodging into the augers and kicking out. Do not wear loose clothing or dangling jewelry when working with augers. Long hair must be tucked under PPE.	

Job Steps	Hazards	Controls	RAC
	• Chemical release	• Place plastic sheeting around the borehole to prevent contact of subsurface soil with surface soil • Containerize and appropriately manage soil cuttings	
Drill Rod / Auger / Tool Handling	• Striking hazard	• Drill rods and augers stored and transported in racks shall be blocked to prevent shifting. Unload drill rods and augers layer by layer. Be prepared for sudden shifting when tailing rod sections. Keep a wide base and secure footing.	L
	• Heavy or unbalanced loads	• Use proper lifting techniques when manually handling rods, augers, and tools. Use mechanical equipment during lifting whenever possible. Use the buddy system when lifting tools and supplies.	
Hoisting Operations	• Striking hazard	• Never engage the rotary clutch until all personnel and equipment are clear. Never leave the brake unattended when engaged. Drill rods and auger sections should not be picked up or dropped suddenly. Do not lift more than 10 feet of augers or one joint of pipe between tool breaks. Test the brakes daily. Use caution when drilling in wet or damp conditions. Suspend drilling activities if moisture comprises the performance of the braking mechanism.	M
Catline Operations	• Striking hazard	• Do not use more wraps than necessary to lift the load. More than one layer of wraps on the cathead is not allowed. Personnel should not stand near, step over or go under the cathead rope under tension. The cathead must be kept clear of obstructions and entanglements. Never leave the cathead unattended when engaged. Do not stand under the object being lifted with the cathead.	M
Derrick Operations	• Working from elevated locations (i.e. falls)	• The mast should be lowered, if possible, to make repairs or to free up entangled wire rope or obstructions. If the mast must be ascended while upright, a proper ladder safety climbing device or safety block system must be used in conjunction with a full body harness.	M
Drill Rig Maintenance	• Pressurized lines and equipment • Energized equipment • Moving/Twisting components	• The drilling rig and associated equipment must be maintained in a proper functioning condition. Equipment must be operated and maintained in accordance with manufacturer's guidelines. • All motors must be shut off and electrical, mechanical, and hydraulic components locked out of service when making repairs. • All equipment must be inspected daily prior to use. Safety shutoff system must be tested daily and not disabled. Bleed off pressure on hydraulic lines before undoing fittings. Do not leave tools or parts loose on the rig after maintenance has been performed.	L
	• Flammable liquids and fires	• All motors must be shut off during refueling. Smoking in the	

Job Steps	Hazards	Controls	RAC
		vicinity of the drilling rig is not permitted. An ABC fire extinguisher must be maintained on a drill rig and associated motorized equipment. Fuel containers will not be stored within 10' of the drilling rig motor. Fuel will be stored in UL approved safety containers with contents clearly labeled.	
Borehole abandonment (pressure grouting)	• Pressurized lines and equipment	• The pump must not exceed the maximum rated pressure of grout and mud lines. High-pressure lines must be secured to the rig. Pumps, hoses, and connections must be inspected daily and replaced if worn or damaged. Engage pump in low gear initially, then shift to higher gears. • Ensure that equipment is properly functioning	**L**
	• Cement dusts	• Wear appropriate PPE (see HASP, Section 6.0) • Personnel should remain upwind of borehole abandonment location	
	• Heavy or unbalanced loads	• Implement proper lifting techniques when moving water containers and cement, concrete, and bentonite bags • If a tremie pipe is used to emplace annular materials, secure the pipe with clamps.	
Hazardous Drilling Locations	• Flammable gasses and fires	• Special procedures will be implemented when drilling in known natural gas locations, such as special mud procedures and blow out preventers.	**M**
Sample collection and packaging	• Chemical exposure	• Wear appropriate PPE (see HASP, Section 6.0)	**L**
	• Sharp objects • Pinch points	• Wear appropriate PPE (see HASP, Section 6.0) • Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar)	

Chemical Hazards and Monitoring Procedures	
Chemical Hazard(s) (list):	**VOCs, SVOCS, and metals**
Applicable HASP Section(s):	
Monitoring Instrument(s):	**Photoionization detector (PID)**

Additional Safety Considerations

1. Ensure all personnel have read and signed the HASP.
2. Ensure that vehicles and heavy equipment are equipped with a fire extinguisher (≥5 lbs ABC). Ensure equipment has a working kill switch and back-up alarms, and follow equipment inspection procedures.
3. Ensure aboveground and underground utilities have been verified by facility personnel or toner and are clearly marked, and the operator is aware of the location(s).
4. All equipment operators must be Competent Persons for the task/equipment being performed/operated.
5. All ground personnel must stay clear of equipment and make eye contact (and receive confirmation) with operator prior to approaching. Wear high visibility reflective vests and stay out of travel lanes and swing radius of heavy equipment.
6. Dust hazard are expected to be minimal due to the nature of the activity. If visible emissions of dust observed, then dust suppression techniques will be implemented.

Additional Safety Considerations
7. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time by using maps and known construction zones. Consult with the other team members before making any changes to the travel path. 8. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs. 9. Stow all materials in vehicle properly; use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle. 10. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible. 11. Conduct equipment inspection of all hoses and switches. Stay clear of running equipment. 12. Maintain good housekeeping practices. When possible, use mechanical equipment to lift heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting heavy or unbalanced loads. 13. Stay clear of moving rig, do not move rig with mast raised, do not drive on slopes greater than 30 degrees, avoid soft areas when moving rig and setting up, and chock wheels. Use spotter when moving rig, check for overhead obstructions. 14. Wear nitrile gloves when collecting environmental samples to avoid dermal contact with chemicals. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

Additional Operational Safety Procedures	PPE
SOP 5-208, Personal Protective Equipment Program SOP 5-305, Hand & Power Tools SOP 5-306, Highway and Road Work SOP 5-307, Housekeeping, Worksite SOP 5-308, Manual Lifting SOP 5-309, Mobile or Heavy Equipment SOP 5-310, Rigging, Hoisting, Cranes and Lifting Devices SOP 5-313, Wildlife, Plants and Insects SOP 5-405, Drilling, Boring, and Direct Push Probing SOP 5-406, Electrical Lines, Overhead SOP 5-411, Machine Guarding SOP 5-417, Utilities, Underground SOP 5-511, Heat Stress Prevention	LEVEL D • ANSI approved hard hat • ANSI approved safety glasses • Shirts with sleeves and full-length pants. • ANSI approved steel safety-toe boots or approved equivalent. • High visibility reflective traffic vest • Nitrile Gloves • Leather work gloves • Hearing protection required when around operating machines (85 dBA). • First aid kit (located in vehicle). • Fire extinguisher (located in vehicle). Modified LEVEL D (biohazard avoidance) • Tyvek suit LEVEL C (upgrade per Air Monitoring Requirements) • APR with OV/P100 cartridges ; change cartridges daily

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Drill Rig	Sampling to be performed by competent person as certified by employer.	Equipment will be inspected daily by the rig operator. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made.

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- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

Print Name & Company	Date	Signature

Activity Hazard Analysis (AHA)

Activity/Work Task: **Well Installation and Development**	Overall Risk Assessment Code (RAC) (Use highest code) **M**
Project Location: Site 40, NAS Whiting Field	**Risk Assessment Code (RAC) Matrix**
Project Number: 60268998	
Date Prepared: 8/21/2012	
Prepared by (Name/Title): Bill Duffy, PG/ Geologist	
Reviewed by (Name/Title): Harold McDaniel, CSP/ Safety, Health, & Environmental Representative	
Notes: (Field Notes, Review Comments, etc.)	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
General Physical Hazards	• Uneven or slippery ground surface (i.e. slips/trips/falls) • Biological Hazards • Sharp objects (i.e. cuts and abrasions) • Heavy or uneven loads (i.e. manual lifting)	• Wear appropriate PPE (see HASP, Section 6.0) • Maintain a clean and organized work area. • Watch your step and ensure proper footing. • Provide a first aid kit. • Assess work area for poisonous plants and animals and communicate observations to avoid them. • Wear appropriate work gloves for task • Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 50 lbs without assistance)	L
	• Adverse Weather Conditions • Cold/Heat Stress	• Be aware of changing weather conditions and provide appropriate weather gear. • Wear appropriate clothing for weather conditions. • Implement a work-rest regime • Provide drinking water or other fluids for hydration • When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP)	
Establish EZ around well location and unload/set-up equipment	• Traffic in roadways and parking lots	• Use combination of vehicles, cones, traffic barriers, and caution tape. • A traffic plan may be necessary depending on location.	L
	• Sharp objects	• Wear leather gloves.	
	• Stacking heights	• Avoid stacking equipment and boxes.	

Job Steps	Hazards	Controls	RAC
Install monitoring well and place annular materials	• Heavy or unbalanced loads	• Implement proper lifting techniques when installing well casing/screens, placing annular materials, and constructing surface completions • If a tremie pipe is used to emplace annular materials, secure the pipe with clamps.	M
	• Pressurized lines and equipment • Energized equipment	• The drilling rig and associated equipment must be maintained in a proper functioning condition. Equipment must be operated and maintained in accordance with manufacturer's guidelines. • Ensure that personnel are familiar with the location of emergency shut off switches on the drill rig • Drill rig operator to inspect rig and complete drill rig inspection form daily	
	• Chemical and noise exposure	• Wear appropriate PPE (see HASP, Section 6.0) • Monitor the breathing zone for volatiles and dusts as directed by HASP • Upgrade level of PPE (i.e. respirator) based on breathing zone measurements • Wear appropriate hearing protection as directed by HASP • Personnel should remain upwind of well installation location	
	• Sharp objects • Pinch points	• Wear leather gloves when moving well construction materials	
Water level measurements	• Striking hazard	• Lower the probe into the well by turning the reel in a controlled manner. Do not allow the tape to unreel itself.	L
Well development	• Chemical exposure	• Wear appropriate PPE (see HASP, Section 6.0) • Monitor the breathing zone for volatiles as directed by HASP • Upgrade level of PPE (i.e. respirator) based on breathing zone measurements	M
	• Suspended loads (Surge block and bailer attached to a rig)	• Avoid walking beneath suspended loads • Ensure that personnel are familiar with the location of emergency shut off switches on the drill rig • Drill rig operator to inspect rig and complete drill rig inspection form daily	
	• Sharp objects • Pinch points	• Use appropriate cutting devices (scissors, etc.) for pump tubing. Fix blade knives or razor blades are not permitted. • Use proper tools for equipment repairs/maintenance.	
	• Pressurized lines and equipment • Energized equipment	• Ensure employees are properly trained in the use of the compressors, e.g., use correct contacts for 12 volt batteries and avoid arcing situations • Inspect tubing, well development equipment, and power sources prior to use	

Job Steps	Hazards	Controls	RAC
	• Chemical release	• Place plastic sheeting around the well vault to prevent releases of groundwater to surface soil • Containerize and appropriately manage well development water	

Chemical Hazards and Monitoring Procedures	
Chemical Hazard(s) (list):	**VOCs, SVOCS, and metals**
Applicable HASP Section(s):	
Monitoring Instrument(s):	**Photoionization detector (PID)**

Additional Safety Considerations

1. Ensure all personnel have read and signed the HASP.
2. Ensure that vehicles and heavy equipment are equipped with a fire extinguisher (≥5 lbs ABC).
3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time by using maps and known construction zones. Consult with the other team members before making any changes to the travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment whenever possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to lift heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting heavy or unbalanced loads.
8. Wear nitrile gloves when collecting environmental samples to avoid dermal contact with chemicals. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

Additional Operational Safety Procedures	PPE
SOP 5-208, Personal Protective Equipment Program SOP 5-305, Hand & Power Tools SOP 5-306, Highway and Road Work SOP 5-307, Housekeeping, Worksite SOP 5-308, Manual Lifting SOP 5-309, Mobile or Heavy Equipment SOP 5-310, Rigging, Hoisting, Cranes and Lifting Devices SOP 5-313, Wildlife, Plants and Insects SOP 5-511, Heat Stress Prevention	LEVEL D • ANSI approved hard hat • ANSI approved safety glasses • Shirts with sleeves and full-length pants. • ANSI approved steel safety-toe boots or approved equivalent. • High visibility reflective traffic vest • Hearing protection required when around operating machines (85 dBA). • Nitrile Gloves • Leather work gloves • First aid kit (located in vehicle). • Fire extinguisher (located in vehicle). Modified LEVEL D (biohazard avoidance) • Tyvek suit LEVEL C (upgrade per Air Monitoring Requirements) • APR with OV/P100 cartridges ; change cartridges daily

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Well installation and development equipment	Well installation and development tasks to be performed by qualified person.	Equipment will be inspected prior to use. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made.

Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, Resolution Consultants employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

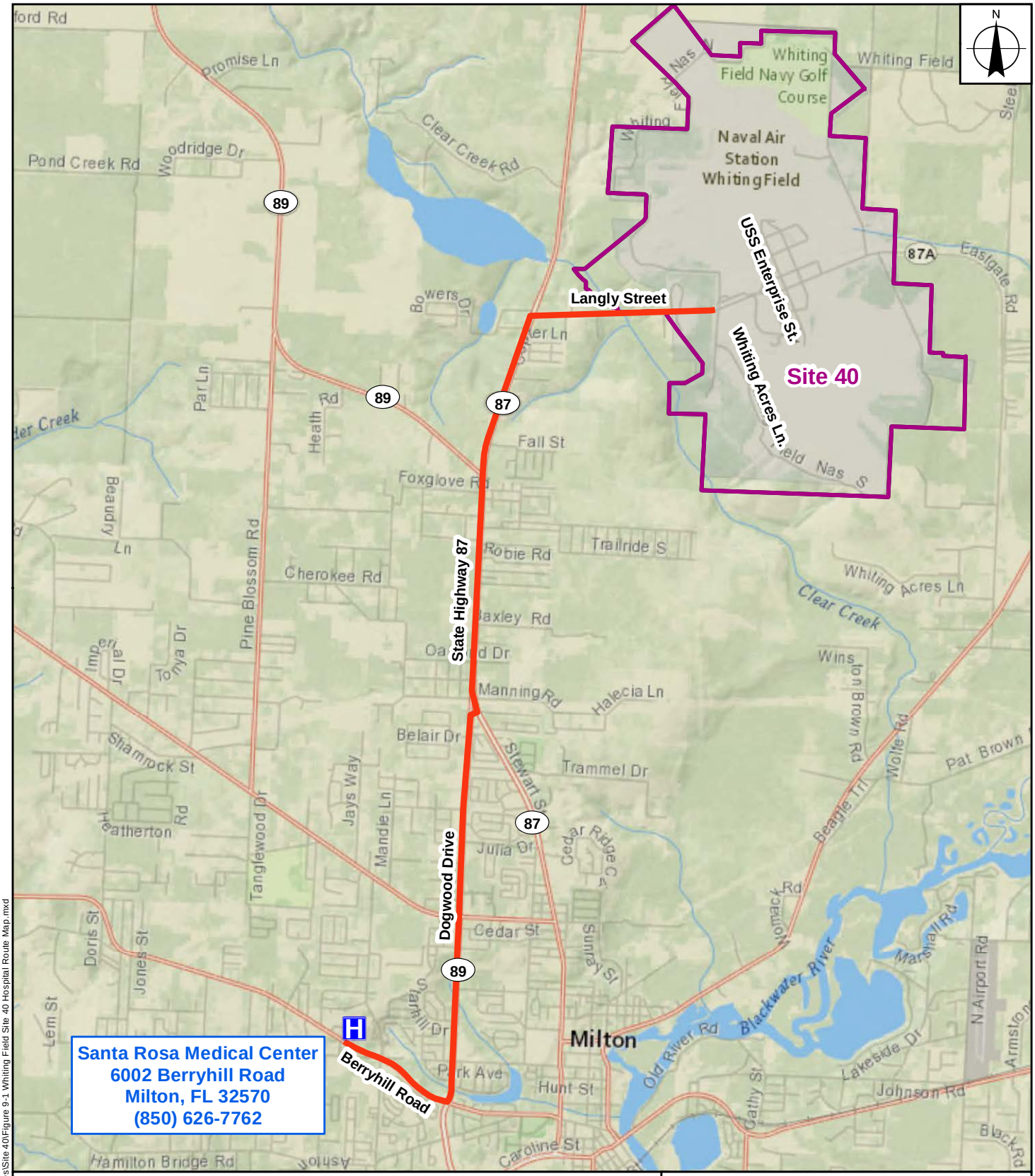
- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

Print Name & Company	Date	Signature

Attachment 5
Resolution Consultants Safety Standard Operating Procedures
(See *Appendix C* of the APP)

Attachment 6

Route Map to Emergency Medical Facility



Legend

Hospital Route

0 5,000 10,000 Feet

FIGURE 9-1
EMERGENCY OCCUPATIONAL HOSPITAL ROUTE/ DETAIL MAP - SITE 40
WHITING FIELD

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: Trent Sims	DATE: 10/11/2012
DRAWN BY: Tammy Godfrey	TASK ORDER NUMBER: XXXX

L:\Group\IT_GIS\GIS Projects\NAVFAC\MXDs\Site 40\Figure 9-1 Whiting Field Site 40 Hospital Route Map.mxd

Appendix I

Subcontractor Health and Safety Plan

This has been intentionally omitted.

APPENDIX E

LABORATORY ELAP CERTIFICATIONS
(PROVIDED ELECTRONICALLY ONLY)

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO
10775 Central Port Drive
Orlando, FL 32824
Russell Macomber Phone: 407 826 5314
rmacomber@encolabs.com

ENVIRONMENTAL

Valid To: March 31, 2014 Certificate Number: 3000.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Metals	EPA 6020A/200.8	EPA 6020A
Aluminum	EPA 6020A/200.8	EPA 6020A
Antimony	EPA 6020A/200.8	EPA 6020A
Arsenic	EPA 6020A/200.8	EPA 6020A
Barium	EPA 6020A/200.8	EPA 6020A
Beryllium	EPA 6020A/200.8	EPA 6020A
Cadmium	EPA 6020A/200.8	EPA 6020A
Calcium	EPA 6020A/200.8	EPA 6020A
Chromium	EPA 6020A/200.8	EPA 6020A
Cobalt	EPA 6020A/200.8	EPA 6020A
Copper	EPA 6020A/200.8	EPA 6020A
Hardness	SM 2340 B	----------
Iron	EPA 6020A/200.8	EPA 6020A
Lead	EPA 6020A/200.8	EPA 6020A
Magnesium	EPA 6020A/200.8	EPA 6020A
Manganese	EPA 6020A/200.8	EPA 6020A
Mercury	EPA 245.1/7470A	EPA 7471B
Molybdenum	EPA 6020A/200.8	EPA 6020A
Nickel	EPA 6020A/200.8	EPA 6020A
Potassium	EPA 6020A/200.8	EPA 6020A
Selenium	EPA 6020A/200.8	EPA 6020A
Silver	EPA 6020A/200.8	EPA 6020A
Sodium	EPA 6020A/200.8	EPA 6020A
Thallium	EPA 6020A/200.8	EPA 6020A
Tin	EPA 6020A/200.8	EPA 6020A
Titanium	EPA 6020A/200.8	EPA 6020A
Vanadium	EPA 6020A/200.8	EPA 6020A

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Metals	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
Microbiology		
Total Coliforms	SM 9222B	----------
Fecal Coliforms	SM 9222D	----------
General Chemistry		
Acidity, as $CaC0_3$	EPA 305.1/SM 2310 B (4A)	----------
Alkalinity as $CaC0_3$	EPA 310.1/SM 2320 B	EPA 310.1/SM 2320 B
Alkalinity as $CaC0_3$	EPA 310.2	EPA 310.2
Biochemical oxygen demand	EPA 405.1/SM 5210 B	----------
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B	----------
Chemical oxygen demand	EPA 410.4	----------
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr D	EPA 7196
Conductivity	EPA 120.1	----------
Cyanide	EPA 335.2/SM 4500-CN E	EPA 9014
Cyanide, Reactive	----------	SW-846 7.3.3
Ferric iron (calculated)	SM 3500-Fe D	----------
Ferrous iron	SM 3500-Fe D	----------
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C	----------
Kjeldahl nitrogen -total	EPA 351.2	EPA351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/SM 4500-NO_2 B	EPA 9056A/ SM 4500-NO_2 B
Organic nitrogen	EPA 351.2/350.1	EPA 351.2/350.1
Orthophosphate as P	EPA 365.1	----------
Orthophosphate as P	EPA 365.3	----------
pH	EPA 150.1/9040C/SM 4500-H^+-B	EPA 9045D
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-filterable (TDS)	SM 2540 C	----------
Residue-nonfilterable (TSS)	SM 2540 D	----------
Residue-total	SM 2540 B/SM 2540 G/EPA 160.3	SM 2540G/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S E	EPA 9030B/9034
Sulfide, Reactive	----------	SW-846 7.3.4
Surfactants -MBAS	SM 5540 C	----------
Total nitrate-nitrite	EPA 9056 A/SM 4500-$N0_3$ H	EPA 9056 A/SM 4500-$N0_3$ H
Total cyanide	EPA 9014	EPA 9014
Total nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B	TOC Walkley Black
Total phenolics	EPA 420.1	EPA 420.1
Total, fixed, and volatile residue	SM 2540 G	SM 2540 G
Turbidity	EPA 180.1	----------
Un-ionized ammonia	DEP SOP 10/03/83	DEP SOP 10/03/83
Extractable Organics		
1,2,4-Trichlorobenzene	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Extractable Organics		
1,2,4,5-Tetrachlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Diphenylhydrazine	EPA 8270D/625	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1- Methylnaphthalene	EPA 8270D/625/ Scan-Sim	EPA 8270D/ Scan-Sim
2,3,4,6-Tetrachlorophenol	EPA 8270D/625	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dimethylphenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrophenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/625/ Scan-Sim	EPA 8270D
2,6-Dichlorophenon	EPA 8270D/625	EPA 8270D
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/625	EPA 8270D
2-Chloronaphthalene	EPA 8270D/625	EPA 8270D
2-Chlorophenol	EPA 8270D/625	EPA 8270D
2·Methyl-4,6-dinitrophenol	EPA 8270D/625	EPA 8270D
2-Methylnaphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
2-Methylphenol (o-Cresol)	EPA 8270D/625	EPA 8270D
2-Nitroaniline	EPA 8270D/625	EPA 8270D
2-Nitrophenol	EPA 8270D/625	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D/625	EPA 8270D
3/4-Methylphenols (m/p-Cresols)	EPA 8270D/625	EPA 8270D
3-Nitroaniline	EPA 8270D/625	EPA 8270D
4-Bromophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D/625	EPA 8270D
4-Chloroaniline	EPA 8270D/625	EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Nitrophenol	EPA 8270D/625	EPA 8270D
Acenaphthene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Acenaphthylene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
4-Melhylphenol (p-Cresol)	EPA 8270D/625	EPA 8270D
4-Nitroaniline	EPA 8270D/625	EPA 8270D
Acetophenone	EPA 8270D/625	EPA 8270D
Anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Atrazine	EPA 8270D/625	EPA 8270D
Benzaldehyde	EPA 8270D/625	EPA 8270D
Benzidine	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(a)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(b)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(g,h,i)perylene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(k)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzyl alcohol	EPA 8270D/625	EPA 8270D
1,1-Biphenyl	EPA 8270D/625	EPA 8270D
bis(2-Chloroethoxy) methane	EPA 8270D/625	EPA 8270D
bis(2-Chloroethyl) ether	EPA 8270D/625	EPA 8270D
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270D/625	EPA 8270D
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Extractable Organics		
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenz(a,h)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenzofuran	EPA 8270D/625	EPA 8270D
Diethyl phthalate	EPA 8270D/625	EPA 8270D
Dimethyl phthalate	EPA 8270D/625/ Scan-Sim	EPA 8270D
Di-n-butyl phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Fluorene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Hexachlorobenzene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
n-Nitrosopyrrolidine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/ Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Pyridine	EPA 8270D/625	EPA 8270D
Total Petroleum Hydrocarbons (TPH)	FL·PRO	FL·PRO
Volatile Organics		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504/8011/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,2-Dichloroethane	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Volatile Organics		
1,2-Dichloropropane	EPA 8260B/624	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,3-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,3-Dichloropropane	EPA 8260B/624	EPA 8260B
1,4-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,4-Dioxane (1,4-Diethylencoxide)	EPA 8260B/8260C SIM/624	EPA 8260B/8260C SIM
2,2-Dichloropropane	EPA 8260B/624	EPA 8260B
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B/624	EPA 8260B
2-Chloroethyl vinyl ether	EPA 8260B/624	EPA 8260B
2-Chlorotoluene	EPA 8260B/624	EPA 8260B
2-Hexanone	EPA 8260B/624	EPA 8260B
4-Chlorotoluene	EPA 8260B/624	EPA 8260B
4-Methyl-2-pentanone (MIBK)	EPA 8260B/624	EPA 8260B
Acetone	EPA 8260B/624	EPA 8260B
Acetonitrile	EPA 8260B/624	EPA 8260B
Acrolein (Propenal)	EPA 8260B/624	EPA 8260B
Acrylonitrile	EPA 8260B/624	EPA 8260B
Allyl chloride (3-Chloropropene)	EPA 8260B/624	EPA 8260B
Benzene	EPA 8260B/624	EPA 8260B
Bromobenzene	EPA 8260B/624	EPA 8260B
Bromochloromethane	EPA 8260B/624	EPA 8260B
Bromodichloromethane	EPA 8260B/624	EPA 8260B
Bromoform	EPA 8260B/624	EPA 8260B
Carbon tetrachloride	EPA 8260B/624	EPA 8260B
Carbon disulfide	EPA 8260B/624	EPA 8260B
Chlorobenzene	EPA 8260B/624	EPA 8260B
Chloroethane	EPA 8260B/624	EPA 8260B
Chloroform	EPA 8260B/624	EPA 8260B
Chloroprene	EPA 8260B/624	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
Cyclohexane	EPA 8260B/624	EPA 8260B
Dibromochloromethane	EPA 8260B/624	EPA 8260B
Dibromomethane	EPA 8260B/624	EPA 8260B
Dichlorodifluoromethane	EPA 8260B/624	EPA 8260B
Ethyl methacrylate	EPA 8260B/624	EPA 8260B
Hexachlorobutadiene	EPA 8260B/624	EPA 8260B
Ethylbenzene	EPA 8260B/624	EPA 8260B
Iodomethane (Methyl iodide)	EPA 8260B/624	EPA 8260B
Isobutyl alcohol (2-Methyl-l-propanol)	EPA 8260B/624	EPA 8260B
Isopropylbenzene	EPA 8260B/624	EPA 8260B
m+p-Xylenes	EPA 8260B/624	EPA 8260B
Methacrylonitrile	EPA 8260B/624	EPA 8260B
Methyl acetate	EPA 8260B/624	EPA 8260B
Methyl bromide (Bromomethane)	EPA 8260B/624	EPA 8260B
Methyl chloride (Chloromethane)	EPA 8260B/624	EPA 8260B
Methyl methacrylate	EPA 8260B/624	EPA 8260B
Methyl tert-butyl ether (MTBE)	EPA 8260B/624	EPA 8260B
Methylcyclohexane	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Volatile Organics		
Methylene chloride	EPA 8260B/624	EPA 8260B
Naphthalene	EPA 8260B/624	EPA 8260B
n-Butylbenzene	EPA 8260B/624	EPA 8260B
n-Propylbenzene	EPA 8260B/624	EPA 8260B
o-Xylene	EPA 8260B/624	EPA 8260B
Pentachloroethane	EPA 8260B/624	EPA 8260B
p-Isopropyltoluene	EPA 8260B/624	EPA 8260B
Propionitrile (Ethyl cyanide)	EPA 8260B/624	EPA 8260B
sec-Butylbenzene	EPA 8260B/624	EPA 8260B
Styrene	EPA 8260B/624	EPA 8260B
tert-Butylbenzene	EPA 8260B/624	EPA 8260B
Tetrachloroethene (Perchloroethylene)	EPA 8260B/624	EPA 8260B
Toluene	EPA 8260B/624	EPA 8260B
trans-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B/624	EPA 8260B
Trichloroethene (Trichloroethylene)	EPA 8260B/624	EPA 8260B
Trichlorofluoromethane	EPA 8260B/624	EPA 8260B
Vinyl acetate	EPA 8260B/624	EPA 8260B
Vinyl chloride	EPA 8260B/624	EPA 8260B
Xylene (total)	EPA 8260B/624	EPA 8260B
Pesticides-Herbicides-PCBs		
2,4,5-T	EPA 8151A /615	EPA 8151A
2,4-D	EPA 8151A /615	EPA 8151A
2,4-DB	EPA 8151A /615	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A /615	EPA 8151A
4.4'-DDD	EPA 8081B/608	EPA 8081B
4.4'-DDE	EPA 8081B/608	EPA 8081B
4,4'·DDT	EPA 8081B/608	EPA 8081B
4-Nitrophenol	EPA 8151A/615	EPA 8151A
Acifluorfen	EPA 8151A/615	EPA 8151A
Aldrin	EPA 8081B/608	EPA 8081B
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
alpha-Chlordane	EPA 8081B/608	EPA 8081B
Aroclor-1016(PCB-1016)	EPA 8082A/608	EPA 8082A
Aroclor-1221 (PCB-1221)	EPA 8082A/608	EPA 8082A
Aroclor-1232 (PCB-1232)	EPA 8082A/608	EPA 8082A
Aroclor-1242 (PCB-1242)	EPA 8082A/608	EPA 8082A
Aroclor-1248 (PCB-1248)	EPA 8082A/608	EPA 8082A
Aroclor-1254 (PCB-1254)	EPA 8082A/608	EPA 8082A
Aroclor-1260 (PCB-1260)	EPA 8082A/608	EPA 8082A
Aroclor-1262 (PCB-1262)	EPA 8082A/608	EPA 8082A
Aroclor-1268 (PCB-1268)	EPA 8082A/608	EPA 8082A
Azinphos-methyl (Guthion)	EPA 8141B	EPA 8141B
Bentazon	EPA 8151A/615	EPA 8151A
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
Bolstar (Sulprofos)	EPA 8141B	EPA 8141B
Chloramben	EPA 8151A/615	EPA 8151A

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Pesticides-Herbicides-PCBs		
Chlordane (tech.)	EPA 8081B/608	EPA 8081B
Chlorpynfos	EPA 8141B	EPA 8141B
Coumaphos	EPA 8141B	EPA 8141B
Dacthal (DCPA)	EPA 8151A/615	EPA 8151A
Dalapon	EPA 8151A/615	EPA 8151A
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton, Total	EPA 8141B	EPA 8141B
Diazinon	EPA 8141B	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dlchlorovos (DDVP, Dichtorvos)	EPA 8141B	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B	EPA 8141B
Dinoseb (2-sec-buty1-4 ,6-dinilrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin aldehyde	EPA 8081B/608	EPA 8081B
Endrin ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B	EPA 8141B
Ethion	EPA 8141B	EPA 8141B
Ethoprop	EPA 8141B	EPA 8141B
fensulfothion	EPA 8141B	EPA 8141B
fenthion	EPA 8141B	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
MCPP	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl parathion (Parathion. methyl)	EPA 8141B	EPA 8141B
Mevinphos	EPA 8141B	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B	EPA 8141B
Naled	EPA 8141B	EPA 8141B
Parathion, ethyl	EPA 8141B	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B	EPA 8141B
Silvex (2A.5-TP)	EPA 8151B/615	EPA 8151B
Stirofos	EPA 8141B	EPA 8141B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Pesticides-Herbicides-PCBs		
Sulfotepp	EPA 8141B	EPA 8141B
Tetraethyl pyrophosphate (TEPP)	EPA 8141B	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B
Trichloronate	EPA 8141B	EPA 8141B

Preparation Methods

Fraction	Analytical Method	Preparation Method
Cyanide	EPA 9014 EPA 335.2 /SM 4500-CN E	EPA 9010C
TX	EPA 9056A	EPA 5050
Metal water prep	EPA 6020A/200.8	EPA 3005A
Metals soil prep	EPA 6020A	EPA 3050B
Metals TCLP prep	EPA 6020A/200.8	EPA 3010A
Extractable organics and Pesticides water prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3510C
Extractable organics and Pesticides waste prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3580A
Extractable organics and Pesticides soil prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3550C
Organics water and mid-level soil prep	EPA 8260B/624	EPA 5030B
Organics low-level soil prep	EPA 8260B/624	EPA 5035
Soil/water leachate	Wets	ENCO WETS-88
SPLP	Wets, Organics, and Metals	EPA 1312
TCLP	Wets, Organics, and Metals	EPA 1311

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 29th day of May 2012.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to March 31, 2014

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

State of Florida

Department of Health, Bureau of Public Health Laboratories

This is to certify that

E84207

SPECTRUM ANALYTICAL, INC. FEATURING HANIBAL TECHNOLOGY
FLORIDA DIVISION
8405 BENJAMIN ROAD, SUITE A
TAMPA, FL 33634

has complied with Florida Administrative Code 64E-1,
for the examination of environmental samples in the following categories

NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: July 01, 2013 Expiration Date: June 30, 2014

Victor Johnson, Director
Division of Emergency Preparedness and Community Support
DH Form 1697, 7/04
NON-TRANSFERABLE E84207-28-07/01/2013
Supersedes all previously issued certificates

Laboratory Scope of Accreditation

Attachment to Certificate #: E84207-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E84207 **EPA Lab Code: FL00311** **(813) 888-9507**

E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260	Volatile Organics	NELAP	11/24/2008
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	Extractable Organics	NELAP	10/19/2010
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270	Extractable Organics	NELAP	10/19/2010
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

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State Laboratory ID: E84207 **EPA Lab Code: FL00311** **(813) 888-9507**

E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
1-Nitroso-3,5-dinitro-1,3,5-hexahydrotriazine (MNX)	PEL SOP00055/HPLC-UV	Pesticides-Herbicides-PCB's	NELAP	7/8/2011
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	7/24/2006
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	7/24/2006
2-Acetylaminofluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	11/24/2008
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Hexanone	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitropropane	EPA 8260	Volatile Organics	NELAP	11/24/2008
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

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State Laboratory ID: E84207 **EPA Lab Code: FL00311** **(813) 888-9507**

E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
3,3-Dimethyl-1-butanol	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	7/8/2011
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Methylphenol (m-Cresol)	EPA 8270	Extractable Organics	NELAP	11/24/2008
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
5-Nitro-o-toluidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
a,a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Acetone	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetophenone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Aliphatic Hydrocarbons	PEL SOP00175/GC-FID	Extractable Organics	NELAP	7/8/2011
Alkalinity as CaCO3	EPA 310.1	General Chemistry	NELAP	10/1/2008
Alkalinity as CaCO3	SM 2320 B	General Chemistry	NELAP	3/25/2010
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aluminum	EPA 6010	Metals	NELAP	7/1/2003
Ammonia as N	EPA 350.1	General Chemistry	NELAP	3/25/2010
Ammonia as N	SM 4500-NH3 G (19th,20th,21st Ed.)/UV-VIS	General Chemistry	NELAP	3/25/2010
Aniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Antimony	EPA 6010	Metals	NELAP	7/1/2003
Antimony	EPA 7041	Metals	NELAP	11/24/2008
Aramite	EPA 8270	Extractable Organics	NELAP	7/1/2003
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aromatic Hydrocarbons	PEL SOP00175/GC-FID	Extractable Organics	NELAP	7/8/2011
Arsenic	EPA 6010	Metals	NELAP	1/24/2001
Arsenic	EPA 7010	Metals	NELAP	11/24/2008
Arsenic	EPA 7060	Metals	NELAP	11/24/2008
Atrazine	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Azinphos-ethyl (Ethyl guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Azinphos-methyl (Guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Barium	EPA 6010	Metals	NELAP	7/1/2003
Benzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Benzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

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E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl chloride	EPA 8260	Volatile Organics	NELAP	11/24/2008
Beryllium	EPA 6010	Metals	NELAP	7/1/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Bolstar (Sulprofos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Bromide	EPA 300.0	General Chemistry	NELAP	7/8/2011
Bromide	EPA 300.1	General Chemistry	NELAP	7/24/2006
Bromide	EPA 9056	General Chemistry	NELAP	7/8/2011
Bromobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromoform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Cadmium	EPA 6010	Metals	NELAP	1/24/2001
Calcium	EPA 6010	Metals	NELAP	7/1/2003
Carbazole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chlorfenvinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Chloride	EPA 300.0	General Chemistry	NELAP	7/8/2011
Chloride	EPA 300.1	General Chemistry	NELAP	7/24/2006
Chloride	EPA 325.2	General Chemistry	NELAP	3/25/2010
Chloride	EPA 9056	General Chemistry	NELAP	7/8/2011

Laboratory Scope of Accreditation

Attachment to Certificate #: E84207-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E84207 **EPA Lab Code: FL00311** **(813) 888-9507**

E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Chloride	SM 4500-Cl⁻ E	General Chemistry	NELAP	3/25/2010
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroprene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chlorpyrifos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chromium	EPA 6010	Metals	NELAP	7/1/2003
Chromium VI	EPA 7196	General Chemistry	NELAP	7/8/2011
Chromium VI	SM 3500-Cr B (20th/21st Ed.)/UV-VIS	General Chemistry	NELAP	7/8/2011
Chrysene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Chrysene	EPA 8310	Extractable Organics	NELAP	7/1/2003
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	11/24/2008
Cobalt	EPA 6010	Metals	NELAP	7/1/2003
Copper	EPA 6010	Metals	NELAP	1/24/2001
Coumaphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Demeton-o	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Demeton-s	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diazinon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenz(a,h)anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Dibenz(a,j)acridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dibromomethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dichlorovos (DDVP, Dichlorvos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Diethyl ether	EPA 8260	Volatile Organics	NELAP	11/24/2008
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-isopropylether (DIPE)	EPA 8260	Volatile Organics	NELAP	11/24/2008
Dimethoate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Disulfoton	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
EPN	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Ethanol	EPA 8260	Volatile Organics	NELAP	11/24/2008
Ethion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Ethoprop	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	11/24/2008
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethyl-t-butylether (ETBE)	EPA 8260	Volatile Organics	NELAP	11/24/2008
Famphur	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fensulfothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fenthion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Fluoride	EPA 300.0	General Chemistry	NELAP	7/8/2011
Fluoride	EPA 300.1	General Chemistry	NELAP	7/24/2006
Fluoride	EPA 9056	General Chemistry	NELAP	7/8/2011
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	7/1/2003
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Iron	EPA 6010	Metals	NELAP	7/1/2003
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isodrin	EPA 8270	Extractable Organics	NELAP	7/1/2003
Isophorone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isosafrole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Kjeldahl nitrogen - total	EPA 351.2	General Chemistry	NELAP	3/25/2010
Kjeldahl nitrogen - total	SM 4500-NorgD	General Chemistry	NELAP	3/25/2010
Lead	EPA 6010	Metals	NELAP	1/24/2001
Lead	EPA 7010	Metals	NELAP	11/24/2008
Lead	EPA 7421	Metals	NELAP	11/24/2008
Leptophos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Magnesium	EPA 6010	Metals	NELAP	7/1/2003
Malathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Manganese	EPA 6010	Metals	NELAP	7/1/2003
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Mercury	EPA 7470	Metals	NELAP	1/24/2001
Merphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methapyrilene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Methyl parathion (Parathion, methyl)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methylene chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Mevinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Molybdenum	EPA 6010	Metals	NELAP	7/1/2003
m-Xylene	EPA 8260	Volatile Organics	NELAP	11/24/2008
Naled	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Naphthalene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Naphthalene	EPA 8310	Extractable Organics	NELAP	7/1/2003
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Nickel	EPA 6010	Metals	NELAP	1/24/2001
Nitrate	EPA 300.1	General Chemistry	NELAP	7/24/2006
Nitrate	EPA 9056	General Chemistry	NELAP	7/8/2011
Nitrate as N	EPA 300.0	General Chemistry	NELAP	7/8/2011
Nitrate as N	EPA 353.2	General Chemistry	NELAP	3/25/2010
Nitrate as N	SM 4500-NO3 F	General Chemistry	NELAP	3/25/2010
Nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	3/25/2010
Nitrate-nitrite	SM 4500-NO3 F	General Chemistry	NELAP	3/25/2010
Nitrite	EPA 300.1	General Chemistry	NELAP	7/24/2006
Nitrite	EPA 9056	General Chemistry	NELAP	7/8/2011
Nitrite as N	EPA 300.0	General Chemistry	NELAP	7/8/2011
Nitrite as N	EPA 353.2	General Chemistry	NELAP	3/25/2010
Nitrite as N	EPA 354.1	General Chemistry	NELAP	3/25/2010
Nitrite as N	SM 4500-NO3 F	General Chemistry	NELAP	3/25/2010
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	7/24/2006
Nitroglycerin	EPA 8330	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Nitroguanidine	SPECTRUM SOP 00198 (EPA 8330 Modified)/HPLC-UV	Extractable Organics	NELAP	6/26/2012
Nitroquinoline-1-oxide	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
o,o,o-Triethyl phosphorothioate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Oil & Grease	EPA 1664A	General Chemistry	NELAP	3/25/2010
Orthophosphate as P	EPA 300.0	General Chemistry	NELAP	7/8/2011
Orthophosphate as P	EPA 300.1	General Chemistry	NELAP	7/24/2006
Orthophosphate as P	EPA 365.1	General Chemistry	NELAP	3/25/2010
Orthophosphate as P	EPA 9056	General Chemistry	NELAP	7/8/2011
Orthophosphate as P	SM 4500-P F	General Chemistry	NELAP	3/25/2010
o-Toluidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
o-Xylene	EPA 8260	Volatile Organics	NELAP	11/24/2008
Parathion, ethyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentachlorophenol	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	12/14/2005
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	11/24/2008
Perchlorate	EPA 314.0	General Chemistry	NELAP	7/24/2006
pH	EPA 150.1	General Chemistry	NELAP	1/24/2001
pH	SM 4500-H+-B	General Chemistry	NELAP	6/25/2008
Phenacetin	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenanthrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Phenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phorate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Phosphamidon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Phosphorus, total	EPA 365.4	General Chemistry	NELAP	3/25/2010
Picloram	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Potassium	EPA 6010	Metals	NELAP	7/1/2003
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	11/24/2008
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
p-Xylene	EPA 8260	Volatile Organics	NELAP	11/24/2008
Pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Residue-filterable (TDS)	EPA 160.1	General Chemistry	NELAP	3/25/2010
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	3/25/2010
Residue-nonfilterable (TSS)	EPA 160.2	General Chemistry	NELAP	3/25/2010
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	3/25/2010
Ronnel	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Safrole	EPA 8270	Extractable Organics	NELAP	7/1/2003
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Selenium	EPA 6010	Metals	NELAP	1/24/2001
Selenium	EPA 7010	Metals	NELAP	11/24/2008
Selenium	EPA 7740	Metals	NELAP	11/24/2008
Silver	EPA 6010	Metals	NELAP	7/1/2003
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Simazine	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Sodium	EPA 6010	Metals	NELAP	6/8/2004
Stirofos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Styrene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Sulfate	ASTM D516-90	General Chemistry	NELAP	3/25/2010
Sulfate	EPA 300.0	General Chemistry	NELAP	7/8/2011
Sulfate	EPA 300.1	General Chemistry	NELAP	7/24/2006
Sulfate	EPA 375.4	General Chemistry	NELAP	3/25/2010
Sulfate	EPA 9056	General Chemistry	NELAP	7/8/2011
Sulfide	EPA 376.1	General Chemistry	NELAP	3/25/2010
Sulfide	SM 4500-S F	General Chemistry	NELAP	3/25/2010
Sulfotepp	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
T-amylmethylether (TAME)	EPA 8260	Volatile Organics	NELAP	11/24/2008
Terbufos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
tert-Amyl alcohol (2-methyl-2-butanol)	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008

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Analyte	Method/Tech	Category	Certification Type	Effective Date
tert-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	11/24/2008
tert-Butyl alcohol	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008
tert-Butyl formate	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetraethyl pyrophosphate (TEPP)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Thallium	EPA 6010	Metals	NELAP	7/1/2003
Thallium	EPA 7010	Metals	NELAP	11/24/2008
Thallium	EPA 7841	Metals	NELAP	11/24/2008
Thionazin (Zinophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Tin	EPA 6010	Metals	NELAP	7/1/2003
Titanium	EPA 6010	Metals	NELAP	11/24/2008
Tokuthion (Prothiophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Toluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Total cyanide	EPA 9012	General Chemistry	NELAP	3/25/2010
Total nitrate-nitrite	EPA 300.0	General Chemistry	NELAP	7/8/2011
Total nitrate-nitrite	EPA 9056	General Chemistry	NELAP	7/8/2011
Total organic carbon	EPA 415.1	General Chemistry	NELAP	3/25/2010
Total organic carbon	EPA 9060	General Chemistry	NELAP	3/25/2010
Total organic carbon	SM 5310 B	General Chemistry	NELAP	3/25/2010
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	7/1/2003
Total Petroleum Hydrocarbons (TPH)	PEL SOP00175/GC-FID	Extractable Organics	NELAP	7/8/2011
Total Petroleum Hydrocarbons (TPH)	TPHCWG Direct Method	Extractable Organics	NELAP	3/27/2012
Total Petroleum Hydrocarbons (TPH)	TX1005	Extractable Organics	NELAP	7/1/2003
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichloronate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Vanadium	EPA 6010	Metals	NELAP	7/1/2003
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Xylene (total)	EPA 8260	Volatile Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

Attachment to Certificate #: E84207-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E84207** **EPA Lab Code:** **FL00311** **(813) 888-9507**

E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Zinc	EPA 6010	Metals	NELAP	1/24/2001

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8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	5/30/2002
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	11/29/2001
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260	Volatile Organics	NELAP	11/24/2008
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	11/29/2001
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	11/29/2001
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	11/24/2008
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	Extractable Organics	NELAP	1/24/2001
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	1/24/2001
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270	Extractable Organics	NELAP	10/19/2010
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	1/24/2001
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	1/24/2001
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	1/24/2001
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	1/24/2001
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001

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E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
1-Nitroso-3,5-dinitro-1,3,5-hexahydrotriazine (MNX)	PEL SOP00055/HPLC-UV	Pesticides-Herbicides-PCB's	NELAP	7/8/2011
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	1/24/2001
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/30/2002
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	1/24/2001
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/30/2002
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	7/24/2006
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	1/24/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	7/24/2006
2-Acetylaminofluorene	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	1/24/2001
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	1/24/2001
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	11/24/2008
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	1/24/2001
2-Hexanone	EPA 8260	Volatile Organics	NELAP	1/24/2001
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	1/24/2001
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	11/29/2001
2-Nitropropane	EPA 8260	Volatile Organics	NELAP	11/24/2008
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	1/24/2001
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	1/24/2001
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
3,3-Dimethyl-1-butanol	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008

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E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
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Tampa, FL 33634

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	7/8/2011
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	11/24/2008
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	1/24/2001
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	1/24/2001
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	1/24/2001
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	1/24/2001
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	1/24/2001
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	5/30/2002
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	1/24/2001
5-Nitro-o-toluidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	1/24/2001
a,a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
Acenaphthene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Acenaphthene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Acetone	EPA 8260	Volatile Organics	NELAP	1/24/2001
Acetonitrile	EPA 8260	Volatile Organics	NELAP	1/24/2001
Acetophenone	EPA 8270	Extractable Organics	NELAP	1/24/2001
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	1/24/2001
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aliphatic Hydrocarbons	PEL SOP00175/GC-FID	Extractable Organics	NELAP	7/8/2011

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E84207
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8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	1/24/2001
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aluminum	EPA 6010	Metals	NELAP	1/24/2001
Aniline	EPA 8270	Extractable Organics	NELAP	1/24/2001
Anthracene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Anthracene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Antimony	EPA 6010	Metals	NELAP	1/24/2001
Antimony	EPA 7010	Metals	NELAP	3/25/2010
Antimony	EPA 7041	Metals	NELAP	11/24/2008
Aramite	EPA 8270	Extractable Organics	NELAP	1/24/2001
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Aromatic Hydrocarbons	PEL SOP00175/GC-FID	Extractable Organics	NELAP	7/8/2011
Arsenic	EPA 6010	Metals	NELAP	1/24/2001
Arsenic	EPA 7010	Metals	NELAP	3/25/2010
Arsenic	EPA 7060	Metals	NELAP	11/24/2008
Atrazine	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Azinphos-ethyl (Ethyl guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Azinphos-methyl (Guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Barium	EPA 6010	Metals	NELAP	1/24/2001
Benzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Benzidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	1/24/2001

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Benzoic acid	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	1/24/2001
Benzyl chloride	EPA 8260	Volatile Organics	NELAP	11/24/2008
Beryllium	EPA 6010	Metals	NELAP	1/24/2001
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	1/24/2001
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	1/24/2001
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	1/24/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	1/24/2001
Bolstar (Sulprofos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Bromide	EPA 300.0	General Chemistry	NELAP	7/8/2011
Bromide	EPA 9056	General Chemistry	NELAP	7/8/2011
Bromobenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Bromoform	EPA 8260	Volatile Organics	NELAP	1/24/2001
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Cadmium	EPA 6010	Metals	NELAP	1/24/2001
Calcium	EPA 6010	Metals	NELAP	1/24/2001
Carbazole	EPA 8270	Extractable Organics	NELAP	1/24/2001
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	1/24/2001
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	1/24/2001
Carbophenothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Chlorfenvinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Chloride	EPA 300.0	General Chemistry	NELAP	7/8/2011
Chloride	EPA 9056	General Chemistry	NELAP	7/8/2011
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Chloroethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Chloroform	EPA 8260	Volatile Organics	NELAP	1/24/2001
Chloroprene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Chlorpyrifos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Chlorpyrifos methyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Chromium	EPA 6010	Metals	NELAP	1/24/2001
Chromium VI	EPA 7196	Metals	NELAP	7/8/2011
Chrysene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Chrysene	EPA 8310	Extractable Organics	NELAP	1/24/2001
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	1/24/2001
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	1/24/2001
cis-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	11/24/2008
Cobalt	EPA 6010	Metals	NELAP	1/24/2001
Copper	EPA 6010	Metals	NELAP	1/24/2001
Coumaphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Demeton-o	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Demeton-s	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Diazinon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Dibenz(a,h)anthracene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Dibenz(a,j)acridine	EPA 8270	Extractable Organics	NELAP	1/24/2001
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	1/24/2001
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Dibromomethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/30/2002
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Dichlorovos (DDVP, Dichlorvos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	1/24/2001
Diethyl ether	EPA 8260	Volatile Organics	NELAP	11/24/2008
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Di-isopropylether (DIPE)	EPA 8260	Volatile Organics	NELAP	11/24/2008
Dimethoate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001

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State Laboratory ID: E84207 **EPA Lab Code: FL00311** **(813) 888-9507**

E84207
Spectrum Analytical, Inc. featuring Hanibal Technology Florida Division
8405 Benjamin Road, Suite A
Tampa, FL 33634

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270	Extractable Organics	NELAP	1/24/2001
Dioxathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Disulfoton	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/21/2004
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
EPN	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Ethion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Ethoprop	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	11/24/2008
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	1/24/2001
Ethyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Ethyl-t-butylether (ETBE)	EPA 8260	Volatile Organics	NELAP	11/24/2008
Famphur	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Fensulfothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Fenthion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Fluoranthene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Fluoranthene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Fluorene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Fluorene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Fluoride	EPA 300.0	General Chemistry	NELAP	7/8/2011
Fluoride	EPA 9056	General Chemistry	NELAP	7/8/2011
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	1/24/2001
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	1/24/2001

Laboratory Scope of Accreditation

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Iron	EPA 6010	Metals	NELAP	1/24/2001
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Isophorone	EPA 8270	Extractable Organics	NELAP	1/24/2001
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Isosafrole	EPA 8270	Extractable Organics	NELAP	1/24/2001
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Lead	EPA 6010	Metals	NELAP	1/24/2001
Lead	EPA 7010	Metals	NELAP	3/25/2010
Lead	EPA 7421	Metals	NELAP	11/24/2008
Leptophos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Magnesium	EPA 6010	Metals	NELAP	1/24/2001
Malathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Manganese	EPA 6010	Metals	NELAP	11/28/2001
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Mercury	EPA 7471	Metals	NELAP	1/24/2001
Merphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	1/24/2001
Methapyrilene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	1/24/2001
Methyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	1/24/2001
Methyl parathion (Parathion, methyl)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Methylene chloride	EPA 8260	Volatile Organics	NELAP	1/24/2001
Mevinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Molybdenum	EPA 6010	Metals	NELAP	1/24/2001
Monocrotophos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Naled	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Naphthalene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Naphthalene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Naphthalene	EPA 8310	Extractable Organics	NELAP	1/24/2001
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Nickel	EPA 6010	Metals	NELAP	1/24/2001
Nitrate	EPA 9056	General Chemistry	NELAP	7/8/2011
Nitrate as N	EPA 300.0	General Chemistry	NELAP	7/8/2011
Nitrite	EPA 9056	General Chemistry	NELAP	7/8/2011
Nitrite as N	EPA 300.0	General Chemistry	NELAP	7/8/2011
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	7/24/2006
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	11/24/2008
Nitroguanidine	SPECTRUM SOP 00055 (EPA 8330)/HPLC-UV	Extractable Organics	NELAP	6/26/2012
Nitroquinoline-1-oxide	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
o,o,o-Triethyl phosphorothioate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	1/24/2001
Orthophosphate as P	EPA 300.0	General Chemistry	NELAP	7/8/2011
Orthophosphate as P	EPA 9056	General Chemistry	NELAP	7/8/2011
o-Toluidine	EPA 8270	Extractable Organics	NELAP	1/24/2001
Parathion, ethyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics	NELAP	1/24/2001
Pentachlorophenol	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	11/24/2008

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
pH	EPA 9045	General Chemistry	NELAP	1/24/2001
Phenacetin	EPA 8270	Extractable Organics	NELAP	1/24/2001
Phenanthrene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Phenanthrene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Phenol	EPA 8270	Extractable Organics	NELAP	1/24/2001
Phorate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Phosmet (Imidan)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	11/24/2008
Phosphamidon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Picloram	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Potassium	EPA 6010	Metals	NELAP	1/24/2001
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	1/24/2001
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Pyrene	EPA 8270	Extractable Organics	NELAP	1/24/2001
Pyrene	EPA 8310	Extractable Organics	NELAP	1/24/2001
Pyridine	EPA 8270	Extractable Organics	NELAP	1/24/2001
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	1/24/2001
Ronnel	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Safrole	EPA 8270	Extractable Organics	NELAP	1/24/2001
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Selenium	EPA 6010	Metals	NELAP	1/24/2001
Selenium	EPA 7010	Metals	NELAP	3/25/2010
Selenium	EPA 7740	Metals	NELAP	11/24/2008
Silver	EPA 6010	Metals	NELAP	1/24/2001
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/30/2002
Simazine	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Sodium	EPA 6010	Metals	NELAP	11/28/2001
Stirofos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Strontium	EPA 6010	General Chemistry	NELAP	3/25/2010
Styrene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Sulfate	EPA 300.0	General Chemistry	NELAP	7/8/2011
Sulfate	EPA 9056	General Chemistry	NELAP	7/8/2011
Sulfotepp	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	1/24/2001
T-amylmethylether (TAME)	EPA 8260	Volatile Organics	NELAP	11/24/2008
Terbufos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
tert-Amyl alcohol (2-methyl-2-butanol)	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008
tert-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	11/24/2008
tert-Butyl alcohol	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008
tert-Butyl formate	PEL SOP 00039/GC-MS	Volatile Organics	NELAP	11/24/2008
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Tetraethyl pyrophosphate (TEPP)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	1/24/2001
Thallium	EPA 6010	Metals	NELAP	1/24/2001
Thallium	EPA 7010	Metals	NELAP	3/25/2010
Thallium	EPA 7841	Metals	NELAP	11/24/2008
Thionazin (Zinophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Tin	EPA 6010	Metals	NELAP	1/24/2001
Titanium	EPA 6010	General Chemistry	NELAP	3/25/2010
Tokuthion (Prothiophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Toluene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Total cyanide	EPA 9012	General Chemistry	NELAP	3/25/2010
Total nitrate-nitrite	EPA 300.0	General Chemistry	NELAP	7/8/2011
Total nitrate-nitrite	EPA 9056	General Chemistry	NELAP	7/8/2011
Total organic carbon	EPA 9060	General Chemistry	NELAP	3/25/2010
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	1/24/2001
Total Petroleum Hydrocarbons (TPH)	PEL SOP00175/GC-FID	Extractable Organics	NELAP	7/8/2011
Total Petroleum Hydrocarbons (TPH)	TPHCWG Direct Method	Extractable Organics	NELAP	3/27/2012
Total Petroleum Hydrocarbons (TPH)	TX1005	Extractable Organics	NELAP	1/24/2001
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	1/24/2001
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	1/24/2001
trans-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	1/24/2001
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	1/24/2001
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	1/24/2001
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	1/24/2001
Trichloronate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
Vanadium	EPA 6010	Metals	NELAP	1/24/2001
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	1/24/2001
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	1/24/2001
Xylene (total)	EPA 8260	Volatile Organics	NELAP	1/24/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Zinc	EPA 6010	Metals	NELAP	5/30/2002