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NAS CORPUS CHRISTI
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WORK PLAN FOR THE SITE INVESTIGATION AT UST 9, FUEL FARMS 217 AND 244, NAS CORPUS CHRISTI TX

3/20/2014

RESOLUTION CONSULTANTS

WORK PLAN
SITE INVESTIGATION

UNDERGROUND STORAGE TANK SITE 9
FUEL FARMS 217 AND 244
NAVAL AIR STATION CORPUS CHRISTI, TEXAS

Version: 0

Prepared for:

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

Prepared by:

Resolution Consultants
A Joint Venture of AECOM & EnSafe
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Norfolk, Virginia 23510

Contract Number N62470-11-D-8013
CTO JM46

March 20, 2014

Table of Contents

Tables

Attachments

List of Acronyms

APP	Accident Prevention Plan
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	Contract Task Order
FF	Fuel Farm
HASP	Investigation-derived waste
IDW	Investigation-derived waste
MTBE	Methyl tertiary-butyl ether
NAVFAC SE	Naval Facilities Engineering Command Southeast
NIRIS	Naval Installation Restoration Information Solution
PAH	Polynuclear aromatic hydrocarbon
PST	Petroleum storage tank
PWD	Public Works Department
SI	Site Investigation
SOP	Standard operating procedure
SOW	Statement of Work
TCEQ	Texas Commission on Environmental Quality
TDEM	Time domain electromagnetics
TPH	Total petroleum hydrocarbons
UFP SAP/QAPP	Uniform Federal Policy – Sampling and Analysis Plan/Quality Assurance Project Plan
U.S. EPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
WP	Work Plan

1.0 PURPOSE AND SCOPE

At the request of the Naval Facilities Engineering Command, Southeast (NAVFAC SE), Resolution Consultants has prepared the following Work Plan (WP) for Contract N62470-11-D-8013 Contract Task Order (CTO) JM46 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) program.

This WP describes the Site Investigation (SI) activities to address the potential release of petroleum contamination from Underground Storage Tank Site 9, which includes tanks in the former Fuel Farms (FF) 217 and 244 at Naval Air Station (NAS) Corpus Christi, Texas.

Specifically, requirements of the Texas Petroleum Storage Tank (PST) Program for SI and reporting of potential petroleum releases as identified in Texas Commission on Environmental Quality (TCEQ) Guidance RG-411 *Investigating and Reporting Releases from Petroleum Storage Tanks* are being applied to FF 217 and FF 244 at Site 9. An SI report, along with applicable PST Program registration forms, is intended meet the requirements of the Texas PST Program for evaluation of both FF 217 and FF 244 to determine whether a release has occurred. This WP also addresses analysis for lead scavengers in groundwater in accordance with the U.S. Environmental Protection Agency's (U.S. EPA's) May 2010 technical memorandum.

The components of the SI addressed by this WP include the SI field activities for utility clearance, soil sampling, and investigation-derived waste (IDW) management, and the SI reporting activities including data management/evaluation, risk assessment, and preparation of the SI report and applicable Texas PST Program site registration forms.

1.1 Work Plan Approach

This WP was specifically developed to meet the requirements of the Statement of Work (SOW) Number GCAO112612a prepared by NAVFAC SE, dated 26 November 2012. The SOW (Attachment A) identifies the tasks to be completed. The Uniform Federal Policy Sampling and Analysis Plan/Quality Assurance Project Plan (UFP-SAP/QAPP) in Attachment B defines project objectives, decision making criteria, and associated remediation data needs to eventually reach project closeout, describes the data quality objectives, and the general methodology for performing the site work, including (but not limited to):

- Site preparation, including tank and utility location/clearance

- Methodology for selecting sampling locations and obtaining samples (per RG-411 section entitled "Sampling at Tank Systems Remaining In Place")

- Sample Handling, Custody, and Analytical and field methods to be implemented (per RG-411 section entitled "Analytical Requirements")

- Laboratory standard operating procedures (SOPs) and accreditation documentation

- Geographic information systems and data management

- IDW management

Scope of sampling will closely follow the recommendations in TCEQ publication RG-411, *Investigating and Reporting Releases from Petroleum Storage Tanks,* August 2012*.*

The site-specific Accident Prevention Plan (APP) and associated Health and Safety Plan (HASP) for the field investigation/activities are in Attachment C. The APP/HASP contains an Activity Hazard Analysis for each site-specific task to be conducted. The UFP-SAP/QAPP (Attachment B) and APP/HASP (Attachment C) provide detailed information for how to address free product fuel, if encountered.

2.0 WORK PLAN ACTIVITIES

2.1 Field Investigation Activities

Tank/Piping/Utility Location Clearance

At both FF 217 and FF 244, Resolution Consultants will first conduct a geophysical survey (time domain electromagnetics, or TDEM) to confirm tank and piping layout and to place sample locations per Texas PST Program requirements described in RG-411. The TDEM surveys will cover an area of approximately 74,000 square feet at each fuel farm, with data collected at a high density over a subset of this area (about 150 feet by 250 feet) to precisely locate the tanks. The high density data collection will consist of lines every 5 feet or better and data collected along the lines at 0.5 foot. Outside the tank areas, data collection will be less dense, e.g., lines every 20 to 50 feet, with the objective of tracing the layout of pipes that radiate out from the tank array and manifolds.

Utility clearance for field work shall be performed in accordance with the UFP-SAP/QAPP (Attachment B) and includes the following anticipated activity. Resolution Consultants will coordinate with the Public Works Department (PWD) to document the utility clearance process and obtain approval for conducting intrusive activities. Resolution Consultants will coordinate verbally or via e-mail with the NAS Corpus Christi point of contact at least 7 days in advance of site access to initiate the utility clearance process for the boring locations. Resolution Consultants will contact both the Texas One Call system and NAS Corpus Christi infrastructure personnel verbally or via e-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.

Soil and Groundwater Sampling

Soil and groundwater sampling shall be performed in accordance with the UFP-SAP/QAPP (Attachment B) for both tank farms. The tank hold perimeter is to be sampled at 25-foot intervals; piping is to be sampled at a rate of every 20 linear feet of trench and at turns and fittings. The pipe fittings are assumed to be internal to the tank hold and thus each fitting need not be sampled, but the precise number of sample stations along pipe will not be known until completion of the TDEM surveys. Sampling will consist of 24 tank hold perimeter locations and six additional sample locations for a total of 30. At each station, one soil sample is to be obtained from the piping trench or top of groundwater encountered in each boring. Borings will be advanced by a direct push technology rig.

Soil sampling and analysis will be per TCEQ guidance, with volatile organic compound (VOC) and methyl tertiary-butyl ether (MTBE) analysis and total petroleum hydrocarbon (TPH) screening of each soil sample. No analysis for lead in soil is planned at this stage of investigation, although lead could be expected as a component of aviation gasoline historically released. Resolution Consultants will obtain an additional soil aliquot to be held for potential follow-up analysis for polynuclear aromatic hydrocarbons (PAHs) (submitting only the highest C-12 or higher molecular weight TPH result at each farm).

Groundwater is expected to be encountered above or near the base of the tank holds. Groundwater analytical data will be collected to determine the current concentrations of VOCs, MTBE, and TPH at a minimum of one location per fuel farm site in accordance with TCEQ guidance in RG-411. However, six temporary wells will be installed and developed for groundwater sampling based on input from TCEQ and U.S. EPA due to the size and distribution of the tank holds and associated piping. Well locations will be upgradient (1), downgradient (1), cross gradient (2), and located within the tank holds or pipeline chases (2) based on locations exhibiting the highest photo-ionization detector readings.

Groundwater samples will be collected from properly developed temporary wells using dedicated tubing and peristaltic pumps and analyzed for ethylene dibromide, 1,2-dichloroethane, BTEX, MTBE, and TPH in accordance with the UFP-SAP/QAPP (Attachment B). Groundwater samples for PAHs will be collected at the same time as the TPH samples, but will be put on hold after extraction. TPH sample analysis results will be used to determine whether PAH analysis is required in accordance with the UFP-SAP/QAPP (Attachment B).

All temporary wells will be removed within 48 hours of well completion, the boreholes will be backfilled to within 6 to 24 inches of grade using bentonite grout or other acceptable method described in UFP-SAP/QAPP (Attachment B). After 24 hours, the grouted borehole will be inspected for grout shrinkage and re-grouted if necessary. The remaining portion of the hole will be filled with soil cuttings removed from borehole, local topsoil, and/or appropriate paving materials to match areas where pavements are impacted by the boring location. Well abandonment reports will be prepared in accordance with State of Texas water well abandonment requirements.

Investigation-Derived Waste

IDW shall be managed in accordance with the UFP-SAP/QAPP (Attachment B). Solid (soil cuttings), and liquid IDW generated during sampling, (decontamination fluids, excess groundwater aliquots) will be handled in accordance with the UFP-SAP/QAPP. All IDW will be containerized in drums provided by Resolution Consultants' drilling subcontractor; IDW will be managed by the NAS Corpus Christi PWD Part B facility.

The NAS Corpus Christi PWD will pick up the filled drums and stage them at the designated waste accumulation area to await waste characterization analyses. Resolution Consultants will sample and characterize the waste. Based on waste characterization results, the drummed IDW will be managed by the NAS Corpus Christi PWD. Used personal protective equipment will be bagged and disposed of as regular trash in an appropriate facility waste container.

2.2 SI Report Activities

Data Management/Data Evaluation

Resolution Consultants shall update and manage the project data in the Naval Installation Restoration Information Solution (NIRIS). Project related spatial data including maps, models, and associated collected or created data must then be submitted back to NIRIS according to the NIRIS Non-NEDD Deliverable Submittal Guidelines SOP.

This task also includes Administrative Records File maintenance and entry/loading of deliverables, correspondence, and field, survey, and analytical data to the NIRIS web portal per applicable NIRIS SOPs. All documentation submittals for NIRIS will be coordinated with the Command Environmental Restoration Records Manager.

This task includes data verification and validation in accordance with the UFP-SAP/QAPP (Attachment B), and table generation for completion of the SI Report. Data verification will be performed to assess the completeness of field and laboratory data by reviewing all chain of custody forms, field log notebooks, field records, laboratory sample logs and receipt condition reports, and laboratory deliverables. Data validation will be performed to assess and document the performance of the field sample collection process and the analytical process by reviewing quality control results and raw data calculations from the laboratory. Results from the data validation will be incorporated into the SI Report. Tables presenting field and analytical results to be included in the SI Report will be generated under this task.

SI Report

Resolution Consultants will compile, review, and evaluate available data, conduct risk assessments, and produce an SI Report. The SI Report will include all forms and information as listed under the "What to Submit to the TCEQ" section of the RG-411 guidance. For the FF 244 site this will include summarized results of prior field investigations. Report elements will include a summary of field efforts, deviations from the work plans (if any), data tables and figures, Resolution Consultants independent review of the data, and comparison with PST Program Action Levels, and all other standard TCEQ requirements for SI/release determination reports as indicated in the UFP-SAP/QAPP (Attachment B).

3.0 DELIVERABLES

Per the SOW (Attachment A), Table 1 lists the major deliverables. This WP is prepared with the assumption that requirements of the Texas PST Program as identified in TCEQ Guidance RG-411 are applicable to this site and that the SI Report along with applicable PST Program submittal forms will meet the requirements of the Texas PST Program for registering either site (if applicable). This WP also addresses analysis for lead scavengers in groundwater in accordance with U.S. EPA's May 2010 technical memorandum.

Table 1
Schedule of Deliverables

Deliverable	Number of Hard Copies/Disks			Due Date
	RPM	Activity/Installation	Regulatory	
Completion of Field Work	—	—	—	120 Days from Work Plan Approval
Draft SI Report	1/1	1/1	0/0	30 days from field work completion
Navy Review/Comment	—	—	—	30 days from draft SI report
Draft-Final SI Report	1/1	1/1	2/2	30 days from comment receipt
Regulatory Review/Comment	—	—	—	60 days from draft-final SI report
Final SI Report	2/2	1/1	2/2	30 days from comment receipt

Electronic Deliverables of Records

Resolution Consultants will submit electronic version/file of the draft, draft-final, and final after comments are addressed in both the native format, typically a Microsoft product, and Adobe Acrobat PDF format.

4.0 HEALTH AND SAFETY

Resolution Consultants will comply with the most recent Corporate Health and Safety Procedures, the CLEAN Health and Safety Management Plan, and the site-specific APP/HASP (Attachment C).

5.0 QUALITY ASSURANCE

The quality of service and deliverables under this WP will be the responsibility of the task order manager for this CTO, while the overall responsibility for implementation and monitoring the Resolution Consultants Quality Assurance Program resides with the CLEAN Program Management team. The CLEAN Program Manager, Deputy Program Manager, Quality Assurance/Quality Control Manager, and Contracts Manager will be responsible for ensuring the quality of all submittals required under this CTO. Resolution Consultants will comply with the most recent CLEAN Program Management Plan and the UFP-SAP/QAPP (Attachment B) for this effort.

Attachment A
Statement of Work

Section C - Descriptions and Specifications

STATEMENT OF WORK

W DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHEAST
P.O. BOX 30
BUILDING 135
JACKSONVILLE, FLORIDA 32212

UST 9 – Site Investigation, Fuel Farms 217 and 244, NAS Corpus Christi.

CONTRACT NUMBER N62470-11-D-8013

STATEMENT OF WORK NO – GCAO112612a

November 26, 2012

CTO NUMBER JM46

1.0 GENERAL INTENTION

1.1 Scope

The purpose of this task order is to conduct a Site Investigation, and prepare a Site Investigation Report for Fuel Farms 217 and 244, Naval Air Station (NAS) Corpus Christi, Texas. The contractor shall provide labor, equipment, and materials necessary to perform the above tasks for Underground Storage Tank (UST) Site 9, Fuel Farms 217 and 244.

1.2 Background

NASCC is located in Nueces County, Texas, and lies approximately 140 miles southeast of San Antonio and approximately 25 miles south of Naval Station Ingleside, across Corpus Christi Bay. The installation encompasses a total of 2,844 acres and lies within the corporate bounds of the City of Corpus Christi. NASCC is situated on the northern end of the Encinal Peninsula and is bounded on three sides by water, Oso Bay lies to the west, Corpus Christi Bay to the north, and Laguna Madre to the east. A barrier island (Mustang Island) lies east of Laguna Madre and separates Corpus Christi from the Gulf of Mexico. Residential neighborhoods and State Highway 358 bound the installation on the south. NAS Corpus Christi was officially commissioned on March 12, 1941. The installation is, home to the Chief of Naval Air Training, maintains and operates facilities and provides services and material to support the operations of the aviation facilities of the Naval Air Training Command and other tenant activities. The general command assignment is pilot training, primarily focusing on primary and intermediate flight maneuvering and traffic pattern operations.

Fuel Farm 217 consists of 8 – 25,000 gallon USTs that were installed in 1940. Between 1977 and 1980 a total of 7000 gallons of aviation fuel is known to have been released to the environment from these USTs. The fuel farm was abandoned in-place between 1982 and 1987. Fuel Farm 244 consists of 8 – 25,000 gallon USTs that were installed during the 1940's. The fuel farm was abandoned in-place, by filling with sand, in 1973.

1.3 General Description.

The work includes the requirements specified in the Environmental the Comprehensive, Long-Term Environmental Action Navy (CLEAN) contract number **N62470-11-D-8013**, and the detailed requirements. The following phases are required:

Task 1 – Conduct Site Investigation
- a. Phase 1: Project Management
- b. Phase 2: Prepare Site Investigation Work Plans
- c. Phase 3: Undertake Site Investigation Field Work

Task 2 – Prepare Site Investigation Report

Additional Phases and Tasks beyond those identified in the original contract task order and subsequent modifications, will be negotiated and included at a later date by formal modification to this contract task order.

1.2.1 Location

Naval Air Station Corpus Christi, Texas.

1.2.2 Description of Contaminants Present.

Based upon very limited information aviation fuel related contaminants are suspected to be present at Fuel Farms 217 and 244. This description may not include all contaminants present at Fuel Farms 217 and 244.

2.0 APPLICABLE DOCUMENTS

2.1 Reference Reports Accompanying Specification

There are no Reference Reports associated with Fuel Farms 217 and 244.

3.0 GENERAL REQUIREMENTS

3.1 Government-Furnished Material and Equipment

There is no Government furnished material or equipment.

3.1.1 Government Furnished Property and Services

3.1.1.1 Government Furnished Property
There is no Government furnished property identified at this time for the performance of work under this statement of work.

3.2 Facilities and Services

3.2.1 Government Furnished Facilities
Government provided office space and operational facilities available to the Contractor will be determined during Phase 1 (See Detailed Requirements, 4.1). The basis for this determination will be the type of facilities available at the site and adaptability of such facilities.

3.2.2 Availability of Utilities Services
The availability, type, and possible cost of any utility services provided to the contractor will be determined during Phase 1 (See Detailed Requirements, 4.1.). The basis for this determination will be the type of utilities available at the site, the amount of the services required, and the cost of the services.

3.2.3 Security Requirements

3.2.3.1 Identification Badges
Comply with NAS Corpus Christi requirements

3.2.3.2 Extraordinary Security Requirements

None

3.2.3.3 Any Other Requirements
None

3.3 Restrictions on Equipment

3.3.1 Radio Transmitter Restrictions
Conform to the restrictions and procedures for the use of radio transmitting equipment, as directed. Do not use transmitters without prior approval.

3.4 Submittals from Basic Contract

3.4.1 Submittal Delivery Schedule.
As part of the Strategic Planning Meeting, described in 4.0 Detailed Requirements, Phase 1, the Government will establish the time frames for each of the required submittals for this contract task order.

3.4.2 Administrative Records / Information Repository.
Documents shall be created and submitted in accordance with the requirements set forth in the CERCLA Environmental Restoration Recordkeeping Manual and the *Environmental Work Instruction.*

Contractors who create and publish documents which shall be housed in NIRIS will adhere to document submission requirements set forth in the Standard Operating Procedure For Identifying, Preserving, And Submitting Environmental Restoration Documentation To The Mid Atlantic, Mid West, Southeast And Washington Regional Database for Inclusion Into The Naval Installation Restoration Information Solution (NIRIS).

Electronic Environmental Restoration versions of documents shall be submitted in accordance with the Environmental Restoration Recordkeeping Manual requirements.

3.4.3 Special Instructions
Electronic data provided by contractors to NAVFAC SE must be virus free. All computer diskettes, magnetic tapes, and modem transmissions of data must be scanned with up to date computer virus detection equipment prior to being forwarded. The diskettes, magnetic tapes, or modem transmission must be accompanied by a certification of the anti-virus software used and a statement indicating the data is free of detectable viruses.

3.4.4 Estimated Completion Date
May 16, 2014.

4.0 DETAILED REOUIREMENTS

4.1 Task 1 - Perform all actions necessary to complete the Fuel Farm 217 and 244 Site Investigation and produce the Fuel Farm 217 and 244 Site Investigation Report. All work performed under this task shall be performed in accordance with applicable US Navy, US EPA and State of Texas written guidance and policy. Guidance sited in this scope-of-work does not limit the contractor's responsibility to comply with all US Navy, US EPA and State of Texas written guidance and policy. The contractor shall contact NAVFAC SE to determine current status of the study site, to gain access to all additional relevant information concerning the site, and to establish a schedule for submission of required reports. When preparing the schedule for this task the contractor shall allow the US Navy 25 working days to review the Initial-Draft.

4.1.1 Phase a - The contractor shall perform project management activities necessary to maintain project control and to meet reporting requirements, including but not limited to the following:

The contractor will prepare a comprehensive project schedule which shall be due within 15 days after project award. The schedule will be prepared using MS Project and provided in hardcopy and electronically in native format and may be required as a .PDF file as well. The contractor shall update the schedule monthly and provide this as an electronic deliverable (email only for this electronic deliverable) to the RPM.

The contractor shall plan to attend a kickoff meeting via teleconference no later than 15 days after submittal of project schedule. Attendees of this meeting may include the Navy RPM, Environmental Coordinators and others from the site and various FEC personnel. At a minimum, the contractor's Project Manager and/or Technical Lead for this project shall attend. Regulators and stakeholders may be included as determined by the RPM. The agenda for this meeting will include discussions of roles and responsibilities, emergency response, health and safety, access to the site, project schedule, explosives safety, contracted deliverables, investigation methodology, and other issues related to the delivery order. The contractor shall provide a written meeting agenda to all invited participants not less than 5 days prior to the scheduled meeting, coordinate with the RPM to arrange meeting facilities, and provide invited participants written meeting minutes within 5 days after the meeting.

The contractor shall coordinate and attend 18-1 hour ad hoc meetings that will be conducted via teleconference. These meetings will to be held at the discretion of the RPM. Attendees may include regulators and stakeholders. The contractor is responsible for minutes of all of these ad hoc meetings. For meetings involving review of a deliverable, include a brief synopsis of the latest comments and recommendations for the deliverable. The contractor will provide invited participants written meeting minutes within 5 days after the meeting.

4.1.2 Phase b – The contractor shall prepare and submit a Draft, Draft Final and Final Site Investigation Work Plan, with the required appendices, which describe how to implement the requirements and information developed during the planning and scoping of this Site Investigation Work Plan. The Site Investigation Work Plan will define project objectives, decision making criteria, and associated data needs to reach project closeout and describe Data Quality Objectives (DQOs). The basic Site Investigation Work Plan will describe the general methodology for performing the site work, including at a minimum:

- Site preparation
- Sampling
- Geographical Information Systems (GIS) and data management
- Investigation Derived Waste Management

The contractor will prepare and submit a Site Health & Safety Plan (HASP). The HASP will contain an Activity Hazard Analysis (AHA) for each site-specific task to be conducted. The HASP will be appended to the Accident Prevention Plan (APP) that was prepared for the basic contract.

The contractor will prepare a Draft and Final SAP/QAPP in accordance with the Guidance for Quality Assurance Project Plans, the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), the "Uniform Federal Policy for Implementing Environmental Quality Systems" and the " Department of Defense Instruction: Environmental Quality Systems." The SAP will comprise a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP), at a minimum. The FSAP will be submitted as an Appendix to the Removal Work Plan.

The contractor shall propose a methodology for selecting sampling locations, in coordination with the RPM and the stakeholders to characterize and evaluate exposures to site contaminants. Samples shall be analyzed in accordance with the most current approved methods consistent with the QAPP.

The analytical laboratory should be identified in the proposal and must be identified in the FSAP and hold all applicable state certifications to perform the analytical methods required. Laboratories must also meet Navy IR QA Program requirements presented in the most current version of the Navy Installation Chemical Data Quality Manual, SP-02056-ENV.

The contractor shall determine the position of all sample locations using Global Positioning System (GPS) or other location method. The contractor shall prepare a drawing and spreadsheet of the sample location information and submit it as part of the Data Package with the Site Investigation Report. The same information will also be submitted to NIRIS using the NEDD and automated data checker. QA/QC samples of sufficient matrix medium type and quantity must be collected.

The QAPP will outline the contractor's Quality Control and Quality Assurance measures. The duplicate QA and QC samples will be analyzed for the same parameters as the field samples. All samples will be submitted to a Navy-accredited laboratory. All procedures for samples collected and analyzed for MC shall be addressed and identified in the QAPP and FSAP.

4.1.3 Phase c – The contractor shall complete the Fuel Farm 217 and 244 Site Investigation in accordance with Texas Administrative Code (TAC) Title 30, Part 1, Chapter 334 and Texas Commission on Environmental Quality (TCEQ) RG 411 *Investigating and Reporting Releases From Petroleum Storage Tanks* (August 2012). The intent of the Site Investigation is to establish the nature and extent of contamination at Fuel Farms 217 and 244.

4.2 Task 2 – Perform all action necessary to prepare the Fuel Farm 217 and 244 Site Investigation Report.

4.1.2 Phase a – The contractor shall prepare an Initial-Draft, Draft, Draft-Final and Final Site Investigation Report. These reports shall be completed in accordance with Texas Administrative Code (TAC) Title 30, Part 1, Chapter 334 and Texas Commission on Environmental Quality (TCEQ) RG 411 *Investigating and Reporting Releases From Petroleum Storage Tanks* (August 2012).

5.0 SCHEDULE OF PERFORMANCE

5.1 Commencement, Prosecution, and Completion of Work.
The Contractor shall be required to commence work under this contract task order, prosecute the work diligently, and complete the entire project in the manner and time agreed to in the approved Phase 1 meetings, work plans and submittals.

5.2 Schedule of Performance

Table 1. Schedule of Deliverables

Deliverable	# of Hard Copies/Disks			Due Date
	RPM	Activity/ Installation	Regulatory/ Other	
Site Investigation Work Planning Documents				
1. Project Schedule	1/1	0/0	0/0	15 days from award
2. Draft SI Work Plan	1/1	1/1		30 days from 1
3. Navy comments				25 days from 2
4. Draft Final SI Work Plan	1/1	1/1	2/2	25 days from 3
5. All review comments				45 days from 4
6. Final SI Work Plan	1/1	1/1	2/2	30 days from 5
Field Work				
7. Completion of Field Work				120 days from 6
RI/FS REPORT				
8. Draft SI Report	1/1	1/1	0/0	30 days from 7
9. Navy Review/comment				30 days from 8
10. Draft-Final SI Report	1/1	1/1	2/2	30 days from 9
11. All Review/Comment				60 days from 10
12. Final SI Report	2/2	1/1	2/2	30 days from 11

05 Decmber 2012

RFP APPENDIX A

1. A&E Contract No.: N62470-11-D-8013
   CTO-JM46
   Fund Type: Reimbursable

   Project Title/Location: UST 9 – Site Investigation, Fuel Farms 217 and 244, NAS Corpus Christi, TX

   Attachments:

   (a) Scope of Work dated: 26 November 2012

2. Navy Technical Representative

   (RPM)/Code/Telephone: Arne Olsen/904.542.6159

   The NTR is point of contact on technical matters.

   NAVFAC SE Contracting Officer:

   (Name/Code/Telephone) Queen Singleton/904-542-6925

The A&E's responsibility is directly to the Contracting Officer. Any requested change/deviation in scope must be brought to the attention and/or approved by the Contracting Officer. In no case will changes to the contractor scope be made at the Activity level or by any person other than the Contracting Officer.

3. Activity Point of Contact/Telephone: Arne Olsen/904.542.6159

4. CTO Cost: (To be filled in at conclusion of negotiations on A&E contracts)

Direct Labor	$56,558.00
Indirect Costs	$85,968.00
ODC	$ 6,659.00
Subcontractor Costs	$43,504.00
Travel and Subsistence	$ 8,095.00
Fee	$17,094.00
Total CTO Cost:	$217,877.00

Enclosure (1)

5. Project Milestones: See Attachment (a).

6. Scope Description: See Attachment (a)

7. Project Submittal Distribution: See Attachment (a)

MAILING ADDRESSES: DIRECT DISTRIBUTION TO EACH ADDRESSEE BY A&E IS REQUIRED

Atlantic Division, Naval Facilities Engineering Command

COMMANDER
LANTNAVFACENGCOM
ATTN CODE EV31LR Mrs. Lee Anne Rapp
CODE AQ112 Mr. Rollie Burford (Copies of forwarding letters only)
6506 HAMPTON BLVD
NORFOLK VA 23508-1278

Naval Facilities Engineering Command Southeast

Naval Facilities Engineering Command, Southeast
Attn: Code OPU3 Mr. Arne Olsen
135 Ajax Street North, PO Box 30
Jacksonville, FL 32212-0030

Attachment B

UFP-SAP / QAPP

SAMPLING AND ANALYSIS PLAN

SITE INVESTIGATION
UNDERGROUND STORAGE TANK SITE 9, FUEL FARMS 244 AND 217
NAVAL AIR STATION CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

Version Number: 0

Prepared For:

Department of the Navy
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
CTO JM46

September 2013

SAP WORKSHEET #1: TITLE AND APPROVAL PAGE

(UFP-QAPP Manual Section 2.1)

SAMPLING AND ANALYSIS PLAN

Site Investigation
Underground Storage Tank Site 9, Fuel Farms 244 and 217
Naval Air Station Corpus Christi
Corpus Christi, Texas

Version Number: 0

Prepared For:

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

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1500 Wells Fargo Building
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Norfolk, Virginia 23510

Contract Number: N62470-11-D-8013
CTO JM46

September 2013

Cantwell.Tina Digitally signed by Cantwell.Tina DN: cn=Cantwell.Tina, o=Resolution Consultants, ou, email=tcantwell@ensafe.com, c=US Date: 2013.09.23 12:07:40 -05'00'

Tina Cantwell, Resolution Consultants
Project Chemist/ Quality Assurance Officer/Date

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Judy Solomon, NAVFAC Atlantic
Quality Assurance Officer/Chemist/Date

Claire Barnett, PE Digitally signed by Claire Barnett, PE DN: cn=Claire Barnett, PE, o=Resolution Consultants, ou, email=cbarnett@ensafe.com, c=US Date: 2013.09.23 11:42:06 -05'00'

Claire Barnett, Resolution Consultants
Task Order Manager/Date

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Arne Olsen, NAVFAV SE
Remedial Project Manager/Date

EXECUTIVE SUMMARY

Resolution Consultants has prepared this Uniform Federal Policy Sampling and Analysis Plan under the Comprehensive Long-Term Environmental Action Navy Contract No. N62470-11-D-8013 Contract Task Order JM46. This Uniform Federal Policy Sampling and Analysis Plan has been prepared for a Site Investigation (SI) to address the potential release of petroleum contamination from Underground Storage Tank Site 9, which includes underground storage tanks in the former Fuel Farms 217 and 244 at Naval Air Station Corpus Christi, Texas.

This SI is intended to establish whether a release to environmental media has occurred, and whether either fuel farm site merits additional investigation or a no further action determination in accordance with state and federal requirements. The SI sampling plan will closely follow the recommendations in Texas Commission on Environmental Quality publication RG-411, *Investigating and Reporting Releases from Petroleum Storage Tanks (PST) (*August 2012). The SI sampling plan also takes into consideration the evaluation of lead scavengers in groundwater based on recommendations in the May 2010 U.S. Environmental Protection Agency (U.S. EPA) Memorandum: *Recommendations for States, Tribes, and EPA Regions to Investigate and Clean Up Lead Scavengers When Present at Leaking Underground Storage Tank (LUST) Sites.*

This SAP outlines the organization, objectives, planned activities, and data review/reporting procedures associated with the SI. Protocols for sample collection, handling, and storage, chain-of-custody, laboratory and field analyses, data validation, and reporting are also addressed herein. This SAP was generated for, and complies with, applicable United States Department of the Navy, U.S. EPA Region 6, and Texas Commission on Environmental Quality requirements, regulations, guidance, and technical standards, as appropriate. This includes the Department of Defense, Department of Energy, and U.S. EPA Interagency Data Quality Task Force environmental requirements regarding federal facilities, as specified in the Uniform Federal Policy Quality Assurance Project Plan guidance (U.S. EPA 2005) and the Navy's SAP guidance. Field activities conducted under this SAP will be conducted in accordance with Resolution Consultants' Standard Operating Procedures and a Site-Specific Health and Safety Plan.

Table of Contents

Figures

Appendices

List of Acronyms

bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylenes
CAS	Chemical Abstracts Service
CCC	Calibration check compounds
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	Contaminant of potential concern
CSM	Conceptual site model
CTO	Contract task order
1,2-DCA	1,2 dichloroethane
DL	Detection limit
DO	Dissolved oxygen
DoD	Department of Defense
DPT	Direct push technology
DQO	Data quality objective
DVA	Data Validation Assistant
EB	Equipment blank
EDB	Ethylene dibromide
EDD	Electronic data deliverable
EICP	Extracted ion current profile
ELAP	Environmental Laboratory Accreditation Program
eQAPP	Electronic Quality Assurance Project Plan
FD	Field duplicate
FF	Fuel Farm
FID	Flame ionization detector
FRC	Federal Records Center
FTL	Field team leader
GCAL	Gulf Coast Analytical Laboratories
GC	Gas chromatograph
GC/ECD	Gas chromatograph/electron capture detector
GC/MS	Gas chromatograph/mass spectrometer
HSM	Health and safety manager
ICAL	Initial calibration
IDW	Investigation derived waste
LCS	Laboratory control sample
LOD	Limit of detection
LOQ	Limit of quantitation
LPST	Leaking petroleum underground storage tank

List of Acronyms (continued)

mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
µg/L	Micrograms per Liter
MPC	Measurement performance criteria
MS/MSD	Matrix spike/matrix spike duplicate
MTBE	Methyl tert-butyl ethylene
mV	MilliVolt
MQL	Method quantitation limit
NAPL	Non-aqueous phase liquid
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NAVFAC SE	Naval Facilities Engineering Command Southeast
NELAP	National Environmental Laboratory Accreditation Program
NIRIS	Naval Installation Restoration Information Solution
NTU	Ne turbidity unit
ORP	Oxidation reduction potential
PAH	Polynuclear aromatic hydrocarbon
PAL	Project action level
PID	Photoionization detector
PM	Project manager
POC	Point of contact
PSQ	Principal study question
PST	Petroleum storage tank
QA	Quality assurance
QAO	Quality assurance officer
QAPP	Quality assurance project plan
QC	Quality control
QSM	Quality Systems Manual
r	Linear least squares regression
r^2	Non-linear regression-coefficient of determination
%R	Percent recovery
RCRA	Resource Conservation and Recovery Act
RF	Response factor
RPD	Relative percent difference
RPM	Remedial project manager
RRT	Relative retention time
RT	Retention time
RSD	Relative standard deviation

List of Acronyms (continued)

SAP	Sampling and analysis plan
SI	Site Investigation
SIM	Selective ion monitoring
SOP	Standard operating procedure
SPCC	System performance check compound
SRA	Screening risk assessment
SSO	Site safety officer
SWMU	Solid waste management unit
TAC	Texas Administrative Code
TBD	To be determined
TCEQ	Texas Commission on Environmental Quality
TDEM	Time domain electromagnetics (geophysics technique)
TOM	Task order manager
TPH	Total petroleum hydrocarbon
TRRP	Texas Risk Reduction Program
TX $^{GW}GW_{Class\ 3}$	Texas Class 3 Groundwater Protective Concentration Level
UFP	Uniform Federal Policy
U.S. EPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VOC	Volatile organic compounds

SAP WORKSHEET #2: SAMPLING AND ANALYSIS PLAN IDENTIFYING INFORMATION

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Underground Storage Tank Site 9, Former Fuel Farms 217 and 244, Naval Air Station (NAS) Corpus Christi, Texas

Contractor Name: Resolution Consultants

Contract Title: Comprehensive Long-term Environmental Action (CLEAN)

Contract Number: N62470-11-D-8013

Work Assignment No: JM46

1. This sampling and analysis plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (U.S. EPA 2005) and United States Environmental Protection Agency (U.S. EPA) *Guidance for Quality Assurance Project Plans, EPA QA/G-5* (U.S. EPA 2002).

2. Identify regulatory program: National Oil and Hazardous Substances Pollution Contingency Plan and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ; Texas Petroleum Storage Tank Program requirements established at Chapter 334 of Title 30 Texas Administrative Code and as outlined by Texas Commission on Environmental Quality (TCEQ) guidance RG-411, *Investigating and Reporting Releases from Petroleum Storage Tanks (PST) (*August 2012).

3. This SAP is a project-specific SAP.

4. List organizational partners (stakeholders) and identify the connection with lead organization:

Organization Partners/Stakeholders	Connection
U.S. EPA Region 6	Lead Regulatory Oversight
Texas Commission on Environmental Quality	Lead Regulatory Oversight
Naval Facilities Engineering Command Southeast	Lead Agency
NAS Corpus Christi	Property Owner
Resolution Consultants	Tier I Team Partner
The Management Edge	Tier I Team Partner

5. Lead organization: Naval Facilities Engineering Command Southeast

6. If any required SAP elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below: Not Applicable, as there are no exclusions.

SAP WORKSHEET #3: DISTRIBUTION LIST

(UFP-QAPP Manual Section 2.3.1)

SAP Recipients	Title	Organization	Telephone Number	E-mail Address or Mailing Address
Arne Olsen	Navy Remedial Project Manager	Naval Facilities Engineering Command, Southeast 135 Ajax Street North, PO Box 30 Jacksonville, Florida 32212-0030	904-542-6159 904-654-3059 (cell)	arne.olsen@navy.mil
Ross Ybarra	Lead Environmental Protection Specialist/Point of Contact	Naval Air Station Corpus Christi, Public Works Department 11001 D Street, Building 19 Corpus Christi, Texas 78419	361-961-2170 361-658-9572 (cell)	ross.ybarra@navy.mil
Tara Hubner	Project Manager	U.S. Environmental Protection Agency Region 6, Multimedia Planning and Permitting Division (6PD) RCRA Federal Facilities Section 1445 Ross Avenue, Suite 200 Dallas, Texas 75202	214-665-7246 972-571-2439 (cell)	hubner.tara@epa.gov
Allan Posnick	Project Manager	Texas Commission on Environmental Quality PO Box 13087 Austin, Texas 78711	512-239-2332 512-739-0668 (cell)	allan.posnick@tceq.texas.gov
Claire Barnett	Task Order Manager	Resolution Consultants 5724 Summer Trees Drive Memphis, Tennessee 38134	901-937-4425 901-634-4554 (cell)	cbarnett@ensafe.com
Ben Elliott	Project Engineer/ Technical Lead	Resolution Consultants 10918 Whisper Valley San Antonio, Texas 78230	210-545-9527 512-635-4229 (cell)	belliott@ensafe.com
Tina Cantwell	Project Chemist/Data Manger/Quality Assurance Officer	Resolution Consultants 2724 Summer Trees Drive Memphis, Tennessee 38134	901-937-4315	tcantwell@ensafe.com
Brett Hamby	Field Team Leader	Resolution Consultants 4545 Fuller Drive, Suite 342 Irving, Texas 75038	972-791-3222 940-577-5755 (cell)	bhamby@ensafe.com
Brenda Martinez	Laboratory Project Manager	Gulf Coast Analytical Laboratories 7979 GSRI Rd. Baton Rouge, Louisiana 70820	225-769-4900	brenda.martinez@gcal.com

SAP WORKSHEET #4: PROJECT PERSONNEL SIGN-OFF SHEET

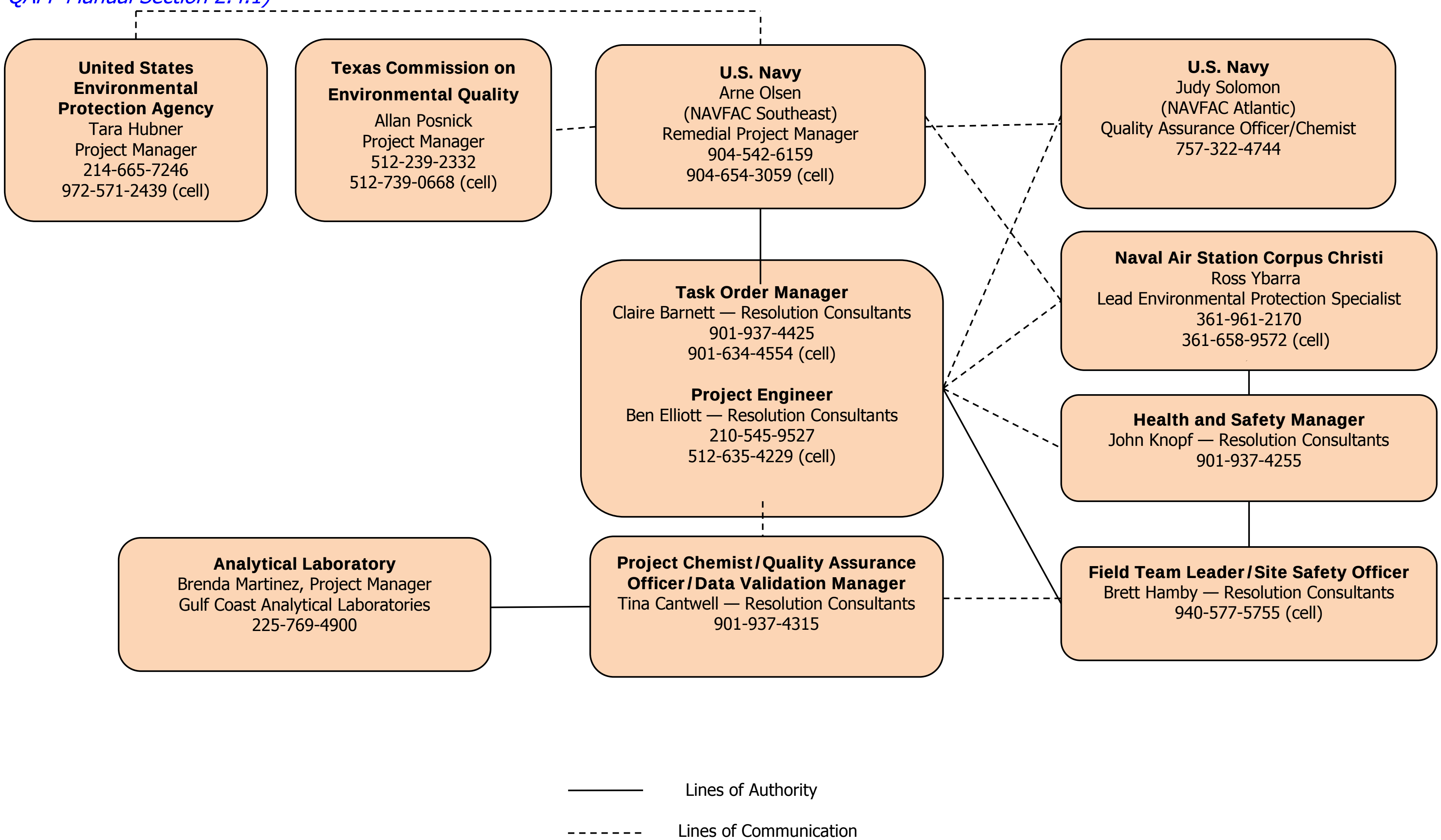
(UFP-QAPP Manual Section 2.3.2)

Project Personnel Sign-Off Sheet					
Name	**Organization/Title/Role**	**Telephone Number**	**Signature/e-mail receipt**	**SAP Section Reviewed**	**Date SAP Read**
Navy and Regulator Project Team Personnel					
Arne Olsen	Navy Remedial Project Manager	904-542-6159		All	
Ross Ybarra	NAS Corpus Christi Point of Contact	361-961-2170		All	
Tara Hubner	U.S. EPA Region 6 Project Manager	214-665-7246		All	
Allan Posnick	TCEQ Project Manager	512-239-2332		All	
Resolution Consultants Project Team Personnel					
Claire Barnett	Resolution Consultants/TOM	901-937-4425		All	
Ben Elliott	Resolution Consultants/Project Engineer	512-635-4229 (cell)		All	
Tina Cantwell	Resolution Consultants/Chemist/QAO/ Data Manager	901-937-4315		All	
Brett Hamby	Resolution Consultants/Field Team Leader	940-577-5755		All	
Subcontractor Personnel					
Brenda Martinez	Laboratory Project Manager	225-769-4900		Worksheets #6, #12, #14, #15, #19, #20, #23-28, #30, and #34-36	

Notes:
Persons listed on this worksheet will be responsible for distributing the Sampling and Analysis Plan to the appropriate people within their organizations.
SAP = Sampling and Analysis Plan
U.S. EPA = United States Environmental Protection Agency
TCEQ = Texas Commission on Environmental Quality
NAS = Naval Air Station
TOM = Task Order Manager
QAO = Quality Assurance Officer

SAP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART

(UFP-QAPP Manual Section 2.4.1)



SAP WORKSHEET #6: COMMUNICATION PATHWAYS

(UFP-QAPP Manual Section 2.4.2)

The communication pathways for the SAP are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	Navy RPM TCEQ RPM U.S. EPA RPM	Arne Olsen Allan Posnick Tara Hubner	904-542-6159 512-239-2332 214-665-7246	The Navy RPM informs the regulatory agencies of work progress on a periodic basis.
Field Progress Reports	Resolution Consultants FTL Resolution Consultants TOM	Brett Hamby Claire Barnett	940-577-5755 901-937-4425	The Resolution Consultants FTL will contact the Resolution Consultants TOM on a daily basis via phone, and every 1-2 days summarizing progress via e-mail.
Gaining Site Access	Resolution Consultants FTL NAS Corpus Christi POC	Brett Hamby Ross Ybarra	940-577-5755 361-961-2170	The Resolutions Consultants FTL will contact the NAS Corpus Christi POC verbally or via e-mail at least 3 days before commencement of field work to arrange for access to the site for all personnel.
SAP Changes prior to Field/ Laboratory work	Resolution Consultants TOM Navy RPM TCEQ RPM U.S. EPA RPM	Claire Barnett Arne Olsen Allan Posnick Tara Hubner	901-937-4425 904-542-6159 512-239-2332 214-665-7246	Any change of the approved SAP will be made only upon authorization by the Navy RPM and regulatory agencies. The Resolution Consultants TOM is responsible for initiating any SAP change requests via the communication channels described for the Navy and regulatory agencies.
Obtaining Utility Clearances for Intrusive Activities	Resolution Consultants FTL NAS Corpus Christi POC	Brett Hamby Ross Ybarra	940-577-5755 361-961-2170	The Resolution Consultants FTL will coordinate verbally or via e-mail with NAS Corpus Christi POC at least 7 days in advance of the site access to initiate the utility clearance process for all intrusive sampling locations. The Resolution Consultants FTL will contact both the Texas 811 utility locator service and NAS Corpus Christi POC verbally or via e-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.
Field Corrective Actions	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM	Brett Hamby Claire Barnett Arne Olsen	340-577-5755 901-937-4425 904-542-6159	FTL informs TOM verbally within same day; TOM informs Navy RPM via e-mail within 24 hours that corrective actions have been implemented. Corrective actions will be documented in weekly progress reports. Navy RPM will notify TCEQ and U.S. EPA of any significant corrective actions taken.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Stop Work due to Safety Issues	Resolution Consultants TOM Resolution Consultants FTL/SSO Resolution Consultants HSM Navy RPM NAS Corpus Christi POC	Claire Barnett Brett Hamby John Knopf Arne Olsen Ross Ybarra	901-937-4425 940-577-5755 901-937-4255 904-542-6159 361-961-2170	Any field team member who observes an unsafe situation has the authority to stop work. The responsible party verbally informs the TOM and subcontractor within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours. If a subcontractor is the responsible party, the subcontractor PM must verbally inform 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 FTL/SSO Resolution Consultants TOM Navy RPM TCEQ RPM U.S. EPA RPM	Brett Hamby Claire Barnett Arne Olsen Allan Posnick Tara Hubner	940-577-5755 901-937-4425 904-542-6159 512-239-2332 214-665-7246	FTL informs TOM verbally within the same day; TOM informs Navy RPM via e-mail within 24 hours; TOM sends a concurrence letter, if warranted, within 7 calendar days and the RPM signs the letter within 5 business days of receipt. The scope change is to be implemented before work is executed. Document the change on a field task modification request form (within 2 business days) or SAP amendment (within timeframe agreed to by Project Team). Any change of the approved SAP, affecting the scope or implementation of the sampling program, will be made only upon authorization of the Navy RPM and regulatory agencies.
Recommendations to stop work and initiate work upon corrective action	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM TCEQ RPM U.S. EPA RPM	Brett Hamby Claire Barnett Arne Olsen Allan Posnick Tara Hubner	940-577-5755 901-937-4425 904-542-6159 512-239-2332 214-665-7246	Responsible party verbally informs the TOM, FTL, and subcontractors within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours. Significant corrective actions will be communicated to the regulatory agencies.
Sample Receipt Variances	Laboratory PM Resolution Consultants TOM Resolution Consultants FTL	Brenda Martinez Claire Barnett Brett Hamby	225-769-4900 901-937-4425 940-577-5755	The Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants FTL immediately upon receipt of any chain of custody/sample variances for clarification or direction from the Resolution Consultants FTL. The Resolution Consultants FTL will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 business day, if corrective action is required. The Resolution Consultants TOM will notify (verbally or via e-mail) the Laboratory PM and the Resolution Consultants FTL within 1 business day of any required corrective action.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Analytical Data Quality Issues	Laboratory PM Resolution Consultants TOM Resolution Consultants Project Chemist Navy RPM	Brenda Martinez Claire Barnett Tina Cantwell Arne Olsen	225-769-4900 901-937-4425 901-397-4315 904-542-6159	The laboratory PM notifies (verbally or via e-mail) the Resolution Consultants chemist within 1 business day of when an issue related to laboratory data is discovered. Resolution Consultants chemist notifies Resolution Consultants TOM within 1 business day. Resolution Consultants chemist notifies the Resolution Consultants TOM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. Resolution Consultants TOM verbally advises the Navy RPM within 24 hours of notification from the project chemist. The Navy RPM takes corrective action that is appropriate for the identified deficiency. The Navy RPM, may at his discretion, contact the Navy QAO/Chemist for assistance in problem resolution. If there are significant data quality or non-useable data issues the Navy QAO/Chemist will be contacted to ensure the issues do not have the potential to impact other Navy projects.
Analytical Corrective Actions	Laboratory PM Resolution Consultants Chemist	Brenda Martinez Tina Cantwell	225-769-4900 901-397-4315	The laboratory shall notify the Resolution Consultants chemist of any analytical data anomaly within 1 business day of discovery. After the laboratory receives guidance from the Resolution Consultants chemist, the laboratory shall initiate any corrective action to prevent further anomalies.
Reporting Data Validation Issues/ Data Validation Corrective Actions	Resolution Consultants Project Chemist Resolution Consultants TOM	Tina Cantwell Claire Barnett	901-397-4315 901-937-4425	The Resolution Consultants project chemist/data validator, performing validation as specified in Worksheets #34, #35, and #36, will contact the laboratory as soon as possible if issues are found that require corrective action. If, the Resolution Consultants project chemist/data validator identifies non-usable data that require corrective action, the Resolution Consultants TOM will coordinate with the project chemist to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the TOM.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Laboratory PM Resolution Consultants TOM Resolution Consultants Chemist Navy RPM TCEQ RPM U.S. EPA RPM	Brenda Martinez Claire Barnett Tina Cantwell Arne Olsen Allan Posnick Tara Hubner	225-769-4900 901-937-4425 901-397-4315 904-542-6159 512-239-2332 214-665-7246	If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants project chemist within 1 business day of when the issue is discovered. The Resolution Consultants project chemist will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 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 affected samples. If the Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process, the TOM will be notified verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data. 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 e-mail) the Navy RPM of 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 his discretion, contact the Navy QAO/Chemist for assistance in problem resolution. Such notification will be made within 1 business day of when the issue is discovered. The Navy RPM will notify the TCEQ RPM when any significant corrective action is taken.

Notes:

RPM	=	Remedial project manager	FTL	=	Field team leader
TOM	=	Task order manager	NAS	=	Naval Air Station
POC	=	Point of contact	SSO	=	Site safety officer
HSM	=	Health and safety manager	SAP	=	Sampling and Analysis Plan
TCEQ	=	Texas Commission on Environmental Quality	PM	=	Project manager
U.S. EPA	=	Environmental Protection Agency	QAO	=	Quality Assurance officer

SAP WORKSHEET #7: PERSONNEL RESPONSIBILITIES TABLE

(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities
Arne Olsen	Remedial Project Manager/ Manages project activities for the Navy	Naval Facilities Engineering Command, Southeast	Primary Point of Contact for the Navy. Oversees project implementation, including scoping, data review, and evaluation, on behalf of the Navy.
Ross Ybarra	Activity Point of Contact/ Oversees onsite project activities	Naval Air Station Corpus Christi	Point of Contact for base-specific activity. Oversees onsite activities.
Tara Hubner	Project Manager/ Regulatory Support	U.S. EPA Region 6	Functions as primary U.S. EPA interface. Participates in scoping and data review/evaluation, and provides review and approval of project deliverables.
Allan Posnick	Project Manager/ Regulatory Support	TCEQ	Functions as primary TCEQ interface. Participates in scoping and data review/evaluation, and provides review and approval of project deliverables.
Claire Barnett	Contractor Task Order Manager/ Manages project on a daily basis	Resolution Consultants	Primary point of contact for Resolution Consultants. Oversees project implementation, including financials, schedule, and technical aspects.
Ben Elliott	Contractor Project Engineer/ Manages project on a daily basis	Resolution Consultants	Secondary point of contact for Resolution Consultants. Assists in overseeing project implementation, including financials, schedule, and technical aspects.
Brett Hamby	Field Team Leader/Site Safety Officer/ Manages field operations and oversees site activities to ensure safety requirements are met	Resolution Consultants	Supervises, coordinates, and performs field activities. Responsible for onsite project-specific health and safety training and monitoring site conditions.
Tina Cantwell	Project Chemist/Quality Assurance Officer/Data Validation Manager/ Oversees quality and chemistry aspects of project	Resolution Consultants	As project chemist, prepares laboratory scopes of work, and coordinates laboratory related functions with laboratory. Performs or oversees data reviews and quality assurance of data validation deliverables. As quality assurance officer, ensures quality aspects of the project are implemented, documented, and maintained. As data validation manager, performs or oversees data validation and data input in both the project database and the Navy's Naval Installation Restoration Information Solution database.
John Knopf	Health and Safety Manager/ Oversees health and safety activities	Resolution Consultants	Oversees the Resolution Consultants Health and Safety Program.
Brenda Martinez	Laboratory Project Manager/ Analytical Subcontractor	Gulf Coast Analytical Laboratories	Oversees quality and technical aspects related to subcontracted analytical services.

Notes:
U.S. EPA = United States Environmental Protection Agency
TCEQ = Texas Commission on Environmental Quality

SAP WORKSHEET #8: SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

(UFP-QAPP Manual Section 2.4.4)

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response training specified in Occupational Safety and Health Administration 29 Code of Federal Regulations 1910.120(e). Additionally, the field team leader will have the 30-hour Occupational Safety and Health Administration Standards for Construction training.

SAP WORKSHEET #9: PROJECT SCOPING SESSION PARTICIPANTS SHEET

(UFP-QAPP Manual Section 2.5.1)

Project Name:	Site Investigation	**Site Name:** UST Site 9, Former Fuel Farms 217 & 244
Projected Sampling Date(s):	Fall 2013	**Site Location:** NAS Corpus Christi, Texas
Project Manager:	Claire Barnett, PE/Ben Elliott, PE — Project Engineer	
Date of Session:	27 June 2013	
Scoping Session Purpose:	Conceptual Site Model, Data Quality Objectives, and Sampling Design	

Name	Title/role	Affiliation	Phone #	E-mail Address
Arne Olsen	Remedial Project Manager	NAVFAC SE	904-542-6159	arne.olsen@navy.mil
Ross Ybarra	Lead Environmental Protection Specialist/ Point of Contact	NAS Corpus Christi NAVFAC SE, Public Works Department	361-658-2170	ross.ybarra@navy.mil
Allan Posnick	Remedial Project Manager	TCEQ — Corrective Action	512-239-2332	allan.posnick@tceq.texas.gov
Tara Hubner	Remedial Project Manager	U.S. EPA Region 6	214-665-7246	hubner.tara@epa.gov
Ben Elliott	Project Engineer/Technical Lead	Resolution Consultants	512-635-4229	belliott@ensafe.com

Notes:

UST	=	Underground storage tank
NAS	=	Naval Air Station
NAVFAC SE	=	Department of the Navy, Naval Facilities Engineering Command Southeast
TCEQ	=	Texas Commission on Environmental Quality
U.S. EPA	=	U.S. Environmental Protection Agency

Comments/Decisions:

A site walk though was conducted during the 28 November 2012 partnering meeting at NAS Corpus Christi. At the request of the Navy Remedial Project Manager, on 14 June 2013, Resolution Consultants issued Sampling and Analysis Plan (SAP) worksheets #10, #11, and #17 to the project team for review prior to the data quality objectives (DQO) scoping session. The DQO scoping session was held on 27 June 2013 at the NAS Corpus Christi partnering team meeting in Austin, Texas. At the DQO scoping meeting, the project team reviewed and discussed the conceptual site models, project quality objectives/systematic planning process statements, and sampling design and rationale. The TCEQ and U.S. EPA requested clarification on the approach to vertical delineation of potential contamination, particularly with respect to groundwater.

Action Items:

Resolution Consultants was tasked with completing the full SAP and submitting it to the project team for review. The SAP will address temporary well completion, development, and abandonment requirements and will incorporate sampling requirements of the Texas PST Program as identified in TCEQ Guidance RG-411. The SAP also will address analysis for lead scavengers in groundwater in accordance with U.S. EPA's May 2010 technical memorandum.

Consensus Decisions:

None.

SAP WORKSHEET #10: CONCEPTUAL SITE MODEL

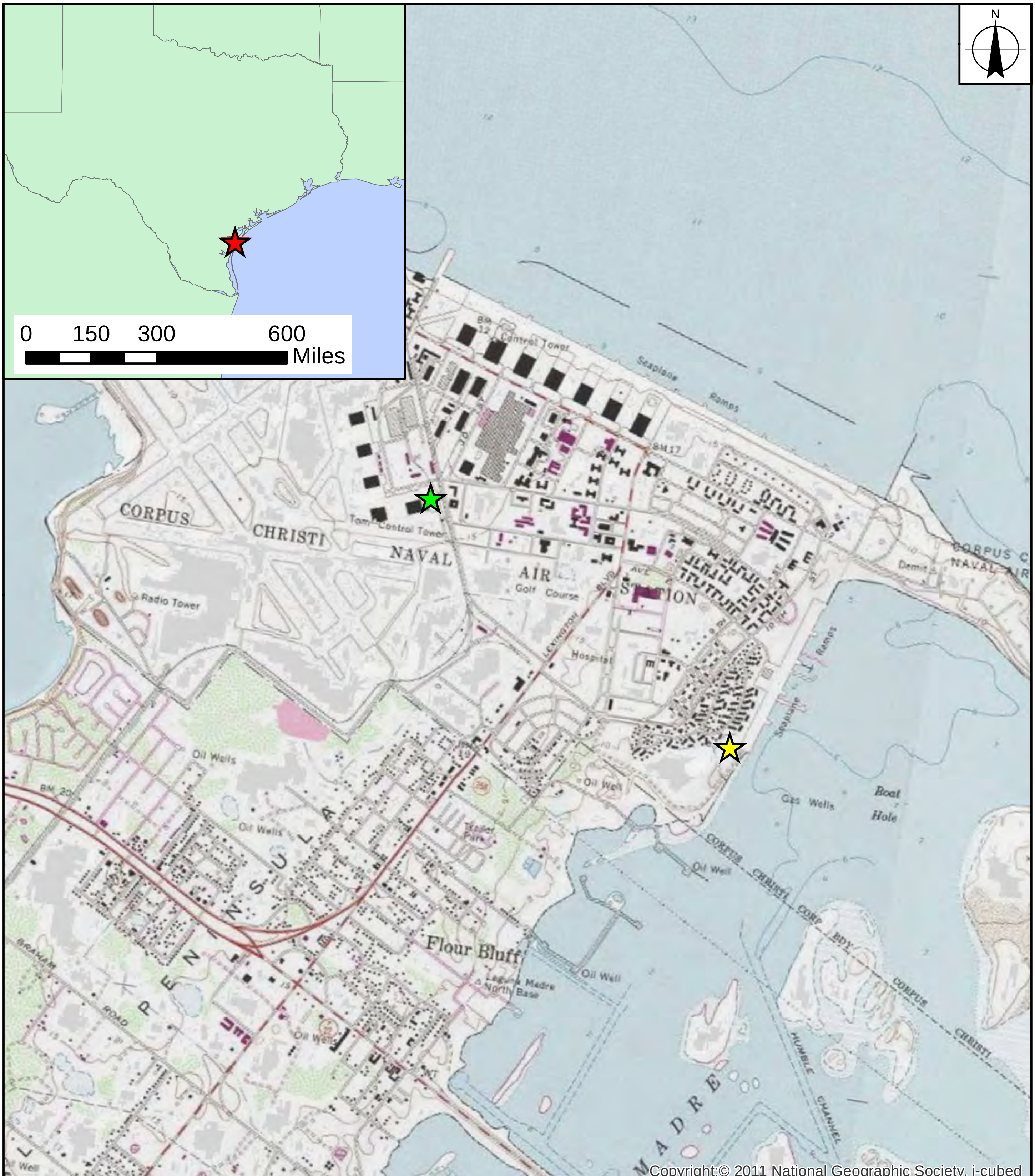
(UFP-QAPP Manual Section 2.5.2)

This worksheet presents a brief site description, history, and a preliminary conceptual site model (CSM) for Underground Storage Tank (UST) Site 9, which includes tanks in former Fuel Farms 217 and 244 at NAS Corpus Christi, Texas. Historical reports and records, including an *Initial Assessment Study of Naval Air Station Corpus Christi* (Navy 1984), a *RCRA Facility Assessment Evaluation Preliminary Review Visual Site Inspection and Sampling Visit* (U.S. EPA Region 6, 1989), and miscellaneous project files for Fuel Farm 244, were used to develop this preliminary CSM, which will be used in establishing the basis for the Site Investigation (SI) sampling and analysis program.

The following contaminants of potential concern (COPCs) have been determined based on historical documentation of operations at the site: benzene, toluene, ethylbenzene, and xylenes (BTEX), methyl tert-butyl ether (MTBE), total petroleum hydrocarbons (TPH), and polynuclear aromatic hydrocarbons (PAHs). This preliminary CSM will be refined following implementation of the SI to better define the COPCs, potential contamination routes and possible exposure pathways to humans and ecological receptors, and will serve as the basis for future phases and tasks that may be conducted at UST Site 9. At this time, the SI (and site DQOs) will be focused on meeting the requirements outlined by TCEQ guidance RG-411, *Investigating and Reporting Releases from Petroleum Storage Tanks (PST)* (August 2012). The requirements for the Texas PST Program are described in this guidance and are based on Title 30 of the Texas Administrative Code, Chapter 334 (30 TAC 334). The objective of the RG-411 site investigation approach is determining whether or not a PST site must be entered into the Texas PST program and issued a Leaking PST (LPST) number, and if the site warrants further investigation prior to closure under the requirements of 30 TAC 334 as administered by the TCEQ.

10.1 Site Description

NAS Corpus Christi is situated on the northern end of the Encinal Peninsula and is bounded on three sides by water: Oso Bay lies to the west, Corpus Christi Bay to the north, and Laguna Madre to the east. A barrier island (Mustang Island) lies east of Laguna Madre and separates Corpus Christi from the Gulf of Mexico (Figure 10-1).



Legend

- 217 Fuel Farm
- 244 Fuel Farm
- NAS Corpus Christi

0 1,000 2,000 3,000 4,000
Feet

FIGURE 10-1
AREA LOCATION MAP
UST SITE 9
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC
Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 3/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: JM46

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Former Fuel Farm 217 (FF217) consists of eight 25,000-gallon USTs that were installed in 1940 in the eastern area of NAS Corpus Christi, less than 100 feet from the shore of Laguna Madre (Figure 10-2). The current surface conditions at FF217 include regularly mowed grass. The tanks were used to store aviation gasoline and JP-5 fuel (U.S. EPA 1989). The tanks were abandoned-in-place by filling with sand and cement sometime in 1987.

Former Fuel Farm 244 (FF244) consists of eight 25,000-gallon USTs that were installed in 1940 near Building 252 in the central part of NAS Corpus Christi (Figure 10-3). The tanks were used to store aviation fuels (U.S. EPA 1989). The tanks were abandoned-in-place by filling with sand sometime in 1973.

10.2 Site History

Former Fuel Farm 217. The eight former FF217 tanks (Solid Waste Management Unit [SWMU] Nos. 54 through 61) were active between 1945 and 1986 and were filled with sand and cement in 1987. Between 1977 and 1980, 7,000 gallons of aviation fuel are known to have been released to the environment from the FF217 USTs during three separate events; however, the specific tanks sourcing these spills are not identified in the record.

Former Fuel Farm 244. The eight former FF244 tanks (SWMU Nos. 62 through 69) were active from the early 1940s until 1973 when they were filled with sand. There are no documented releases on file from FF244.

10.3 Preliminary Conceptual Site Model

A summary of the CSMs based on current site conditions at UST Site 9 Fuel Farms 217 and 244 are shown on Figure 10-4 (FF217) and Figure 10-5 (FF244), respectively. The following text describes the current CSM for each site. Development of the CSM is an iterative process, and will be refined during the SI and subsequent stages of investigation associated with UST Site 9.

10.3.1 Nature and Extent of Contamination

The following COPCs have been determined based on historical documentation of operations at the site: BTEX, MTBE, TPH and PAHs. The nature and extent of COPCs is unknown, and must be determined during the SI and any subsequent investigations in accordance with RG-411.

Legend

Transfer Pit

Underground Storage Tank

Fuel Farm 217 Site Boundary
SWMU Nos. 54 through 61

0 100 200 Feet

FIGURE 10-2
SITE MAP
UST SITE 9 FUEL FARM 217
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

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Legend

- Transfer Pit
- Underground Storage Tank
- Fuel Farm 244 Site Boundary
  SWMU Nos. 62 through 69

0 100 200
Feet

FIGURE 10-3
SITE MAP
UST SITE 9 FUEL FARM 244
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC
Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

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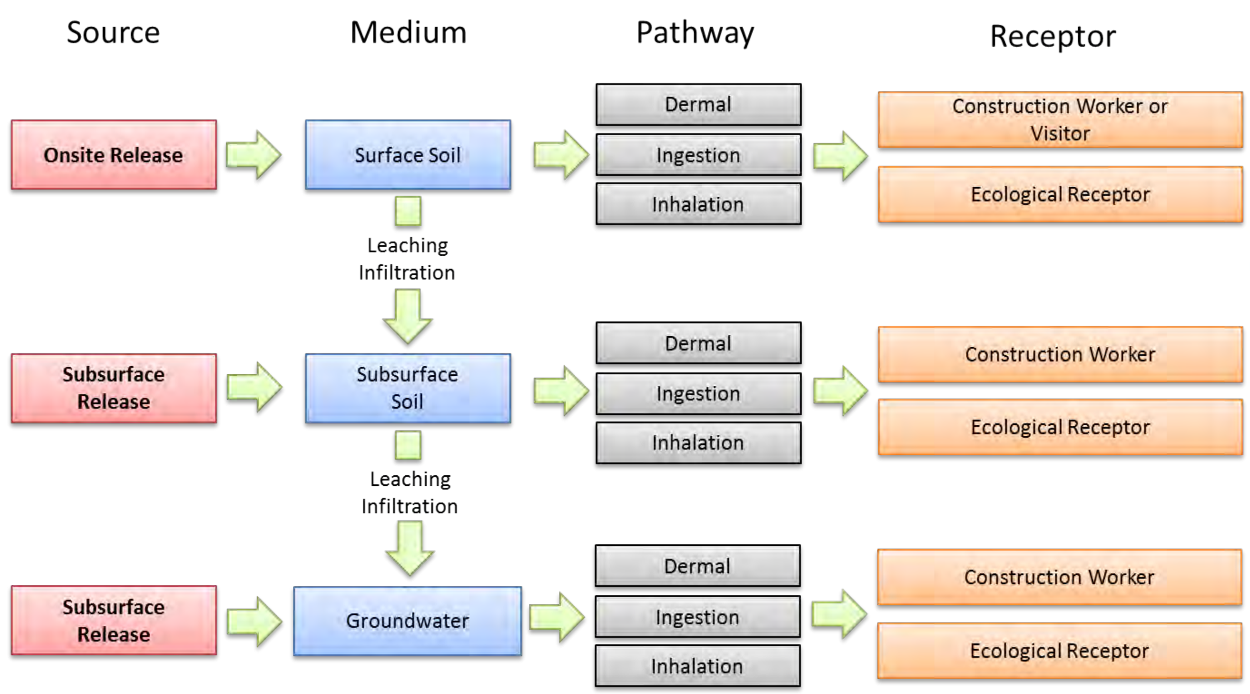
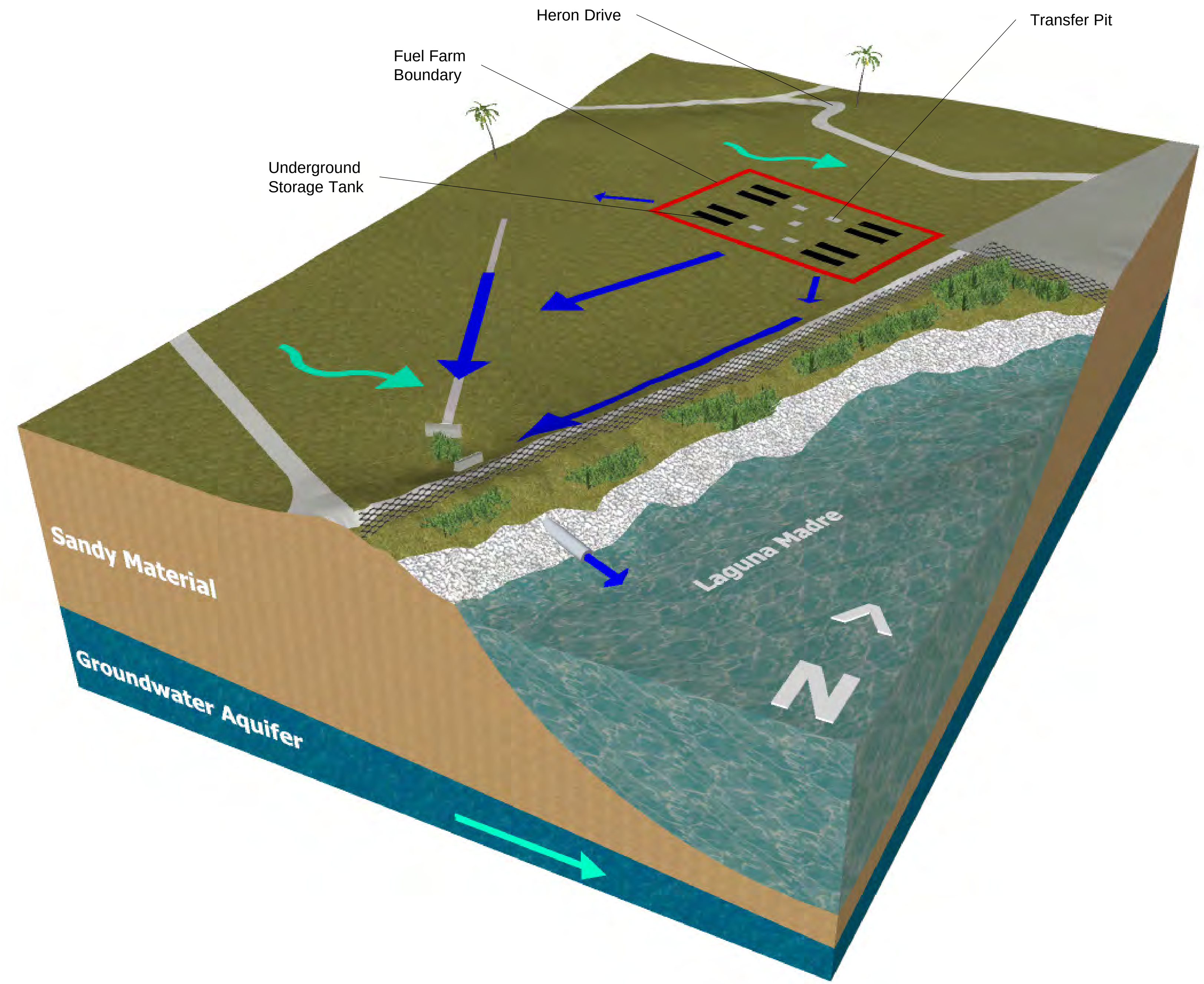




Component Credits: bush, Stefevr; bush#1, Stefevr; Tropical fan palm tree, SketchUp; Terrain created from National Elevation Dataset (NED) from USGS

Legend

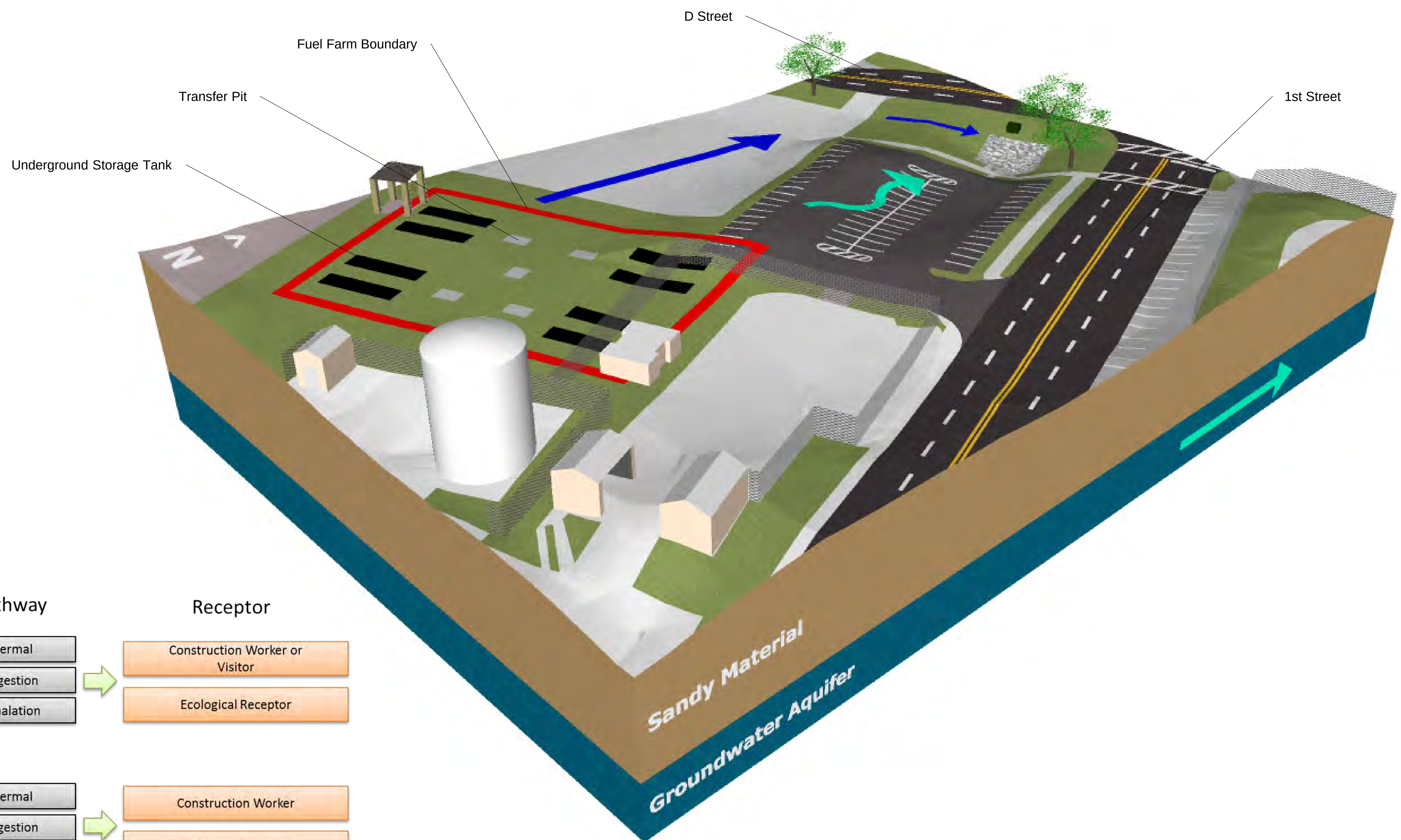
- Groundwater Flow
- Surface Water Flow
- Fuel Farm 217 Site Boundary SWMU Nos. 54 through 61
- Transfer Pits
- Underground Storage Tank

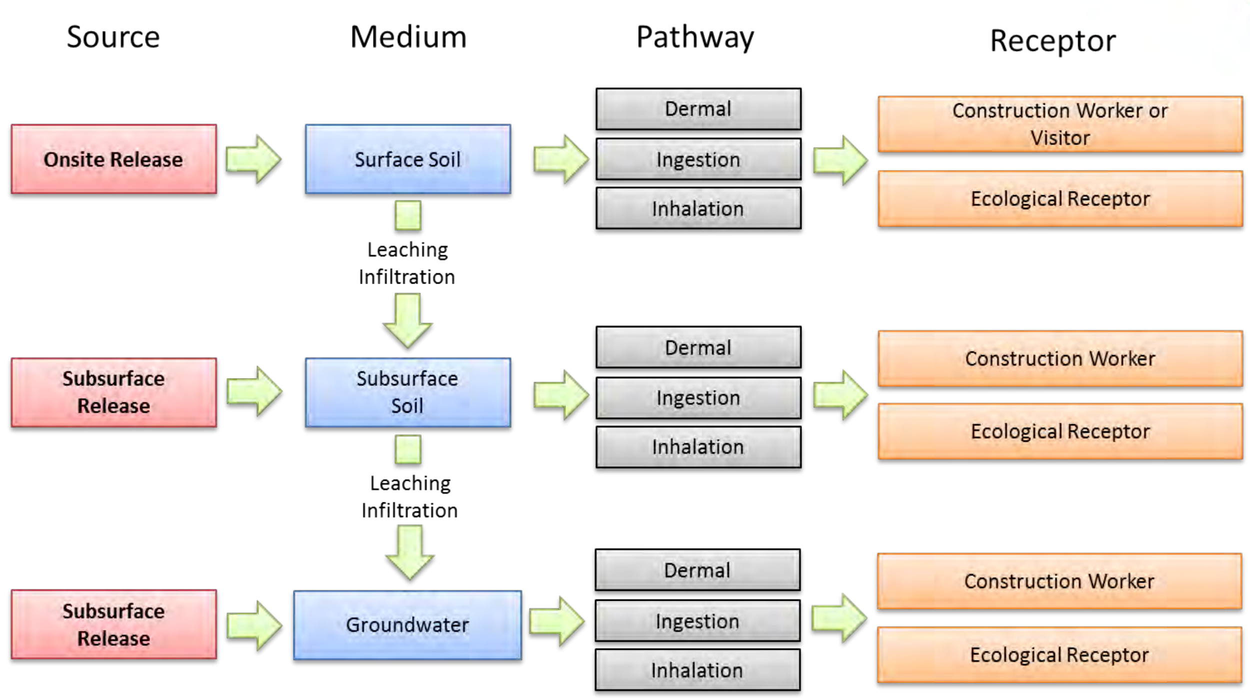
FIGURE 10-4
CONCEPTUAL SITE MODEL
UST SITE 9 FUEL FARM 217
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 03/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: JM46





Component Credits: tree, amilagroso; Terrain created from National Elevation Dataset (NED) from USGS

Legend

- Groundwater Flow
- Surface Water Flow
- Fuel Farm 244 Site Boundary SWMU Nos. 62 through 69
- Transfer Pits
- Underground Storage Tank

FIGURE 10-5
CONCEPTUAL SITE MODEL
UST SITE 9 FUEL FARM 244
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 03/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: JM46

10.3.2 Geology, Hydrogeology, and Hydrology

No site-specific investigations have been performed to date, to provide lithologic or hydrogeologic information. However, general hydrology and soil series information is provided below to begin the CSM process.

Former Fuel Farm 217 is situated on top of made land. Made land consists of sand, mud and shells that have been excavated from the floor of lagoons and bays. Within NAS Corpus Christi these soils are typically deep, undulating, and of variable permeability. They are generally clayey, saline, and covered with 6 to 8 inches of topsoil to support vegetation. Laguna Madre is less than 100 feet away from the abandoned tank farm and likely influences and is influenced by shallow groundwater in this area. Surface water runoff in the vicinity of FF217 generally sheet flows to the south southeast where it is intercepted and directed by a roadside ditch. The roadside ditch drains toward a culvert under the road to a designated outfall to Laguna Madre approximately 450 feet to the southwest of the tank farm. More specific site hydrogeology and hydrology will be obtained as part of the SI.

Former Fuel Farm 244 is situated on top of a sandy fill placed over Galveston-Mustang series soils near the center of the Encinal Peninsula between Oso Bay and Laguna Madre, over 7,000 feet away from surface water to the east and west, and closest to Corpus Christi Bay approximately 3,600 feet to the north. The sandy fill consists of fine sand and loam with variable permeability that has been used to raise the original land surface to a uniform height for runway sites. The Galveston-Mustang series soils consists of deep nearly level to sloping, slightly acidic, loose fine sands with moist to wet sandy subsoils with permeability ranging between 3 and 8 inches per hour (Galveston) and slightly less permeable clayey sands (Mustang) with permeability ranging from less than 0.05 inches per hour to 3 inches per hour. Surface water runoff in the vicinity of FF244 generally sheet flows to the north northeast where it is intercepted by paved surfaces and directed by curb and gutter to the storm water system. More specific site hydrogeology and hydrology will be obtained as part of the SI.

10.3.3 Contamination Migration Pathways

Residual product (aviation fuels) is suspected to be present within the abandoned-in-place tanks associated with former fuel farms FF217 and FF244. Historical fuel spills at FF217 have been documented, but little detail on the associated tanks or cleanup performed is presently known. No fuel spills or releases are documented associated with FF244.

The nature and extent of potential releases to surface or subsurface soils from tanks and spills at FF217 and FF244 are largely unknown at this stage and will be developed during the SI and any future investigations associated with UST Site 9. Based on current and historical aerials, potential anthropogenic migration pathways may include the following:

- The fuel pipelines and corridors associated with the fuel conveyances for FF217 and FF244.
- The surface water conveyances near FF217 do not appear to have been lined; they are a consideration for contaminant migration of any surface spills in the area.
- The storm sewer in the vicinity of FF244 may be a consideration in the evaluation of migration pathways.

Natural migration pathways may exist along geologic/stratigraphic contacts (e.g., between overburden and subsoil).

Fuel releases to surface or subsurface soils in these areas have the potential to impact shallow groundwater and possibly surface water and sediments due to proximity, soil permeability, and potential influence of tidal interactions between shallow groundwater and surface waters.

As indicated by available permeability data for surficial and shallow soils and geologic units at NAS Corpus Christi, shallow groundwater migration is possible with potential flows in the shallow water table toward Corpus Christi Bay, Laguna Madre, and Oso Bay. Artesian aquifers in the vicinity of NAS Corpus Christi become increasingly saline with depth and the base of fresh to slightly saline water (less than 3,000 milligrams per Liter [mg/L] total dissolved solids) is at or above sea level, indicating very limited potential for fresh artesian water at these sites. The presence of saline groundwater is a consideration in the evaluation of potential impacts to shallow groundwater in these areas, and in assessing geochemical conditions relative to natural attenuation or other potential site remedies.

10.3.4 Receptors and Exposure Pathways

The information presented in the preceding sections was used to develop the CSMs shown on Figures 10-4 (FF217) and 10-5 (FF244). Both human and ecological receptors are assumed to have the potential to contact contaminated site media. The facility's current land uses are expected to remain unchanged in the near future and residential land use is unlikely. As shown on the CSM, current human receptors include visitors and construction workers. Human receptors may be exposed to contaminated media through dermal contact, ingestion, or inhalation.

Potential ecological receptors include terrestrial plants and invertebrates, birds, and mammals. Ecological receptors may be exposed through direct contact with or ingestion of contaminated media, as well as through the food chain (i.e., by ingesting plants and animals that have been impacted through uptake of soil contaminants). TCEQ Guidance presented in RG-411 for investigating releases at PST sites does not specifically address ecological receptors. However, in the event a release is confirmed for either FF217 or FF244 with the potential to impact surface soil, water, and/or sediments, exclusion and *de minimus* criteria will be evaluated with respect to Tier 1 Ecological Checklist requirements described under the Texas Risk Reduction Program (TRRP).

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

(UFP-QAPP Manual Section 2.6.1)

11.1 Problem Statement

Historical information regarding fuel farm operations and fuel releases and information from previous studies indicate that soil and groundwater at the FF217 and FF244 have potential to be impacted by release of petroleum products remaining in the abandoned tanks or spilled on the surface during operations. These UST sites were abandoned–in-place prior to the implementation of the Texas PST Program requirements and, consequently, were never entered into the PST Program for site closure. Additional sampling is required to determine whether or not a release associated with the abandoned tanks has occurred and to take measures to close the fuel farms under the Texas PST requirements and guidelines.

11.2 Goals of the Study

The goal of the SI is to obtain an understanding of the FF217 and FF244 potential source areas to determine if either site must be entered into the Texas PST Program and issued an LPST number, and if either site warrants further investigation prior to closure. To fill the data gaps, the following tasks will be performed:

1. Geophysical survey to locate the abandoned tanks and pipeline features.

2. Soil sampling via direct push technology (DPT) core barrels spaced at 25-foot intervals around each of the fuel farm perimeters and at key pipeline locations identified during the geophysical survey to assess the potential for petroleum related releases at each site.

3. Groundwater sampling via DPT installation, development, and sampling of temporary groundwater monitoring wells at six locations per fuel farm site where groundwater is encountered to screen for potential groundwater contaminants identified by TCEQ guidance RG-411 that may warrant further investigation under the Texas PST Program; additional analysis for lead scavengers will be performed in accordance with guidance in the May 2010 U.S. EPA technical memorandum on lead scavengers in groundwater.

4. Visual inspection of soil samples to screen for potential non-aqueous phase liquid (NAPL) presence.

Principal study questions (PSQs) for the initial phase are as follows:

- PSQ1: What are the physical boundaries of the abandoned USTs at FF217 and FF244?
- PSQ2: Do concentrations in soil or groundwater at either FF217 or F244 exceed Project Action Limits (PALs), thus requiring follow-up action?
- PSQ3: Do sufficient ecological receptors exist at either FF217 or F244 or in the immediate vicinity, resulting in the need for further evaluation?
- PSQ4: Based on visual inspections, do any of the soil or groundwater samples observed at FF217 or F244 exhibit signs of NAPL presence, thus requiring follow-up action?
- PSQ5: Can either or both of the fuel farm sites be closed under Texas PST Program requirements established in 30 TAC 334 based on current conditions or will the sites require a removal/response action or additional investigation? The answer to this question may be determined after this SI or subsequent sampling, depending on the results of the SI.

Based on these PSQs, the following project decision statements have been developed:

- Ascertain the physical boundaries of the abandoned USTs.
- Assess whether COPCs in soil and groundwater exceed PALs.
- Identify the presence of ecological receptors; if identified, supplemental sampling may be necessary (not currently included in Worksheet #17).
- Assess the presence/absence of residual NAPL, as required to obtain site closure under 30 TAC 334.
- If chemicals of concern are detected above PALs or if NAPL is present in either soil or groundwater make recommendations for further assessment and/or remedial action as necessary to obtain site closure under 30 TAC 334. (Note, the current SAP scope does not include evaluation of remedial actions or further site assessment — field activities include SI efforts only.)

11.3 Information Inputs to Problem Resolution

The inputs needed to resolve the project problem statement identified in Section 11.1 include field observations and measurements, analytical data, site feature locations, and PALs as described below. Specific informational inputs, to serve as the basis for decisions during the execution of this project, include the following:

- Tank System, Piping Layout and Sample Locations: The understanding of tank system and piping layouts will be updated with observations made during time domain electromagnetic (TDEM) geophysical surveys of each site.

- Geologic/Hydrogeologic Information: Site geology and hydrogeology will be updated with observations made during installation of soil borings using a DPT rig. Up to six temporary monitoring wells per fuel farm site are included in this SAP based on input from TCEQ and U.S. EPA regarding RG-411 guidance for meeting the requirements under 30 TAC 334. In the event that either of these sites meets the requirements for listing within the PST Program, then additional investigation phases may be required to include groundwater sampling from permanently installed wells.

- Sample Location Data: Sample location horizontal coordinates and vertical depths will be measured for use in mapping each location so that data can be analyzed and presented in a spatial context. Horizontal coordinates of each sample location will be determined by Global Positioning System, which will allow for future reacquisition of the locations if further investigation or remedial action is necessary.

- Ecological Checklist and Screening Risk Assessment: Site habitats will be characterized using TCEQ's Tier 1 Ecological Exclusion Criteria Checklist to determine if ecological communities at the site and in the nearby surrounding area could be affected by site activities and if the impact could have an adverse effect at a community or population level. Such information will be considered in determining the need for a Screening Risk Assessment (SRA).

- Chemical Data: Soil and groundwater chemical data will be collected for BTEX, MTBE, TPH, and PAHs to determine if target analytes are present. In addition to these target analytes identified by RG-411, the presence of lead scavengers ethylene dibromide (EDB) and 1,2-dichloroethane (1,2-DCA) in groundwater will be assessed. The concentrations of any detected target analytes will be compared to their respective PALs and the results will support the decision making process for future actions such as permanent monitoring well installation.

- Project Screening Limits: PALs for this investigation are the Texas PST Program Action Levels (TCEQ, 12 August 2011). These soil and groundwater action levels are the lowest applicable health based or groundwater protective target concentration for BTEX, MTBE, TPH and PAHs, and include limitations toward their use that precludes the presence of NAPLs in environmental media onsite and also potential for direct impacts to surface water or impacts associated with vapor intrusion. The PALs for the Texas PST program do not identify a class of receptors as either residential or industrial. The PALs for lead scavengers EDB and 1,2-DCA are identified in the 2010 U.S. EPA technical memorandum on lead scavengers. The PALs for all COPCs are in Worksheet #15. UST Site 9 former FF217 and FF244 sites are not currently in a TCEQ program; as such, TCEQ standards from more than one program could eventually become applicable. The project requires laboratory data that can be compared to PALs so that appropriate decisions can be made. Laboratory quantitation limits must be low enough to measure COPC concentrations equal to or below the PALs.

- Field Screening: Results of field screening, including the use of a photoionization detector (PID) to measure organic vapors and visual inspection of soils and groundwater samples for the presence of NAPL, will assist with characterization and in selecting soil samples to be submitted for laboratory analysis. If NAPL is visible in a given sample, the sample will not need to be analyzed in a lab setting because the presence of NAPL is already a determining factor in listing a site in the Texas PST program. The PID results are not considered definitive; thus, decision making will be made using analytical data.

11.4 Define the Study Boundaries

FF217 consists of eight 25,000-gallon USTs laid out in an approximately half acre site, less than 100 feet from the shore of Laguna Madre (Figure 10-2). FF244 consists of eight 25,000-gallon USTs laid out in an approximately half acre site near Building 252 in the central part NAS Corpus Christi (Figure 10-3).

The populations of interest are the soil and groundwater that have been contaminated either directly (by site operations) or indirectly (by subsequent migration of contaminants). The Texas PST program guidance in RG-411 suggests sampling from two depths at each location unless groundwater is encountered prior to the bottom of the tank hold. The tank hold is defined in the guidance as the footprint of the tank or tanks plus 3 feet out laterally and vertical limits are defined as 1 foot below the bottom of the tank. Tank depths are currently assumed to be 15 feet; shallow groundwater is expected to be encountered between 10 and 20 feet below ground surface (bgs) at FF244 and less than 10 feet bgs at FF217. Therefore, the vertical boundary of the SI extends from the ground surface to approximately 10 to 16 feet bgs. There are no existing monitoring wells at either FF217 or FF244 but groundwater is currently assumed to be present at both fuel farm sites near or above the bottom of the tank holds.

Temporal boundaries of the SI include the estimated duration of the field activities.

11.5 Analytical Approach

The SI will investigate potential contamination and assess potential threats to human health and the environment at the site. Biased sampling locations will be collected within the area of suspected contaminated area based TCEQ RG-411 guidance. Sampling locations may be adjusted based on field observations and professional judgment.

Initial determinations on the need for follow-up action will be based on whether analytical data exceed PALs. Prior to implementing decision rules, risk managers will review the analytical data and effective pathways to determine if the site poses any unacceptable risk, whether additional information is needed, or whether tank closure can be sought. The resulting decision rules are summarized as follows.

The decision rules for the investigations are:

- Decision Rule 1: If TPH is detected in soil or groundwater, the sample with the highest TPH >C12 concentration must be analyzed for PAHs.

- Decision Rule 2: If soil or groundwater exceed PALs, then the site meets the requirements for listing in the Texas PST Program and additional investigation and/or response actions may be required to meet the site closure needs of 30 TAC 334. However, if the former tank farms comply with closure requirements outlined in RG-411, then a Release Determination Report (TCEQ–0621) requesting closure/no further action will be submitted.

- Decision Rule 3: If NAPL is present in either soil or groundwater, then the site meets the requirements for listing in the Texas PST Program and additional investigation and/or response action may be required to meet the site closure needs of 30 TAC 334.[1]

- Decision Rule 4: If the ecological checklist and resulting scientific management decision indicate the presence of sufficient ecological habitat, then an SRA will be recommended to determine if unacceptable risk is present.[2] If the ecological checklist and resulting scientific management decision do not indicate the presence of sufficient ecological habitat, then no further action is required to evaluate ecological risks.

- Decision Rule 5: If groundwater PAL exceedances have been identified (or free product is present), permanent monitoring wells will be recommended.

As stated previously, investigations will be focused on meeting the requirements outlined by TCEQ guidance RG-411, *Investigating and Reporting Releases from Petroleum Storage Tanks (PST)* (August 2012). The decision rules described above are based on this guidance; the flow chart in Figure 11-1 summarizes regulatory guidance.

11.6 Performance Criteria

The objective of this section is to complete the following:

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

Sampling Strategy — Biased sampling will be used to collect soil and groundwater to fill data gaps for decision making purposes. This sampling approach was developed, based on TCEQ RG-411 guidance, to determine if any further remedial work is required in the source zone, to characterize COPCs in soil and groundwater, and to help in determining future actions.

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[1] No groundwater samples will be collected from locations with identifiable free product.
[2] Supplemental sampling may be necessary to further characterize receptors. If required, sampling will be scoped upon completion of the ecological checklist.

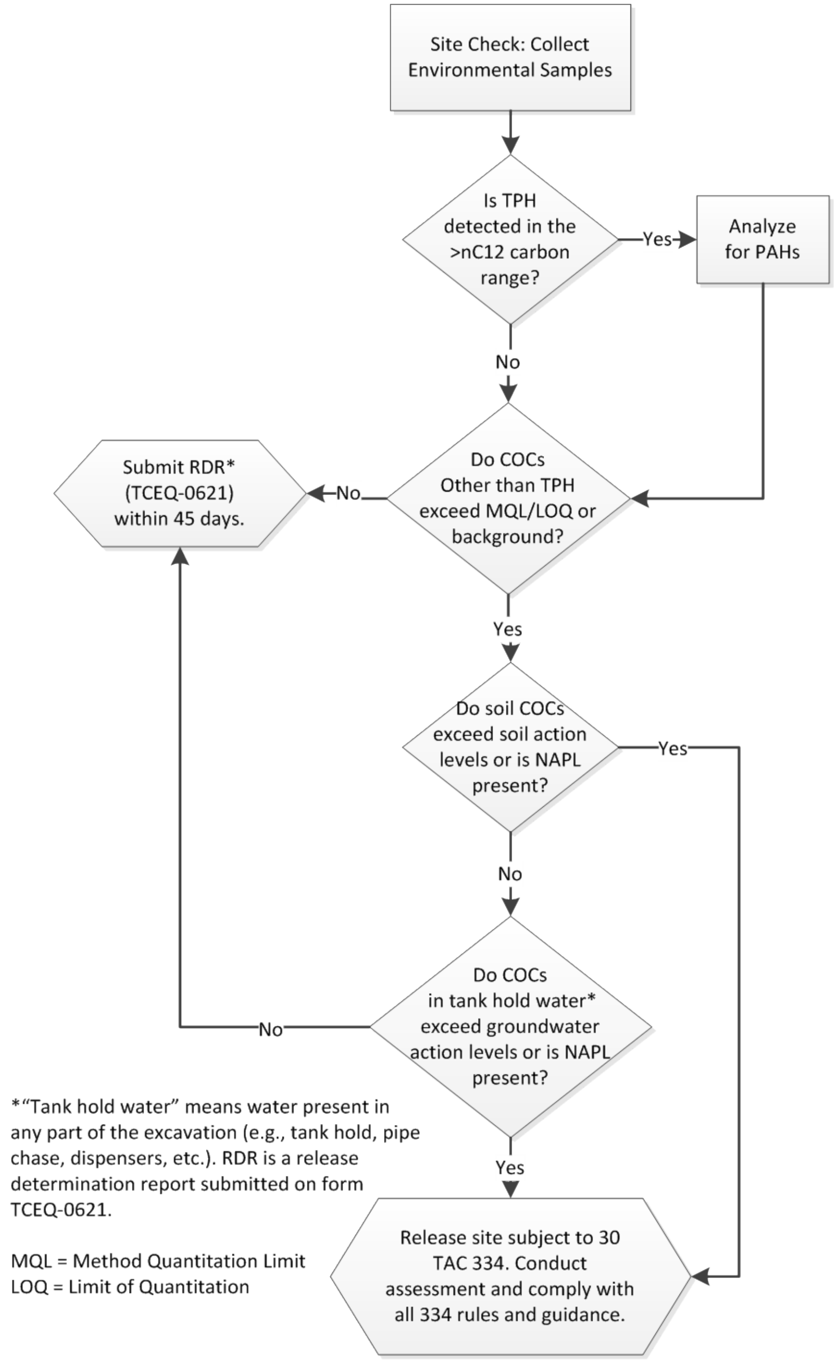


Figure 11-1 Investigation Flow Chart

PST Release Investigation — Release Determination Reporting (Source: RG-411 Figure 2)

Sources of Error — Sources may be divided into two main categories: sampling errors and measurement errors. A sampling error occurs when the sampling design, planning, and implementation do not provide for a representative range of heterogeneity at the site. A measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The U.S. EPA identifies the combination of all these errors as a "total study error" (U.S. EPA 2006). One objective of the investigation is to reduce the total study error so that decision-makers can be confident that the data collected accurately represent the chemical characteristics of the site.

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

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

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

Sampling Methodologies and Procedures — Possible decision errors generated by sampling errors will be minimized during the field investigation by applying standardized field sampling methodologies (discussed in Worksheets #18, #20, #21, and #22). Sampling activities will be performed in accordance with the SOPs specified in Appendix A of this SAP.

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

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

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

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

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

11.7 Sampling Design

Non-statistical methods (professional judgment), based on TCEQ RG-411 guidance, will be used as the primary basis for the sampling design. This approach was chosen to identify the extent of specific COPCs and assess whether or not an impact to human or ecological receptors (if any) has occurred. The sample design, rationale, and locations are presented in Worksheets #17 and #18. These worksheets identify where soil and groundwater samples will be collected and the analyses to be conducted for each sample.

SAP WORKSHEET #12: FIELD QUALITY CONTROL SAMPLES

(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table — Field QC Samples

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria
Trip Blanks	EDB, 1,2-DCA, BTEX and MTBE	One per cooler containing EDB, 1,2-DCA, BTEX and MTBE samples	Accuracy/Bias/ Contamination	No analytes > ½ LOQ, except common lab contaminants, which must be < LOQ
Equipment Rinsate Blanks	EDB, 1,2-DCA, BTEX, MTBE, PAHs, and TPH	One per matrix per sampling event [1]	Accuracy/Bias/ Contamination	No analytes > ½ LOQ, except common lab contaminants, which must be < LOQ
Field Duplicates	EDB, 1,2-DCA, BTEX, MTBE, PAHs, and TPH	One per 10 field samples	Precision	Values > 5X LOQ: RPD must be ≤30 (aqueous); ≤50 (solids)[2].
Matrix Spike/Matrix Spike Duplicate	EDB, 1,2-DCA, BTEX, MTBE, PAHs, and TPH	One pair per 20 field samples	Accuracy/Bias/ Precision	Percent recoveries — DoD QSM Limits RPD must be ≤ 30
Cooler Temperature Indicator	All	One per cooler	Representative ness	Temperature less than 6 degrees Celsius

Notes:

[1] Equipment rinsate blanks will be collected when decontamination is required.

[2] If duplicate values are less than five times the LOQ, the absolute difference should be less than or equal to two times the LOQ.

EDB = Ethylene dibromide
1,2-DCA = 1,2-Dichloroethane
BTEX = Benzene, toluene, ethylbenzene, xylenes
MTBE = Methyl tert-butyl ether
PAHs = Polynuclear aromatic hydrocarbons
TPH = Total petroleum hydrocarbons
LOQ = Limit of Quantitation
RPD = Relative Percent Difference
DoD QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010 or the most recent version at the time of sampling.

SAP WORKSHEET #13: SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

(UFP-QAPP Manual Section 2.7)

Secondary Data Criteria and Limitations Table				
Secondary Data	**Data Source (originating organization, report title and date)**	**Data Generator(s) (originating organization, data types, data generation/collection dates)**	**How Data Will Be Used**	**Limitations on Data Use**
Historical Background Information	RCRA Facility Assessment Evaluation, Preliminary Review, Visual Site Inspection, Corpus Christi Naval Air Station, May 1989	*Originating Organization*: U.S. EPA Region 6 *Data Types*: Background information *Data Collection Dates*: 1989	Background information was used in planning of the sampling effort	None
Historical Background Information	Internal files including historical utility maps and aerial photos, site chronology notes, unpublished draft reports and proposals, communication logs	*Originating Organization*: NAS Corpus Christi *Data Types*: Background information *Data Collection Dates*: 1951 — 2009	Background information was used in planning of the sampling effort	Not Available for Publication

Notes:
RCRA = Resource Conservation and Recovery Act
U.S. EPA = United States Environmental Protection Agency
NAS = Naval Air Station

SAP WORKSHEET #14: SUMMARY OF PROJECT TASKS

(UFP-QAPP Manual Section 2.8.1)

The following project tasks are summarized below:

- Field Tasks
- Analytical Tasks
- Data Management and Review
- Project Report

Field Tasks

Mobilization/Demobilization — Mobilization includes procurement of field equipment and supplies; a Site walkover; mobilization of field staff, equipment, and supplies to the Site; and Site set-up. The Navy Remedial Project Manager (RPM) and NAS Corpus Christi point of contact (POC) will be notified of Resolution Consultants' mobilizations a minimum of 1 week before the start of field activities.

A field team orientation meeting will be conducted prior to starting the fieldwork to familiarize the team personnel with the Site-specific health and safety requirements, the objectives and scope of the field activities, and chain-of-command. This meeting will be attended by the field staff and conducted by the Field Team Leader (FTL).

Demobilization includes removing field equipment and supplies from the site, returning rented equipment, managing investigation derived waste (IDW), performing general site cleanup, organizing and finalizing field paperwork, and entering field records/data into the database.

Utility Clearance — The Resolution Consultants FTL will coordinate verbally or via e-mail with NAS Corpus Christi POC at least 7 days in advance of the site access to initiate the utility clearance process for all intrusive sampling locations in accordance with SOP-3-01. The Resolution Consultants FTL will contact both the Texas 811 utility locator service and NAS Corpus Christi POC verbally or via electronic-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.

Utilities that are identified in the field, but not shown or incorrectly located on the work approval documentation, will be marked directly on the document and returned to the NAS Corpus Christi POC for inclusion in the Geographic Information System database.

TDEM Geophysical Survey — A TDEM geophysical survey will be conducted at both fuel farms, to confirm tank and piping layout in accordance with SOP-3-09. TDEM will locate only metallic features to a depth of approximately 6 feet. The basis of the TDEM surveys is to cover an area of approximately 74,000 square feet at each fuel farm, with data collected at a high density over a subset of this area (about 150 feet by 250 feet based on the FF244 layout sketch) to precisely locate the tanks: lines will be located approximately 5 feet apart and data collected every 0.5 foot along the lines. Outside of the tank areas, data collection will be less dense, e.g., lines every 20 to 50 feet, with the objective of tracing the layout of pipes that radiate out from the tank array and manifolds. After data processing, the TDEM survey results will be projected on a site map and sample location coordinates will be selected. Field personnel for the soil sampling task will use these coordinates to locate and stake boring locations in the field.

Soil Sampling — The soil sampling and analysis program is outlined in Worksheets #17 and #18. Subsurface soil samples will be collected from soil borings advanced via direct push technology (DPT) tooling, in accordance with SOP-3-17(CC) and SOP-3-21. Sample collection and handling will be in accordance with SOP-3-03A, SOP-3-04A, and SOP-3-21 and as described in Worksheet #21. At the discretion of the FTL, head space samples per SOP-3-21 and SOP-3-19 may be used to select soil samples based on qualitative TPH concentration data from a PID; however head space readings are not required for soil sample collection. If a photoionization detector (PID) is used for soil screening, SOP-3-20 will be followed for calibration. All soil samples will be collected as discrete grab samples. A soil boring log will be prepared for each boring with soil descriptions and relevant information, observations, depth to water, sample depths, and field screening results in accordance with SOP-3-17(CC). After sampling, each borehole will be backfilled to within 6 to 24 inches of grade using bentonite grout or other acceptable method described in SOP-3-17(CC). After 24 hours, the grouted borehole will be inspected for grout shrinkage and re-grouted if necessary. The remaining portion of the hole will be filled with soil cuttings removed from borehole, local topsoil, and/or appropriate paving materials to match areas where pavements are impacted by the boring location.

Groundwater Sampling — Six temporary groundwater monitoring wells per fuel farm will be installed by DPT, completed, and developed in accordance with SOP-3-17(CC). Well locations will be upgradient (1), downgradient (1), cross gradient (2), and located within the tank holds or pipeline chases based on locations (2) exhibiting the highest PID readings. At the discretion of the FTL, head space samples per SOP-3-21 and SOP-3-19 may be used to select temporary well locations based on qualitative soil TPH concentration data from a PID; however head space readings are not required for temporary well location selection. If a PID is used for selection of temporary well locations, SOP-3-20 will be followed for calibration. Groundwater will be sampled in accordance with SOP-3-17(CC) and SOP-3-14. Well development for these temporary wells will consist of obtaining stabilized water quality parameters in accordance with SOP-3-24. In the event that a temporary well does not produce sufficient groundwater for a groundwater sample, that well may be surged at the discretion of the FTL with input from the driller or replaced by a temporary well at a different location. Groundwater is expected to be encountered above or near the base of the tank holds. Groundwater samples will be collected from properly developed temporary wells using dedicated tubing and peristaltic pumps in accordance with SOP-3-17(CC) and SOP-3-24. Sample collection and handling will be in accordance with SOP-3-03A, SOP-3-04A, and SOP-3-24 and as described in Worksheet #21. All temporary wells will be removed within 48 hours of well completion, the boreholes will be backfilled to within 6 to 24 inches of grade using bentonite grout or other acceptable method described in SOP-3-17(CC). After 24 hours, the grouted borehole will be inspected for grout shrinkage and re-grouted if necessary. The remaining portion of the hole will be filled with soil cuttings removed from borehole, local topsoil, and/or appropriate paving materials to match areas where pavements are impacted by the boring location. Well abandonment reports will be prepared in accordance with State of Texas water well abandonment requirements.

Ecological Receptor Survey/Checklist — A field survey of potential ecological receptors will be conducted within a 0.5-mile radius of each range to properly evaluate ecological risk. The Texas Commission on Environmental Quality (TCEQ) Tier I ecological exclusion criteria checklist will be used to assess whether or not further ecological evaluation is necessary. This checklist will aid in determining whether there are incomplete or insignificant ecological exposure pathways due to the nature of the affected property setting and/or the condition of the affected property media. The TCEQ Tier I ecological exclusion checklist is in Appendix A.

Field Documentation Procedures — Field documentation will be performed in accordance with Resolution Consultants SOP-3-02. Sample collection information will be recorded in bound field notebooks or specific field forms. Samples will be packaged and shipped according to Resolution Consultants SOP-3-04A.

A summary of field activities will be properly recorded in indelible ink in a bound logbook with consecutively numbered pages that cannot be removed. Logbooks will be assigned to field personnel and stored in a secured area when not in use.

All entries will be written in indelible ink, and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; and the person making the correction will initial and date the change. Boring logs, sampling forms, and other field forms will also be used to document field activities.

Surveying — Soil sampling locations will be marked in the field using a wooden stake or brightly colored pin flag. Coordinates of each sample location will be determined by Global Positioning System, in accordance with SOP-3-07.

Field Quality Control Tasks — Field quality control (QC) samples will be collected as part of each sample round, including field duplicates, matrix spikes, and matrix spike duplicates, and equipment rinsate blanks (if sampling tools are decontaminated in the field). Worksheet #20 presents the field QC sample summary.

Decontamination — Non-disposable equipment that comes into contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points. Decontamination of sampling equipment will not be necessary for dedicated and disposable samplers. Decontamination of reusable sampling equipment (e.g., non-disposable spoons and hand augers) will be conducted prior to sampling and between samples at each location. The decontamination procedures in SOP-3-06 will be followed.

Investigation-Derived Waste — Solid or liquid decontamination fluids will be generated during field activities. To the extent possible, soil removed during sampling activities but not included in the sample volume shipped to the laboratory for analysis will be replaced into the boring from which it was removed.

If non-disposable equipment is used to collect soil samples, liquid IDW decontamination fluids, will be handled in accordance with Resolution Consultants SOP-3-05-TX. All aqueous IDW will be containerized in drums provided by the NAS Corpus Christi Public Works Department. The Public Works Department will pick up the filled drums and stage them at the designated waste accumulation area to await waste characterization analyses. Based on waste characterization results, the drummed IDW will be transported and appropriately disposed at a Navy-approved offsite disposal facility coordinated through the NAS Corpus Christi Public Works Department. Used personal protective equipment will be bagged and disposed of as regular trash in an appropriate facility waste container.

Analytical Tasks

To support the environmental decisions, the analytical laboratory will hold and maintain current National Environmental Laboratory Accreditation Program (NELAP) accreditation in Texas. In addition, the laboratory will be accredited through the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP). The laboratory analytical data packages will contain summary forms, raw data, laboratory review checklists and exception reports and will comply with TCEQ's *Regulatory Guidance for Review and Reporting of Chemical of Concern Concentration Data under TRRP* (RG-366/TRRP-13 May 2010).

Chemical analyses will be performed by Gulf Coast Analytical Laboratories (GCAL) who holds accreditation from both the Texas NELAP and DoD ELAP. Analyses will be performed in accordance with the analytical methods identified in Worksheet #19 and the laboratory will strive to meet the project quantitation limit goals specified in Worksheet #15. GCAL will perform the chemical analyses following laboratory-specific SOPs identified in Worksheet #23. Full laboratory SOPs are available upon request.

The laboratory will report soil results on a dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated electronic data deliverable (EDD) files. This information will also be captured in the project database, which will eventually be uploaded to the Naval Installation Restoration Information Solution (NIRIS) database.

Data Management and Review

The principal data generated for this project will be from field data and laboratory analytical data. The field forms, chain of custody, air bills, and logbooks will be placed in the project files after the completion of the field program. The field logbooks for this project will be used only for this site, and will also be categorized and maintained in the project files after the completion of the field program. All project records will be maintained in a secure location.

Data Tracking — The Resolution Consultants Task Order Manager (TOM), or designee, is responsible for the overall tracking and control of data generated for the project. Data are tracked from generation to archiving in the project specific files. The project chemist, or designee, is responsible for tracking the samples collected and shipped to the contracted laboratory. Upon receipt of the data packages from the analytical laboratory, the project chemist will oversee the data validation effort, which includes verifying that the data packages are complete and that results for all samples have been delivered by the analytical laboratory.

Resolution Consultants shall submit all Administrative Record Files, Site Files, and Post Decision Files in accordance with the specifications defined in the NAVFAC *Environmental Restoration Recordkeeping Manual* (NAVFAC, 2009). Additionally, Resolution Consultants will update and manage the project related documents, data, and maps in NIRIS. Project related spatial data including maps, models, and associated collected or created data will also be uploaded into NIRIS. All documentation submittals for NIRIS will be coordinated with the Navy RPM.

Data Storage, Archiving, and Retrieval — After the data are validated, the data packages are entered into the Resolution Consultants' file system and archived in secure files. The field records including field logbooks, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Resolution Consultants FTL to be entered into the file system before archiving in secure project files. Project files are audited for accuracy and completeness. Project files will be kept in a secured, limited access area. At the completion of the Navy contract, files will be shipped to the Federal Records Center for storage where the files will remain until 50 years after the last decision document for NAS Corpus Christi.

Data Security — Access to Resolution Consultants project files is restricted to designated personnel only. The Resolution Consultants data manager maintains the electronic data files, and access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

Electronic Data — Laboratory data, provided in electronic format, will be verified for accuracy prior to use and during the data validation process. After data are validated, the electronic data results will be uploaded into the Resolution Consultants database for use in data evaluation and subsequent report preparation. The project database will be on a password protected secure network and access to changing data files will be restricted to qualified personnel. The Resolution Consultants TOM (or designee) is responsible for the overall tracking and control of data generated for the project. All final electronic data and administrative records will be compiled and uploaded into NIRIS for final repository.

Data Review and Validation — After receipt of analytical laboratory results, Resolution Consultants will verify data completeness as specified on Worksheet #34. To ensure that the analytical results meet the project quality objectives, the laboratory data will undergo verification and validation as cited in Worksheets #34 through #36 and described below. The usability assessment processes are described in Worksheet #37.

Prior to data validation, electronic laboratory data will be verified for accuracy against the hardcopy laboratory report and the electronic quality assurance project plan (eQAPP) will be established using the project-specific criteria defined in Worksheets #12, #19, and #28. The laboratory will be requested to resubmit electronic data found to be inaccurate.

During the data validation process, the Resolutions Consultant's Data Validation Assistant (DVA) tool will be used to review method accuracy and precision data from field and laboratory QC samples contained in the laboratory EDD and qualify that data according to the project-specific eQAPP. The DVA tool uses the power of EarthSoft's EQuIS relational database to assemble a series of Excel worksheets into a DVA workbook for the validator that present:

- Data validation QC elements that need review, compared to control limits stored in the project-specific eQAPP
- Associated sample results for duplicated samples and blanks
- A place to make the necessary qualifications and result updates directly into an electronic format documentation of qualifications using coded reasons
- A list of all samples affected by the qualification

Laboratory calibration will be assessed against the criteria presented in Worksheet #24 using the hardcopy laboratory report, and the results of these findings will be added to the Excel DVA workbook. The DVA workbook ultimately serves as an EDD to update the project database with the validator's changes. Using standard EQuIS tools that check and load data, qualifiers and edits are directly uploaded to the database, thereby eliminating the manual data entry process and allowing for 100 percent of data to be reviewed prior to uploading to the project database.

Project Reports

Resolution Consultants will compile, review, and evaluate available data, and produce an SI Report. If during data evaluation, additional information is required to complete the SI process, Resolution Consultants will prepare recommendations for the Navy to fill data gaps as a modification to this SAP. Report elements will include a summary of field efforts, deviations from the work planning documents (if any), data tables and figures, comprehensive discussion of the nature and extent of contamination, and all other standard Navy requirements for SI Reports, and will conclude whether additional action(s) are warranted or if a no further action determination can be made.

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

(UFP-QAPP Manual Section 2.8.1)

TPH does not have action levels as it is used to determine whether PAHs need to be analyzed.

Matrix: Soil
Analytical Group: BTEX and MTBE
Analytical Method: SW-846 Method 8260B

Analyte	CAS No.	Project Action Level (mg/kg)	Project Action Level Source	Project Quantitation Limit Goal (mg/kg)	Laboratory Limit of Quantitation[1] (mg/kg)	Laboratory Limit of Detection[1] (mg/kg)	Laboratory Method Detection Limit[1] (mg/kg)
Benzene	71-43-2	0.12	RG-411	0.04	0.005	0.0005	0.000051
Ethylbenzene	100-41-4	36.8	RG-411	13	0.005	0.0005	0.000183
Toluene	108-88-3	39.1	RG-411	13	0.005	0.0005	0.000107
Xylene (Total)	1330-20-7	117	RG-411	39	0.015	0.0015	0.000247
Methyl Tert-Butyl Ether	1634-04-4	2.56	RG-411	0.83	0.005	0.0005	0.000061
Total Petroleum Hydrocarbons (>C12)	NA	NA	RG-411	NA	10	5	1

Notes:

[1] LOQ, LOD, and DLs are provided by Gulf Coast Analytical Laboratories and are targets that are achievable under optimal conditions; they may vary during the course of the project. Soil results will be reported on a dry weight basis. Physical characteristics, such as moisture content, will affect the actual limits achieved.

BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
CAS = Chemical Abstracts Service
mg/kg = Milligram per kilogram
NA = not applicable
RG-411 = *Investigating and Reporting Releases from Petroleum Storage Tanks,* Texas Commission on Environmental Quality Regulatory Guidance RG-411, Revised August 2011

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES (continued)

Matrix: Soil
Analytical Group: Polynuclear Aromatic Hydrocarbons
Analytical Method: SW-846 Method 8270D (dibenzofuran) and 8270D — SIM (remaining PAHs)

Analyte	CAS No.	Project Action Level (mg/kg)	Project Action Level Source	Project Quantitation Limit Goal (mg/kg)	Laboratory Limit of Quantitation[1] (mg/kg)	Laboratory Limit of Detection[1] (mg/kg)	Laboratory Method Detection Limit[1] (mg/kg)
Acenaphthene	83-32-9	34.1	RG-411	11	0.00333	0.00165	0.000828
Acenaphthylene	208-96-8	54.7	RG-411	18	0.00333	0.00165	0.000530
Anthracene	120-12-7	2.04	RG-411	0.68	0.00333	0.00165	0.000227
Benzo(a)anthracene	56-55-3	0.877	RG-411	0.29	0.00333	0.00165	0.000669
Benzo(a)pyrene	50-32-8	0.0877	RG-411	0.029	0.00333	0.00165	0.000400
Benzo(b)fluoranthene	205-99-2	0.877	RG-411	0.29	0.00333	0.00165	0.000892
Benzo(g,h,i)perylene	191-24-2	0.824	RG-411	0.27	0.00333	0.00333	0.000716
Benzo(k)fluoranthene	207-08-9	1.35	RG-411	0.45	0.00333	0.00165	0.000312
Chrysene	218-01-9	1.24	RG-411	0.41	0.00333	0.00333	0.000347
Dibenz(a,h)anthracene	53-70-3	0.0877	RG-411	0.029	0.00333	0.00333	0.000410
Dibenzofuran	132-64-9	48.8	RG-411	16	0.33	0.033	0.005135
Fluoranthene	206-44-0	25.5	RG-411	8.5	0.00333	0.00165	0.000613
Fluorene	86-73-7	30.2	RG-411	10	0.00333	0.00165	0.000314
Indeno(1,2,3-cd)pyrene	193-39-5	0.877	RG-411	0.29	0.00333	0.00333	0.000591
Naphthalene	91-20-3	99.7	RG-411	33	0.00333	0.00333	0.000543
Phenanthrene	85-01-8	28.2	RG-411	9.4	0.00333	0.00165	0.000574
Pyrene	129-00-0	10.3	RG-411	3.4	0.00333	0.00165	0.000521

Notes:
[1] LOQ, LOD, and DLs are provided by Gulf Coast Analytical Laboratories and are targets that are achievable under optimal conditions; they may vary during the course of the project. Soil results will be reported on a dry weight basis. Physical characteristics, such as moisture content, will affect the actual limits achieved.

SIM = Selective ion monitoring
PAHs = Polynuclear aromatic hydrocarbons
CAS = Chemical Abstracts Service
mg/kg = Milligram per kilogram
RG-411 = *Investigating and Reporting Releases from Petroleum Storage Tanks,* Texas Commission on Environmental Quality Regulatory Guidance RG-411, Revised August 2011

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES (continued)

TPH does not have action levels as it is used to determine whether PAHs need to be analyzed.

Matrix: Groundwater
Analytical Group: Selected VOCs: Ethylene Dibromide, 1,2-Dichloroethane, BTEX and MTBE
Analytical Method: SW-846 Method 8011 (Ethylene Dibromide) and 8260B (remaining VOCs)

Analyte	CAS No.	Project Action Level (µg/L)	Project Action Level Source	Project Quantitation Limit Goal (µg/L)	Laboratory Limit of Quantitation[1] (µg/L)	Laboratory Limit of Detection[1] (µg/L)	Laboratory Method Detection Limit[1] (µg/L)
Benzene	71-43-2	5	RG-411	1.7	1	0.2	0.111
Ethylene Dibromide	106-93-4	5	TX CI $^{GW}GW_{Class3}$	0.05	0.01	0.01	0.0039
Ethylbenzene	100-41-4	700	RG-411	230	1	0.2	0.109
1,2-Dichloroethane	107-06-2	500	TX CI $^{GW}GW_{Class3}$	5	1	0.2	0.116
Toluene	108-88-3	1000	RG-411	330	1	0.2	0.122
Xylene (Total)	1330-20-7	10000	RG-411	3300	3	0.6	0.179
Methyl Tert-Butyl Ether	1634-04-4	240	RG-411	80	1	0.2	0.078
Total Petroleum Hydrocarbons (>C12)	NA	NA	RG-411	NA	5000	1000	1000

Notes:

[1] LOQ, LOD, and DLs are provided by Gulf Coast Analytical Laboratories and are targets that are achievable under optimal conditions; they may vary during the course of the project.

VOCs	=	Volatile organic compounds
BTEX	=	Benzene, toluene, ethylbenzene, xylenes (total)
MTBE	=	Methyl tert-butyl ether
CAS	=	Chemical Abstracts Service
µg/L	=	Micrograms per Liter
NA	=	not applicable
RG-411	=	*Investigating and Reporting Releases from Petroleum Storage Tanks,* Texas Commission on Environmental Quality Regulatory Guidance RG-411, Revised August 2011
TX CI $^{GW}GW_{Class3}$	=	Tier 1 Commercial/Industrial Groundwater Protective Concentration Level for 0.5 acre source area and Class 3 Groundwater, June 2012

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES (continued)

Matrix: Groundwater
Analytical Group: Polynuclear Aromatic Hydrocarbons
Analytical Method: SW-846 Method 8270D (dibenzofuran) and 8270D- SIM (remaining PAHs)

Analyte	CAS No.	Project Action Level (µg/L)	Project Action Level Source	Project Quantitation Limit Goal (µg/L)	Laboratory Limit of Quantitation[1] (µg/L)	Laboratory Limit of Detection[1] (µg/L)	Laboratory Method Detection Limit[1] (µg/L)
Acenaphthene	83-32-9	2190	RG-411	730	0.1	0.05	0.037
Acenaphthylene	208-96-8	2190	RG-411	730	0.1	0.10	0.070
Anthracene	120-12-7	11000	RG-411	3700	0.1	0.05	0.024
Benzo(a)anthracene	56-55-3	0.117	RG-411	0.039	0.1	0.10	0.059
Benzo(a)pyrene	50-32-8	0.2	RG-411	0.067	0.1	0.05	0.022
Benzo(b)fluoranthene	205-99-2	0.117	RG-411	0.039	0.1	0.05	0.018
Benzo(g,h,i)perylene	191-24-2	1100	RG-411	370	0.1	0.05	0.036
Benzo(k)fluoranthene	207-08-9	1.17	RG-411	0.39	0.1	0.05	0.039
Chrysene	218-01-9	11.7	RG-411	3.9	0.1	0.05	0.018
Dibenz(a,h)anthracene	53-70-3	0.2	RG-411	0.067	0.1	0.05	0.034
Dibenzofuran	132-64-9	146	RG-411	49	10	0.5	0.198
Fluoranthene	206-44-0	1460	RG-411	487	0.1	0.05	0.039
Fluorene	86-73-7	1460	RG-411	487	0.1	0.10	0.097
Indeno(1,2,3-cd)pyrene	193-39-5	0.117	RG-411	0.039	0.1	0.05	0.040
Naphthalene	91-20-3	730	RG-411	240	0.1	0.05	0.037
Phenanthrene	85-01-8	1100	RG-411	370	0.1	0.05	0.028
Pyrene	129-00-0	1100	RG-411	370	0.1	0.05	0.036

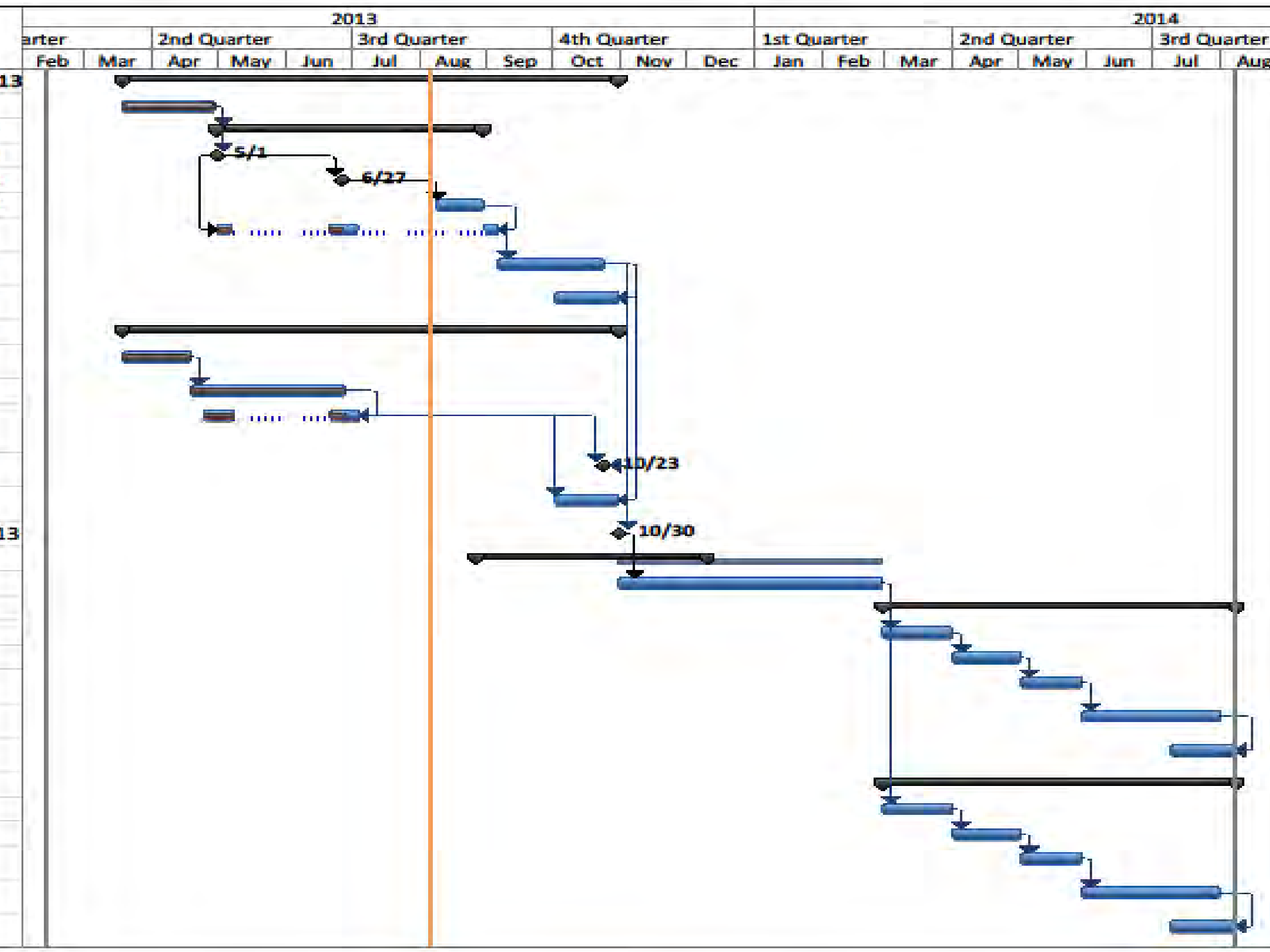
Notes:
[1] LOQ, LOD, and DLs are provided by Gulf Coast Analytical Laboratories and are targets that are achievable under optimal conditions; they may vary during the course of the project.

SIM = Selective ion monitoring
PAHs = Polynuclear aromatic hydrocarbons
CAS = Chemical Abstracts Service
µg/L = Micrograms per Liter
RG-411 = *Investigating and Reporting Releases from Petroleum Storage Tanks,* Texas Commission on Environmental Quality Regulatory Guidance RG-411, Revised August 2011

SAP WORKSHEET #16: PROJECT SCHEDULE/TIMELINE TABLE

(UFP-QAPP Manual Section 2.8.2)

ID	WBS	Task Name	Duration	Start	Finish
1	1	**UFP-SAP/QAPP**	**162 days**	**Tue 3/19/13**	**Wed 10/30/13**
2	1.1	Draft UFP-SAP/QAPP	30 days	Tue 3/19/13	Mon 4/29/13
3	1.2	**Navy Review & Comments**	**87 days**	**Wed 5/1/13**	**Thu 8/29/13**
4	1.2.1	RPM Review of Worksheets 10, 11, 17	0 days	Wed 5/1/13	Wed 5/1/13
5	1.2.2	DQO Team Meeting (Worksheets 10, 11, 17)	0 days	Thu 6/27/13	Thu 6/27/13
6	1.2.3	Navy Chemist Review of Worksheets 10, 11, 17	15 days	Fri 8/9/13	Thu 8/29/13
7	1.3	Comment Response & Draft Final UFP-SAP/QAPP	19 days	Wed 5/1/13	Thu 9/5/13
8	1.4	Regulatory Review (TCEQ & USEPA)	34 days	Fri 9/6/13	Wed 10/23/13
9	1.5	Response to Comments & Final UFP-SAP/QAPP	21 days	Wed 10/2/13	Wed 10/30/13
10	2	**SI Work Plan & HASP**	**162 days**	Tue 3/19/13	Wed 10/30/13
11	2.1	Draft SI Work Plan & Draft HASP	23 days	Tue 3/19/13	Thu 4/18/13
12	2.2	Navy Review & Comments (HASP)	50 days	Fri 4/19/13	Thu 6/27/13
13	2.3	Response to Comments & Draft Final SI Work Plan & Final HASP	19 days	Thu 4/25/13	Thu 7/4/13
14	2.4	Regulatory Review SI Work Plan (TCEQ & USEPA)	0 days	Wed 10/23/13	Wed 10/23/13
15	2.5	Response to Comments & Final SI Work Plan	21 days	Wed 10/2/13	Wed 10/30/13
16	3	Final RI Work Plan (UFP-SAP & HASP)	0 days	Wed 10/30/13	Wed 10/30/13
17	3	**SI Field Work**	**75 days**	Tue 8/27/13	Mon 12/9/13
18	4.1	SI Field Work	86 days	Thu 10/31/13	Thu 2/27/14
19	4	**SI Report**	**115 days**	Fri 2/28/14	Thu 8/7/14
20	4.1	Draft SI Report	22 days	Fri 2/28/14	Mon 3/31/14
21	4.2	Navy Review & Comments	23 days	Tue 4/1/14	Thu 5/1/14
22	4.3	Response to Comments & Draft Final SI Report	20 days	Fri 5/2/14	Thu 5/29/14
23	4.4	Regulatory Review (TCEQ & USEPA)	45 days	Fri 5/30/14	Thu 7/31/14
24	5.5	Response to Comments & Final SI Report	22 days	Wed 7/9/14	Thu 8/7/14
25	5	**Feasibility Study**	**115 days**	Fri 2/28/14	Thu 8/7/14
26	5.1	Draft FS Report	22 days	Fri 2/28/14	Mon 3/31/14
27	5.2	Navy Review & Comments	23 days	Tue 4/1/14	Thu 5/1/14
28	5.3	Response to Comments & Draft Final FSReport	20 days	Fri 5/2/14	Thu 5/29/14
29	5.4	Regulatory Review (TCEQ & USEPA)	45 days	Fri 5/30/14	Thu 7/31/14
30	6.5	Response to Comments & Final FS Report	22 days	Wed 7/9/14	Thu 8/7/14



Project: JM46_SI_FuelFarms_217-244_NASCC__trackingschedule_6AUG2013
Date: Tue 8/6/13
JM46 NAS Corpus Christi Texas
UST Site 9 SI: Fuel Farms 217 & 244

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

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SAP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

(UFP-QAPP Manual Section 3.1.1)

17.1 General Sampling Design and Rationale

The sampling design and rationale was developed using information on historical operations, the CSM (including subsurface conditions and anticipated groundwater flow directions) as presented in Worksheet #10, assumptions regarding potential contaminant distribution, general site information collected during previous studies, and guidance provided on Texas PST Program requirements in RG-411. The steps outlined in this worksheet represent the initial steps in the SI.

17.1.1 Geophysical Survey

For each fuel farm site, TDEM geophysical surveys will cover an area of approximately 74,000 square feet, with data collected at a high density over a subset of this area (about 150 feet by 250 feet based on the FF244 layout sketch) to precisely locate the USTs. Survey lines will be spaced every 5 feet or better and data collected along that line at 0.5 feet. Outside of the tank areas, data collection will be less dense, every 20 to 50 feet, with the objective of tracing the layout of pipes that radiate out from the tank array and manifolds. Other utilities in the area may also be observable within the survey; however the geophysical survey will not be used in place of obtaining actual utility clearances from each utility stakeholder with utilities in these areas. The objective of the survey is solely to locate underground features associated with the tanks and pipelines to assist in refining the soil sample locations. The currently proposed approach does not anticipate the use of geophysical techniques to detect the presence or absence of light non-aqueous phase liquid or the sand tank fill.

17.1.2 Soil Sampling Program

For the fuel farms, soil and groundwater sampling shall be performed generally as outlined in the Texas PST Program requirements in RG-411. The tank hold perimeter for each fuel farm will be defined during the TDEM surveys and will be sampled at 25-foot intervals. As per RG-411, piping is to be sampled at a rate of every 20 linear feet of trench and at turns and fittings; however,because it is anticipated that much of the piping will be internal to the tank hold, sampling along piping will be limited to that outside the tank hold. The exact number of sample stations along pipe will not be known until completion of the TDEM surveys; for planning purposes, six sample locations along the pipelines are proposed at each fuel farm (not shown in Figures 17-1 or 17-2). Based on available information regarding the tank hold configuration, approximately 24 tank hold perimeter sampling locations are planned for each fuel farm. At each fuel farm site, 30 samples are planned (total of 60 locations for the UST Site 9 SI effort), as shown on Figures 17-1 and 17-2 for FF217 and FF244, respectively.

Note: Where groundwater is encountered, soil samples will be collected from the unsaturated zone only. Groundwater samples will be collected from a least one location when groundwater is present at the site. Sample location(s) for groundwater to be determined in the field.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Proposed Sample Location
- Proposed Temporary Well Location
- Groundwater Flow Direction
- Transfer Pit
- Underground Storage Tank
- Fuel Farm 217 Site Boundary SWMU Nos. 54 through 61

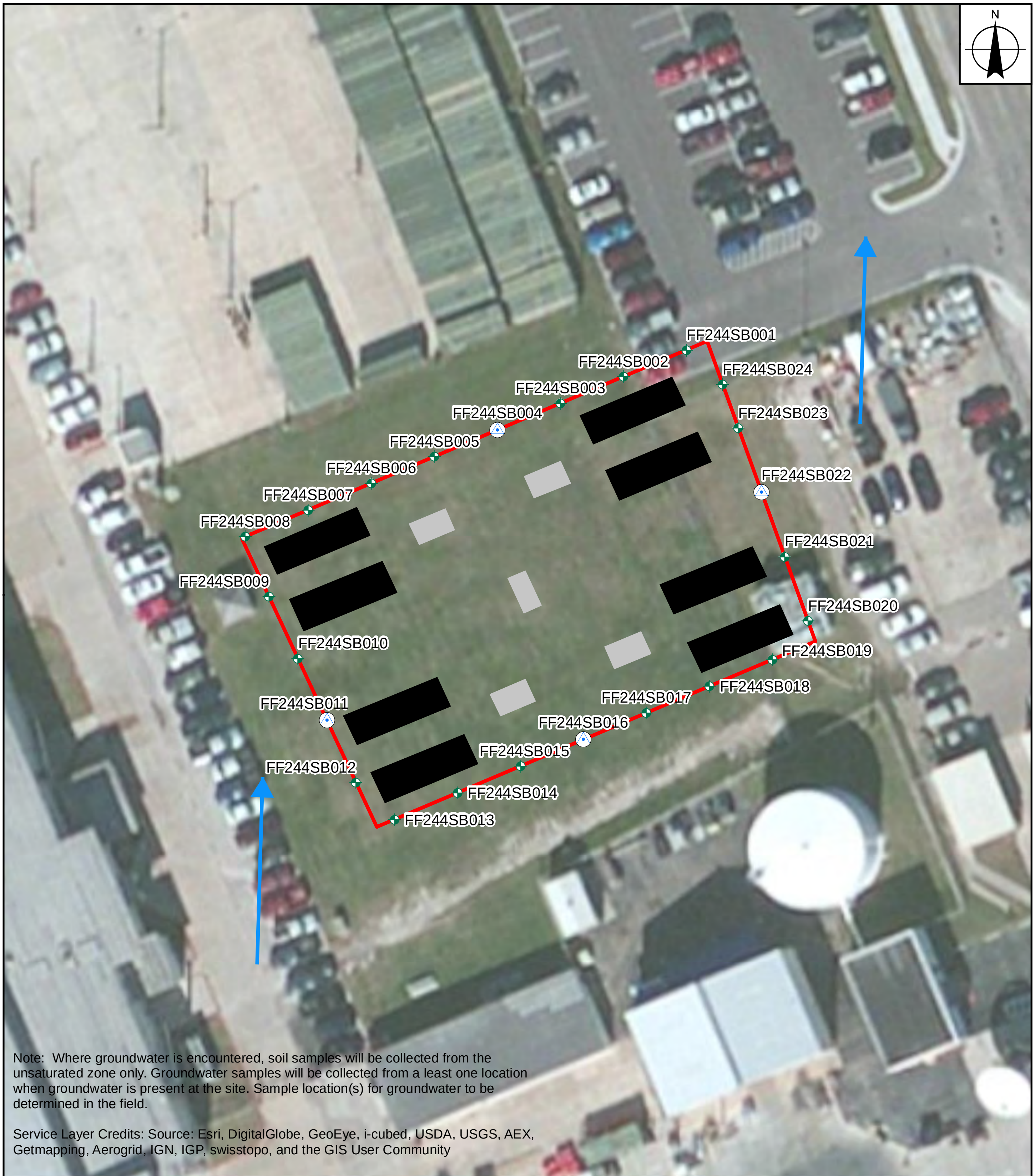
0 50 100 Feet

FIGURE 17-1
PROPOSED SAMPLE LOCATIONS
UST SITE 9 FUEL FARM 217
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 3/19/2014
DRAWN BY: BL, SS	TASK ORDER NUMBER: JM46

X:\Navy\NAS_Corpus_Christi\Fig17-1PrSampLocs.mxd



Note: Where groundwater is encountered, soil samples will be collected from the unsaturated zone only. Groundwater samples will be collected from a least one location when groundwater is present at the site. Sample location(s) for groundwater to be determined in the field.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Proposed Sample Location
- Proposed Temporary Well Location
- Groundwater Flow Direction
- Transfer Pit
- Underground Storage Tank
- Fuel Farm 244 Site Boundary SWMU Nos. 62 through 69

0 50 100 Feet

FIGURE 17-2
PROPOSED SAMPLE LOCATIONS
UST SITE 9 FUEL FARM 244
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 3/19/2014
DRAWN BY: BL, SS	TASK ORDER NUMBER: JM46

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Due to the fuel farms' proximity to Oso Bay, Corpus Christi Bay, and Laguna Madre, it is anticipated that groundwater will be encountered before the bottom of the tank holds are reached during the DPT soil boring. Therefore, at each soil boring location, collection of a single soil sample at the top of groundwater at a depth of less than 15 feet below ground surface is expected based on guidance in RG-411. At each piping trench station, one soil sample is to be obtained from the top of groundwater (when present) encountered in each boring, or 1 foot below anticipated bottom of pipeline. Professional judgment may be used to adjust sampling locations and/or depths in the field based on visual observations/staining, free product, odors, and elevated headspace PID readings.

Soil samples will be analyzed for BTEX, MTBE, and TPH. Soil samples for PAH analysis will be collected at the same time as the TPH samples but will be put on hold after extraction. TPH sample analysis results will be used to determine if PAH analysis is required, as outlined in Section 11.5. Worksheet #18 provides sample identifications that will be used.

17.1.3 Groundwater Sampling Program

Groundwater analytical data should be collected to determine the current concentrations of COPCs at a minimum of one location per fuel farm site in accordance with TCEQ guidance in RG-411. However, six temporary wells will be installed and developed for groundwater sampling based on input from TCEQ and U.S. EPA due to the size and distribution of the tank holds and associated piping. Well locations will be upgradient (1), downgradient (1), cross gradient (2), and located within the tank holds or pipeline chases based on locations (2) exhibiting the highest PID readings. Groundwater will be sampled in accordance with SOP-3-17(CC) and SOP-3-14. Groundwater is expected to be encountered above or near the base of the tank holds.

Groundwater samples will be collected from properly developed temporary wells using dedicated tubing and peristaltic pumps in accordance with SOP-3-17(CC) and SOP-3-24. Sample collection and handling will be in accordance with SOP-3-03A, SOP-3-04A, and SOP-3-24 and as described in Worksheet #21. All temporary wells will be removed within 48 hours of well completion, the boreholes will be backfilled to within 6 to 24 inches of grade using bentonite grout or other acceptable method described in SOP-3-17(CC). After 24 hours, the grouted borehole will be inspected for grout shrinkage and re-grouted if necessary. The remaining portion of the hole will be filled with soil cuttings removed from borehole, local topsoil, and/or appropriate paving materials to match areas where pavements are impacted by the boring location. Well abandonment reports will be prepared in accordance with State of Texas water well abandonment requirements.

The groundwater sampling depth will be from a minimum of 2 feet and a maximum of 5 feet below the initial top of groundwater column elevation with the intent of collecting a sample from the top of the water column. This depth may be adjusted in the field to collect sufficient sample for analysis.

Groundwater samples will be analyzed for ethylene dibromide, 1,2-dichloroethane, BTEX, MTBE, and TPH. Groundwater samples for PAHs will be collected at the same time as the TPH samples but will be put on hold after extraction. TPH sample analysis results will be used to determine if PAH analysis is required, as outlined in Section 11.5. Worksheet #18 provides sample identifications that will be used.

SAP WORKSHEET #18: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Sample Matrix: **Soil**
Location: **Fuel Farm 217**

Sample Location	Sample ID	Longitude	Latitude	Depth, feet bgs	Sampling Standard Operating Procedures	BTEX	MTBE	TPH	PAHs
FF217SB001	FF217SB001xx FF217CB001xx (FD)	-97.2607956	27.6833305	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB002	FF217SB002xx FF217CB002xx (FD) FF217SB002xx (+MS/MSD)	-97.2607193	27.6833096	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB003	FF217SB003xx	-97.260643	27.6832905	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB004	FF217SB004xx	-97.2605667	27.6832695	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB005	FF217SB005xx	-97.260498	27.6832504	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB006	FF217SB006xx	-97.2604218	27.6832294	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB007	FF217SB007xx	-97.2603455	27.6832104	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB008	FF217SB008xx	-97.2602768	27.6831913	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB009	FF217SB009xx	-97.2602386	27.6832314	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB010	FF217SB010xx	-97.2602158	27.6832962	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB011	FF217SB011xx	-97.2601852	27.683363	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB012	FF217SB012xx	-97.2601624	27.6834278	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB013	FF217SB013xx	-97.2601395	27.6834927	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB014	FF217SB014xx	-97.2602081	27.6835155	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB015	FF217SB015	-97.2602844	27.6835346	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB016	FF217SB016xx	-97.2603607	27.6835556	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB017	FF217SB017xx	-97.2604294	27.6835766	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB018	FF217SB018xx	-97.2605057	27.6835957	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB019	FF217SB019xx	-97.260582	27.6836166	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	

Sample Matrix: **Soil**
Location: **Fuel Farm 217**

Sample Location	Sample ID	Longitude	Latitude	Depth, feet bgs	Sampling Standard Operating Procedures	BTEX	MTBE	TPH	PAHs
FF217SB020	FF217SB020xx	-97.2606506	27.6836357	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB021	FF217SB021xx	-97.260704	27.6836243	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB022	FF217SB022xx	-97.2607269	27.6835575	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB023	FF217SB023xx	-97.2607422	27.6834908	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB024	FF217SB024xx	-97.2607651	27.683424	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB025	FF217SB025xx	-97.2607803	27.6833572	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB026	FF217SB026xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB027	FF217SB027xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB028	FF217SB028xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB029	FF217SB029xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF217SB030	FF217SB030xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	

Notes:

bgs = Below ground surface
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
TPH = Total petroleum hydrocarbons
PAHs = Polynuclear aromatic hydrocarbons
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis
FD = Field duplicate will be sampled from this location
TBD = Sample location to be determined based on geophysical survey
Example sample identification: FF217SB007xx = Fuel Farm 217, soil boring, location 007, x-foot sampling end depth
If TPH is detected in soil or groundwater, the sample with the highest concentration of carbon chains 12 or greater (TPH >C12) must be analyzed for PAHs. Samples for PAHs will be collected at the same time as the TPH samples for soil and groundwater, but will be put on hold after extraction until it is determined whether PAH analysis is required.

SAP WORKSHEET #18: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE (continued)

Sample Matrix: **Soil**
Location: **Fuel Farm 244**

Sample Location	Sample ID	Longitude	Latitude	Depth, feet bgs	Sampling Standard Operating Procedures	BTEX	MTBE	TPH	PAHs
FF244SB001	FF244SB001xx FF244CB001xx (FD)	-97.279007	27.6935024	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB002	FF244SB002xx FF244CB002xx (FD) FF244SB002xx (+MS/MSD)	-97.2790833	27.6934757	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB003	FF244SB003xx	-97.2791519	27.693449	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB004	FF244SB004xx	-97.2792282	27.6934242	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB005	FF244SB005xx	-97.2792969	27.6933975	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB006	FF244SB006xx	-97.2793655	27.6933708	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB007	FF244SB007xx	-97.2794418	27.693346	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB008	FF244SB008xx	-97.2795105	27.6933193	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB009	FF244SB009xx	-97.27948	27.6932583	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB010	FF244SB010xx	-97.2794495	27.6931973	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB011	FF244SB011xx	-97.2794189	27.6931343	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB012	FF244SB012xx	-97.2793884	27.6930714	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB013	FF244SB013xx	-97.279274	27.6930599	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB014	FF244SB014xx	-97.2792053	27.6930866	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB015	FF244SB015	-97.279129	27.6931114	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB016	FF244SB016xx	-97.2790604	27.6931381	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB017	FF244SB017xx	-97.2789917	27.6931648	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB018	FF244SB018xx	-97.2789154	27.6931915	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB019	FF244SB019xx	-97.2788773	27.6932297	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB020	FF244SB020xx	-97.2789001	27.6932945	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB021	FF244SB021xx	-97.2789307	27.6933594	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB022	FF244SB022xx	-97.2789536	27.6934242	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB023	FF244SB023xx	-97.2789688	27.6934662	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	

Sample Matrix: **Soil**
Location: **Fuel Farm 244**

Sample Location	Sample ID	Longitude	Latitude	Depth, feet bgs	Sampling Standard Operating Procedures	BTEX	MTBE	TPH	PAHs
FF244SB024	FF244SB024xx	-97.2793427	27.6930332	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB025	FF244SB025xx	-97.279007	27.6935024	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB026	FF244SB026xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB027	FF244SB027xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB028	FF244SB028xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB029	FF244SB029xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	
FF244SB030	FF244SB030xx	TBD	TBD	capillary fringe	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-21	X	X	X	

Notes:

bgs = Below ground surface
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
TPH = Total petroleum hydrocarbons
PAHs = Polynuclear aromatic hydrocarbons
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis
FD = Field duplicate will be sampled from this location
TBD = Sample location to be determined based on geophysical survey

Example sample identification: FF217SB007xx = Fuel Farm 217, soil boring, location 007, x-foot sampling end depth

If TPH is detected in soil or groundwater, the sample with the highest concentration of carbon chains 12 or greater (TPH >C12) must be tested for PAHs. Samples for PAHs will be collected at the same time as the TPH samples for soil and groundwater, but will be put on hold after extraction until it is determined whether PAH analysis is required.

SAP WORKSHEET #18: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE (continued)

Sample Matrix: Groundwater
Location: Fuel Farm 217

Sample Location	Sample ID	Longitude	Latitude	Depth, feet bgs	Sampling Standard Operating Procedures	BTEX	MTBE	TPH	PAHs	EDB	1,2-DCA
FF217TW001	FF217TW001mmddyy FF217TW001mmddyy (FD)	TBD	TBD	TBD	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF217TW002	FF217TW002mmddyy FF217TW002mmddyy (+MS/MSD)	TBD	TBD	TBD	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF217TW003	FF217TW003mmddyy	TBD	TBD	TBD	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF217TW004	FF217TW004mmddyy	TBD	TBD	TBD	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF217TW005	FF217TW005mmddyy	TBD	TBD	TBD	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF217TW006	FF217TW006mmddyy	TBD	TBD	TBD	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X

Notes:
bgs = Below ground surface
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
TPH = Total petroleum hydrocarbons
PAHs = Polynuclear aromatic hydrocarbons
EDB = Ethylene dibromide
1,2-DCA = 1,2-Dichloroethane
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis
FD = Field duplicate will be sampled from this location
TBD = Sample location and depth to be determined based on geophysical survey and actual field conditions
Example sample identification: FF217TW007mmddyy = Fuel Farm 217, temporary well location 007, sample date
If TPH is detected in soil or groundwater, the sample with the highest concentration of carbon chains 12 or greater (TPH >C12) must be tested for PAHs.

SAP WORKSHEET #18: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE (continued)

Sample Matrix: **Groundwater**
Location: **Fuel Farm 244**

Sample Location	Sample ID	Longitude	Latitude	Depth, feet bgs	Sampling Standard Operating Procedures	BTEX	MTBE	TPH	PAHs	EDB	1,2-DCA
FF244TW001	FF244TW001mmddyy FF244TW001mmddyy (FD)	TBD	TBD	BGWT	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF244TW002	FF244TW002mmddyy FF244TW002mmddyy(MS/MSD)	TBD	TBD	BGWT	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF244TW003	FF244TW003mmddyy	TBD	TBD	BGWT	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF244TW004	FF244TW004mmddyy	TBD	TBD	BGWT	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF244TW005	FF244TW005mmddyy	TBD	TBD	BGWT	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X
FF244TW006	FF244TW006mmddyy	TBD	TBD	BGWT	SOP-3-03A, SOP-3-04A, SOP-3-17(CC), SOP-3-14, SOP-3-24	X	X	X		X	X

Notes:

bgs = Below ground surface
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
TPH = Total petroleum hydrocarbons
PAHs = Polynuclear aromatic hydrocarbons
EDB = Ethylene dibromide
1,2-DCA = 1,2-Dichloroethane
+MS/MSD = Sample will be used for matrix spike/matrix spike duplicate analysis
FD = Field duplicate will be sampled from this location
TBD = Sample location and depth to be determined based on geophysical survey and actual field conditions

Example sample identification: FF244TW007mmddyy = Fuel Farm 244, temporary well location 007, sample date

If TPH is detected in soil or groundwater, the sample with the highest concentration of carbon chains 12 or greater (TPH >C12) must be tested for PAHs.

SAP WORKSHEET #19: FIELD SAMPLING REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference	Containers (number, size, and type)	Sample Volume	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[1] (preparation / analysis)
Groundwater	1,2-DCA, BTEX, and MTBE	SW-846 5030/8260B *GCMSV-003*	(3) 40 milliliter glass volatile vials	40 milliliters	Hydrochloric acid to a pH less than 2; Cool to 0-6° Celsius; no headspace	14 days
Groundwater	EDB	SW-846 8011 *GC-034*	(2) 40 milliliter glass volatile vials	35 milliliters	Cool to 0-6° Celsius; no headspace	7 days
Soil	BTEX and MTBE	SW-846 5035/8260B *GCMSV-003*	(3) 40 milliliter glass plus 2 ounce jar	5 grams	Methanol (1 vial) and water (2 vials); Cool to 0-6° Celsius	14 days
Groundwater	PAHs	SW-846 3510C/8270D and 8270D SIM *EXT-003/GCMSSV-004*	(2) 1 liter amber glass bottles	1000 milliliters	Cool to 0-6° Celsius	7 days to preparation 40 days to analysis
Soil	PAHs	SW-846 3550C/8270D and 8270D SIM *EXT-001/GCMSSV-004*	(1) 4 ounce glass jar	30 grams	Cool to 0-6° Celsius	14 days to preparation 40 days to analysis
Groundwater	TPH	*TCEQ Method 1005 EXT-010/GC-007*	(3) 40 milliliter glass volatile vials	40 milliliters	Hydrochloric acid to a pH less than 2; Cool to 0-6° Celsius; no headspace	14 days to preparation 14 days to analysis
Soil	TPH	*TCEQ Method 1005 EXT-002/GC-007*	(3) 40 milliliter glass (C6-C12 range) plus 4 ounce jar (>C12 range)	10 grams	Sodium bisulfate; Cool to 0-6° Celsius	14 days to preparation 14 days to analysis

Notes:
[1] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.
1,2-DCA = 1,2-Dichloroethane
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
EDB = Ethylene dibromide
PAH = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
TPH = Total petroleum hydrocarbons
C6-C12 = 6 to 12 carbon range
>C12 = Greater than 12 carbon range

SAP WORKSHEET #20: FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Number of Sampling Locations	Number of Field Duplicates	Number of Equipment Blanks[1]	Number of Trip Blanks	Number of MS/MSDs	Total Number of Samples to Lab[2]
Soil	BTEX and MTBE	60	4	3	10	4/4	77
Soil	TPH	60	4	3	10	4/4	77
Soil	PAHs	2	2	3	0	1/1	7
Groundwater	1,2-DCA, BTEX, and MTBE	12	2	0	2	2/2	16
Groundwater	EDB	12	2	0	2	2/2	16
Groundwater	TPH	12	2	0	2	2/2	16
Groundwater	PAHs	2	1	0	0	1/1	3

Notes:
[1] Equipment rinsate blanks will be collected if decontamination is required.
[2] Total number of samples does not include MS/MSD analysis.
MS = Matrix spike
MSD = Matrix spike duplicate
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
TPH = Total petroleum hydrocarbons
PAHs = Polynuclear aromatic hydrocarbons
1,2-DCA = 1,2-Dichloroethane
EDB = Ethylene dibromide

Frequency of QA/QC sample collection:
Field Duplicate = One per 20 field samples for each site
MS/MSD = One pair per 20 field samples (including field quality control samples)
Equipment Blank = One per field-cleaned sampling equipment per week
Trip Blank = One per cooler containing volatile organic compounds

SAP WORKSHEET #21: PROJECT SAMPLING SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.1.2)

Field SOPs presented below are in Appendix A.

SOP Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP-3-01	*Utility Clearance*, Revision 0, June 2012	Resolution Consultants	None	No	None
SOP-3-02	*Field Log Books*, Revision 0, May 2012	Resolution Consultants	None	No	None
SOP-3-03A	*Sample Labeling and Chain of Custody*, Revision 0, August 2012	Resolution Consultants	None	No	None
SOP-3-04A	*Packaging and Shipping Procedures for Low Concentration Samples*, Revision 0, May 2012	Resolution Consultants	None	No	None
SOP-3-05-TX	*Investigative Derived Waste Management for Texas* Revision 0, May 2012	Resolution Consultants	None	No	None
SOP-3-06	*Equipment Decontamination*, Revision 0, May 2012	Resolution Consultants	Buckets, brushes	No	None
SOP-3-07	*Land Surveying*, Revision 0, August 2012	Resolution Consultants	Global Positioning System	No	None
SOP-3-09	*Geophysical Testing Procedures*, Revision 0, April 2013	Resolution Consultants	TDEM	No	None
SOP-3-14	*Monitoring Well Sampling*, Revision 0, May 2012	Resolution Consultants	Peristaltic pump	No	None
SOP-3-16	*Soil Classification*, Revision 0, August 2012	Resolution Consultants	None	No	None
SOP-3-17 (CC)	*Direct Push Sampling Techniques (Corpus Christi)*, Revision 0, July 2013	Resolution Consultants	Drill Rig, Peristaltic pump	Yes	Includes groundwater well installation and sampling
SOP-3-19	*Headspace Screening for VOCs*, Revision 0, May 2012	Resolution Consultants	PID	No	None
SOP-3-20	*Operation and Calibration of a Photoionization Detector, Revision 0,* May 2012	Resolution Consultants	PID	No	None
SOP-3-21	*Surface and Subsurface Soil Sampling*, Revision 0, May 2012	Resolution Consultants	Direct Push Sampling, Spoons, Bowl	No	None
SOP-3-24	*Water Quality Parameter Testing, Revision 0,* August 2012	Resolution Consultants	Flow Thru Cell with Meters		
TCEQ Ecological Checklist	*Figure: 30 TAC §350.77(b) Tier I: Exclusion Criteria Checklist*	TCEQ	None	No	None

Notes:

PID = Photoionization Detector
SOP = Standard operating procedure
TCEQ = Texas Commission on Environmental Quality
TDEM = Time Domain Electromagnetic Method

SAP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Comments
Global Positioning System Trimble Geo XT (or similar)	Positioning	Beginning and end of each day used	Accuracy: sub-meter horizontal dilution of precision < 3, number of satellites must be at least six	Wait for better signal, replace unit, or choose alternate location technique	Resolution Consultants FTL or designee	SOP-3-07	None
Geophysical Survey Equipment EM61 Mk2	Locate metal tanks & pipes	Null; base station ties periodically & beginning and end of the day	System precision ±100 mV	Identify noise source, QC equipment, or replace equipment	Resolution Consultants FTL or designee	SOP-3-09	None
pH Meter	Groundwater Parameters	Daily	±0.2 Standard pH Units	Recalibrate or replace meter	Resolution Consultants FTL or designee	SOP-3-24	None
Specific Conductance	Groundwater Parameters	Daily	±5% of the standard	Recalibrate or replace meter	Resolution Consultants FTL or designee	SOP-3-24	None
ORP Meter	Groundwater Parameters	Daily	±10 mV from the theoretical standard value at that temperature	Recalibrate or replace meter	Resolution Consultants FTL or designee	SOP-3-24	None
Turbidity Meter	Groundwater Parameters	Daily	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard	Recalibrate or replace meter	Resolution Consultants FTL or designee	SOP-3-24	None
DO	Groundwater Parameters	Daily	±0.3 mg/L of the theoretical oxygen solubility	Recalibrate or replace meter	Resolution Consultants FTL or designee	SOP-3-24	None
Thermometer	Groundwater Parameters	Daily	Not applicable	Not applicable	Resolution Consultants FTL or designee	SOP-3-24	None
Flow Rate	Groundwater Parameters	Daily	Not applicable	Not applicable	Resolution Consultants FTL or designee	SOP-3-24	None
PID	Soil Screening	Daily	Per Manufacturer Instructions	Recalibrate or replace meter	Resolution Consultants FTL or designee	SOP-3-20	None

Notes:

FTL = Field team leader
mg/L = Milligrams per liter
DO = Dissolved oxygen
SOP = Standard operating procedure
SU = Standard units
ORP = Oxidation reduction potential
mV = Millivolts
PID = Photoionization Detector
NTU = Nephelometric turbidity units
QC = Quality control

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.2.1)

Laboratory Name and Address: Gulf Coast Analytical Laboratories, 7979 GSRI Road, Baton Rouge, LA 70820
Laboratory Point of Contact/Project Manager: Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900

SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work? (Yes/No)
EXT-001	*Preparation of Base/Neutral/Acid Low Level Soil/Sediment Samples,* Revision 19, 04/11/13	Definitive	Soil Extraction PAHs	Not applicable	No	No
EXT-003	*Base/Neutral/Acid Sample Extraction Using Separatory Funnel*, Revision 23, 04/01/13	Definitive	Groundwater Extraction PAHs	Not applicable	No	No
GC-007	*TPH by TCEQ 1005 and Characterization of C6 to C35 Petroleum Hydrocarbons by TCEQ 1006 in Environmental Samples,* Revision 11, 01/01/12	Screening	Soil and Groundwater Extraction and Analysis TPH	GC Agilent 6890N	No	No
GCMSV-003	*SOP for the Analysis of Volatile Samples by 8260B,* Revision 23, 12/12/11	Definitive	Soil and Groundwater, 1,2-DCA, BTEX, and MTBE	GC Agilent 6890 and 7890 with MS Agilent 5973 and 5975 Or HP5890 with 5972 MS	No	No
GC-034	*SOP for Determination of 1,2-Dibromoethane and 1,2-Dibromo-3-Chloropropane by Microextraction and Gas Chromatography SW-846 8011*, Revision 9, 07/25/2013	Definitive	Groundwater, EDB	GC Agilent 6890N	No	No
GCMSSV-004	*Standard Operating Procedure for the Analysis Semi-volatile Mass Spec Samples for 8270D,* Revision 8, 01/25/13	Definitive	Soil and Groundwater Analysis PAHs	GC/MS Agilent 5973-6890N or 5975-6890N	No	No

Notes:
Laboratory standard operating procedures will be available upon request.

SOP = Standard operating procedure
PAH = Polynuclear aromatic hydrocarbons
GC = Gas chromatograph
MS = Mass spectrometer
GC/MS = Gas chromatograph/mass spectrometer
TPH = Total petroleum hydrocarbons
BTEX = Benzene, toluene, ethylbenzene, xylenes (total)
MTBE = Methyl tert-butyl ether
1,2-DCA = 1,2-Dichloroethane
EDB = Ethylene dibromide

SAP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION TABLE

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	GCAL SOP Reference
GC/MS 1,2-DCA, BTEX and MTBE	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate.	Analyst, Supervisor	GCAL SOP GCMSV-003
GC/MS 1,2-DCA, BTEX and MTBE	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis and after any routine maintenance (source cleaning, new column, etc.) or if ICAL fails.	Average RF for SPCCs: ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane, %RSD for RFs for CCCs: ≤ 30% and must meet <u>one</u> of the following: <u>Option 1</u>: %RSD for each analyte ≤ 15%; <u>Option 2</u>: linear least squares regression for each analyte: r ≥ 0.995; <u>Option 3</u>: non-linear regression-coefficient of determination for each analyte: $r^2 \geq 0.99$.	Repeat calibration if criterion is not met	Analyst, Supervisor	GCAL SOP GCMSV-003
GC/MS 1,2-DCA, BTEX and MTBE	Second source CV	Once after each ICAL	All analytes within ± 20% of expected value	Remake standard, recalibrate if necessary	Analyst, Supervisor	GCAL SOP GCMSV-003
GC/MS 1,2-DCA, BTEX and MTBE	CCV	CV daily, before sample analysis, and every 12 hours of analysis time	RF for SPCCs: ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane; and %D ≤20 for all target compounds	Repeat initial calibration and reanalyze all samples analyzed since the last successful ICV	Analyst, Supervisor	GCAL SOP GCMSV-003
GC/MS 1,2-DCA, BTEX and MTBE	RRT Evaluation	Prior to sample analysis	Set at mid-point of ICAL; +/- 30 seconds each CCV	CCV fails, perform column maintenance, inspect pumps, and leak checks. After instrument correction, repeat ICAL.	Analyst, Supervisor	GCAL SOP GCMSV-003
GC/ECD EDB	RT window width calculated for each analyte and surrogate	After installing a new column, performing major maintenance or at initial set-up	Width is 3 times standard deviation of a minimum of three injections over a minimum of 72 hours, or default of 0.03 minutes whichever is greater.	Not applicable	Analyst, Supervisor	GCAL SOP GC-034
GC/ECD EDB	RT Window position establishment and verification for each analyte and surrogate	Set using mid-point of ICAL or at first CCV of the day if ICAL is not performed.	Not applicable	Not applicable	Analyst, Supervisor	GCAL SOP GC-034

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	GCAL SOP Reference
GC/ECD EDB	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD <20% for all compounds or linear or quadratic calibration r^2 > 0.990	Repeat calibration if criterion is not met	Analyst, Supervisor	GCAL SOP GC-034
GC/ECD EDB	Second source ICV	Once after each ICAL	All analytes within ± 15% of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful ICV.	Analyst, Supervisor	GCAL SOP GC-034
GC/ECD EDB	CCV	CCV after every 10 samples and at the end of the analytical sequence	%D or Drift < 20% for all analytes	Repeat initial calibration and reanalyze all samples analyzed since the last successful Calibration verification.	Analyst, Supervisor	GCAL SOP GC-034
GC/ECD EDB	Confirmation of positive results (second column or second detector)	All samples and quality control samples	Detections agree within 40%	Report the result from the primary column and include a narrative unless matrix interference is creating a high bias.	Analyst, Supervisor	GCAL SOP GC-034
GC/MS PAHs	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate.	Analyst, Supervisor	GCAL SOP GCMSV-004
GC/MS PAHs	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 the breakdown check. No samples shall be run until degradation ≤ 20%	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis and after any routine maintenance (source cleaning, new column, etc.) or if ICAL fails.	<u>Average RF</u> ≥ 0.050 RSD for RFs for CCCs: $\leq$ 30% and must meet <u>one</u> of the following: <u>Option 1</u>: %RSD for each analyte ≤ 15%; <u>Option 2</u>: linear least squares regression for each analyte: r ≥ 0.995; <u>Option 3</u>: non-linear regression-coefficient of determination for each analyte: r^2 ≥ 0.99.	Repeat calibration if criterion is not met	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs	Second source ICV	Once after each ICAL	All analytes within ± 20% of expected value	Remake standard, recalibrate if necessary	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs	CCV	CV daily, before sample analysis, and every 12 hours of analysis time	All targets $\leq$ 20%D	Repeat initial calibration and reanalyze all samples analyzed since the last successful ICV	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/MS PAHs	RRT Evaluation	Prior to sample analysis	Set at mid-point of ICAL; +/- 30 seconds each CCV	CCV fails, perform column maintenance, inspect pumps, and leak checks. After instrument correction, repeat ICAL.	Analyst, Supervisor	GCAL SOP GCMSSV-004

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	GCAL SOP Reference
GC/FID TPH	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis and after any routine maintenance (new column, etc.) or if ICAL fails.	Each analyte must meet one of the following: Option 1: %RSD for each analyte ≤ 25%; or Option 2: linear regression for each analyte: $r^2 \geq 0.995$	Repeat calibration if criterion is not met	Analyst, Supervisor	GCAL SOP GC-007
GC/FID TPH	Second source ICV	Once after each ICAL	All analytes within ± 15% of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	Analyst, Supervisor	GCAL SOP GC-007
GC/FID TPH	CCV	CCV after every 10 samples and at the end of the analytical sequence	%D or Drift < 25% for all analytes	Repeat initial calibration and reanalyze all samples analyzed since the last successful Calibration verification	Analyst, Supervisor	GCAL SOP GC-007

Notes:

GCAL = Gulf Coast Analytical Laboratories
SOP = Standard operating procedure
GC/MS = Gas chromatograph/mass spectrometer
1,2-DCA = 1,2-Dichloroethane
BTEX = Benzene, toluene, ethylbenzene, xylenes
MTBE = Methyl tert-butyl ether
ICAL = Initial calibration
RF = Response factor
SPCC = System performance check compound
%RSD = Percent relative standard deviation
CCCs = Calibration check compounds
r = linear least squares regression
r^2 = Non-linear regression-coefficient of determination
ICV = Initial calibration verification
CCV = Continuing calibration verification
%D = Percent difference or percent drift
RRT = Relative retention time
GC/ECD = Gas chromatography/Electron capture detector
RT = Retention time
PAH = Polynuclear aromatic hydrocarbons
DDT = 4,4'-Dichlorodiphenyltrichloroethane
GC/FID = Gas chromatography/Flame ionization detector
TPH = Total petroleum hydrocarbon

SAP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	GCAL SOP Reference
GC/MS	Check for leaks, replace gas line filters, recondition or replace trap, replace column, clean injection port/liner	1,2-DCA, BTEX, and MTBE	Inspect vacuum pressure daily. Instrument will be inspected prior to each ICAL and/or as needed. Clean source and replace vacuum pump oil annually or as needed. Routine maintenance as necessary.	As needed	No maintenance is required as long as instrument meets tuning criteria and QC meets DoD QSM criteria.	Replace connections, clean source, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port, replace Electron Multiplier. Inspect system and correct problem; re-tune instrument and perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP GCMSV-003
GC/ECD	Clean injection port and replace liner Clip column Maintain pumps	EDB	Instrument will be inspected prior to each ICAL and/or as needed. Routine maintenance as necessary.	Daily	No maintenance is required as long as calibration meets SOP criteria.	Replace connections, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port. Inspect system and correct problem; perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP GC-034
GC/MS	Check for leaks, replace gas line filters, replace column, clean injection port/liner	PAHs	Inspect vacuum pressure daily. Instrument will be inspected prior to each ICAL and/or as needed. Clean source and replace vacuum pump oil annually or as needed. Routine maintenance as necessary.	As needed	No maintenance is required as long as instrument meets tuning criteria and QC meets DoD QSM criteria.	Replace connections, clean source, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port, replace Electron Multiplier. Inspect system and correct problem; re-tune instrument and perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP GCMSSV-004
GC/FID	Clean injection port and replace liner Clip column Maintain pumps	TPH	Instrument will be inspected prior to each ICAL and/or as needed. Routine maintenance as necessary.	Daily	No maintenance is required as long as calibration meets SOP criteria.	Replace connections, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port. Inspect system and correct problem; perform new initial calibration after major maintenance.	Analyst, Supervisor	GCAL SOP GC-007

Notes:

GCAL	=	Gulf Coast Analytical Laboratories
SOP	=	Standard operating procedure
GC/MS	=	Gas chromatograph/mass spectrometer
1,2-DCA	=	1,2-Dichloroethane
BTEX	=	Benzene, toluene, ethylbenzene, xylenes
MTBE	=	Methyl tert-butyl ether
ICAL	=	Initial calibration
QC	=	Quality control
DoD QSM	=	Department of Defense Quality Systems Manual
GC	=	Gas chromatograph
GC/ECD	=	Gas chromatograph/electron capture detector
EDB	=	Ethylene dibromide
PAHs	=	Polynuclear aromatic hydrocarbons
GC/FID	=	Gas chromatograph/flame ionization detector
TPH	=	Total Petroleum hydrocarbons

SAP WORKSHEET #26: SAMPLE HANDLING SYSTEM

(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization):	FTL/Resolution Consultants
Sample Packaging (Personnel/Organization):	FTL/Resolution Consultants
Coordination of Shipment (Personnel/Organization):	FTL/Resolution Consultants
Type of Shipment/Carrier:	Overnight via FedEx
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization):	Sample Receiving Supervisor, Charlotte Saucier/GCAL
Sample Custody and Storage (Personnel/Organization):	Sample Receiving Supervisor, Charlotte Saucier/GCAL
Sample Preparation (Personnel/Organization):	Extractions, Prep Supervisor, Rob Martin/GCAL
Sample Determinative Analysis (Personnel/Organization):	Laboratory Manager, Scott Bailey/GCAL
SAMPLE ARCHIVING	
Field Sample Storage (No. of days from sample collection):	180 Days from Receipt of Samples
Sample Extract/Digestate Storage (No. of days from extraction/digestion):	180 Days from Receipt of Samples
SAMPLE DISPOSAL	
Personnel/Organization:	Waste Compliance Manager John Bailey/GCAL
Number of Days from Analysis:	180 Days from Receipt of Samples

Notes:
FTL = Field team leader
GCAL = Gulf Coast Analytical Laboratories

SAP WORKSHEET #27: SAMPLE CUSTODY REQUIREMENTS

(UFP-QAPP Manual Section 3.3.3)

27.1 Sample Nomenclature, Sample Collection Documentation, Handling, and Tracking Procedures

The following sections outline the procedures that will be used to document project activities and sample collection, handling, tracking, and custody procedures during the investigation. All forms must be filled in as completely as possible.

27.1.1 Sample Nomenclature

Sample labeling will be conducted in general accordance with the procedures outlined in Worksheet #18. Nomenclature for soil samples includes the site being investigated, matrix code, soil boring identification number, and depth interval.

Sample type codes planned for this event will include N for normal samples, FD for field duplicates, and EB for equipment blanks. Field duplicates will be labeled so they will be "blind" to the laboratory; they will use the same sample identification as the parent sample but the differentiator will be the fifth character, which will be changed to a C. For example, a soil duplicate of FF244SB00110 would be indicated using FF244CB00110. Equipment blanks will be labeled sequentially followed by the date (i.e., EB07222013). Samples to be used for matrix spike (MS) and matrix spike duplicate (MSD) will be labeled MS/MSD on the container label and noted on the chain-of-custody; however, "MS/MSD" will not be part of the unique sample identifier in order to maintain consistency with the project database. Worksheet #18 provides anticipated sample identifiers for this scope of work.

27.1.2 Sample Collection Documentation

Documentation of field observations will be recorded in a field logbook(s) and/or field log sheets including sample collection logs, boring logs, and monitoring well construction logs. The field logbook utilized on this project will consist of a bound, water-resistant logbook. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink.

Field sample log sheets will be used to document sample collection details and other observations and activities will be recorded in the field logbook. Instrument calibration logs will be used to record the daily instrument calibration.

For sampling and field activities, the following types of information will be recorded in the field logbook as appropriate:

- Site name and location
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions
- Activities involved with the sampling
- Subcontractor activity summary
- Site observations including site entry and exit times
- Site sketches made onsite
- Visitor names, affiliations, arrival and departure times
- Health and safety issues, including personal protective equipment

27.1.3 Sample Handling and Tracking System

Following collection, all samples will be immediately placed on ice in a cooler. The glass sample containers will be enclosed in bubble-wrap in order to protect the bottleware during shipment. The cooler will be secured using strapping tape along with a signed custody seal. Sample coolers will be delivered to a local courier location for priority overnight delivery to the selected laboratory for analysis. Samples will be preserved as appropriate based on the analytical method. The laboratories will provide pre-preserved sample containers for sample collection. Samples will be maintained at 0 to 6 degrees Celsius until delivery to the laboratory. Proper custody procedures will be followed throughout all phases of sample collection and handling.

After collection, each sample will be maintained in the sampler's custody until formally transferred to another party (e.g., FedEx). For all samples collected, chain-of-custody forms will document the date and time of sample collection, the sampler's name, and the names of all others who subsequently held custody of the sample. Specifications for chemical analyses will also be documented on the chain-of-custody form. Further details on chain-of-custody procedures are provided in SOP-3-03A.

The following subsections outline the procedures that will be used by field and laboratory personnel to document project activities and sample-collection procedures. All forms must be filled in as completely as possible.

Resolution Consultants personnel will collect the samples. The samplers will take care not to contaminate samples through improper handling. Samples will be sealed in appropriate containers, packaged by Resolution Consultants' personnel and placed into sealed coolers under chain-of-custody in accordance with the applicable SOP. All coolers will contain a temperature blank. Samples will be transferred under chain-of-custody to a courier as described below. Once received by the laboratory, receipt will be documented on the chain-of-custody form and the samples will be checked in. The samples will remain under chain-of-custody throughout the analysis period to ensure their integrity is preserved. Details are provided below.

Samples to be delivered to the laboratory(s) will be made by a public courier (i.e., FedEx). After samples have been collected, they will be sent to the laboratory(s) within 24 hours.

27.2 Field Sample Custody Procedures

Chain-of-custody protocols will be used throughout sample handling to establish the evidentiary integrity of sample containers. These protocols will be used to demonstrate that the samples were handled and transferred in a manner that would eliminate possible tampering. Samples for the laboratory will be packaged and shipped in accordance with Resolution Consultants SOP-3-04A.

A sample is under custody if:

- The sample is in the physical possession of an authorized person
- The sample is in view of an authorized person after being in his/her possession
- The sample is placed in a secure area by an authorized person after being in his/her possession
- The sample is in a secure area, restricted to authorized personnel only

Custody documentation is designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. A multi-part form is used with each page of the form signed and dated by the recipient of a sample or portion of sample. The person releasing the sample and the person receiving the sample each will retain a copy of the form each time a sample transfer occurs.

Integrity of the samples collected will be the responsibility of identified persons from the time the samples are collected until the samples, or their derived data, are incorporated into the final report.

The Resolution Consultants FTL is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the laboratory SOPs.

27.3 Laboratory Chain-of-Custody

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) will be used in accordance with laboratory SOPs. Coolers are received and checked for proper temperature. A sample cooler receipt form will be filled out to note conditions and any discrepancies. The chain-of-custody form will be checked against the sample containers for accuracy. Samples will be logged into the laboratory information management system and given a unique log number, which can be tracked through processing. The laboratory project manager will notify the Resolution Consultants Field Team Leader verbally or via e-mail immediately if any problems are identified. Discrepancies and resolutions will be documented on the sample receiving checklist.

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE

(UFP-QAPP Manual Section 3.4)

Matrix:	Soil and Groundwater
Analytical Group:	1,2-Dichloroethane, BTEX and MTBE
Analytical Method/SOP Reference:	SW-846 8260B/GCAL SOP GCMSV-003

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
Surrogates	All field and QC samples	**DoD QSM Surrogate Limits** / **Soil %R** / **Water %R** 1,2-Dichloroethane-d4: 62-125* / 70-120 4-Bromofluorobenzene: 85-120 / 75-120 Dibromofluoromethane: 65-130* / 85-115 Toluene-d8: 85-115 / 85-120 * Laboratory limit is used; %R not listed in DoD QSM.	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Method/SOP QC Acceptance Limit Column
LCS	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2	Correct problem. If the LCS recoveries are high but the sample results are <LOQ narrate. Otherwise, re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2
Internal Standards	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect MS or GC for malfunctions. Reanalyze all samples with internal standard failures. If reanalysis confirms matrix interference, report sample and narrate	Analyst, Supervisor, QA Manager	Accuracy Bias	See Method/SOP QC Acceptance Limit Column

Matrix:	Soil and Groundwater
Analytical Group:	1,2-Dichloroethane, BTEX and MTBE
Analytical Method / SOP Reference:	SW-846 8260B/GCAL SOP GCMSV-003

QC Sample	Frequency & Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
MS/MSD	One per batch of 20 or fewer samples per matrix	For matrix accuracy evaluation, use LCS recovery criteria; RPD $\leq$30%.	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	See Method/SOP QC Acceptance Limit Column

Notes:

BTEX	=	Benzene, toluene, ethylbenzene, xylenes
MTBE	=	Methyl tert-butyl ether
SOP	=	Standard operating procedure
GCAL	=	Gulf Coast Analytical Laboratories
QC	=	Quality control
LOQ	=	Limit of quantitation
DoD QSM	=	Department of Defense Quality Systems Manual
QA	=	Quality assurance
%R	=	Percent recovery
LCS	=	Laboratory control sample
ICAL	=	Initial calibration
EICP	=	Extracted ion current profile
MS	=	Mass Spectrometer
GC	=	Gas chromatograph
MS/MSD	=	Matrix spike/matrix spike duplicate
RPD	=	Relative percent difference

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (continued)

Matrix:	Groundwater
Analytical Group:	Ethylene Dibromide
Analytical Method/SOP Reference:	SW-846 8011/GCAL SOP GC-034

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	Correct problem; Re-prepare and/or reanalyze any sample associated with a blank that fails criteria	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
Surrogates	All field and QC samples	%R — 70-130%	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate	Analyst, Supervisor, QA Manager	Accuracy Bias	%R — 70-130%
LCS	One per batch of 20 or fewer samples per matrix	%R — 55-141% RPD <40%	Re-prepare and/or reanalyze all associated samples	Analyst, Supervisor, QA Manager	Accuracy Bias	%R — 55-141% RPD <40%
MS/MSD	One per batch of 20 or fewer samples per matrix	%R — 55-141% RPD <40%	Contact the client to determine if additional measures are required	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	%R — 55-141% RPD <40%

Notes:

GCAL	=	Gulf Coast Analytical Laboratories
SOP	=	Standard operating procedure
QC	=	Quality control
LOQ	=	Limit of quantitation
QA	=	Quality assurance
%R	=	Percent recovery
LCS	=	Laboratory control sample
RPD	=	Relative percent difference
MS/MSD	=	Matrix spike/matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (continued)

Matrix:	Soil and Groundwater
Analytical Group:	PAHs
Analytical Method/SOP Reference:	SW-846 Method 8270D (dibenzofuran) and 8270D-SIM (remaining PAHs) /GCAL SOP GCMSSV-004

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
Surrogates	All field and QC samples	**DoD QSM Surrogate Limits** / **Soil %R** / **Water (Soil Leach) %R** 2-Fluorobiphenyl 45-105 50-110 Terphenyl-d14 30-125 50-135 Nitrobenzene-d5 35-100 40-110	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Method/SOP QC Acceptance Limit Column
LCS	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2	Correct problem. If the LCS recoveries are high but the sample results are <LOQ narrate. Otherwise, re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2
Internal Standards	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect MS or GC for malfunctions. Reanalyze all samples with internal standard failures. If reanalysis confirms matrix interference, report sample and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	See Method/SOP QC Acceptance Limit Column

Matrix:	Soil and Groundwater
Analytical Group:	PAHs
Analytical Method/SOP Reference:	SW-846 Method 8270D (dibenzofuran) and 8270D-SIM (remaining PAHs) /GCAL SOP GCMSSV-004

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
MS/MSD	One per batch of 20 or fewer samples per matrix	For matrix accuracy evaluation, use LCS recovery criteria; RPD $\leq$30%.	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	See Method/SOP QC Acceptance Limit Column

Notes:

PAHs	=	Polynuclear aromatic hydrocarbons
SIM	=	Selective ion monitoring
GCAL	=	Gulf Coast Analytical Laboratories
SOP	=	Standard operating procedure
QC	=	Quality control
LOQ	=	Limit of quantitation
DoD QSM	=	Department of Defense Quality Systems Manual
QA	=	Quality assurance
%R	=	Percent recovery
LCS	=	Laboratory control sample
ICAL	=	Initial calibration
EICP	=	Extracted ion current profile
MS	=	Mass Spectrometer
GC	=	Gas chromatograph
MS/MSD	=	Matrix spike/matrix spike duplicate
RPD	=	Relative percent difference

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (continued)

Matrix:	Soil and Groundwater
Analytical Group:	TPH
Analytical Method/SOP Reference:	Texas 1005 /GCAL SOP GC-007

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	Correct problem; Re-prepare and/or reanalyze any sample associated with a blank that fails criteria	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
Surrogates	All field and QC samples	o-Terphenyl %R — 58-148% (soil and water)	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate	Analyst, Supervisor, QA Manager	Accuracy Bias	%R — 58-148%
LCS	One per batch of 20 or fewer samples per matrix	%R — 75-125% RPD <u><</u>20%	Re-prepare and/or reanalyze all associated samples	Analyst, Supervisor, QA Manager	Accuracy Bias	%R — 75-125% RPD <u><</u>20%
MS/MSD	One per batch of 20 or fewer samples per matrix	%R — 75-125% RPD <u><</u>20%	Contact the client to determine if additional measures are required	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	%R — 75-125% RPD <u><</u>20%

Notes:

TPH	=	Total petroleum hydrocarbons
GCAL	=	Gulf Coast Analytical Laboratories
SOP	=	Standard operating procedure
QC	=	Quality control
LOQ	=	Limit of quantitation
QA	=	Quality assurance
%R	=	Percent recovery
LCS	=	Laboratory control sample
RPD	=	Relative percent difference
MS/MSD	=	Matrix spike/matrix spike duplicate

SAP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS TABLE

(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Sample Collection Documents and Records Project personnel sign-off record Field logbook (and sampling notes) Field sample forms (e.g., sample log sheets, drilling logs, etc.) Chain-of-custody records Sample shipment air bills Equipment calibration logs Photographs Sampling and Analysis Plans including field sampling standard operating procedures Safe work permit forms	Sample collection documents and records (may include printed copy as well as electronic information) will be maintained at the Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134. These records will be transferred to the Federal Records Center (FRC) accordance with in the NAVFAC *Environmental Restoration Recordkeeping Manual* where they will be retained for 50 years after the last decision document is signed.
Analytical Results Documents and Records Sample receipt/log-in forms Sample preparation logs Equipment calibration logs Sample analysis run logs Reported field sample results Reported results for standards, quality control checks Reported results for standards, quality control samples Data completeness checklists Data validation memoranda	Analytical results, documents and records will be provided by the laboratory in printed and electronic formats. Printed copies of laboratory data will be stored at Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134 until transfer to the FRC. The records will be retained by the FRC for 50 years after the last decision document is signed. Electronic analytical results will also be verified, entered, and maintained in a database on a password protected Structured Query Language server. Data qualifiers will be added to the database during data validation. After validation, the validated data files will be transferred to the Navy's NIRIS data management system.

Document	Where Maintained
Other Documents Personnel training records Health and Safety certifications Health and Safety Plan Letter reports, Investigation Reports, etc. Analytical Audit Checklist	Personnel training records and health and safety certificates will be stored in personnel records and electronically in the Resolution Consultants training database located at project file at 5724 Summer Trees Drive, Memphis, Tennessee 38134. Plans and reports will be stored in printed version and electronically in the Administrative Record file. Printed copies will be stored at Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134 transfer to the FRC. The records will be retained by the FRC for 50 years after the last decision document is signed. Analytical Audit Checklists will be retained by the respective accreditation authorities.
Final Document/Records Repository Administrative Record files Site files Post decision Files Analytical data Spatial data Maps	All final documents/Records repositories will be stored in accordance with in the NAVFAC *Environmental Restoration Recordkeeping Manual*. Printed copies will be stored at Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134 until transfer to the FRC, and electronic copies will be maintained, verified, and stored on the Navy's NIRIS data management system. These files will be retained by the FRC for 50 years after the last decision document is signed.

Notes:
FRC = Federal Records Center
NIRIS = Naval Installation Restoration Information Solution
NAVFAC = Naval Facilities Engineering Command

SAP WORKSHEET #30: ANALYTICAL SERVICES TABLE

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization[1] (name and address, contact person and telephone number)	Backup Laboratory/Organization
Soil and Groundwater	1,2-DCA, BTEX, and MTBE	See Worksheet #18	GCAL GCMSV-003	21 Days	Gulf Coast Analytical Laboratories, 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Groundwater	EDB	See Worksheet #18	GCAL GC-034	21 Days	Gulf Coast Analytical Laboratories, 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil and Groundwater	PAHs	See Worksheet #18	GCAL GCMSSV-004	21 Days	Gulf Coast Analytical Laboratories, 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None
Soil and Groundwater	TPH	See Worksheet #18	GCAL GC-007	21 Days	Gulf Coast Analytical Laboratories, 7979 GSRI Road, Baton Rouge, Louisiana 70820 Brenda Martinez, brenda.martinez@gcal.com, 225-769-4900	None

Notes:
[1] Laboratory meets accreditation requirements to support project needs.
1,2-DCA = 1,2-Dichloroethane
EDB = Ethylene dibromide
BTEX = Benzene, toluene, ethylbenzene, xylenes
MTBE = Methyl tert-butyl ether
PAHs = Polynuclear aromatic hydrocarbons
TPH = Total petroleum hydrocarbon
GCAL = Gulf Coast Analytical Laboratories

SAP WORKSHEET #31: PLANNED PROJECT ASSESSMENTS TABLE

(UFP-QAPP Manual Section 4.1.1)

Worksheet is not applicable; no project-specific assessments are planned.

SAP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES TABLE

(UFP-QAPP Manual Section 4.1.2)

Worksheet is not applicable; no project-specific assessments are planned.

SAP WORKSHEET #33: QUALITY ASSURANCE MANAGEMENT REPORTS TABLE

(UFP QAPP Manual Section 4.2)

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Data Validation	Report per data package	Within 4 weeks of receipt of laboratory data	Resolution Consultants project chemist or designee	TOM, project file, Resolution Consultants
Major Analysis Problem Identification (Internal Resolution Consultants Memorandum)	When persistent analysis problems are detected by Resolution Consultants that may impact data usability	Immediately upon detection of problem (same day)	Resolution Consultants quality assurance officer or project chemist	TOM, program manager, contracts department, project file, Resolution Consultants
Progress Report	Monthly for duration of the project	Monthly	TOM, Resolution Consultants	Navy RPM, program manager, project file, Resolution Consultants
Laboratory Quality Assurance Report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection of problem (same day)	Laboratory quality assurance manager or project manager	TOM, project chemist, project file, Resolution Consultants

Notes:
TOM = Task order manager
RPM = Remedial project manager

SAP WORKSHEETS #34-36: 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)

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External
Verification Chain-of-custody forms Sample Login/Receipt	Review the sample shipment for completeness, integrity, and sign accepting the shipment. All sample labels will be checked against the chain-of-custody form, and any discrepancies will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms. Verification of sample login/receipt and chain-of-custody forms will be documented on the laboratory sample receipt form.	Laboratory sample custodians and analysts, Gulf Coast Analytical Laboratories	I	Internal
Verification Chain-of-custody forms	Check that the chain-of-custody form was signed/dated by the sampler relinquishing the samples and by the laboratory sample custodian receiving the samples for analyses. Verification of chain-of-custody forms will be documented in the DVA workbook.	Project chemist or data validators, Resolution Consultants	I	External
Verification SAP sample tables	Verify that all proposed samples listed in the SAP tables have been collected. Sample completeness will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	FTL or designee, Resolution Consultants	I	External
Verification Sample log sheets and field notes	Verify that information recorded in the log sheets and field notes are accurate and complete. Sample log sheet verification will be documented by dated signature on the last page or page immediately following the review material.	FTL or designee, Resolution Consultants	I	External
Verification Field QC samples	Check that field QC samples, described in Worksheet #12 and listed in Worksheet #20, were collected as required. QC sample completeness will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	FTL or designee, Resolution Consultants	I	External
Verification Analytical data package	Verify all analytical data packages will be verified internally for completeness by the laboratory performing the work. The laboratory project manager (or designee) will sign the case narrative for each data package. All laboratory data package reviews will be documented on the laboratory review checklists and exception reports that accompany the data in accordance with TCEQ TRRP-13.	Laboratory project manager, Gulf Coast Analytical Laboratories	I	Internal
Verification Analytical data package	Verify the data package for completeness. Missing information will be requested from the laboratory and validation (if performed) will be suspended until missing data are received. Data package completeness will be documented in the DVA workbook.	FTL, Project chemist or data validators, Resolution Consultants	I	External
Verification Electronic data deliverables	Verify the electronic data against the chain-of-custody and hard copy data package for accuracy and completeness. Electronic data deliverable verification will be documented in the DVA workbook.	Data manager and/or validator, Resolution Consultants	I	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I / IIa / IIb [1]	Internal / External
Validation Chain-of-custody	Examine the traceability of the data from time of sample collection until reporting of data. Ensure that the custody and integrity of the samples were maintained from collection to analysis and the custody records are complete and any deviations are recorded. Chain-of-custody verification will be documented in the DVA workbook.	Project chemist or data validators, Resolution Consultants	IIa	External
Validation Holding Times	Review that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times. If holding times were not met, confirm that deviations were documented. Holding time examination will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa	External
Validation Sample results for representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis. Sample receipt and preservation will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Laboratory data results for accuracy	Ensure that the laboratory QC samples were analyzed and that the measurement performance criteria, listed in Worksheet #28, were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed, as listed in Worksheet #12, and that the analytical QC criteria were met. Accuracy will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Field and laboratory duplicate analyses for precision	Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSDs. Ensure compliance with the precision goals listed in Worksheet #12 and 28. Precision will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Project action limits	Assess and document the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant, on the other target compounds reported as undetected. Project action limit achievement will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Data quality assessment report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Present tabular qualified data and data qualifier codes and summarize data qualification outliers. Determine if the data met the measurement performance criteria and determine the impact of any deviations on the technical usability of the data. Result qualification will be documented in the in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/IIa/IIb [1]	Internal/External
Validation SAP QC sample documentation	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within acceptance limits. QC sample completeness and assessment will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Analytical data deviations	Determine the impact of any deviation from sampling or analytical methods and laboratory SOP requirements and matrix interferences effect on the analytical results. Data deviations will be documented in the DVA workbook and Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIb	External
Validation Project quantitation limits for sensitivity	Ensure that the project detection limits were achieved. Project quantitation limit achievement will be documented in the DVA workbook and in the Data Usability Summary Report in accordance with TCEQ TRRP-13	Project chemist or data validators, Resolution Consultants	IIb	External
Validation Soil and Groundwater 1,2-Dichloroethane, BTEX and MTBE	Validate 1,2-dichloroethane, BTEX and MTBE data using TCEQ TRRP-13 and MPC identified in Worksheets #12, 19, 24, and 28. All data will be validated and raw instrument outputs assessed and recalculated for 10% of the reported results. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, (June 2008) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, 19, 24, and 28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. All data validation finding will be documented in a Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Soil and Groundwater PAHs	Validate PAH data using TCEQ TRRP-13 and MPC identified in Worksheets #12, 19, 24, and 28. All data will be validated and raw instrument outputs assessed and recalculated for 10% of the reported results. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, (June 2008) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, 19, 24, and 28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. All data validation finding will be documented in a Data Usability Summary Report in accordance with TCEQ TRRP-13.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External

<table>
<tr><th>Data Review Input</th><th>Description</th><th>Responsible for Verification (name, organization)</th><th>Step I/ IIa/IIb [1]</th><th>Internal/ External</th></tr>
<tr><td>Validation
Soil and Groundwater
TPH</td><td>Validate TPH data using TCEQ TRRP-13 and MPC identified in Worksheets #12, #19, #24, and #28. U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, (June 2008) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, #19, #24, and #28 are not met.

The end use of the TPH results data will be to screen samples and determine if PAH analysis is required. Therefore, validation for will be limited to the following elements: holding times, blank analyses, laboratory control samples, and laboratory duplicates.

All data validation finding will be documented in a Data Usability Summary Report in accordance with TCEQ TRRP-13.</td><td>Project chemist or data validators, Resolution Consultants</td><td>IIa/IIb</td><td>External</td></tr>
<tr><td>Validation
Data qualifiers</td><td>Qualifiers that will be applied during the data validation process are summarized below and, as indicated, results will be considered usable for interpretation unless the results are rejected when extreme data quality indicator failures are noted.
<table>
<tr><th>Data Qualifier</th><th>Qualifier Definition</th><th>Interpret Result As a Detection?</th><th>Result Usable?</th><th>Potential Result Bias</th></tr>
<tr><td>no qualifier</td><td>Acceptable</td><td>Yes</td><td>Yes</td><td>None expected</td></tr>
<tr><td>J</td><td>Estimated</td><td>Yes</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>JH</td><td>Estimated and Biased High</td><td>Yes</td><td>Yes</td><td>High</td></tr>
<tr><td>JL</td><td>Estimated and Biased Low</td><td>Yes</td><td>Yes</td><td>Low</td></tr>
<tr><td>U</td><td>Undetected</td><td>No</td><td>Yes</td><td>None expected</td></tr>
<tr><td>UJ</td><td>Undetected and Estimated</td><td>No</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>UJL</td><td>Undetected and Estimated Biased Low</td><td>No</td><td>Yes</td><td>Low</td></tr>
<tr><td>UR</td><td>Undetected and Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
<tr><td>R</td><td>Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
</table></td><td>Project chemist or data validators, Resolution Consultants</td><td>IIa/IIb</td><td>External</td></tr>
</table>

Notes:

[1] IIa = compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]
IIb = comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005]
SAP = Sampling and analysis plan
DVA = Data validation assistant
FTL = Field team leader
QC = Quality control
RPD = Relative percent difference
MS/MSD = Matrix spike/Matrix Spike duplicate
LCS/LCSD = Laboratory control sample/laboratory control sample duplicate

SOP	=	Standard operating procedure
BTEX	=	Benzene, toluene, ethylbenzene, xylenes
MTBE	=	Methyl tert-butyl ether
TCEQ	=	Texas Commission on Environmental Quality
TRRP-13	=	Texas Risk Reduction Program *Review and Reporting of Chemical of Concern (COC) Concentration Data under TRRP*, RG-366/TRRP-13, Revised May 2010.
U.S. EPA	=	U.S Environmental Protection Agency
PAH	=	Polynuclear aromatic hydrocarbons
TPH	=	Total petroleum hydrocarbon
MPC	=	Measurement performance criteria

SAP WORKSHEET #37: USABILITY ASSESSMENT

(UFP-QAPP Manual Section 5.2.3)

Data Review

The usability of the data directly affects whether project objectives can be achieved and the following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics:

- *Completeness* — Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under correct normal conditions. It is expected that 100% of the planned sampling points will be collected. The completeness goal for field measurements will be greater than 90%. Laboratory analysis for this project will have a completeness goal greater than 95% to account for unanticipated results that may be rejected during data validation. Completeness can be calculated using the following equation.

$$\%Completeness = \frac{No.\ of\ Valid\ Tests}{Total\ Tests\ Taken} x100$$

  The FTL, acting on behalf of the Project Team, will determine whether deviations from the scheduled sample collection or analyses occurred. If they have occurred and the Resolution Consultants TOM determines that the deviations compromise the ability to meet project objectives he will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

- *Precision* — Precision measures the reproducibility of measurements and methods and is defined for qualitative data as a group of values' variability compared with its average value. To assess the precision of the measurement systems used in this project, field duplicates will be obtained and analyzed with the samples collected. Precision of laboratory analysis will be assessed by comparing the relative percent difference (RPD) of analytical results between matrix spike (MS) and matrix spike duplicates (MSDs) or sample duplicates and the measurement quality objectives will be those cited in Worksheets #12 and #28. The RPD will be calculated for each pair of duplicate analysis using the following equation:

$$RPD = \frac{(S \quad D)}{(S + D)/2} x100$$

Where:

S = sample result
D = duplicate result

The project chemist, acting on behalf of the Project Team, will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #12 and #28. This also will include a comparison of field and laboratory precision with the expectation that laboratory duplicate results will be no less precise than field duplicate results. If the goals are not met or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report.

- *Accuracy* — Accuracy is the degree to which a given result agrees with the true value. The accuracy of an entire measurement system is an indication of any bias that exists. Spiked sample results provide information needed to assess the accuracy of analyses. Specifically, surrogate spike, MS/MSD, and laboratory control sample (LCS) percent recoveries (%Rs) are used to assess accuracy. Every organic sample is spiked with known quantities of non-target surrogate compounds. Five percent of all samples analyzed are spiked with target chemicals for the MS/MSD (or sample duplicates). If the calculated %Rs for the known spike concentrations are within defined control limits set by each method, the reported sample concentrations are considered accurate. The accuracy measurement quality objectives will be those cited in Worksheets #12 and #28. Accuracy is calculated using the following equation:

$$\% R = \frac{(SSR \quad SR)}{SA} x100$$

Where:

SSR = spike sample recovery
SR = sample recovery
SA = concentration of spike added

The project chemist, acting on behalf of the Project Team, will determine whether the accuracy/bias goals were met for project data. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, MS/MSD, and LCS against the goals identified in Worksheets #24 and #28. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report.

- *Representativeness* — A project scientist, identified by the Resolution Consultants TOM and acting on behalf of the Project Team, will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and analyzed in accordance with this SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required.

- *Comparability* — The project chemist, acting on behalf of the Project Team, will determine whether the data generated under this project are sufficiently comparable to historical property data generated by different methods and for samples collected using different procedures and under different property conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless the project chemist indicates that such quantitative analysis is required.

- *Sensitivity* — The project chemist, acting on behalf of the Project Team, will determine whether project sensitivity goals listed in Worksheet #15 are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

After completion of the data validation, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The Project Team members, identified by the Resolution Consultants TOM, will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data.

Identify the personnel responsible for performing the usability assessment:

The Resolution Consultants TOM, project chemist, and FTL will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Project Team. If deficiencies affecting the attainment of project objectives are identified, the review will take place either in a face to face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). The project report will identify and describe the data usability limitations and suggest re-sampling or other corrective actions, if necessary. Graphical presentations of the data such as concentration tag maps will be generated as part of the overall data evaluation process.

REFERENCES

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— *Texas PST Program Action Levels.* August 2011.

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Appendix A
Field Standard Operating Procedures

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.

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.

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

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)

Logbooks

Procedure 3-02

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

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

3.0 Terms and Definitions

3.1 Logbook

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

3.2 Data Form

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

4.0 Training and Qualifications

4.1 The **Contract Task Order (CTO) Manager** or **designee** is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The **CTO Manager** shall review the field logbook on at least a monthly basis. The **CTO Manager** or **designee** is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.

4.2 A knowledgeable individual such as the **Field Manager**, **CTO Manager**, or **Program Quality Manager** shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

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

4.4 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures and that the logbook is completed properly and daily. The **Field Manager** is also responsible for submitting copies to the **CTO Manager**, who is responsible for filing them and submitting a copy (if required by the CTO Statement of Work).

4.5 The **logbook user** is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The **logbook user** is also responsible for safeguarding the logbook while having custody of it.

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

5.0 Equipment and Supplies

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

5.2 Pens shall have indelible black ink.

6.0 Procedure

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

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

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

6.4 Typical information to be entered includes the following:

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

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

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

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

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

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

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

7.0 Quality Control and Assurance

7.1 Review per Section 4.2 shall be recorded.

8.0 Records, Data Analysis, Calculations

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

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

9.0 Attachments or References

9.1 Attachment 1 – Description of Logbook Entries

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

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

Attachment 1
Description of Logbook Entries

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

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

Sample Labeling and Chain of Custody Procedures
Procedure 3-03A

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, 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 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**, or designee, 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**, or designee, shall review COC forms at the completion of each sampling event.

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

4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 The **Project Chemist**, or designee, is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analytical plan. The **Project Chemist**, or designee, is responsible for notifying the laboratory, data managers, and data validators in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with the laboratory and must be made in accordance with a respective contract.

4.5 All **Field Personnel** are are responsible for recording pertinent data onto the COC forms to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

5.0 Procedure

This procedure provides standards for 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 Sample Labeling

Affix a waterproof sample label with adhesive backing to each individual sample container. 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)
- 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.

5.2 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. A description of sample custody procedures is provided below.

Sample Collection Custody Procedures

According to the 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
- 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 shipping coolers (and sample jars, if required) if the cooler/container is to be removed from the sampler's custody. Place a minimum of two 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
- 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 0, 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 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 completed COC/analytical request form that may be used by field personnel, with box numbers identified and discussed in text below. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Each record on the form (Attachment 2) is identified with a bold number corresponding to the instructions given below.

1. Record the project name, site location.
2. Record the site location, including the state.
3. Record the Contract Task Order number
4. Record the Resolution Consultants Task Order Manager
5. Record the sampler/site phone or cell number (if applicable).
6. Record the laboratory name where the samples were sent.
7. Record the requested turnaround time, in days. If a specific turnaround time is required to meet project objectives, but was not indicated on the laboratory service request form submitted to the purchasing department, the sampler, project manager, or site manager should contact the purchasing department so the laboratory contract can be modified.
8. Record the COC number that is defined by the sampler and should be unique throughout the project's history. An example would be to use the sampler's initials followed by the data. If multiple custodies are generated on a given day, use a unique sequential identifier. <u>Example</u>: CRC040105A, CRC040105B
9. Record the purchase order number provided by the purchasing department.
10. Record the page and total number of COC forms used in a shipment.
11. Record the project, and phase applicable to the sampling task.
12. Record the two-character code corresponding to the *chemical* preservation type, which is found on the bottom of the COC form. If no chemical preservation was added to the sample, the field should be left blank. Temperature preservation need not be documented at this location, but will be indicated elsewhere on the COC form (see 33).

13. List the requested analysis. Whenever possible, list the corresponding analytical method. (e.g., VOCs, 8260).

14. For Lab identification use only.

15. Record the full *unique* sample identification as detailed in the Site's Sampling and Analysis Plan.

16. Record the location identification, which is a shortened ID used for presentation and mapping, as detailed in the Site's Sampling and Analysis Plan.

17. Record the sample date using the format mm/dd/yy.

18. Record the sample time using the military format of hhmm.

19. Record the matrix code of the sample, which is located at the bottom of the COC form. The matrix code is a crucial element of the Navy's data management system. For simplicity, only typical matrix codes are listed on the bottom COC form, but below is a complete listing of all applicable Navy matrix codes:

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
AA	Ambient air	RK	Rock
AC	Composite air sample	SB	Bentonite
AD	Air - Drilling	SBS	Sub-surface soil (> 6")
AIN	Integrated air sample (under sample form of gas)	SC	Cement/Concrete
AQ	Air quality control matrix	SD	Drill cuttings — solid matrix
AQS	Aqueous	SE	Sediment
ASB	Asbestos	SEEP	SEEP
ASBF	Asbestos-Fibrous	SF	Filter sand pack
ASBNF	Asbestos-Non-Fibrous	SJ	Sand
AVE	Air-Vapor extraction, effluent	SK	Asphalt
AX	Air sample from unknown origin	SL	Sludge
BK	Brick	SM	Water filter (solid material used to filter water)
BS	Brackish sediment	SN	Miscellaneous solid/building materials
CA	Cinder ash	SO	Soil
CK	Caulk	SP	Casing (PVC, stainless steel, cast iron, iron pipe
CN	Container	SQ	Soil/Solid quality control matrix
CR	Carbon (usually for a remediation system)	SS	Scrapings
DF	Dust/Fallout	SSD	Subsurface sediment
DR	Debris/rubble	STKG	Stack gas
DS	Storm drain sediment	STPM	Stripper Tower Packing Media
DT	Trapped debris	SU	Surface soil (less than 6 inches)
EF	Emissions flux	SW	Swab or wipe
EW	Elutriate water	SZ	Wood
FB	Fibers	TA	Animal tissue
FL	Forest litter	TP	Plant tissue
GE	Soil gas effluent — stack gas (from system)	TQ	Tissue QC
GI	Soil gas influent (into system)	TX	Tissue
GL	Headspace of liquid sample	UNK	Unknown
GQ	Gaseous or Headspace QC	W	Water (not groundwater, unspecified)
GR	Gravel	WA	Drill cuttings - aqueous mix
GS	Soil gas	WB	Brackish Water

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
GT	Grit	WC	Drilling water (used for well construction)
IC	IDW Concrete	WD	Well development water
IDD	IDW Solid	WF	Freshwater (not groundwater)
IDS	IDW soil	WG	Ground water
IDW	IDW Water	WH	Equipment wash water
IW	Interstitial water	WI	Ground water influent (into system)
LA	Aqueous phase of a multiphase liquid/soil	WL	Leachate
LF	Product (floating or free)	WM	Marine water
LQ	Organic liquid quality control matrix	WN	Pore water
MA	Mastic	WO	Ocean water
MO	Mortar	WP	Drinking water
MR	Marine sediment	WQ	Water for QC samples
MS	Metal shavings	WR	Ground water effluent (from system)
NS	Near-surface soil	WS	Surface water
PA	Paper	WT	Composite groundwater sample
PC	Paint Chips	WU	Storm water
PP	Precipitate	WW	Waste water
RE	Residue		

Field QC blanks will require matrix codes that identify the type of blank associated with parent sample. Aqueous field QC blanks are not automatically identified with a matrix code of "WQ," indicating a water quality control blank; they are only identified with a matrix code of "WQ" if the associated samples are also aqueous. Trip blanks, field blanks, and equipment rinsate blanks collected in association with ***soil*** samples will be identified with a matrix code of "SQ," even though the actual matrix is aqueous, because the blanks were collected to assess potential contamination imparted during decontamination activities or transport of ***soil*** samples.

20. Record the sample type code, which is located at the bottom of the COC form. The sample type is a crucial element of the EQuIS data management system. For simplicity, only typical sample type codes are listed on the bottom of the COC form, but below is a list of all applicable Navy field sample type codes:

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
AB	Ambient condition blank
BIOCON	Bioassay control sample
BS	Blank spike
BSD	Blank spike duplicate
EB	Equipment blank
EBD	Equipment blank/rinsate duplicate
FB	Field blank
FD	Field duplicate
FS	Field spike
IDW	Purge and rinsate water
LB	Lab Blank

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
LR	Lab Replicate
MB	Material blank
MIS	Multi-Incremental Sample
MS	Matrix spike
N	Normal (Regular)
PE	Performance evaluation
PURGE	Purge water sample
RD	Regulatory duplicate
SB	Source blank
SBD	Source blank duplicate
SCREEN	Screening Sample
SD	Matrix spike duplicate
SPLIT	Sample split
SRM	Standard reference material
TB	Trip Blank
TBD	Trip blank duplicate
TBR	Trip blank replicate

Field duplicate samples — Field duplicates will be identified using the format detailed in the Site's Sampling and Analysis Plan. However, field duplicates will also be differentiated from the parent sample on the chain-of-custody form. The parent sample will have a sample type code of "N," for normal environmental sample; while its duplicate will have a sample type code of "FD."

21. Record whether the sample is field filtered with a "Y" or not field filtered with an "N." If a project requires collecting samples for both total and dissolved constituents, the same sample and location ID is used for both (see 15 and 16); however, the sampler will indicate whether the sample is field filtered at this location on the COC form. This field <u>must</u> always be filled out; even when soil samples are collected (where "N" appropriately applies, in most cases).

22. Record the total number of containers that are submitted for all of the tests. This must add up to the total number of containers listed for each individual test in 23.

23. Record the number of containers for each test. Do not use Xs, rather indicate the number of containers submitted for each test listed in 14. For example, Sample 010MW007002 requires analysis for VOCs (8260), and SVOCs (8270). Record 3 under the VOC analysis and 2 under the SVOC (assuming 3 containers were submitted for VOCs and 2 were submitted for SVOCs). The total number of containers in this example is 5, which should be the total number of containers listed in 22. Extra containers submitted for matrix spike/matrix spike duplicates (MS/MSDs) will be appropriately recorded.

24. Indicate if extra sample volume was included for MS/MSD analysis using an "X." Samples to be used for MS/MSDs will use the same sample ID and location ID (see 15 and 16), but will be collected in triplicate, particularly for liquid samples, to ensure the analytical laboratory receives sufficient volume for the analyses.

25. Indicate if the samples should be held by the laboratory for future testing using an "X."

26. Record any field comments.

27. Reserved for laboratory comments.

28. Indicate the total number of coolers in each shipment. *Note*: When multiple coolers are submitted, each should contain a COC form.

29. Signature(s) of the person(s) relinquishing sample custody.

30. Signature(s) of the person(s) receiving sample custody.

31. Indicate whether the samples are iced, by checking the appropriate response.

32. Indicate the method of shipment (e.g., FedEx, hand-delivered, laboratory courier).

33. Record the airbill number when a commercial courier is used. This is particularly important when multiple coolers are sent in the same shipment or when the laboratory is sent the COC form in advance of receiving samples because it aids in tracking lost coolers.

34. Record the date the coolers were shipped.

COC forms tailored to each CTO can be drafted and printed onto multiple 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; turnaround time; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all volatile organic 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.

6.0 Records

The COC/analytical request form shall be faxed or emailed approximately daily to the Project Chemist, or designee for verification of accuracy. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the CTO Manager for storage in project files. The 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.

7.0 References and Attachments

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.

Attachment 1: Chain-of-Custody Seal

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

Author	Reviewer	Revisions (Technical or Editorial)
Tina Cantwell QA Officer	Ben Brantley Project Manager	Rev 0 — Initial Issue

Attachment 1
Chain-of-Custody Seal

EXAMPLE 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>

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

RESOLUTION CONSULTANTS	CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD	COC No. 7	Page of 9
	Project Name: 1	PO No. 8	Project No. 10
	Site Location: 2		Lab Name 11
	Contract Task Order No. 3	**Sample Analysis Requested** (Enter number of containers for each test)	

Sampler/Site Phone#	4
Send Results To:	5
Data Shipping Address:	6

Lab ID	Sample ID (sys_samp_code)	Location ID (sys_loc_code)	Date (mm/dd/yy)	Time (Military) (hhmm)	Matrix Code (1)	Sample Type (2)	Field Filtered (Y/N)	Total No. of Containers	12 / 13										Extra Volumen for MS/MSD	HOLD
14	15	16	17	18	19	20	21	22	23										24	25

Turnaround Time(specify): 26 **Final** _____ days **Email** (if applicable) _____ days			Deliverable(check): 27 Level 2_____ Level 3_____ Full/Level 4_____ TX TRRP-13_____		
Field **Comments:** 28			*Lab* **Comments:** 29		**Sample Shipment and Delivery Details** Number of coolers in shipment: 30
Relinquished by (signature)	Date	Time	Received by (signature)	Date Time	Samples Iced?(check) 33 Yes___ No___
1 31			1 32		Method of Shipment: 34
2			2		Airbill No: 35
3			3		Date Shipped: 36

(1) AA=Ambient air, **AQ**=Air quality control, **ASB**=Asbestos, **CK**=Caulk, **DS**=Storm drain sediment, **GS**=Soil gas, **IC**=IDW Concrete, **IDD**=IDW Solid, IDS=IDW soil, **IDW**=IDW Water, **LF**=Free Product, **MA**=Mastic, **PC**=Paint Chips, **SC**=Cement/Concrete, **SE**=Sediment, **SL**=Sludge, **SO**=Soil, **SQ**=Soil/Solid quality control, **SSD**=Subsurface sediment, **SU**=Surface soil (<6 in), **SW**=Swab or wipe, **TA**=Animal tissue, **TP**=Plant tissue, **TQ**=Tissue quality control, **WG**=Ground water, **WL**=Leachate, **WO**=Ocean water, **WP**=Drinking water, **WQ**=Water quality control, **WR**=Ground water effluent, **WS**=Surface water, **WU**=Storm water, **WW**=Waste water

(2) Sample Type: **AB**=Ambient Blk, **EB**=Equipment Blk, **FB**=Field Blk, **FD**=Field Duplicate Sample, **IDW**=Investigative-Derived Waste, **MIS**=Incremental Sampling Methodology, **N**=Normal Environmental Sample, **PE**=Performance Eval., **TB**=Trip Blk

(3) Preservative added: **HA**=Hydrochloric Acid, **NI**=Nitric Acid, **SH**=Sodium Hydroxide, **SA**=Sulfuric Acid, **AA**=Ascorbic Acid, **HX**=Hexane, **ME**=Methanol, **SB**=sodium bisulfate, **ST**=Sodium Thiosulfate, If **NO preservative** added leave blank

Sample Handling, Storage, and Shipping of Low Level Environmental Samples

Procedure 3-04A

1.0 Purpose and Scope

1.1 This Standard Operating Procedure (SOP) sets forth the methods for use by personnel engaged in handling, storing, and transporting low level environmental samples.

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 To avoid lifting injuries associated with heavy coolers, use the large muscles of the legs, not the back. Use dollies if possible.

2.2 When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.

2.3 Wear proper gloves, such as blue nitrile and latex, as defined in the site-specific project health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

3.0 Terms and Definitions

DOT — Department of Transportation

4.0 Training and Qualifications

4.1 The **Contract Task Order** (CTO) **Manager** is responsible for verifying that these 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 sample handling, storage, and shipping are performed in accordance with this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedures

5.1 Handling and Packaging

Environmental samples should be packaged prior to shipment using the following procedures:

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

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

3. Glass bottles should be wrapped in bubble wrap — preferably sealable bubble wrap sample bags, if available. Place bottles in separate and appropriately-sized polyethylene bags and seal the bags.

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, if available, 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 bubble wrap or other suitable absorbent material.

7. Securely fasten the top of the large garbage bag with packaging tape.

8. Place the completed Chain-of-Custody (COC) Record into a sealed 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. COC seals should be affixed to opposing sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

5.2 Shipping

Follow all appropriate DOT regulations (e.g., 49 Code of Federal Regulations, Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized in the following subsections.

5.2.1 Non-hazardous Materials Shipment

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

When a cooler is ready for shipment to the laboratory, prepare standard air bill paperwork for shipment of the samples to the laboratory. Write the shippers tracking/airbill number on the COC form. Place two copies of the COC form inside a self-sealing bag and tape it to the inside of the cooler. Seal the cooler with waterproof tape and label it with "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Affix a label stating the destination (laboratory address) to each cooler. Personnel should be aware of carrier weight or other policy restrictions.

5.2.2 Hazardous Materials Shipment

Shipment of Hazardous Material is not covered in this SOP; all samples handled under this SOP are anticipated to be non-hazardous or not dangerous goods. The CTO Manager, or designee, 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, of International Air Transport Authority (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 a waste sample or a highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

6.0 Records

Maintain all copies of chain of custodies and air bills with the project file. .

7.0 Attachments or References

International Air Transport Authority (IATA). Dangerous Goods Regulations

http://www.iata.org/whatwedo/cargo/dangerous_goods/Documents/DGR52-significant-changes.pdf

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)
Ben Brantley	Tina Cantwell	Rev 0 — Initial Issue
Program Manager	QA Officer	

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities regarding the management of investigation-derived waste (IDW) at project sites in the state of Texas. The purpose of this procedure is to provide guidance for the minimization, handling, labeling, temporary storage, inventory, classification, and disposal of IDW. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of remedial actions. If there are procedures whether it is from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to IDW, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan.

2.0 SCOPE

This procedure shall serve as management-approved professional guidance for 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.

This procedure was developed to serve as management-approved professional guidance for the management of IDW in the state of Texas. It focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure. This procedure was developed based on the rules promulgated in Title 30, Texas Administrative Code (TAC), Chapter 335, and Title 40 Code of Federal Regulations (CFR), Subchapter I.

3.0 DEFINITIONS

3.1 Logbook

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

3.2 Hazardous Waste

A waste is defined as hazardous by the U.S. Environmental Protection Agency (USEPA) if it is one of over 400 wastes listed in the CFR as hazardous or if it exhibits one or more of four hazardous characteristics; i.e., it is ignitable, corrosive, reactive or toxic. (40 CFR 261.3)

3.3 Class 1 Industrial Waste

A waste that, because of its concentration or physical or chemical characteristics, is toxic; corrosive; flammable; a strong sensitizer or irritant; a generator of sudden pressure by decomposition, heat or other means; or may pose a substantial present or potential danger to human health or the environment when improperly processed, stored , transported, disposed of or otherwise managed. (30 TAC 335.1[14])

A waste that contains specific constituents which equal or exceed the levels listed in 335.521(a)(1) is a Class 1 waste. Generators should document that a waste with significant concentrations of Table 2 constituents is not Class 1 (335.521 Table 2). A waste is classified as Class 1 if a liquid has a flash point of less than 65.6 degrees Celsius (150 degrees Fahrenheit), or is a solid or semi-solid capable of causing fires through friction, or retained heat from process, or ignited readily and burns vigorously and persistently, creating serious hazard. A waste is classified as Class 1 if it is a semi-solid or solid which when mixed with distilled water produces a solution with pH less than 2 or greater than 12.5; if total recoverable cyanides are greater than 20 parts per million; if absence of analytical data and/or process knowledge which proves waste is Class 2 or Class 3; if identified as Class 1 in 335.508 (Specific Wastes); or if not a hazardous waste and generator chooses to classify as Class 1.

3.4 Class 2 Industrial Waste

Any waste that cannot be described as a hazardous waste or as a non-hazardous Class 1 or Class 3 waste. (30 TAC 335.1[15]) A generator can choose not to classify waste as Class 3.

3.5 Class 3 Industrial Waste

A waste that is inert and essentially insoluble, usually including materials such as rock, brick, glass, dirt, certain plastics, rubber, and similar materials that are not readily decomposable. (30 TAC 335.1[16])

4.0 RESPONSIBILITIES

The CTO Manager is responsible for identifying instances of non-compliance with this procedure and ensuring that IDW is properly handled and managed in accordance with this SOP and any site-specific or project-specific planning documents. The CTO Manager is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks. The QA Manager or CTO Manager is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all IDW is managed according to this procedure. Field personnel are responsible for the implementation of this procedure and will be accountable for the comprehension and implementation of this SOP during all field activities, as well as obtaining the appropriate field logbooks, forms, labels, records and equipment needed to complete the field activities.

5.0 PROCEDURE

5.1 Equipment/Supplies

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

- Containers for waste (e.g., U.S. Department of Transportation (DOT) approved 55-gallon open or closed top drums) and material to cover waste to protect it from weather (e.g., plastic covering)
- Equipment (i.e., pumps, generators, water/interface level indicators, safety monitoring equipment, drum sampling equipment, wrenches to secure drum bungs or lids)
- Hazardous/non-hazardous waste drum labels (weatherproof)
- Permanent marking pens
- Inventory forms for project file
- Plastic garbage bags, zip lock storage bags, rolls of plastic sheeting
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the site-specific Site Health and Safety Plan (SHSP).

5.2 Drum Handling

IDW shall be containerized using DOT-approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids or bungs (i.e., United Nations Code 1A2 or 1H2). Typically, 55-gallon drums are used; however, smaller drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums.

Recycled drums should not be used for hazardous waste, polychlorinated biphenyl compounds or other regulated shipments. For sites where large quantities of liquids will be generated, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system or offsite disposal versus longer-term drum storage.

When DOT-approved drums with removable lids are used, verify the integrity of any foam or rubber sealing ring located on the underside the drum lids prior to sealing drums containing IDW liquids. If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum and segregate the paper towel or rag used to remove the material with visibly soiled PPE and disposable sampling equipment. Label all IDW drums and place them on pallets or within secondary containment in the designated storage area.

5.3 Labeling

Containers used to store IDW must be properly labeled. Two general conditions exist: 1) waste characteristics are known to be either hazardous or nonhazardous from previous studies or onsite data; or 2) waste characteristics are unknown until additional data are obtained.

For situations where the waste characteristics are known, the waste containers should be packaged and labeled in accordance with appropriate state and federal regulations that may govern the labeling of waste.

The following information shall be placed on all non-hazardous waste labels:

- Description and source of waste (i.e., purge water from MW-1, soil cuttings from HA-2)
- Contact information, including name and telephone number
- Date when the container becomes full

The following information shall be placed on all hazardous waste labels:

- Description and source of waste (i.e., purge water from MW-1, soil cuttings from HA-2)

- Generator information (i.e., name, address, contact telephone number)

- USEPA identification number and Texas Solid Waste Registration number (supplied by onsite client representative)

- Date when the container becomes full

When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words "waste characterization pending analysis" and the following information included on the label:

- Description and source of waste (i.e., purge water from MW-1, soil cuttings from HA-2)
- Contact information, including name and telephone number
- Date when the container becomes full

Once the waste has been characterized, the label should be changed as appropriate for a non-hazardous or hazardous waste.

Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it also may be helpful to include labels on the top of the containers to facilitate organization and disposal.

Each container of waste generated shall be recorded in the logbook used by the person responsible for labeling the waste. After the waste is disposed, either by transportation offsite or disposal onsite in an approved disposal area, an appropriate record shall be made in the same logbook to document proper disposition of IDW.

5.4 Types of Site Investigation Waste

Several types of waste are generated during site investigations that may require special handling. These include soil and drilling fluids, groundwater, decontamination water, and used PPE, as discussed further in the following subsections.

5.4.1 Soil and Drilling Fluids

Soil cuttings from boreholes can be shoveled back into the borehole after drilling is complete, if feasible. If all of the soil cuttings cannot be returned to the borehole, soil cutting should be placed in an open-top 55-gallon drum. Drilling mud generated during investigation activities shall be collected in 55-gallon drums as well. Containers must remain closed at all times unless waste is being added. The containers shall be labeled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged on prescribed forms and kept in the project file.

5.4.2 Groundwater or Decontamination Water

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Wastewater generated during decontamination of field and sampling equipment will be collected and containerized in drums. Using bung style drums helps prevent leaks when drums are moved. Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labeled in accordance with this SOP.

5.4.3 Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. If not, all PPE should be disposed as Texas Class 2 non-hazardous waste in municipal sanitary landfill. Trash that is generated as part of field activities may be disposed in a municipal sanitary landfill as long as the trash was not exposed to hazardous media.

5.5 Waste Accumulation Onsite

IDW generated during investigation activities may be subject to storage times dictated by the site's hazardous waste generator status. Hazardous waste can either be stored in the designated waste management unit either 90 days (large quantity generator), 180 days (small quantity generator), or 12 months (conditionally exempt small quantity generator). This information can be obtained from the site or client point of contact. Until final offsite disposal, such containers should be inventoried, stored as securely as possible, and inspected weekly, as a general good practice.

The following requirements for the hazardous waste storage area must be implemented:

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

More requirements may be enforced by the client or site point of contact based on generator status. Weekly storage area inspections shall be performed and documented to ensure compliance with these requirements. Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated.

5.6 Waste Disposal

IDW will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.

All waste generated during field activities will be stored, transported, and disposed according to applicable state, federal, and local regulations. In Texas, IDW will be classified as hazardous, Industrial Class 1, Industrial Class 2, or Industrial Class 3 based on the waste determination process. Hazardous waste must be handled and disposed offsite at an approved hazardous waste disposal facility. Class 1 non-hazardous waste must be disposed at a facility permitted to accept Class 1 waste. Class 2 waste can be disposed at a municipal landfill, Class 1 landfill, or hazardous waste facility. All wastes classified as industrial Class 3 or general rubbish will be disposed at a municipal sanitary landfill, or in the case of construction and demolition (C&D) debris, must be disposed of at a facility that can accept C&D material.

In general, waste disposal should be carefully coordinated with the client or site point of contact, which would be considered the "generator" of the waste. Waste profiles should be carefully reviewed to ensure accuracy, as well as waste manifests prior to transportation offsite for disposal. In addition, facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements during the profile approval process.

5.7 Regulatory Requirements

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

- CFR, Title 40, Part 261
- CFR, Title 49, Parts 172, 173, 178, and 179
- 30 TAC, Title 30, Chapter 335

5.8 Waste Transport

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

6.0 RECORDS

Describe all IDW management activities in the field logbook. This should include all handling activities from when a container becomes full until it is transported offsite for disposal. Tracking of IDW will include applicable dates and weekly inspections.

7.0 HEALTH AND SAFETY

The CTO Manager or designee shall prepare a site-specific health and safety plan. All onsite personnel shall adhere to the site-specific SHSP.

8.0 REFERENCES

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

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9.0 ATTACHMENTS

None.

Equipment Decontamination

Procedure 3-06

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes methods of equipment decontamination, to be used for activities where samples for chemical analysis are collected or where equipment will need to be cleaned before leaving the site or before use in subsequent activities.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

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

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

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

2.1 Chemical Hazards associated with Equipment Decontamination

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

2.2 Physical Hazards associated with Equipment Decontamination

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

- Take necessary precautions when handling field sampling equipment.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

4.1 The **CTO Manager** is responsible for ensuring that decontamination activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.

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

4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedure

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

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

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

5.1 Decontamination Area

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

5.2 Types of Equipment

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

5.3 Frequency of Equipment Decontamination

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

5.4 Cleaning Solutions and Techniques

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

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

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

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

Rinse equipment used for measuring field parameters, such as pH (indicates the hydrogen ion concentration – acidity or basicity), temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 Containment of Residual Contaminants and Cleaning Solutions

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

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

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

6.0 Quality Control and Assurance

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

7.0 Records, Data Analysis, Calculations

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

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

8.0 Attachments or References

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

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

8.3 Procedure 3-05, *IDW Management*.

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

RESOLUTION CONSULTANTS

Land Surveying

Procedure 3-07

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. 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 surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

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 land surveying then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field sampling personnel** must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

2.4 The health and safety considerations for the work associated with land surveying include:

- Slip, trips and falls associated with work in the field;

- Biological hazards associated with work in the field; and,
- Potential hazards associated with contaminants of concern (COC) that may be located in the survey area,

3.0 Terms and Definitions

3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

3.2 Global Positioning System (GPS)

A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

4.0 Interferences

4.1 Commercially available GPS units typically have a level of precision of (±) 3 to 5 meters. Field corrections can be made as described in Section 8.3 below.

5.0 Training and Qualifications

5.1 Qualifications and Training

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

5.2 Responsibilities

5.2.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that land surveying activities comply with this procedure. The CTO Manager is responsible for ensuring that all field sampling personnel involved in land surveying 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 (FM)** is responsible for ensuring that all field personnel follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The FM or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- Commercially available GPS unit; and,
- Field Logbook.

7.0 Calibration or Standardization

7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.

7.2 Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet.

8.0 Procedure

8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying conducted under the NAVFAC CLEAN Program:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.
- Reference surveyed points to Mean Sea Level (Lower Low Water Level).
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing or well riser that is surveyed by filing grooves into the casing/riser on either side of the surveyed point, or by marking the riser with a permanent ink marker.

8.2 Global Positioning System (GPS) to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing that is surveyed by filing grooves into the casing on either side of the surveyed point.

8.3 Global Positioning System (GPS) to Position Sample Locations or Locate Site Features

Experienced field personnel may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use field personnel or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically when a level of precision greater than (±) 3 to 5 meters is required, a licensed surveyor will be required. When a level of precision of (±) 3 to 5 meters is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in GIS figures) experienced field personnel may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- A commercially available GPS unit with Wide Angle Averaging System (WAAS), topographic map display, and waypoint storage capabilities should be used.
- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or USGS benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (±) 5 meters as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units “Go To” function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labeled.

- It is recommended that GPS coordinates be uploaded to a storage device such as PC at the end of each day.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a WAAS system at the site, this should also be noted.

9.0 Quality Control and Assurance

None.

10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and placed in the project files.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

11.0 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)*
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

GEOPHYSICS

Procedure 3-09

1.0 Purpose and Scope

1.1 This Standard Operating Procedure (SOP) introduces the general methodologies, terms, and procedures for geophysical techniques. Geophysics deploys artificially induced signals or naturally occurring signals to investigate the physical properties of materials through arrays of airborne, surface, or subsurface sensors, and examines how these properties vary spatially and temporally.

A large number of geophysical techniques are employed in the industry, and some applications are rapidly evolving. Accordingly, this SOP describes in broad terms the main methods available, quality control procedures, and interpretation guidelines for subsurface environmental assessments. Project-specific criteria, including performance standards, are specified in Sampling and Analysis Plans (SAPs) or Work Plans (WPs), while further details on emerging technologies may be surmised in a supplemental SOP. Ultimately, the implementation of geophysical technologies should generally be reserved for locations where standard subsurface invasive investigation techniques (e.g., digging, drilling, puncturing, etc.) are deemed too costly or unsafe without supplemental information captured from the geophysical surveys. Even when used in favorable locations, however, geophysical techniques have inherent limitations that must be carefully considered in their deployment.

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 plans and reviews, inclusive of direct notification from at least one of the two program-level geophysicists within Resolution Consultants: (1) Larry Hughes, PG [lhughes@EnSafe.com] and (2) Brian Brunette, PGP [brian.brunette@aecom.com].

2.0 Safety

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

2.2 Some geophysical techniques, especially those with active transmitters (e.g., resistivity, radar, etc.), pose method-specific hazards. The hazards and procedures for minimizing risk must be explicitly stated in the HASP for all project sites; unexploded ordnance (UXO) sites may require additional Explosive Safety Submission or Hazards of Electromagnetic Radiation to Ordnance certifications.

3.0 Terms and Definitions

3.1 **Available Technologies**. Geophysical methods commonly applied to environmental issues generally fall into three broad categories: seismic (using a vibration/acoustic signal), electrical (using direct-current, inductive, or naturally occurring electromagnetic field sources), and potentiometric (using natural gravity or magnetic properties). These methods can be applied in boreholes (downhole logging), at the surface, underwater, within subsurface voids, from airborne platforms, and from space, or in various combinations of these configurations. Typical methods include (referring to definitions in Section 3.2):

3.1.1 **Reflection seismic:** Creates a seismic wave using an impact source (hammer on a plate, weight drop, explosive, vibrating device), and measures amplitudes and arrival times of reflected seismic waves from subsurface geology though geophones either planted in the soil or dragged along the surface ("streaming" array). Typically used to map deep structure and lithology for energy exploration, but in recent decades, evolving technology has allowed work in the sub-10 meter depth range of interest in many environmental investigations. Overall, perhaps the most powerful, highest-resolution geophysical method, though infrequently used for environmental issues.

3.1.2 **Refraction seismic:** Uses an impact source (typically hammer on a plate) and detects refracted waves from a higher-velocity material at depth. Typical application is mapping bedrock at depths of less than 30 meters. Refraction delivers reasonably high resolution. Limitations can arise from the large source-receiver spread, which can extend beyond the bounds of the survey area or be interrupted by surface features.

3.1.3 **Surface wave seismic:** Uses an impact source (typically hammer on a plate) to induce surface waves in the shallow subsurface to measure shear-wave velocity variations, often indicative of matrix stiffness. Used to evaluate landfills, engineering properties of the ground, and map shallow geology. The dominant method is multichannel analysis of surface waves (MASW). Occasionally passive MASW (refraction microtremor, or ReMi) is used to monitor deeper seismic activity, for example from oilfield fracking operations, or image geology in a manner similar to MASW.

3.1.4 **Electrical Resistivity (ER):** Uses multiple grounded electrodes to transmit low-frequency electrical current and receive voltage responses, which are used to construct resistivity images of the subsurface; a less commonly used, shallower application employs capacitively-coupled (ungrounded) electrodes as a towed array. ER uses either frequency-domain or time-domain technologies, which deliver similar results; typical depths of exploration are 1 to 100 meters (but up to 1,000 meters for specially designed surveys). Commonly used in environmental applications, particularly in mapping hydrogeology and karst structure. In addition to its surface-based applications, resistivity is a standard borehole tool. Resistivity has limited effectiveness in areas with highly conductive surface material (e.g., surface water inundation or saturated clays) due to current channeling.

3.1.5 **Induced polarization (IP):** A more powerful version of ER that, in addition to the resistivity parameter, measures voltages at multiple frequencies or time gates to infer the capacitive effect, or electrical polarization, due to certain materials such as clays, sulfide minerals, and alteration environments. Sometimes IP is called spectral induced polarization or complex resistivity. Less frequently used than ER for environmental issues, despite its superior qualities, which are especially useful in landfill and leachate delineation. Applications include hydrogeology, karst, 3D landfill characterization, and alteration from contaminants or remedial processes.

3.1.6 **Spontaneous potential (SP):** A passive method measuring potential differences due to electrochemical effects from variations in lithology, geochemical alteration, or mineralization; or, alternatively, measuring electrokinetic-flow phenomena from leaky membranes such as dams or liners in landfills or ponds. SP uses simple equipment consisting of a high-impedance digital voltmeter, insulated cable, and several nonpolarizing electrodes. In addition to its surface-based applications, SP is a standard borehole tool.

3.1.7 **Frequency domain electromagnetic (FDEM):** Pulses a small coil with a current (typically around 10 kiloHertz) and measures the response from subsurface conductors in a second coil. The response is separated into two components: quadrature (giving the conductivity of the ground) and in-phase (related to metal responses). FDEM is reliable only for low induction numbers (ground resistivity greater than 10 ohm-meters). Generally used to characterize the bulk conductivity of the ground, though some configurations allow limited depth profiling; typical depth penetration is to 5 meters. Surface-based deployment is fast and efficient. Airborne FDEM is commonly used for mining, less so for smaller-sized environmental projects.

3.1.8 **Transient electromagnetic methods:** These typically pulse an antenna with a sharp current and measure the ground's response in a second antenna after current turn-off. Transient methods roughly divide into two categories according to measurement times, which affect depths of investigation: **transient electromagnetics (TEM)** and **metal detectors**. TEM measures the signal decay

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immediately after current turnoff to investigate subsurface hydrogeology; this method is excellent for finding conductive features but poor for resistive features. Metal detectors analyze the decay curves at later times, after the signals due to natural geology should have dissipated to zero, for sustained signals from metal objects. The latter application is sometimes called time domain electromagnetics (TDEM), often used with a simple antenna configuration at limited time "windows" for fast ground coverage to map metal utilities, drums, tanks, etc. within the top several meters. UXO-focused TEM analyzes a broad time range to detect UXO, discriminate it from inert scrap, and determine the type and burial geometry of the ordnance; these often use 3-axis antennas and sophisticated software. These applications deploy TEM at the ground level or on airborne platforms. Electromagnetic limitations include discerning individual items in cluttered areas, working close to large metal features, and detecting deeper items due to deteriorating signal-to-noise ratios.

3.1.9 **Controlled source audiofrequency magnetotellurics (CSAMT):** Current is injected into a distant array of electrodes; measurements of electric field voltages and the magnetic field are used to map subsurface resistivity patterns. CSAMT is typically used for deeper energy-sector exploration, but occasionally to map aquifers for environmental applications. Natural source variants magnetotellurics (low frequency, deep) and audiofrequency magnetotellurics (intermediate depths) are rarely used in environmental work. A distant cousin to CSAMT, very low frequency, is occasionally used to map shallow bedrock fracturing in water studies.

3.1.10 **Ground penetrating radar (GPR):** GPR transmits signals in the low-MegaHertz (MHz) to GigaHertz range and measures the response due to changes in subsurface dielectric properties, which are largely driven by water content. GPR is a moderate to high resolution method commonly used to map stratigraphy, water saturation, permafrost, and anthropogenic features such as utilities, tanks, and drums. These applications require close coupling of antennas and the ground surface; an adaptation using non-coupled ("air launched") antennas is used for roadway delamination studies, and satellite-based radar (often in the form of synthetic aperture radar) is used for remote sensing. Depth penetration is limited to nearly zero in heavy clay environments, water inundated areas, or reinforced concreted, but can be tens of meters in dry sands.

3.1.11 **Gravity:** A passive method that measures local variations in the earth's gravitational field due to subsurface density changes. Classic applications include mapping voids beneath paved surfaces, caves and other karst features (such as sinkholes), mine shafts and tunnels, and depth to bedrock. Environmental applications typically demand very high precision, for which the term "microgravity" is often applied; the work requires expensive equipment and accurate elevation surveying, making the cost per station rather high.

3.1.12 **Magnetics:** A passive method that measures local variations in the earth's magnetic field due to subsurface changes in ferrous metal. Classic applications include mapping UXO, drums, underground storage tanks, and old building artifacts. The method is specific to ferrous metal and is less effective in high-magnetic environs such as volcanic areas. Anomalies are usually dipolar in nature, complicating interpretation with respect to TEM; but processing often can identify target positions and depths. In ground use, magnetics is often deployed in the vertical gradient mode, which uses two vertically-stacked magnetometers to distinguish local magnetic changes from regional ones. Airborne magnetics is sometimes used, typically on UXO projects, though TEM is more common for UXO.

3.1.13 **Emergent technologies:** Several promising technologies are in research stages, particularly nuclear magnetic resonance, a sensitive detector of water content with ties to geotechnical properties. Ultrasonic methods have been used for mapping fine-scale delamination and voids in concrete, and are being expanded to other targets relevant to environmental interests.

Global positioning system (GPS) equipment is often used for geophysical positioning; GPS standards are covered in SOP 3-07.

3.2 **Definitions:** Geophysical terms are numerous enough to fill an industry dictionary, but some common terms used in environmental work are:

3.2.1 **Arrival:** The return of a transmitted signal after passing through a material.

3.2.2 **Culture:** Anthropogenic features such as fences, pipelines, powerlines, metal well casings, buried debris, etc. that interfere with imaging a target.

3.2.3 **Geophysics:** A collection of techniques that utilize physical property contrasts in the subsurface to detect or image features of interest.

3.2.4 **MEC:** Munitions and explosives of concern.

3.2.5 **Reflection:** The bounce of waves from an interface. Use of the term usually implies the wavelength is much smaller than the target dimensions and depth.

3.2.6 **Refraction:** The bending of waves (usually seismic in geophysics) as the pass between media of different densities.

3.2.7 **UXO:** Unexploded ordnance, an older term still commonly used in geophysics but supplanted by "MEC" in military circles.

4.0 Interferences

4.1 Seismic methods (surface applications):

- Poor geophone coupling, for example in loose sands.
- Connection problems in stressed geophone cables.
- Poor source signal amplitude or frequency.
- High vibrational noise due to surface vibrations or wind.
- Strong topographic relief (surface-wave methods).
- Inadequate gain or stacking in the field.
- Poor target-to-surroundings velocity contrast.
- Terrain, vegetation, water bodies, hazards, site size, and other obstructions to deployment of contiguous lines.

4.2 Electrical methods (direct coupled, surface applications):

- Poor (high impedance) electrode contact.
- Electromagnetic coupling between transmitting and receiving cables (IP systems, especially frequency domain).
- Inadequate hardware and software to reliably record IP data (IP surveys only).
- Strong, undocumented changes in line orientations or electrode spacings; undocumented terrain changes.
- Inadequate signal amplitude for array size.
- Culture, especially parallel to lines, networked, or near electrodes.
- Anthropogenic signals, especially powerlines with poor frequency regulation and cathodically protected pipelines.
- Noise from local or global thunderstorms.
- Inadequate gain or stacking in the field.
- Poor target-to-surroundings resistivity/chargeability contrast.
- Highly conductive surface layer.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.3 SP (surface applications):

- Nonpolarizing electrodes insufficiently planted in soil, unprotected from drying or large temperature changes.
- Uncharacterized regional SP drift because of failure to monitor a reference electrode or base station.
- Depending on project objective, interference from redox-alteration effects, electrokinetic (active flow) effects, or biological effects (e.g., algae).
- Poor target-to-surroundings SP contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.4 Electromagnetic methods, FDEM (simple surface applications, FDEM):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Highly conductive geology violates the low induction number assumption.
- Extreme cultural signals such as major overhead powerlines.
- Surface/subsurface clutter and culture (when not the survey objective).
- For subtle targets requiring high data precision and density: acquisition speed too high (leveling errors), line-direction (reciprocity) bias, unmonitored instrument drift, inadequate GPS-positioning accuracy with respect to station spacings.
- Inadequate spatial coverage for size of targets sought.
- Target too small or deep for method.
- Poor target-to-surroundings contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.5 Electromagnetic methods, TDEM (surface applications, simple target searches):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations; failure to null the instrument in a nonmetallic area.
- Extreme cultural signals such as major overhead powerlines.
- Metal clutter and culture (when not the survey objective).
- For subtle targets requiring high data precision and density: acquisition speed too high (leveling errors), line-direction (reciprocity) bias, unmonitored instrument drift, inadequate GPS-positioning accuracy with respect to station spacing.
- Inadequate spatial coverage for size of targets sought.
- Target too small or deep for method.
- Poor target-to-surroundings contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.6 Electromagnetic methods, TEM (surface applications):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Extreme cultural signals such as major overhead powerlines.
- Metal clutter and culture, especially culture not symmetric with antenna configurations.
- Target too small or deep for method.
- Poor target-to-surroundings resistivity contrast.
- Unsuitable target, especially a smaller resistive target in a conductive environment.
- Conductivity-thickness ambiguity for a thin conductive layer.
- Inadequate quality control procedures, especially for UXO detection and discrimination (e.g., library target responses, in situ seed target calibrations, noise studies, etc.).
- Inadequate or incorrect application of processing.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

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4.7 CSAMT:

- Improper survey design of transmitting antenna location(s) to maximize far-field data.
- Inadequate transmitter signal.
- Infrequent magnetic field characterization in geology where magnetic field changes.
- Use of scalar data for 3-dimensional targets.
- Culture, especially parallel to lines, networked, or near electrodes.
- Anthropogenic signals, especially powerlines with poor frequency regulation and cathodically protected pipelines.
- Natural signals from regional thunderstorms.
- Target too shallow for expected skin depth range.
- Inadequate gain or stacking in the field.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.8 GPR:

- Failure to verify the GPR unit is licensed by the Federal Communications Commission or similar agencies for use in the designated country.
- Failure to coordinate high-powered GPR transmissions with nearby airports.
- At UXO sites: failure to verify that GPR is safe to operate in the presence of potentially live electronically-fused ordnance.
- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Survey design (antenna frequency/signal wavelength, separation) inadequately matched to expected target.
- Surface/subsurface clutter causing multiple signals.
- Airwaves from nearby trees or structures (particularly for antenna frequencies below 200 MHz).
- Strong radio transmissions nearby (occasional problem).
- Response shifts with changes in ground saturation.
- Inadequate penetration in conductive environments.
- Target too small or deep for method.
- Poor target-to-surroundings dielectric contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.9 Gravity:

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Inadequate protection of gravimeter during transport; failure to maintain internal heater temperature in the days preceding and during use.
- Inadequate leveling before acquisition.
- Inadequate base ties to correct instrument drift.
- Survey design (station spacing) inadequately matched to expected target size.
- Surrounding buildings and structures perturbing the gravitational field.
- Inadequate accuracy of station elevations.
- Poor target-to-surroundings density contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.10 Magnetics (surface based):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Heading error when using alkali vapor instruments.
- Application in high magnetic noise environments such as heavy culture (including reinforced concrete pavement), or in areas with magnetic surface geology (e.g., volcanics or sedimentary outwash of volcanic fragments).
- Magnetic items on operator (belt, keys, steel-toed boots).
- Survey design (station spacing) inadequately matched to expected target size.
- Inadequate characterization of ambient magnetic field drift (for total field surveys).
- Metal targets are not ferrous.
- Poor target-to-surroundings ferrous-metal contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.11 Airborne FDEM, TEM, Magnetics (in addition to ground-based interferences):

- Inability to minimize flight elevation due to trees and other obstructions.
- Inadequate accuracy of sensor elevation and orientation.
- Improper survey design (flight speed, line spacing, data redundancy and ties, etc.).
- Inadequate correction for helicopter-induced noise.
- Safety issues such as weather, remoteness of the site, flight hazards, etc.

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 **CTO Managers** are responsible for issuing SAPs that reflect the procedures and specifications presented in this procedure. The **CTO Manager** shall be familiar with current local and state regulations, and ensure that these regulations are followed. The **CTO Manager** is responsible for ensuring that all personnel involved in geophysics 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 direct supervision of geophysical acquisition and ensuring that procedures and specifications are implemented in the field in accordance with the approved SAP. The qualifications for the **Field Manager** must be in accordance with local jurisdictions with authority over the operations conducted.

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

6.0 Equipment and Supplies

6.1 Materials provided by either Resolution Consultants or its subcontractors shall be sufficient to accomplish the survey objectives. The Field Manager shall have, at a minimum:

- Personal protective equipment for all personnel as required by the HASP.
- Planning documents including the site-specific HASP and SAP.
- Copies of other plans and agreements, for example, those in conjunction with UXO sites.
- Field logbook/field forms/site maps.
- Sufficient tools to analyze data adequacy on site.

7.0 Procedure

7.1 General Note: because of the wide range of available geophysical techniques and even wider range of variations, as well as varying project objectives, details of required survey procedures appear in individual project SAPs. The following are intended as overall guidelines in executing and interpreting geophysical data.

7.2 Survey Design

- Work through the data quality objectives (DQOs): determine the overall project objectives, define the information desired from geophysics, define specific geophysical targets, and determine how the positive or negative outcome of the geophysics will impact resolution of the project objectives.
- Considering the target's anticipated physical properties, depth, size, and environs, develop a short list of potentially applicable techniques. If appropriate, run a forward model for each considered technology to evaluate the probability of detection/characterization in the presence of expected interferences; run multiple models if there is uncertainty in any of the input parameters. An alternative to modeling is hand-calculations based on expected target geometry and properties, or professional experience based on those properties.
- Determine the most appropriate technology to use. Establish a preliminary level of effort and ballpark cost. Then ask the question: is there a simpler, more cost-effective, or less ambiguous way to define the target with a non-geophysical approach? If not, based on the chosen technology, does geophysics merely add *data* (stuff to go in a report appendix) or does it add *information* (decision-making value)? If the latter, proceed with the survey design.
- Begin the survey design using best professional practices to ensure the target is adequately characterized. Examples of factors to consider: sample density with respect to the smallest likely target size (apply spatial aliasing criteria); adequate signal characteristics to resolve target; adequate depth penetration to reliably sample at the deepest likely target depth; signal-to-noise; interferences; best choice of equipment type and supplier for the site; robust survey logistics to meet challenges such as terrain, obstructions, and property constraints; quality control and verification procedures. Restate these in terms of data quality objectives.
- Envision how the report will be written if everything goes well: how will your project summary materially enhance project decisions? What can be changed now, in the survey-design stage, to maximize the decision-making impact?
- Incorporate these determinations in a SAP, stating performance criteria such as data density, repeatability, and verification.

7.3 Field Execution

- Determine if the field work will be done by Resolution Consultants directly or by a subcontractor. Follow standard procurement procedures for ordering equipment or selecting a subcontractor. Subcontracting requires a Statement of Work. All personnel, including subcontractors, must follow the field execution procedures outlined below.
- Equipment must be assembled and tested for correct functioning according to the manufacturer's recommendations. Initial tests may consist of, as examples: internal or external calibrations; comparing instrument response to a known regional response; testing response over visible cultural or geologic features; or tests over buried "seed" items of known physical characteristics. The tests should be sufficient to demonstrate that the equipment is operating within normal and project-specified tolerances before data acquisition begins. Tests should consider both precision and accuracy, as appropriate to the method and project objectives.
- For appropriate applications and methods (e.g., FDEM, TDEM, gravity and total-field magnetometry), establish a base station in a nominally responsive area on or near the site. Repeat measurements at the base station before, during, and after data collection to ensure proper functioning of the instrument and to establish a response curve for later correction of instrument or field drift. The frequency of base

station ties depends upon the variability of the drift being monitored and the DQOs of the survey. For some surveys, particularly total-field magnetometry, a continuously recording base station monitor is desirable. In other cases, such as GPR, the "base station" might be a base line, over which data are repeated to determine effects of rain on target delineation and penetration depth. Base station data are considered part of the official project electronic data record.

- Obtain data in a manner that adheres to the SAP or WP, constitutes reasonable and customary professional geophysical practice, and is continually focused on meeting project objectives.
- Check and document battery levels periodically. Some systems have an incipient data bias as battery voltage drops below a certain threshold, making it difficult to determine what parts of the data are reliable and what parts are not.
- All data should be stored electronically, if practical, and circumstances of field logistics and anything affecting data quality recorded in the field notebook (see Section 9.0).

7.4 Data Processing

- All raw data files downloaded from the instrument must be preserved without modification. Processing is to be performed on *copies* of the raw files.
- The processing stream, including filename protocol and processing algorithms used, must be documented sufficiently to be understandable to and reproducible by a geophysicist with no previous knowledge of the project.
- The level of effort in processing should be appropriate to the project DQOs.
- Whenever possible, data processing should incorporate ground truth information to achieve a more accurate solution. Joint processing of multi-method data sets may be similarly productive.
- A summary of data processing procedures and their rationale should be presented in the project report.

8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance guidelines as outlined in the SAP and any additional procedures identified in the field as necessary to maintain the integrity of the data.

8.2 System calibration, checks, and live tests shall be analyzed in the field before and during data collection to ensure data accuracy and precision.

9.0 Records, Data Analysis, Calculations

All geophysical data should be stored in a data recorder or laptop during acquisition, if practical. At the earliest practical time, and at least at the conclusion of each field day, data should be downloaded to a separate computer and backed up via external drive or email attachments.

Field notes will be recorded in the field logbook, which is a primary document of record for the project. Accordingly, any circumstances potentially affecting the interpretability of the data should be recorded in the notebook as they occur. Examples: times of arrival/departure and key field activities; health and safety factors and pre-work safety meeting (in addition to the required daily safe work assessment and permit form); weather; calibration/test results; records of base station ties; illustrations of instrument setup; details of instrument deployment; survey lines or points acquired; data results as appropriate; identification of anomalies encountered; records of interfering factors such as culture or ambient noise; descriptions of problems encountered, the data blocks affected, and remedy achieved; sketch maps; notes for subsequent processing; and any deviations from the procedures in this SOP and other project plans.

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10.0 Attachments or References

10.1 Butler, D.K., Ed., 1991. Near-Surface Geophysics: Investigations in Geophysics no.13, Society of Exploration Geophysicists.

10.2 Dobrin, M. B., and C. H. Savit, 1988. *Introduction to Geophysical Prospecting*: McGraw-Hill Publishing Environmental.

10.3 Nabighian, M.N., Ed., 1991. Electromagnetic Methods in Applied Geophysics: Investigations in Geophysics no.3, Society of Exploration Geophysicists.

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10.5 Telford, W. M., L. P. Geldart, R. E. Sheriff, and D.A. Keys, 1998. *Applied Geophysics*: Cambridge University Press.

10.6 Ward, S.H., Ed., 1990. Geotechnical and Environmental Geophysics: Investigations in Geophysics no.5, Society of Exploration Geophysicists.

Author	Reviewer	Revisions (Technical or Editorial)
Larry Hughes Senior Geophysicist	Brian Brunette, PGP Technical Lead MMRP	Rev 0 — Initial Issue (April 2013)

Monitoring Well Sampling

Procedure 3-14

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the actions to be used during monitoring well sampling activities and establishes the method for sampling groundwater monitoring wells for water-borne contaminants and general groundwater chemistry. The objective is to obtain groundwater samples that are representative of aquifer conditions with as little alteration to water chemistry as possible.

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. All field sampling personnel responsible for sampling activities must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the well sampling tasks. Conduct preliminary area monitoring of sampling wells to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor phase and liquid matrix through the use of of appropriate personal protective equipment (PPE).

2.2 Observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves and rubberized steel-toed boots. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations. Refer to the project-specific HASP for the required PPE.

2.3 Physical Hazards associated with Well Sampling

- To avoid lifting injuries associated with pump and bailers retrieval, use the large muscles of the legs, not the back.
- Stay clear of all moving equipment, and avoid wearing loose fitting clothing.
- When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid slip/trip/fall conditions as a result of pump discharge, use textured boots/boot cover bottoms.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
- Be aware of restricted mobility due to PPE.

3.0 Terms and Definitions

None.

4.0 Interferences

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

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

5.0 Training and Qualifications

5.1 **Qualifications and Training**

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

5.2 **Responsibilities**

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

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

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

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

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

6.0 Equipment and Supplies

6.1 Purging and Sampling Equipment

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

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

6.2 General Equipment

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

7.0 Calibration or Standardization

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

7.2 If readings are suspected to be inaccurate, the equipment shall be checked with the calibration solutions and/or re-calibrated.

8.0 Procedure

8.1 Preparation

8.1.1 Site Background Information

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

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

8.1.2 Groundwater Analysis Selection

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

8.2 Groundwater Sampling Procedures

Groundwater sampling procedures at a site shall include:

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

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

8.2.1 Well Security and Condition

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

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

8.2.2 Decontamination of Equipment

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

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

8.2.3 Measurement of Static Water Level Elevation

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

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

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

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

8.2.4 Detection of Immiscible Phase Layers

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

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

8.2.5 Purging Equipment and Use

General Requirements

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

According to the U.S. Environmental Protection Agency (EPA) (EPA, 1996), the rate at which groundwater is removed from the well during purging ideally should be less than 0.2 to 0.3 liters/minute. EPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated corrosion or reaction products in the well. EPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

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

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

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

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

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

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

Purging Equipment and Methods

Submersible Pump

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

Steam clean or otherwise decontaminate the pump and discharge tubing prior to placing the pump in the well. The submersible pump shall be equipped with an anti-backflow check valve to limit the amount of water that will flow back down the drop pipe into the well. Place the pump in the middle of the saturated screened interval within the well and maintain it in that position during purging.

Bladder Pump

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

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

Centrifugal, Peristaltic, or Diaphragm Pump

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

Air Lift Pump

Airlift pumps are not appropriate for purging or sampling.

Bailer

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

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

8.2.6 Monitoring Well Sampling Methodologies

Sampling Light, Non-Aqueous Phase Liquids (LNAPL)

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

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

Sampling Dense, Non-Aqueous Phase Liquids (DNAPL)

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

Groundwater Sampling Methodology

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

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

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

Submersible Pumps

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

Bladder Pumps

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

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

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

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

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

***Peristaltic Pumps*:**

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

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

Bailers

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

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

8.2.7 Sample Handling and Preservation

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

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

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

1. VOCs and total organic halogens (TOX)

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

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

Special Handling Considerations

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

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

Field Sampling Preservation

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

Field Sampling Log

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

- Identification of well

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

9.0 Quality Control and Assurance

9.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP. The goal of the QA program should be to ensure precision, accuracy, representativeness, completeness, and comparability in the project sampling program.

9.2 Quality control (QC) requirements for sample collection are dependent on project-specific sampling objectives. The project-specific SAP will provide requirements for sample preservation and holding times, container types, sample packaging and shipment, as well as requirements for the collection of various QC samples such as trip blanks, field blanks, equipment rinse blanks, and field duplicate samples.

10.0 Data and records management

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

- Sample Collection Records;
- Field logbook;
- Chain-of-custody forms; and
- Shipping labels.

10.2 Sample collection records (Attachment 1) will provide descriptive information for the purging process and the samples collected at each monitoring well.

10.3 The field logbook is kept as a general log of activities and should not be used in place of the sample collection record.

10.4 Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes.

10.5 Shipping labels are required is sample coolers are to be transported to a laboratory by a third party (courier service).

11.0 Attachments or References

Attachment 1 – Groundwater Sampling Collection Record

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

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

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

SOP 3-05, *IDW Management.*

SOP 3-06, *Equipment Decontamination*.

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

Attachment 1
Groundwater Sample Collection Record

Well ID:

Groundwater Sample Collection Record

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

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

a. Total Well Length ______ **c.** Length of Water Column ______ (a-b)

Casing Diameter/Material ______

b. Water Table Depth ______ **d.** Calculated Well Volume (see back) ______

2. WELL PURGEABLE DATA

a. Purge Method: ______

b. Acceptance Criteria defined (see SAP or Work Plan)
- Minimum Required Purge Volume (@ ______ well volumes) ______
- Maximum Allowable Turbidity ______ NTUs
- Stabilization of parameters ______ %

c. Field Testing Equipment used: Make Model Serial Number

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

(continued on back)

d. Acceptance criteria pass/fail

	Yes	No	N/A
Has required volume been removed	☐	☐	☐
Has required turbidity been reached	☐	☐	☐
Have parameters stabilized	☐	☐	☐

If no or N/A - Explain below.

______

3. SAMPLE COLLECTION: Method: ______

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

Comments ______

Signature ______ Date ______

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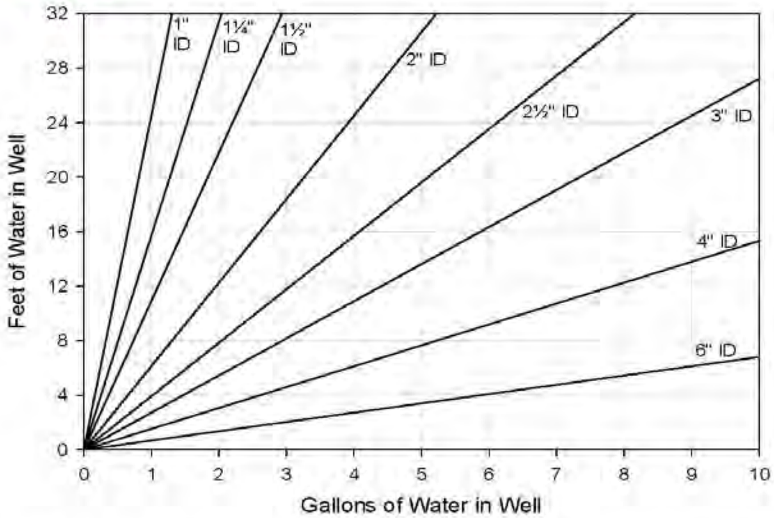
Purge Volume Computation

Well ID:



Volume / Linear Ft. of Pipe		
ID (in)	Gallon	Liter
¼	0.0025	0.0097
3/8	0.0057	0.0217
½	0.0102	0.0386
¾	0.0229	0.0869
1	0.0408	0.1544
1¼	0.0637	0.2413
1½	0.0918	0.3475
2	0.1632	0.6178
2½	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

(continued from front)

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

Signature ______________________________ Date ______________

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Soil and Rock Classification

Procedure 3-16

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) to thoroughly describe the physical characteristics of the sample and classify it according to the Unified Soil Classification System (USCS).

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. 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 surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling. All **field sampling personnel** responsible for sampling activities must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the sampling tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

2.4 The health and safety considerations for the work associated with soil classification include:

- At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils/rocks without the use of gloves.
- Stay clear of all moving equipment and be aware of pinch points on machinery. Avoid wearing loose fitting clothing.
- When using cutting tools, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid heat/cold stress as a results of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and in case of extreme cold, wear insulating clothing.

3.0 Terms and Definitions

None.

4.0 Interference

None.

5.0 Training and Qualifications

5.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that the soil and rock classification procedures comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in soil and rock classification shall have the appropriate education, experience, and training to perform their assigned tasks.

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

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

5.4 Field personnel are responsible for the implementation of this procedure. Minimum qualifications for **field sampling personnel** require that one individual on the field team shall have a minimum of 6 months of experience with soil and rock classification.

5.5 The **project geologist** and/or **task manager** is responsible for directly supervising the soil and rock classification procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the **Program Quality Manager** and then documented in the field logbook and associated report or equivalent document.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP
- Field log book and pen with indelible ink
- Boring log

- Munsell Soil Color Chart
- Scoopula, spatula, and/or other small hand tools
- California Sampler
- Hand-held penetrometer

7.0 Calibration or Standardization

None.

8.0 Procedure

8.1 Soil Classification

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system. The USCS was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log, logbook, and/or electronic field data collection device. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes and maximum particle size
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as consistency, density, and structure
- USCS classification symbol

The USCS serves as ”shorthand“ for classifying soil into 15 basic groups:

GW[1] Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)

GP[1] Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)

GM[1] Silty gravel (>50 percent gravel, >15 percent silt)

GC[1] Clayey gravel (>50 percent gravel, >15 percent clay)

SW[1] Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)

SP[1] Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

[1] If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC.

SM[1] Silty sand (>50 percent sand, >15 percent silt)

SC[1] Clayey sand (>50 percent sand, >15 percent clay)

ML[2] Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)

CL[2] Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)

MH[2] Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)

CH[2] Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)

OL Organic low plasticity silt or organic silty clay

OH Organic high plasticity clay or silt

PT Peat and other highly organic soil

Figure8-1 defines the terminology of the USCS. Flow charts presented in Figure 8-2 and indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

8.1.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).
2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.
3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).
4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).
5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).
6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term “trace”.
7. The percentages of gravel, sand, and fines must add up to 100 percent. “Trace” is not included in the 100 percent total.

8.1.2 Soil Dilatancy, Toughness, and Plasticity

8.1.2.1 Dilatancy

To evaluate dilatancy, follow these procedures:

[2] If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words “with sand” or “with gravel” (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words “sandy” or “gravely” (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use “sandy.”

1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 8-1. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

Table 8-1: Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

8.1.2.2 Toughness

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 8-2.

Table 8-2: Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness.

DEFINITION OF TERMS

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size	GRAVELS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN GRAVELS (Less than 6% Fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS With Fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN SANDS (Less than 6% Fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		SANDS With Fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size	SILTS AND CLAYS Liquid Limit is Less Than 50%		ML	Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines
			CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is Greater Than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt
			CH	inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

GRAIN SIZES

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
200	40	10	4	3/4"	3"	12"	
	U.S. STANDARD SERIES SIEVE			CLEAR SQUARE SIEVE OPENINGS			

Figure8-1: Unclassified Soil Classification System (USCS)

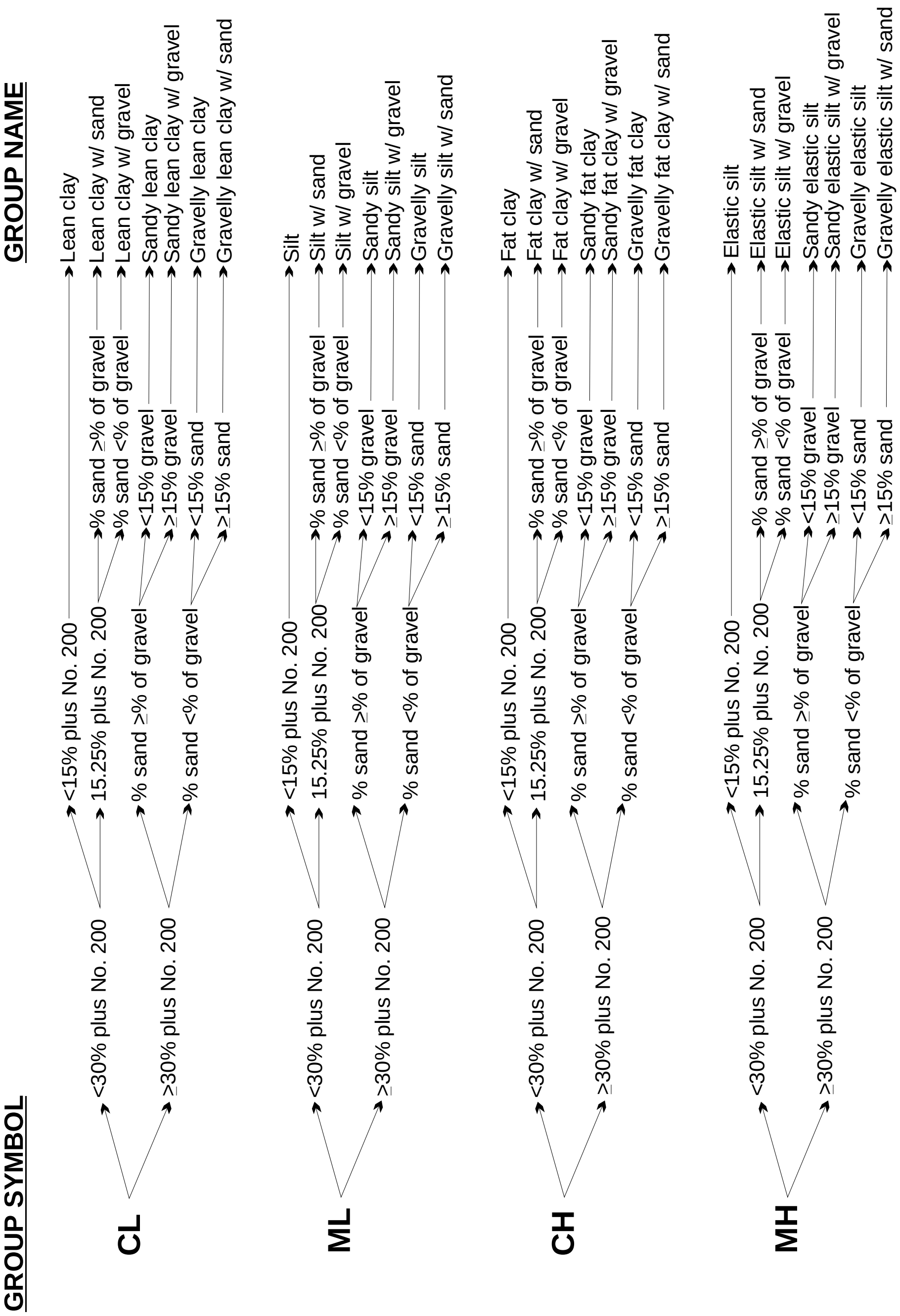

Figure 8-2: Flow Chart for Fine Grain Soil Classification

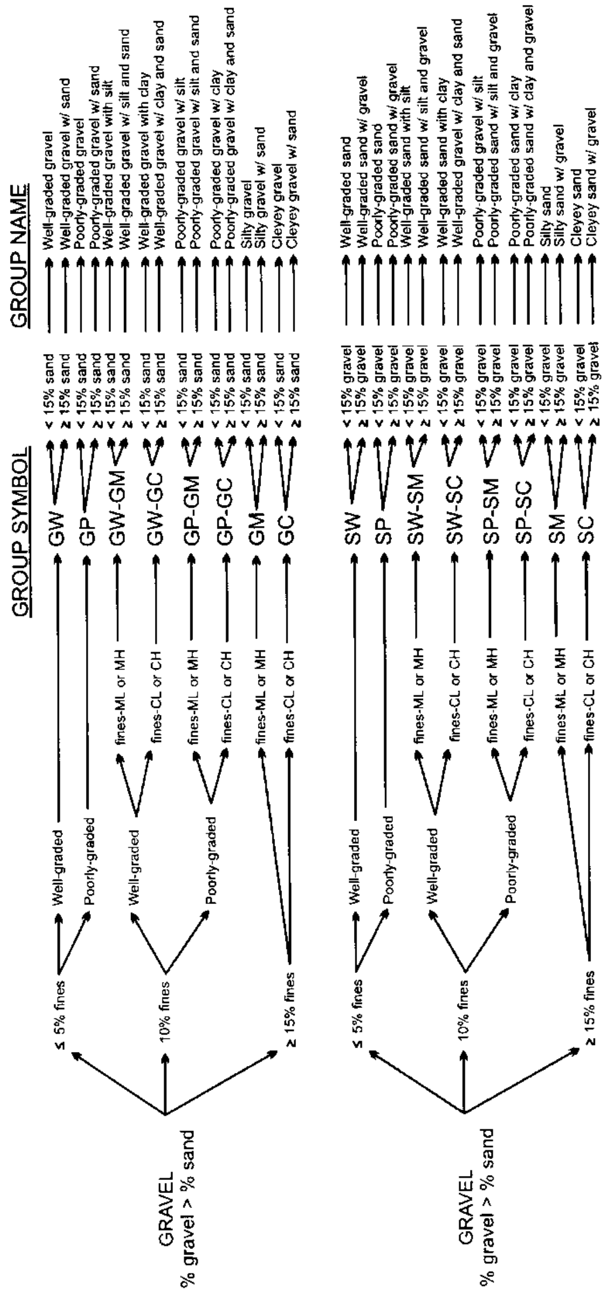

Figure 8-3: Flow Chart for Soil with Gravel

8.1.2.3 *Plasticity*

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table 8-3 presents the criteria for describing plasticity in the field using the rolled thread method.

Table 8-3: Criteria for Describing Plasticity

Description	Criteria
Non-Plastic	A 1/8-inch thread cannot be rolled.
Low Plasticity	The thread can barely be rolled.
Medium Plasticity	The thread is easy to roll and not much time is required to reach the plastic limit.
High Plasticity	It takes considerable time rolling the thread to reach the plastic limit.

8.1.3 Angularity

The following criteria describe the angularity of the coarse sand and gravel particles:

- **Rounded** particles have smoothly-curved sides and no edges.
- **Subrounded** particles have nearly plane sides, but have well-rounded corners and edges.
- **Subangular** particles are similar to angular, but have somewhat rounded or smooth edges.
- **Angular** particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

8.1.4 Color, Moisture, and Odor

The natural moisture content of soil is very important. Table **8-4** shows the terms for describing the moisture condition and the criteria for each.

Table 8-4: Soil Moisture Content Qualifiers

Qualifier	Criteria
Dry	Absence of moisture, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil is below water table

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall utilize this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists. The Munsell Color Chart is a small booklet of numbered color chips with names like "5YR 5/6, yellowish-red." Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.

In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

8.1.5 In-Place Conditions

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

8.1.5.1 Density/Consistency

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term "density" is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term "consistency" is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 lbs (63.5 kilograms [kg]) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the "standard penetration resistance," or the "N-value." The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter (I.D.) Modified California Sampler equipped with brass or stainless steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed "refusal" and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of blows will represent the N-value for this sampling interval. Table 8-5 and Table 8-6 present representative descriptions of soil density/consistency vs. N-values.

Table 8-5: Measuring Soil Density with a California Sampler – Relative Density (Sands, Gravels)

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.43 factor
Very Loose	0–4	0–6
Loose	4–10	6–14
Medium Dense	10–30	14–43
Dense	30–50	43–71
Very Dense	> 50	> 71

Table 8-6: Measuring Soil Density with a California Sampler – Fine Grained Cohesive Soil

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.13 factor
Very Soft	0–2	0–2
Soft	2–4	2–4
Medium Stiff	4–8	4–9
Stiff	8–16	9–18
Very Stiff	16–32	18–36
Hard	> 32	> 36

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot (psf). The values are as follows (Table 8-7):

Table 8-7: Measuring Soil Consistency with a Hand-Held Penetrometer

Description	Pocket Penetrometer Reading (psf)
Very Soft	0–250
Soft	250–500
Medium Stiff	500–1000
Stiff	1000–2000
Very Stiff	2000–4000
Hard	>4000

Consistency can also be estimated using thumb pressure using Table 8-8.

Table 8-8: Measuring Soil Consistency Using Thumb Pressure

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will penetrate soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

8.1.5.2 *Cementation*

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

- Quartz – siliceous
- Chert – chert-cemented or chalcedonic
- Opal – opaline
- Carbonate – calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)
- Iron oxides – hematitic, limonitic (if in doubt, ferruginous should be used)
- Clay minerals – if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as “kaolin-cemented,” “chlorite-cemented,” etc.
- Miscellaneous minerals – pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

- Weak – friable; crumbles or breaks with handling or slight finger pressure
- Moderate – friable; crumbles or breaks with considerable finger pressure
- Strong – not friable; will not crumble or break with finger pressure

8.1.5.3 *Structure*

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- Granular – spherically shaped aggregates with faces that do not accommodate adjoining faces
- Stratified – alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
- Laminated – alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness
- Blocky – cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown
- Lensed – inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included
- Prismatic or Columnar – particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top
- Platy – particles are arranged about a horizontal plane

8.1.5.4 Other Features

- Mottled – soil that appears to consist of material of two or more colors in blotchy distribution
- Fissured – breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)
- Slickensided – fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

8.1.6 **Development of Soil Description**

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

8.1.6.1 Coarse-grained Soil

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is “sand-sized.” It is classified as a gravel if over 50 percent of the coarse fraction is composed of “gravel-sized” particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: POORLY-SORTED SAND WITH SILT, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

8.1.6.2 Fine-grained Soil

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

8.1.6.3 Organic Soil

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

8.2 Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

8.3 Rock Classification

The purpose of rock classification is to thoroughly describe the physical and mineralogical characteristics of a specimen and to classify it according to an established system. The generalized rock classification system described below was developed because, unlike the USCS for soils, there is no universally accepted rock classification system. In some instances, a more detailed and thorough rock classification system may be appropriate. Any modifications to this classification system, or the use of an alternate classification system should be considered during preparation of the site work plan. Both the CTO Manager and the QA Manager or Technical Director must approve any modifications to this classification system, or the use of another classification system.

Describing rock specimens on a common basis is essential so that rocks described by different site geologists are comparable. Site geologists describing rock specimens as a part of investigative activities must use the classification system described herein, or if necessary, another more detailed classification system. Use of a common classification system provides the most useful geologic database for all present and future subsurface investigations and remedial activities.

In order to provide a more consistent rock classification between geologists, a rock classification template has been designated as shown in **Error! Reference source not found.**. The template includes classification of rocks by origin and mineralogical composition. When classifying rocks, all site geologists shall use this template.

The site geologist shall describe the rock specimen and record the description in a boring log or logbook. The items essential for classification include (i.e., metamorphic foliated):

- Classification Name (i.e., schist)
- Color
- Mineralogical composition and percent
- Texture/Grain size (i.e., fine-grained, pegmatitic, aphlitic, glassy)
- Structure (i.e., foliated, fractured, lenticular)
- Rock Quality Designation (sum of all core pieces greater than two times the diameter of the core divided by the total length of the core run, expressed as a percentage)
- Classification symbol (i.e., MF)

Example: Metamorphic foliated schist: Olive gray, 5Y, 3/2, Garnet 25 percent, Quartz 45 percent, Chlorite 15 percent, Tourmaline 15 percent, Fine-grained with Pegmatite garnet, highly foliated, slightly wavy, MF.

9.0 Quality Control and Assurance

None

RESOLUTION CONSULTANTS

DEFINITION OF TERMS				
PRIMARY DIVISIONS			**SYMBOLS**	**SECONDARY DIVISIONS**
SEDIMENTARY ROCKS	Clastic Sediments	CONGLOMERATE	CG	Coarse-grained Clastic Sedimentary Rock types including: Conglomerates and Breccias
SEDIMENTARY ROCKS	Clastic Sediments	SANDSTONE	SS	Clastic Sedimentary Rock types including: Sandstone, Arkose and Greywacke
SEDIMENTARY ROCKS	Clastic Sediments	SHALE	SH	Fine-grained Clastic Sedimentary Rock types including: Shale, Siltstone, Mudstone and Claystone
SEDIMENTARY ROCKS	Chemical Precipitates	CARBONATES	LS	Chemical Precipitates including: Limestone, Crystalline Limestone, Fossiliferous Limestone Micrite and Dolomite
SEDIMENTARY ROCKS	Chemical Precipitates	EVAPORITES	EV	Evaporites including: Anhydrite, Gypsum, Halite, Travertine and Caliche
IGNEOUS ROCKS		EXTRUSIVE (Volcanic)	IE	Volcanic Rock types including: Basalt, Andesite, Rhyolite, Volcanic Tuff, and Volcanic Breccia
IGNEOUS ROCKS		INTRUSIVE (Plutonic)	II	Plutonic Rock types including: Granite, Diorite and Gabbro
METAMORPHIC ROCKS		FOLIATED	MF	Foliated Rock types including: Slate, Phyllite, Schist and Gneiss
METAMORPHIC ROCKS		NON-FOLIATED	MN	Non-foliated Rock types including: Metaconglomerate, Quartzite and Marble

Figure 8-4: Rock Classification System

10.0 Data and Records Management

10.1 Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Copies of this information shall be sent to the **CTO Manager** for the project files.

10.2 Field notes will be kept during coring activities in accordance with SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody. The information pertinent to soil classification activities includes chronology of events, sample locations (x,y,z), time/date, sampler name, methods (including type of core liner/barrel, if applicable), sampler penetration and acceptability, sample observations, and the times and type of equipment decontamination. Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

11.0 Attachments or References

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Author	*Reviewer*	*Revisions (Technical or Editorial)*
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

1.0 PURPOSE

This standard operating procedure (SOP) provides procedures for use of direct push sampling methods for collecting soil and groundwater samples. If there are additional procedures required by state and/or federal requirements 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 Sampling and Analysis Plan.

2.0 SCOPE

This procedure shall serve as management-approved professional guidance 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 either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

The physical nature of the subsurface materials, water depth, regulatory buy-in, data quality objectives, and other issues will play an important part in deciding whether direct push methods are suitable for the project and should be discussed in the project-specific planning documents. Before field implementation of direct push methods, the following aspects will need to be considered:

- Permits required by local/state water Board/Districts, etc.
- Waste generation and handling
- Health and safety issues associated with chemical and physical hazards
- Locating subsurface and overhead utilities before field activities and adjust locations as necessary to account for impediments and obstacles.

If direct push methods are used for constructing small diameter monitoring wells, the following aspects should also be considered:

- Well locations and depths
- Permanent or temporary wells
- Screen length(s)
- Well completion specifications.

3.0 RESPONSIBILITIES

The CTO Manager is responsible for ensuring that the described direct push methods are followed and that all field personnel involved shall have the appropriate education, experience, and training to perform their assigned tasks. QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for implementing or ensuring that all project field staff follow these procedures.

4.0 BACKGROUND

4.1 Direct Push Techniques

Direct push techniques (DPT) rely on use of hydraulically powered machines that utilize static and percussion forces to advance various tools in the subsurface for a variety of uses including soil and groundwater sampling, logging, grouting and materials injections. The machines are very portable and their small size makes them ideal for working inside buildings and confined areas. They are also very fast and generate very little investigative derived waste resulting in direct push methods being a very cost-effective sampling approach compared to traditional drilling methods. A variety of systems are available under several trade names, such as Geoprobe and Strataprobe. Equipment may be skid-mounted, trailered, or mounted directly on the frame of a vehicle. 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.

5.0 PROCEDURES

5.1 Soil Sampling

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 direct push sampling equipment and there are generally two methods for soil sampling, using either an open-tube sampler or closed-point sampler. The open tube sampler enables the continuous collection of soil cores from the ground surface to a depth dependent on the core hole staying open. Upon retrieving the sampler, the plastic liner and soil core are removed, the sampler properly decontaminated, reassembled with a new liner and inserted back down the same hole to collect the next soil core. The plastic liners are split lengthwise and the soil core within is described, screened and/or sampled as specified in the project-specific planning documents. Since a new liner is used with each sampler, the potential cross-contamination risk is minimized, resulting in an inherently safe soil sampling method.

Sandy soils or material collapsing from the probe side wall can make it difficult to collect representative soil cores from significant depths with an open tube sampler. A closed-point sampler (or piston sampler) seals the leading end of the sampler with a point assembly that is held in place with a center rod. Once the sampler is advanced to the top of the sampling interval, the probe rod string is removed which disengages the piston point, allowing soil to enter the sampler. The sampler is retrieved, the plastic liner and soil core are removed and the process is repeated until reaching the desired completion depth.

5.2 Groundwater Sampling

Groundwater samples can be collected in-situ using a groundwater sampling device or through constructing small diameter (< 1.5 inch) monitoring wells, either permanent or temporary, inside the drilling rods.

In-situ Groundwater Sampling

1. Place a drive cap on the assembled direct push sampler and drive it into the subsurface.

2. Continue driving by adding probe rods until the sampler tip has been driven approximately two feet below the groundwater target sampling depth.

3. Disengage the expendable drive point by pulling the rods back a distance of about 2 feet and remove the drive cap.

4. Lower the sensor of an electric water level indicator until the audio signal sounds and record the depth to groundwater. The measurement tape scale (0.01 ft intervals) on the water level indicator wire is read at the top of the probe rod after pulling the tape out and extending it to the ground surface.

5. After recording the water-level depth measurement, the indicator sensor is removed from the probe rods.

6. Lower a 0.25 to 0.375-inch outer diameter (OD) polyethylene or Teflon tube inside the probe rods and evacuate groundwater with a peristaltic pump. When lowering tubing inside the rod string, ensure that it enters the screen interval. The leading end of the tubing will sometimes catch at the screen head giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing past the lip and into the screen.

7. Retrieve the sampler, clean all parts thoroughly, replace the O-rings, and prepare for the next sample.

Typically less than a gallon of water is purged until turbidity levels are stable and sampling follows. Since in-situ groundwater samples are usually collected as "screening" data and are a means to focus permanent monitoring wells, water quality parameters (pH, conductivity, turbidity, temperature) are not normally collected; however, field personnel should defer to the requirements of the project-specific planning documents. If sampling for volatile organic compounds (VOCs), the sample should not be circulated through the peristaltic pump since low level VOCs may be stripped from the sample, causing low bias in analyses. The methods described in SOP 14, *Monitoring Well Sampling* for sampling with a peristaltic pump should be adhered to for groundwater sampling.

In cases where the water depth is greater than 28 feet and the water cannot be lifted, groundwater samples may also be collected by attaching a check valve (with check ball) to the bottom end of the tubing and oscillating the tubing up and down until water exits the top of the tube.

Monitoring Well Installations with Direct Push Methods

1. Place a drive cap on the first section of 2.125-in. probe rod with an expendable drive point installed and advance the rod into the ground.

2. Continue driving by adding probe rods, with O-ring seals between each rod, until the sampler tip reaches approximately one foot below the screen installation depth.

3. After reaching the installation depth, the PVC well screen is lowered into the probe rods while adding threaded lengths of PVC riser pipe as needed. Care must be taken to tighten the threaded sections to prevent leakage at the joints. New, clean, rubber gloves are worn

while handling all well screen and riser pipe materials to provide the highest quality samples from the well after installation.

4. After the screen and riser are set at the installation depth, the probe rods are retracted slightly while holding down pressure on the riser pipe. This disengages the expendable point from the bottom section of drive rod.

5. After disengaging the drive point, the screen is exposed to the aquifer. Before proceeding with the well installation, it is prudent to measure the static water level in the well. This allows for adjustment of the proper screen depth if required.

6. After assuring the proper installation depth, if pre-packed screens are not used, filter-pack sand is slowly poured within the annular space between the well screen and probe rods.

7. Filter sand is added, while retracting the probe rods, until the sand reaches approximately two feet above the screen length.

8. If the native formation is well-sorted sand, coarse enough to filter and not pass through the well screen filter sand may be unnecessary. Retracting the probe rods to approximately two feet above the top of the screen will allow collapse of the native formation around the screen.

9. Above the filter pack, a minimum two-foot thick bentonite seal is installed to prevent any infiltration from above reaching the sand pack and/or well screen. The bentonite seal is tremied from the bottom (top of the filter pack), with the high-pressure grout pump while retracting the probe rods.

10. A bentonite slurry can be used to grout the entire well annulus, or alternatively above the required minimum two-foot thick bentonite seal, the annulus can be grouted with neat cement.

11. Following 24 hours, the development and sampling of the well can proceed as for typical larger diameter wells.

Small-diameter (< 1.25 inch) monitoring wells can be installed using direct push methods and are commonly considered permanent, depending upon local and State regulations. The limitations and abilities of wells constructed using direct push methods should be understood, taking into consideration the following:

1. The method effectively protects the well screen from exposure to contaminated overburden soils during installation.

2. Effective filter packing is placed around the well screen (commercially available pre-packed well screens ensure adequate filter packing around well screen).

3. The well screen to be effectively sealed against the downward infiltration of overlying groundwater or surface precipitation.

4. Well materials are compatible with the intended sampling and analysis goals of the project.

5. The well screen is properly sized and slotted for the needs of the project.

The project-specific planning documents should evaluate the appropriateness of direct push systems and whether collected data will meet the project objectives. As part of this evaluation, regulatory concurrence/approval should also be sought.

5.3 Equipment Decontamination

To avoid cross-contamination, thoroughly decontaminate equipment used for direct push exploration and sampling. 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 with a combination of soapy water and a double rinse of clean water. The inside of the of the sample and extension rods should be cleaned with nylon brushes. Use clean water and phosphate-free soap, cycle the brush inside the probe rod or sample tube to remove contaminants. Rinse with clean water and allow to air dry.

5.4 Borehole 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. Abandon shallow boreholes using one of the procedures described below unless natural caving precludes such closure.

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/bentonite 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.

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. Seal boreholes to within 0.5 to 2.0 feet of the surface. Inspect the abandoned borehole after 24 hours to ensure that grout settlement has notoccured. If significant settlement has occurred, add grout to the borehole. Fill the remaining portion of the hole with local topsoil or appropriate paving materials.

6.0 RECORDS

Record all DPT field activities in the appropriate field log book. Depending on the project objectives, soil classification may or may not be required. If it is required, complete a soil boring log as provided in Attachment 1. Monitoring wells constructed with direct push methods require both a well construction log and groundwater sampling log which are also provided in Attachments 2 and 3. Field personnel should provide copies of all completed forms to the Field Team Leader who is responsible for forwarding the forms to the CTO Manager who will review them for completeness before incorporating them into the project files.

7.0 HEALTH AND SAFETY

The primary hazards associated with direct push sampling are the mechanical hazards associated with machinery. Only qualified personnel should operate the equipment and field personnel should always maintain a safe distance from it. The minimum personal protective equipment (PPE) is safety glasses, hearing protection, steel-toed boots, and a hard hat. Depending upon the site-specific contaminants, additional PPE requirements may be required as designated in the site-specific Health and Safety Plan (HASP).

Employ the following safe work practices:

- Avoid skin contact with and/or incidental ingestion of purge water.

- Use eye protection and gloves when handling acid or caustic preservatives.

- Avoid breathing constituents venting from the borehole by positioning rig upwind between field personnel/operators and the borehole.

- If historical knowledge or evidence of free-phase is present, use a flame or photo ionization detector to ensure the breathing zone is safe.

- If monitoring indicates organic vapors above action levels specified in the HASP, be prepared to upgrade PPE to Level C protection or implement appropriate engineering controls to mitigate vapors.

8.0 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.

SOP-3-12, Monitoring Well Installation

SOP-3-14, Monitoring Well Sampling

SOP-3-17, Direct Push Sampling Techniques

SOP-3-18 (Mid South), Direct Push Sampling

9.0 ATTACHMENTS

Attachment 1 Boring Log

Attachment 2 Monitoring Well Construction Form

Attachment 3 Groundwater Sample Collection Record

Attachment 1
Boring Log

RESOLUTION CONSULTANTS		Boring ID:
		Page 1 of ____
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)

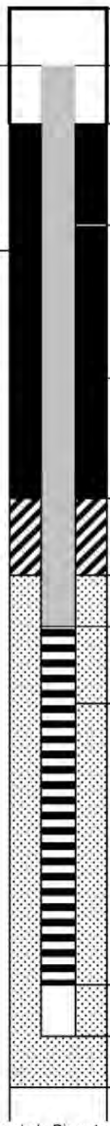
Depth Range	Re covery ft/ft	PID (ppm)	Moisture Content	GA Class.	USCS	GA Class: Garfield Avenue Sites classification & Modified Unified Soil Clasiffication System	
						Ground Surface Cover and Thickness:	Sample name & #:
0-1							
1-2							
2-3							
3-4							
4-5							
5-6							
6-7							
7-8							
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.)	

Attachment 2
Monitoring Well Construction Form

	Client:	***WELL ID:***
	Project Number:	
	Site Location:	*Date installed:*
	Well Location: *Coords:*	*Inspector:*
	Method:	*Contractor:*

MONITORING WELL CONSTRUCTION DETAIL



	Depth from G.S. (feet)	Elevation(feet) Datum ______
Top of Steel Guard Pipe	______	______
Top of Riser Pipe	______	______
Ground Surface (G.S.)	0.0	______
Top of Bentonite	______	______
Top of Sand	______	______
Top of Screen	______	______
▼ Stabilized Water Level	______	______
Bottom of Screen	______	______
Bottom of Tail Pipe:	______	______
Bottom of Borehole	______	______

Measuring Point for Surveying & Water Levels

Cement, Bentonite, Bentonite Slurry Grout, or Native Materials

______ % Cement

______ % Bentonite

______ % Native Materials

Riser Pipe:
- Length ______
- Inside Diameter (ID) ______
- Type of Material ______

Bottom of Steel Guard Pipe

Bentonite Seal Thickness ______

Screen:
- Length ______
- Inside Diameter (ID) ______
- Slot Size ______
- Type of Material ______

Type/Size of sand ______

Sand Pack Thickness ______

Bottom of Tail Pipe:
- Length ______

Borehole Diameter ______

Approved:

Describe Measuring Point:

______ Signature ______ Date

Attachment 3
Groundwater Sample Collection Record

Well ID:

Groundwater Sample Collection Record

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

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

a. Total Well Length________ **c.** Length of Water Column________ (a-b)

Casing Diameter/Material ________________

b. Water Table Depth________ **d.** Calculated Well Volume (see back)____________

2. WELL PURGEABLE DATA

a. Purge Method: ______________________

b. Acceptance Criteria defined (see SAP or Work Plan)
- Minimum Required Purge Volume (@______ well volumes)____________
- Maximum Allowable Turbidity ____________ NTUs
- Stabilization of parameters ____________ %

c. Field Testing Equipment used: Make Model Serial Number

____
____
____

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

d. Acceptance criteria pass/fail Yes No N/A (continued on back)

Has required volume been removed ☐ ☐ ☐
Has required turbidity been reached ☐ ☐ ☐
Have parameters stabilized ☐ ☐ ☐
If no or N/A - Explain below.

____

3. SAMPLE COLLECTION: Method: ______________________

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

____
____
____
____

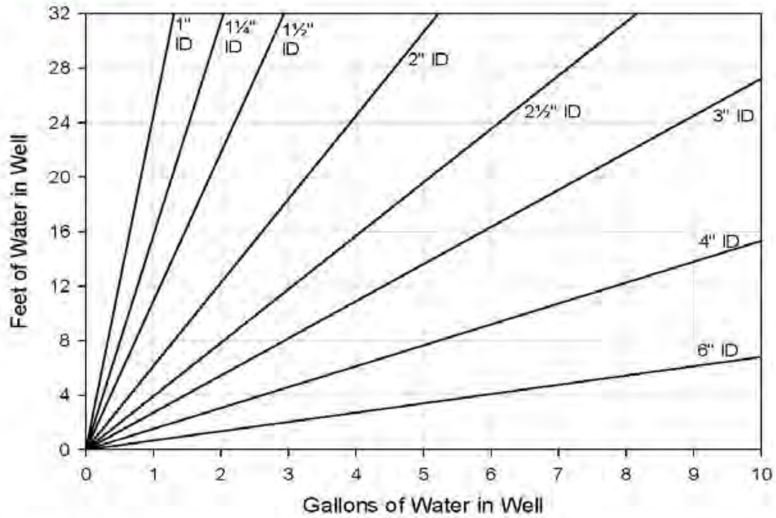
Comments ______________________________
____
____
____

Signature ______________________ Date ____________

Page 1 of 2

Purge Volume Computation

Well ID:



Volume / Linear Ft. of Pipe		
ID (in)	**Gallon**	**Liter**
¼	0.0025	0.0097
⅜	0.0057	0.0217
½	0.0102	0.0386
¾	0.0229	0.0869
1	0.0408	0.1544
1¼	0.0637	0.2413
1½	0.0918	0.3475
2	0.1632	0.6178
2½	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

(continued from front)

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

Signature ______________________ Date ____________

Page 2 of 2

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 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.

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.

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.

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)

Operation and Calibration of a Photoionization Detector

Procedure 3-20

1.0 Purpose and Scope

1.1 **Purpose and Applicability**

1.1.1 This standard operating procedure (SOP) describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

1.1.2 PIDs routinely used by field personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 **Principle of Operation**

1.2.1 The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

1.2.2 The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

1.2.3 Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive- biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

1.2.4 In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

1.3 **Specifications**

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

2.0 Safety

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

2.2 Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 Qualifications and Training

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

5.2 Responsibilities

5.2.1 The CTO Manager is responsible for ensuring that the operation and calibration activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the operation and calibration shall have the appropriate education, experience, and training to perform their assigned tasks.

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

5.2.3 The Field Manager is responsible for ensuring that all operation and calibration activities are conducted according to this procedure.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

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

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

7.0 Procedure

7.1 Preliminary Steps

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

7.2 Calibration

7.2.1 The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.

7.2.2 Calibrate the instrument according to the manufacturer’s instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.

7.2.3 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 7.4).

7.3 Operation

7.3.1 Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

7.3.2 Calibrate the instrument as described in Section 7.2, following the manufacturer’s instructions. Record the calibration information in the field records.

7.3.3 The instrument is now operational. Readings should be recorded in the field records.

7.3.4 When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a “bump” test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.

7.3.5 At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 7.2) except that no adjustment will be made to the instrument. Record the information in the field records.

7.3.6 Recharge the battery after each use (Section 7.4).

7.3.7 When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

7.4 **Routine Maintenance**

7.4.1 Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.

7.4.2 All routine maintenance should be performed in a non-hazardous environment.

7.5 **Troubleshooting Tips**

7.5.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

7.5.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

7.5.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

7.5.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

7.5.5 A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

7.5.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

7.5.7 When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or "flooded". Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

8.0 Quality Control and Assurance

8.1 The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

8.2 Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within ±10%. If the instrument responds outside this tolerance, it must be recalibrated.

8.3 Checks of the instrument response (Section 7.5) should be conducted periodically and documented in the field records.

9.0 Records, Data Analysis, Calculations

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

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

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

10.0 Attachments or References

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

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

RESOLUTION CONSULTANTS

Surface and Subsurface Soil Sampling Procedures

Procedure 3-21

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures for soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pit, direct-push, and split-spoon equipment.

1.2 The procedure includes soil sampling for volatile organic compounds (VOCs). For project specific information (e.g. sampling depths, equipment to be used, and frequency of sampling), refer to the Sampling and Analysis Plan (SAP), which takes precedence over these procedures. Surface soil sampling, typically considered to be up to two feet below ground surface by EPA standards, is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are considered subsurface samples, although normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval, without the need of extracting excess material above the target depth. These methods dramatically reduce time and cost associated with disposal of material from soil cuttings when compared to test pit sampling. In addition, direct-push and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials such as medium to fine sands, silts, and silty clay soils. Split-spoon sampling works well in all types of soil, but is somewhat slower than direct-push methods. Samples are composited so that each sample contains a homogenized representative portion of the sample interval. Due to potential loss of analytes, samples for volatile analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are collected, sealed, and sent directly to the laboratory for analysis. For undisturbed samples, the samples are not homogenized.

2.0 Safety

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

2.2 Before soil sampling commences, appropriate entities (e.g. DigSafe, local public works departments, company facilities) must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and sufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.

4.2 Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect samples that may contain asphalt. If the collection of samples potentially containing asphalt is unavoidable, note the sampling depths at which the presence of asphalt are suspected.

4.3 Instrumentation interferences addressed in SOPs for Calibration of the Photoionization Detector (PID), Headspace Screening for Total Volatile Organics, and Equipment Decontamination must also be considered.

4.4 Cross contamination from sampling equipment must be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

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 soil sampling activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in soil sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

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

5.2.3 The Field Manager is responsible for ensuring that all soil sampling activities are conducted according to this procedure.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the SAP. The following details equipment typically needed for soil sampling, based on the various methods. See the SAP for specific detail of equipment and supply needs.

6.1 Depending on the nature of suspected contamination, field screening instrumentation may be used for direct sampling. Appropriate instrumentation and calibration standards should be available. If volatile organic contaminants are suspected and a PID will be used, refer to the equipment and instrumentation listed in SOP 3-20 Operation and Calibration of a Photoionization Detector. Equipment in this SOP includes but is not limited to:

- PID/FID;
- Calibration gas; and
- Tedlar® gas bags (for calibration).

6.2 If field screening methods include jar headspace screening for volatile organics, refer to the equipment and procedure in SOP 3-19 Headspace Screening for Total VOCs. Equipment in this SOP includes but is not limited to:

- Clean soil (“drillers jars”) jars; and
- Aluminium foil.

6.3 Appropriate decontamination procedures must be followed for sampling equipment. Refer to SOP 3-06 Equipment Decontamination. Equipment in this SOP includes but is not limited to:

- Phosphate-free detergent;
- Isopropyl Alcohol;
- Tap water;
- Deionized Ultra-Filtered (DIUF) Water;
- Plastic buckets or washbasins;
- Brushes; and
- Polyethylene sheeting.

6.4 The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls;
- Stainless steel trowels;
- Appropriate sample containers for laboratory analysis;
- Personal Protective Equipment (PPE);
- Logbook;
- Cooler and ice for preservation; and
- Stakes and flagging to document sampling location.

6.5 The following additional equipment is needed for volatile organic sampling:

- Electronic pan scale and weights for calibration; and
- Syringes or other discrete soil core samplers.

6.6 The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

6.7 The following additional equipment may be needed for soil sampling from direct push and/or split-spoon equipment:

- Tape measure or folding carpenter's rule for recording the length of soil recovered.

Note: All subsurface drilling equipment will be provided and maintained by the subcontractor.

7.0 Procedure

7.1 General Soil Sampling Procedure for All Soil Sampling Methods

7.1.1 Record the weather conditions and other relevant on-site conditions.

7.1.2 Select the soil sampling location, clear vegetation if necessary, and record the sampling location identification number and pertinent location details.

7.1.3 Verify that the sampling equipment is properly decontaminated, in working order, and situated at the intended sampling location.

7.1.4 Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. Cover surfaces onto which soils or sampling equipment will be placed (i.e. tables with polyethylene sheeting).

7.1.5 Follow the appropriate procedures listed below for either surface, split-spoon, direct push, or test pit sample collection (7.2, 7.3, 7.4, and 7.5 respectively).

7.1.6 Collect soil samples according to procedures listed in Section 7.6 depending on project specific analyses.

7.1.7 Record date/time, sample ID, and sample descriptions in the field logbook or field form. A sketch or description of the location may also be recorded so the sample location can be re-constructed, especially if the location will not be recorded using global positioning satellite (GPS) equipment.

7.1.8 Immediately label the sample containers and place them on ice, if required for preservation. Complete the chain-of-custody form(s) as soon as possible.

7.1.9 Dispose of all excess excavated soil in accordance with the SAP.

7.1.10 If required, mark the sample location with a clearly labelled wooden stake or pin flag. If the location is on a paved surface, the location may be marked with spray paint.

7.1.11 Decontaminate the sampling equipment according to SOP 3-06 Equipment Decontamination.

7.2 **Surface Sampling**

7.2.1 The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials);
- Other relevant soil characteristics;
- Site features;
- Screening results;
- Predetermined sampling approach (i.e. grid or random); and
- Sampling objectives as provided in the SAP.

7.2.2 The following procedures are to be used to collect surface soil samples. Surface soils are considered to be soils that are up to two feet below ground surface, though state regulations and project objectives may define surface soils differently; therefore, the SAP should be consulted for direction on the depth from which to collect the surface soil samples. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs may be taken as needed or as specified in the SAP.

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from the exposed sampling area with a trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless steel bowl for homogenizing. Monitor the breathing zone and sampling area as required in the HASP.
3. For VOC analyses, collect representative soil samples directly from the recently-exposed soil using a syringe or other soil coring device (e.g., TerraCore®, EnCore®). Follow procedures in Section 7.6.1 for VOC sampling.
4. Collect sufficient soil to fill all remaining sample jars into a stainless steel bowl. Homogenize the soil samples to obtain a uniform soil composition which is representative of the total soil sample collected according to the following procedure:
    a) Remove all rocks and non-soil objects using a stainless steel spoon or scoop.

b) Form a cone shaped mound with the sample material, then flatten the cone and split the sample into quarters.

c) Use the stainless steel spoon/scoop to mix the quarter samples that are opposite.

d) After mixing the opposite quarters, reform the cone shaped mound.

e) Repeat this procedure a minimum of five (5) times, removing any non-soil objects and breaking apart any clumps.

7.3 Split-Spoon Sampling

7.3.1 At each boring location, the frequency and depth of split-spoon samples will be determined from the SAP. Split-spoon samples may be collected continuously, intermittently, or from predetermined depths.

7.3.2 Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.

7.3.3 After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using the PID. Scan the recovered soil boring by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil on the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the highest PID reading and the depth at which it was observed along with all other pertinent observations. If required in the SAP, VOC and headspace samples should be collected (see Section 7.6.1) prior to logging the sample.

7.3.4 If headspace screening for VOCs is required in the SAP, collect a soil sample (as defined in the SAP) and perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

7.3.5 Soils collected using the split-spoon sampler will be logged by the field representative using the procedure required in the SAP.

7.3.6 Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

7.3.7 The SAP may specify that intervals to be sent to the laboratory be determined by visual observation and/or highest PID screening or headspace results, which can only be determined once the boring is complete. In this instance, a VOC sample should be collected at each interval. The remainder of the soil from that interval will be set aside in a clearly labelled stainless steel bowl covered with aluminium foil. Once the boring has been completed and the sample interval has been determined, the remainder of the soil can be homogenized according to Section 7.2 and submitted for laboratory analysis.

7.3.8 Once a boring is complete and all required samples have been collected, the boring must be completed as specified in the SAP (e.g., completed as a monitoring well, backfilled with bentonite, etc).

7.4 Direct Push Sampling

At each boring location, the frequency of direct-push samples will be determined from the SAP. Typically, samples with direct-push equipment are collected in 4 foot (ft) intervals, but smaller (e.g., 2 ft) and larger (e.g., 5 ft) intervals are also possible.

1. Sample using Macro-Core samplers with acetate liners to obtain discrete soil samples at the depths specified in the SAP.
2. Cut open the acetate liner. If required in the SAP, immediately scan the recovered soil boring for VOCs using a PID by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil on the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the

highest PID reading and the depth at which it was observed along with all other pertinent observations. VOC and headspace samples, if required in the SAP should be collected (see Section 7.6.1) prior to logging the sample.

3. If required in the SAP, collect a soil sample (as defined in the SAP) and perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

4. Soils collected using the direct-push sampler will be logged by the by the field representative using the procedure required in the SAP.

5. Collect the remainder of the sample into a stainless steel bowl. Homogenize the soil collected so that the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

6. Once a boring is complete and all required samples have been collected, the boring must be completed as specified in the SAP (e.g., completed as a monitoring well, backfilled with bentonite, etc).

7.5 **Test Pit Sampling**

7.5.1 Excavate the test pit to the desired depth.

7.5.2 Using the excavator bucket, collect soil samples as specified in the SAP. Collect a sample and perform screening analyses as required by the SAP. If VOCs contamination is suspected, perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

7.5.3 Collect the sample from center of the bucket to avoid potential contamination from the bucket.

7.5.4 VOC samples should also be collected from an undisturbed section soil in the excavator bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples.

7.5.5 Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

7.5.6 Dispose of all excavated soil according to the SAP.

7.6 **Sample Collection Methods**

7.6.1 Volatile Organics Sampling

For soils collected for analyses of volatile organics, including Volatile Petroleum Hydrocarbons (VPH) or other purgable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include three 40-mL VOA vials and one soil jar. Two 40-mL VOA vials will contain either 5 mL reagent water or 5 mL sodium bisulfate and magnetic stir bars (i.e., low level vials). The third VOA vial will contain 15 mL methanol with no magnetic stir bar (i.e., high level vial). These vials are usually provided by the laboratory and are pre-weighed, with the tare weight recorded on the affixed sample label. No additional sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the sample label using an indelible marker. The soil jar is provided for percent solids determination. For VOC or VPH analyses, samples are collected prior to sample homogenization. Collect the VOC sample in accordance with the procedure described below.

1. Determine the soil volume necessary for the required sample weight, typically 5 grams:

   a) Prepare a 5 mL sampling corer (e.g., Terra Core®) or cut-off plastic syringe.

   b) Tare the sampler by placing it on the scale, and zeroing the scale.

   c) Draw back the plunger to the 5 gram mark or 5mL (5cc) mark on cut-off syringe, and insert the open end of the sampler into an undisturbed area of soil with a twisting motion, filling the sampler with soil. Note the location of the plunger with respect to the milliliter (cc) or other graduation printed on the sampler.

d) Weigh the filled sampler, and remove or add soil until the desired weight is obtained. Note the location of the plunger which corresponds to this weight. Do not use this sample for laboratory analysis.

2. Once the required soil volume has been determined, pull the plunger back to this mark and hold it there while filling the syringe for each sample.

3. Collect 5 grams of soil using the cut-off syringe or Terra Core® sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe® and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.

4. Gently swirl the vial so that all of the soil is fully wetted with the preservative.

5. Fill the other low level 40 mL VOA vial in this manner.

6. Repeat the process for the high level VOA vials, only for the high level VOA vial three 5 gram aliquots (i.e., 15 grams total) should be extruded into the high level VOA vial.

   NOTE: Depending on the laboratory, some high level VOA vials only contain 5 mL or 10 mL of methanol. If this is the case, either 5 grams total or 10 grams total, respectively, should be extruded into the high level VOA vial. In other words, the mass of soil in grams should be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).

7. Collect any additional QC sample collected (e.g., field duplicate, MS, and MSD) in the same manner as above.

8. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

7.6.2 Soil Sampling Method (All other analyses except VOC/VPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 7.2. Collect sufficient volume to fill all of the remaining sample containers at least ¾ full for all other analyses. Homogenize the soil in a decontaminated stainless steel bowl, removing rocks, sticks, or other non-soil objects and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

8.0 Quality Control and Assurance

8.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the SAP. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the SAP typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

8.2 Quality control requirements are dependent on project-specific sampling objectives. The SAP will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

9.0 Records, Data Analysis, Calculations

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site logbooks with permanent ink. Data recorded may include the following:

- Weather conditions;
- Arrival and departure time of persons on site;
- Instrument type, lamp (PID), make, model and serial number;
- Calibration gas used;
- Date, time and results of instrument calibration and calibration checks;
- Sampling date and time;
- Sampling location;
- Samples collected;
- Sampling depth and soil type;
- Deviations from the procedure as written; and
- Readings obtained.

10.0 Attachments or References

SOP 3-06, *Equipment Decontamination*

SOP 3-19, *Headspace Screening for Total VOCs*

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)

Water Quality Parameter Testing for Groundwater Sampling

Procedure SOP-3-24

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) This standard operating procedure (SOP) describes methods for measuring water quality parameters during well purging activities.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

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

3.0 Terms and Definitions

3.1 Barometric Pressure (BP)

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

3.2 Conductivity/Specific Conductance

A measure of the ability of water to pass electrical current, which increases with the amount of dissolved ionic substances (i.e., salts). Conductivity is inversely related to the resistance of a solution and is measured in units of mhos per centimeter (mhos/cm) (inverse ohms/cm, Siemens/cm). The conductivity of water increases with increasing temperature. *Specific Conductance is corrected for 25 degrees Celsius (°C); for this reason, it is best to record Specific Conductance. If Conductivity is recorded, the temperature of the sample MUST recorded.*

3.3 Dissolved Oxygen (DO)

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

3.4 Nephelometric Turbidity Unit (NTU)

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

3.5 pH

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

3.6 **Oxidation-Reduction Potential (ORP)**

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

3.7 **Total Dissolved Solids**

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

3.8 **Turbidity**

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

4.0 Responsibilities

4.1 The CTO Manager is responsible for ensuring that this standard operating procedure is followed and shall review all groundwater sampling forms at the conclusion of a sampling event decontamination activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in water quality measurements have the appropriate education, experience, and training to perform their assigned tasks.

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

4.3 The Field Manager is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 All Field Personnel are responsible for the implementation of this procedure.

5.0 Procedures

5.1 **Purpose**

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

5.2 **Cautions**

Improper use of water quality testing equipment could result in equipment damage or compromised sampling results. Personnel should be trained to operate the test equipment being used for a field operation and should be trained in the proper techniques for collecting and logging water quality parameters. Personnel should also be able to recognize problems with test equipment and have someone available for basic troubleshooting and repair.

5.3 **Interferences**

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

pH Meters

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

Dissolved Oxygen

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

Turbidity Meter

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

Temperature

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

5.4 Apparatus and Materials

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

Table 1
Water Quality Parameter Testing — Common Equipment

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

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

5.5 Instrument or Method Calibration

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

Initial Calibration (IC): Before use, the instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a calibration standard. An IC is performed in preparation for the first use of an instrument or if a calibration verification does not meet acceptance criteria.

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

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

5.5.1 Calibration Checks

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

Table 2
Calibration Check Acceptance Limits

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

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

5.5.2 **Possible and Suspected Ranges**

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

Table 3
Minimum and Maximum Result Ranges

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

Notes:

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

5.5.3 **Field Instruments and Calibration Criteria**

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

Table 4
Calibration Check Acceptance Limits

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

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

pH Meters

- For the most accurate of pH measurements, pH meters should receive a three-point calibration. However, if a two-point calibration will bracket the groundwater pH of the site, a two-point calibration is acceptable. Three-point calibrations typically include calibrating to solutions of pH 7.00, 4.00, and 10.00. If groundwater pH is outside the calibration range of the solution standards, special buffers must be ordered to bracket the pH. Some meters will report the slope of the calibration and this may be used in checking the meter calibration (refer to the meter's manual). When performing an ICV, the result must be within +/- 0.2 pH units of the stated buffer value.

- pH meters should be calibrated across the range of values to be measured. The maximum and minimum calibration solutions shall be outside the range of anticipated values. For example, if the expected range is between 7.50 and 9.00, the 7.00 and the 10.00 standard should be used for calibration. Perform the IC using at least two buffers, and always use the pH 7.00 buffer first. A reading that is above the maximum (or below the minimum) calibration standard is an estimate only and is not valid. This condition requires obtaining a new standard that is above (or below) the reported value, depending on the measurement.

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

Specific Conductivity Meters

- For IC, when the sample measurements are expected to be 100 microsiemens per centimeter (µS/cm) or greater, use two standard potassium chloride (KCl) solutions that bracket the range of expected sample conductivities. Calibrate the instrument with the first standard. Verify the calibration of the instrument with the second standard, bracketing the range of expected sample values.

- If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values.

- When the sample measurements are expected to be less than 100 µS/cm, a lower bracket is not required, but one standard (KCl) solution that is within the range of expected measurements must be used for the IC and the ICV.

- Accept the calibration if the meter reads within +/- 5 percent of the value of any calibration standard used to verify the calibration.

- Most field instruments read conductivity directly. Record all readings and calculations in the calibration records.

- For CCV, check the meter with at least one KCl standard with a specific conductance in the range of conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5 percent of the standard value.

- If new environmental samples are encountered outside the range of the IC, verify the instrument calibration with two standards bracketing the range of sample values. If these calibration verifications fail, recalibrate the instrument.

Dissolved Oxygen Meters

- Before calibrating, check the probe membrane for bubbles, tears, or wrinkles. These conditions require replacement of the membrane in accordance with the manufacturer's directions.

- If the meter provides readings that are off-scale, will not calibrate, or drift, check the leads, contacts, etc., for corrosion and/or short circuits. These conditions require replacement maintenance in accordance with the manufacturer's directions.

- Most DO meters must be calibrated based on an environment of 100 percent humidity and a known elevation and barometric pressure (BP).

- For 100 percent humidity, place the probe in the calibration container with a moist towel and allow the probe to remain, undisturbed, for 10 to 20 minutes.

- The IC is an air calibration at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar verification at the end of the day or sampling event. Follow the manufacturer's instructions for your specific instrument. Allow an appropriate warm up period before IC. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100 percent humidity). Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table (see Attachment 2) what DO should measure. The acceptance criterion for DO ICV is +/- 0.3 mg/L.

- Use the same procedure as above for CCV.

ORP Meters

- Verify electrode response before use in the field.

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

- Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on, placing the function switch in the millivolt (mv) mode.

- Let the electrode equilibrate and record the reading to the nearest millivolt. The reading must be within ±10 mv from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.

- Record the mv reading and temperature in the field notebook or in form. Rinse the electrode with distilled water and proceed with the sample measurement, unless using a flow cell. If a flow cell is used, rinse between sample locations.

Turbidity Meters

- Perform an initial calibration using at least two primary standards.

- If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard.

- Perform an ICV by reading at least one primary standard as a sample. The acceptance criterion for the ICV depends on the range of turbidity of the standard value:

    1. Standard Value = 0.1 to 10 NTU: the response must be within 10 percent of the standard;

    2. Standard Value = 11 to 40 NTU: the response must be within 8 percent of the standard;

    3. Standard Value = 41 to 100 NTU: the response must be within 6.5 percent of the standard; and

    4. Standard Value greater than 100 NTU: the response must be within 5 percent of the standard.

- Determining the Values of Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards may be used for CCVs. To initially determine the value of a secondary standard, assign the value that is determined immediately after an ICV or verification with primary standards. This is done by reading the secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10 percent of the assigned standard value. If the +/- 10 percent criterion is not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

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

5.6 **Direct Measurements**

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

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

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

5.7 **Data Acquisitions, Calculations, and Data Reduction**

5.7.1 **Specific Conductivity Correction Factions**

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

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

Where:

K	=	Conductivity in μmhos/cm at 25°C
Km	=	Measured conductivity in μmhos/cm at T degrees Celsius
C	=	Cell constant
T	=	Measured temperature of the sample in degrees Celsius;

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

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

5.7.2 **Percentage Difference Calculation**

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

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

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

$$mmHG = inHG\ x\ 25.4$$

5.7.4 True Barometric Pressure

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

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

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

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

Convert inHG to mmgHG:

mmHg = 30.49 inHg x 25.4 = 774.4 mmHg

Calculate True BP:

TrueBP = (774.4 mmHg) – [2.5 * (544 /100)] = 774.4-13.6 = 760.8 mmHg

6.0 Quality Control and Assurance

Instrument calibration and verification requirements specified in Section 5.5 are used to verify instruments are operating properly and are reliable. If calibration criteria fall outside the acceptance criteria specified in Table 4, the user should consult the instrument operation manual for appropriate corrective action. Data will be recorded promptly, legibly, and in indelible ink on the appropriate logbooks and forms.

7.0 Records

All field data forms and calibration logs shall be scanned and made electronically available to the Project Team at the end of the field effort. Original paper records shall be maintained with the log book in the project file.

8.0 Attachments and References

Attachment 1: Example Field Instrument Calibration Form

Attachment 2: Solubility of Oxygen at Given Temperatures

Attachment 3: Example Field Data Form

Author	Reviewer	Revisions (Technical or Editorial)
David Doyle Project Geologist	Ben Brantley Project Manager	Rev 0 — Initial Issue

Attachment 1

Example Field Instrument Calibration Form

Field Instrument Calibration Form

Site: ______________________________

Sampling Event: ______________________________

Calibrated by: ______________________________

Date: ______________________________

Equipment (Make/Model/Serial#): ______________________________

Equipment (Make/Model/Serial#): ______________________________

Equipment (Make/Model/Serial#): ______________________________

pH (su) — Standard: ± 0.2 standard units

	Initial Calibration		Initial Calibration Verification	
	Brand & Solution Lot #	Reading	Std. Brand	Reading
pH7				
pH4				
pH 10				

Continuing Calibration Verification

	Reading	Deviation	Acceptable Variance (Y/N)
pH7			
pH4			
pH 10			

DO (mg/L) — Standard: ± 0.3 mg/L of theoretical*

IC (Temp:)		ICV (Temp:)	
Saturation (%)	Reading (%)	Theoretical (mg/L)	Reading (mg/L)
100			

Continuing Calibration Verification

Saturation (%)	Reading (%)	Deviation	Acceptable Variance (Y/N)
100			
Theoretical (mg/L)	**Reading (mg/L)**	**Deviation**	**Acceptable Variance (Y/N)**

ORP (mV) — Standard: NA

Initial Calibration		Initial Calibration Verification	
TCS & Solution Lot # (Std/Temp)	Reading	(Std/Temp)	Reading

Continuing Calibration Verification

TCS (Std/Temp)	Reading	Deviation	Acceptable Variance (Y/N)

Turbidity (ntu) — Standard: ±10% of Standard

Initial Calibration

Brand & Solution Lot #	Reading

Continuing Calibration Verification

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Conductivity (ms^C/cm) — Standard: ± 5% of standard value

Initial Calibration		Initial Calibration Verification	
Brand & Solution Lot #			
Standard	Reading	Standard	Reading

Continuing Calibration Verification

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Comments:

Notes:

SL	solution lot	su	standard units	ntu	Nephelometric Turbidity Units
TCS	temperature corrected standard	mV	millivolts	°C	degrees Celsius
Std	standard	%	percent	ms^C/cm	millisiemens per centimeter (temperature corrected)
Temp	temperature	mg/L	milligrams per liter	*	Theoretical value listed on Table FT 1500-1 (attached)

Attachment 2

Solubility of Oxygen at Given Temperatures

ORP Calibration Adjustments for Temperature

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

Notes:

The table provides three decimals to aid interpolation

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

°C	=	degrees Celsius
mg/L	=	milligrams per liter

ORP (Zobell) Temperature Adjustments

Temperature (°C)	Zobell Solution Value (mV)	Temperature (°C)	Zobell Solution Value (mV)
1	262.2	26	229.7
2	260.9	27	228.4
3	259.6	28	227.1
4	258.3	29	225.8
5	257	30	224.5
6	255.7	31	223.2
7	254.4	32	221.9
8	253.1	33	220.6
9	251.8	34	219.3
10	250.5	35	218
11	249.2	36	216.7
12	247.9	37	215.4
13	246.6	38	214.1
14	245.3	39	212.8
15	244	40	211.5
16	242.7	41	210.2
17	241.4	42	208.9
18	240.1	43	207.6
19	238.8	44	206.3
20	237.5	45	205
21	236.2	46	203.7
22	234.9	47	202.4
23	233.6	48	201.1
24	232.3	49	199.8
25	231	50	198.5

Attachment 3

Example Field Data Form

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

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

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

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

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING ☐ Bailer ☐ Pump Description:

Time (hh:mm):												
pH (units):												
Conductivity (mS/cm):												
Turbidity (NTU):												
DO (mg/L): YSI 556												
DO (mg/L): YSI 550												
Temperature (C°):												
ORP (mV):												
Volume Purged (gal):												
Depth to Water (ft):												
							Well Goes Dry While Purging ☐					

SAMPLE DATA ☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 µm)	Remarks

Purging/Sampling Device Decon Process:

COMMENTS:

Purge water placed in drum#______________

Page __ of __

Figure: 30 TAC §350.77(b)

TIER 1: EXCLUSION CRITERIA CHECKLIST

This exclusion criteria checklist is intended to aid the person and the TCEQ in determining whether or not further ecological evaluation is necessary at an affected property where a response action is being pursued under the Texas Risk Reduction Program (TRRP). Exclusion criteria refer to those conditions at an affected property which preclude the need for a formal ecological risk assessment (ERA) because there are **incomplete or insignificant ecological exposure pathways** due to the nature of the affected property setting and/or the condition of the affected property media. This checklist (and/or a Tier 2 or 3 ERA or the equivalent) must be completed by the person for all affected property subject to the TRRP. The person should be familiar with the affected property but need not be a professional scientist in order to respond, although some questions will likely require contacting a wildlife management agency (i.e., Texas Parks and Wildlife Department or U.S. Fish and Wildlife Service). The checklist is designed for general applicability to all affected property; however, there may be unusual circumstances which require professional judgement in order to determine the need for further ecological evaluation (e.g., cave-dwelling receptors). In these cases, the person is strongly encouraged to contact TCEQ before proceeding.

Besides some preliminary information, the checklist consists of three major parts, **each of which must be completed unless otherwise instructed.** PART I requests affected property identification and background information. PART II contains the actual exclusion criteria and supportive information. PART III is a qualitative summary statement and a certification of the information provided by the person. **Answers should reflect existing conditions and should not consider future remedial actions at the affected property.** Completion of the checklist should lead to a logical conclusion as to whether further evaluation is warranted. Definitions of terms used in the checklist have been provided and users are strongly encouraged to familiarize themselves with these definitions before beginning the checklist.

Name of Facility:

Affected Property Location:

Mailing Address:

TCEQ Case Tracking #s:

Solid Waste Registration #s:

Voluntary Cleanup Program #:

EPA I.D. #s:

Definitions[1]

Affected property - The entire area (i.e., on-site and off-site; including all environmental media) which contains releases of chemicals of concern at concentrations equal to or greater than the assessment level applicable for residential land use and groundwater classification.

Assessment level - A critical protective concentration level for a chemical of concern used for affected property assessments where the human health protective concentration level is established under a Tier 1 evaluation as described in §350.75(b) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation), except for the protective concentration level for the soil-to-groundwater exposure pathway which may be established under Tier 1, 2, or 3 as described in §350.75(i)(7) of this title, and ecological protective concentration levels which are developed, when necessary, under Tier 2 and/or 3 in accordance with §350.77(c) and/or (d), respectively, of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels).

Bedrock - The solid rock (i.e., consolidated, coherent, and relatively hard naturally formed material that cannot normally be excavated by manual methods alone) that underlies gravel, soil or other surficial material.

Chemical of concern - Any chemical that has the potential to adversely affect ecological or human receptors due to its concentration, distribution, and mode of toxicity. Depending on the program area, chemicals of concern may include the following: solid waste, industrial solid waste, municipal solid waste, and hazardous waste as defined in Texas Health and Safety Code, §361.003, as amended; hazardous constituents as listed in 40 Code of Federal Regulations Part 261, Appendix VIII, as amended; constituents on the groundwater monitoring list in 40 Code of Federal Regulations Part 264, Appendix IX, as amended; constituents as listed in 40 CFR Part 258 Appendices I and II, as amended; pollutant as defined in Texas Water Code, §26.001, as amended; hazardous substance as defined in Texas Health and Safety Code, §361.003, as amended, and the Texas Water Code, §26.263, as amended; other substances as defined in Texas Water Code, §26.039(a), as amended; and daughter products of the aforementioned constituents.

Community - An assemblage of plant and animal populations occupying the same habitat in which the various species interact via spatial and trophic relationships (e.g., a desert community or a pond community).

Complete exposure pathway - An exposure pathway where a human or ecological receptor is exposed to a chemical of concern via an exposure route (e.g., incidental soil ingestion, inhalation of volatiles and particulates, consumption of prey, etc).

***De minimus* -** The description of an area of affected property comprised of one acre or less where the ecological risk is considered to be insignificant because of the small extent of contamination, the absence of protected species, the availability of similar unimpacted habitat nearby, and the lack of adjacent sensitive environmental areas.

Ecological protective concentration level - The concentration of a chemical of concern at the point of exposure within an exposure medium (e.g., soil, sediment, groundwater, or surface water) which is determined in accordance with §350.77(c) or (d) of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels) to be protective for ecological receptors. These concentration levels are primarily intended to be protective for more mobile or wide-ranging ecological receptors and, where appropriate, benthic invertebrate communities within the waters in the state. These concentration levels are not intended to be directly protective of receptors with limited mobility or range (e.g., plants, soil invertebrates, and small rodents), particularly those residing within active areas of a facility, unless these receptors are threatened/endangered species or unless impacts to these receptors result in disruption of the ecosystem or other unacceptable consequences for the more mobile or wide-ranging receptors (e.g., impacts to an off-site grassland habitat eliminate rodents which causes a desirable owl population to leave the area).

Ecological risk assessment - The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors; however, as used in this context, only chemical stressors (i.e., COCs) are evaluated.

Environmental medium - A material found in the natural environment such as soil (including non-waste fill materials), groundwater, air, surface water, and sediments, or a mixture of such materials with liquids, sludges, gases, or solids, including hazardous waste which is inseparable by simple mechanical removal processes, and is made up primarily of natural environmental material.

Exclusion criteria - Those conditions at an affected property which preclude the need to establish a protective concentration level for an ecological exposure pathway because the exposure pathway between the chemical of concern and the ecological receptors is not complete or is insignificant.

Exposure medium - The environmental medium or biologic tissue in which or by which exposure to chemicals of concern by ecological or human receptors occurs.

Facility - The installation associated with the affected property where the release of chemicals of concern occurred.

Functioning cap - A low permeability layer or other approved cover meeting its design specifications to minimize water infiltration and chemical of concern migration, and prevent ecological or human receptor exposure to chemicals of concern, and whose design requirements are routinely maintained.

Landscaped area - An area of ornamental, or introduced, or commercially installed, or manicured vegetation which is routinely maintained.

Off-site property (off-site) - All environmental media which is outside of the legal boundaries of the on-site property.

On-site property (on-site) - All environmental media within the legal boundaries of a property owned or leased by a person who has filed a self-implementation notice or a response action plan for that property or who has become subject to such action through one of the agency's program areas for that property.

Physical barrier - Any structure or system, natural or manmade, that prevents exposure or prevents migration of chemicals of concern to the points of exposure.

Point of exposure - The location within an environmental medium where a receptor will be assumed to have a reasonable potential to come into contact with chemicals of concern. The point of exposure may be a discrete point, plane, or an area within or beyond some location.

Protective concentration level - The concentration of a chemical of concern which can remain within the source medium and not result in levels which exceed the applicable human health risk-based exposure limit or ecological protective concentration level at the point of exposure for that exposure pathway.

Release - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, with the exception of:

> (A) A release that results in an exposure to a person solely within a workplace, concerning a claim that the person may assert against the person's employer;

(B) An emission from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine;

(C) A release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined by the Atomic Energy Act of 1954, as amended (42 U.S.C. §2011 *et seq*.), if the release is subject to requirements concerning financial protection established by the Nuclear Regulatory Commission under §170 of that Act;

(D) For the purposes of the environmental response law §104, as amended, or other response action, a release of source, by-product, or special nuclear material from a processing site designated under §102(a)(1) or §302(a) of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. §7912 and §7942), as amended; and

(E) The normal application of fertilizer.

Sediment - Non-suspended particulate material lying below surface waters such as bays, the ocean, rivers, streams, lakes, ponds, or other similar surface water body (including intermittent streams). Dredged sediments which have been removed from below surface water bodies and placed on land shall be considered soils.

Sensitive environmental areas - Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young, and overwintering. Examples include critical habitat for threatened and endangered species, wilderness areas, parks, and wildlife refuges.

Source medium - An environmental medium containing chemicals of concern which must be removed, decontaminated and/or controlled in order to protect human health and the environment. The source medium may be the exposure medium for some exposure pathways.

Stressor - Any physical, chemical, or biological entity that can induce an adverse response; however, as used in this context, only chemical entities apply.

Subsurface soil - For human health exposure pathways, the portion of the soil zone between the base of surface soil and the top of the groundwater-bearing unit(s). For ecological exposure pathways, the portion of the soil zone between 0.5 feet and 5 feet in depth.

Surface cover - A layer of artificially placed utility material (e.g., shell, gravel).

Surface soil - For human health exposure pathways, the soil zone extending from ground surface to 15 feet in depth for residential land use and from ground surface to 5 feet in depth for commercial/industrial land use; or to the top of the uppermost groundwater-bearing unit or bedrock, whichever is less in depth. For ecological exposure pathways, the soil zone extending from ground surface to 0.5 feet in depth.

Surface water - Any water meeting the definition of surface water in the state as defined in §307.3 of this title (relating to Abbreviations and Definitions), as amended.

PART I. Affected Property Identification and Background Information

1) Provide a description of the specific area of the response action and the nature of the release. Include estimated acreage of the affected property and the facility property, and a description of the type of facility and/or operation associated with the affected property. Also describe the location of the affected property with respect to the facility property boundaries and public roadways.

Attach available USGS topographic maps and/or aerial or other affected property photographs to this form to depict the affected property and surrounding area. Indicate attachments:

☐ Topo map ☐ Aerial photo ☐ Other

2) Identify environmental media known or suspected to contain chemicals of concern (COCs) at the present time. Check all that apply:

Known/Suspected COC Location	Based on sampling data?
☐ Soil ≤5 ft below ground surface	☐ Yes ☐ No
☐ Soil >5 ft below ground surface	☐ Yes ☐ No
☐ Groundwater	☐ Yes ☐ No
☐ Surface Water/Sediments	☐ Yes ☐ No

Explain (previously submitted information may be referenced):

3) Provide the information below for the nearest surface water body which has become or has the potential to become impacted from migrating COCs via surface water runoff, air deposition, groundwater seepage, etc. Exclude wastewater treatment facilities and storm water conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

The nearest surface water body is ____________________ feet/miles from the affected property and is named ____. The water body is best described as a:

☐ freshwater stream: _____ perennial (has water all year)
_____ intermittent (dries up completely for at least 1 week a year)
_____ intermittent with perennial pools
☐ freshwater swamp/marsh/wetland
☐ saltwater or brackish marsh/swamp/wetland
☐ reservoir, lake, or pond; approximate surface acres:
☐ drainage ditch
☐ tidal stream ☐ bay ☐ estuary
☐ other; specify

Is the water body listed as a State classified segment in Appendix C of the current Texas Surface Water Quality Standards; §§307.1 - 307.10?

 Yes   Segment # _______________ Use Classification:

 No

If the water body is not a State classified segment, identify the first downstream classified segment.

Name:

Segment #:

Use Classification:

As necessary, provide further description of surface waters in the vicinity of the affected property:

PART II. Exclusion Criteria and Supportive Information
Subpart A. Surface Water/Sediment Exposure

1) Regarding the affected property where a response action is being pursued under the TRRP, have COCs migrated and resulted in a release or imminent threat of release to either surface waters or to their associated sediments via surface water runoff, air deposition, groundwater seepage, etc.? Exclude wastewater treatment facilities and storm water conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

 Yes No

Explain:

If the answer is Yes to Subpart A above, the affected property does not meet the exclusion criteria. However, complete the remainder of Part II to determine if there is a complete and/or significant soil exposure pathway, then complete PART III - Qualitative Summary and Certification. If the answer is No, go to Subpart B.

Subpart B. Affected Property Setting

In answering "Yes" to the following question, it is understood that the affected property is not attractive to wildlife or livestock, including threatened or endangered species (i.e., the affected property does not serve as valuable habitat, foraging area, or refuge for ecological communities). (May require consultation with wildlife management agencies.)

1) Is the affected property wholly contained within contiguous land characterized by: pavement, buildings, landscaped area, functioning cap, roadways, equipment storage area, manufacturing or process area, other surface cover or structure, or otherwise disturbed ground?

☐ Yes ☐ No

Explain:

If the answer to Subpart B above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subparts C and D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart B above is No, go to Subpart C.

Subpart C. Soil Exposure

1) Are COCs which are in the soil of the affected property solely below the first 5 feet beneath ground surface **or** does the affected property have a physical barrier present to prevent exposure of receptors to COCs in surface soil?

☐ Yes ☐ No

Explain:

If the answer to Subpart C above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subpart D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart C above is No, proceed to Subpart D.

Subpart D. *De Minimus* Land Area

In answering "Yes" to the question below, it is understood that all of the following conditions apply:

The affected property is not known to serve as habitat, foraging area, or refuge to threatened/endangered or otherwise protected species. (Will likely require consultation with wildlife management agencies.)

Similar but unimpacted habitat exists within a half-mile radius.

The affected property is not known to be located within one-quarter mile of sensitive environmental areas (e.g., rookeries, wildlife management areas, preserves). (Will likely require consultation with wildlife management agencies.)

There is no reason to suspect that the COCs associated with the affected property will migrate such that the affected property will become larger than one acre.

1) Using human health protective concentration levels as a basis to determine the extent of the COCs, does the affected property consist of one acre or less and does it meet all of the conditions above?

☐ Yes ☐ No

Explain how conditions are met/not met:

If the answer to Subpart D above is Yes, then no further ecological evaluation is needed at this affected property, assuming the answer to Subpart A was No. Complete PART III - Qualitative Summary and Certification. If the answer to Subpart D above is No, proceed to Tier 2 or 3 or comparable ERA.

PART III. Qualitative Summary and Certification (Complete in all cases.)

Attach a brief statement (not to exceed 1 page) summarizing the information you have provided in this form. This summary should include sufficient information to verify that the affected property meets or does not meet the exclusion criteria. The person should make the initial decision regarding the need for further ecological evaluation (i.e., Tier 2 or 3) based upon the results of this checklist. After review, TCEQ will make a final determination on the need for further assessment. **Note that the person has the continuing obligation to re-enter the ERA process if changing circumstances result in the affected property not meeting the Tier 1 exclusion criteria.**

Completed by: ____ (Typed/Printed Name)

____ (Title)

____ *(Date)*

I believe that the information submitted is true, accurate, and complete, to the best of my knowledge.

____ *(Typed/Printed Name of Person)*

____ *(Title of Person)*

____ *(Signature of Person)*

____ *(Date Signed)*

---

1 These definitions were taken from 30 TAC §350.4 and may have both ecological and human health applications. For the purpose of this checklist, it is understood that only the ecological applications are of concern.

Attachment C
APP / HASP

ACCIDENT PREVENTION PLAN

SITE INVESTIGATION
UST SITE 9, FUEL FARMS 217 AND 244
NAVAL AIR STATION CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

Revision: 0

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
CTO JM46

May 2013

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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 (U.S. 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 site-wide for all planned investigations at Naval Air Station (NAS) Corpus Christi, including the Site Investigation field activities at the former Underground Storage Tank Site 9 (former Fuel Farms 217 and 244) (see Section 2.g). A Site Safety and Health Plan (SSHP) specific to Resolution Consultants activities and a Health and Safety Plan specific to activities to be performed by our subcontractor are in Appendices H and I of this APP. These plans cover the SSHP elements outlined in Section 28.B.02 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 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 (SOPs), and provides for contingencies that may arise while operations are 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 Title 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' U.S. Operations Safety, Health, and Environmental (SH&E) Manual will be maintained in a readily accessible onsite location for review at all times during 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 SOPs. In the event of a conflict between this APP, the SSHP, the SOPs, 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 (U.S. 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 Representative and approved by the Task Order Manager and Corporate SH&E Manager. All such modifications will be supplied to Naval Facilities Engineering Command, Southeast for review and approval.

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Figures

Tables

Appendices

List of Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
^{o}C	degrees Celsius
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CPR	Cardiopulmonary resuscitation
CSP	Certified Safety Professional
dBA	decibel, A-weighted
DEET	N,N-diethyl-meta-toluamide
DOT	Department of Transportation
DPT	Direct push technology
EM	Engineering Manual
ERP	Emergency Response Plan
ERT	Emergency Response Team
^{o}F	Degrees Fahrenheit
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSI	Hazardous Substance Inventory
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering 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
TLV	Threshold Limit Value
TOM	Task Order Manager
UST	Underground storage tank
WBGT	Wet bulb globe temperature

1. SIGNATURE SHEET

This Accident Prevention Plan (APP) was prepared for employees performing field activities at Naval Air Station (NAS) Corpus Christi, Texas. 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 field activities at NAS Corpus Christi, Corpus Christi, Texas. This APP has been written for exclusive use of Resolution Consultants employees and its subcontractors. This APP was written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Plan Preparer:

______________________________ Date: 6 May 2013

1.a. Eric Allen, ASP
Safety, Health, & Environmental Representative
Resolution Consultants

Plan Concurrence:

______________________________ Date: 6 May 2013

1.b. John Knopf, CSP
Safety, Health, & Environmental Manager
Resolution Consultants

Plan Review:

Claire Barnett
______________________________ Date: 6 May 2013

1.c. Claire Barnett, PE
Task Order Manager
Resolution Consultants

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2. BACKGROUND INFORMATION

2.a. Contractor

Resolution Consultants, a joint-venture between AECOM and EnSafe Inc., is 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 Order JM46.

2.c. Project Name

Site Investigation, Underground Storage Tank (UST) Site 9 Fuel Farms 217 and 244, NAS Corpus Christi, Corpus Christi, Texas.

2.d. Project Description

During this phase of work Resolution Consultants will be performing a non-intrusive geophysical investigation of approximately 74,000 square feet at each of the two former fuel farm sites, and overseeing and sampling 60 direct push technology (DPT) borings taking soil and water samples from DPT sample locations around the associated site perimeters and pipelines. The use of a hand auger may be needed to retrieve soil samples in addition to use for utilities inspections to the depth of 4 feet.

2.e. Project Location

As depicted on Figure 2-1, the UST Site 9 (Fuel Farms 217 and 244) is at the NAS in Corpus Christi, Texas.

2.f. Contractor Accident Experience

A copy of the Occupational Safety and Health Administration (OSHA) 300 form is 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:

- Geophysical Survey
- Soil Sampling (DPT)
- Water Sampling (DPT)
- Mobilization/Demobilization

AHAs for each of the investigation tasks are included as part of the Site Safety and Health Plan (SSHP) discussed in Section 9.gg. of this APP.

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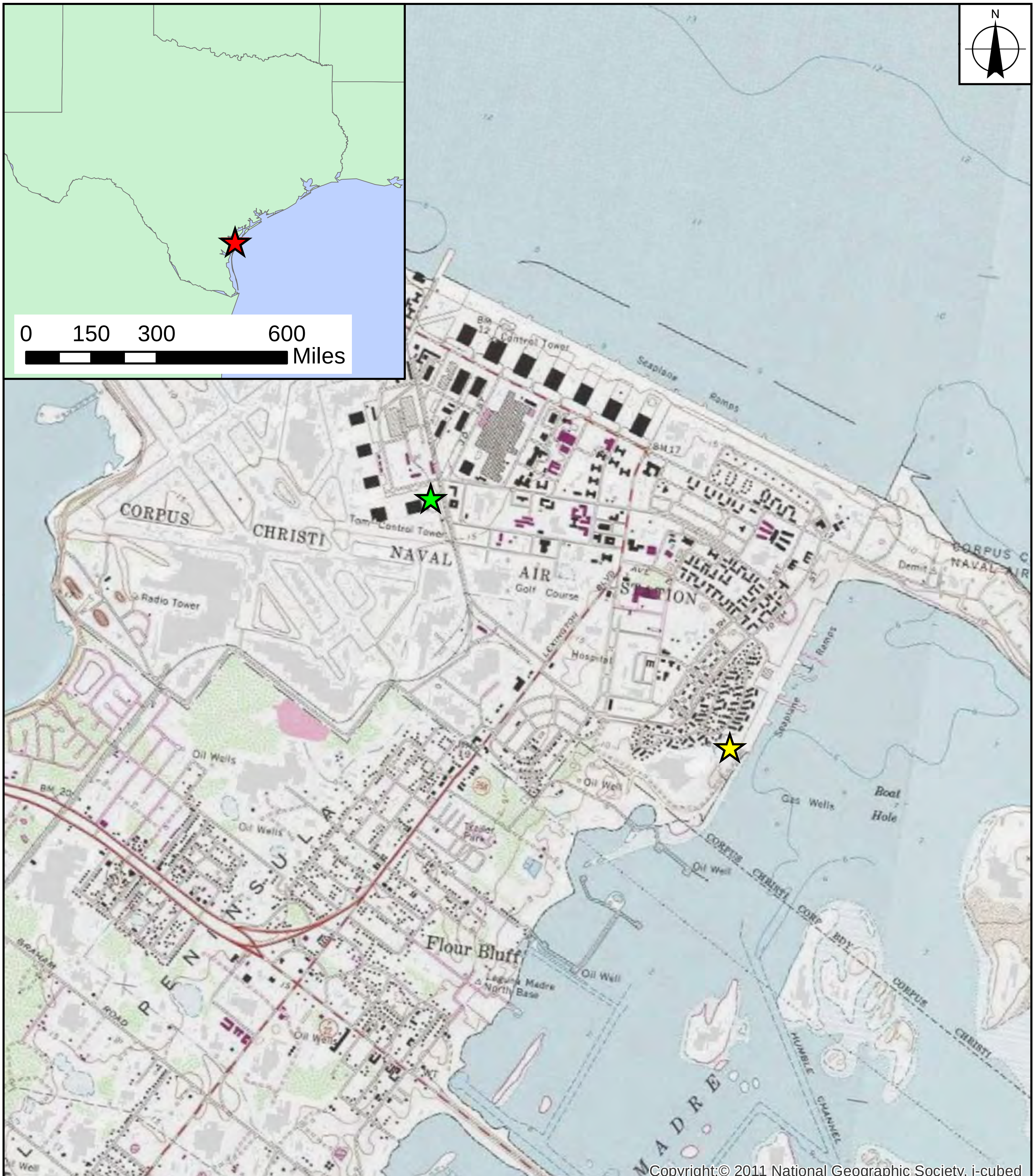

Legend

- 217 Fuel Farm
- 244 Fuel Farm
- NAS Corpus Christi

0 1,000 2,000 3,000 4,000
Feet

FIGURE 2-1
AREA LOCATION MAP
UST SITE 9
NAS CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 3/26/2013
DRAWN BY: B. LIPSCOMB	TASK ORDER NUMBER: JM46

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3. 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 its U.S. operations, which establishes the framework to maintain effective SH&E management, monitoring, measurement, documentation, communication, and methods to promote continuous improvement.

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 and program performance, assist in communications and awareness, facilitate 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 in 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 modified 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 is structured to align 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.

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.

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 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.

Safety Program Goals

Consistent with the Resolution Consultants corporate SH&E policy, the safety program goals under this contract are ZERO injuries and accidents.

SH&E Standard Operating Procedures

Resolution Consultants SH&E Standard Operating Procedures (SOPs) establish minimum safety requirements and guidelines for Resolution Consultants U.S. 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. The SOPs referenced throughout this APP and are in Appendix C. A copy of the SOPs will be kept onsite at all times.

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4. 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 Consultants Site Investigation, UST Site 9 Fuel Farms 217 and 244, NAS Corpus Christi safety and health program (see Appendix D).

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.

Figure 4-1 presents the Resolution Consultants organization chart for the management of safety at both the corporate and project level for this project. The positions/responsibilities presented in the organization chart are discussed in the following paragraphs.

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 include 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
- Visit 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 onsite emergencies or as needed
- Coordinate any modifications to the safety plans with the SSHO and 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 onsite training, which will be provided by the SSHO

Task Order Manager [Claire Barnett]

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

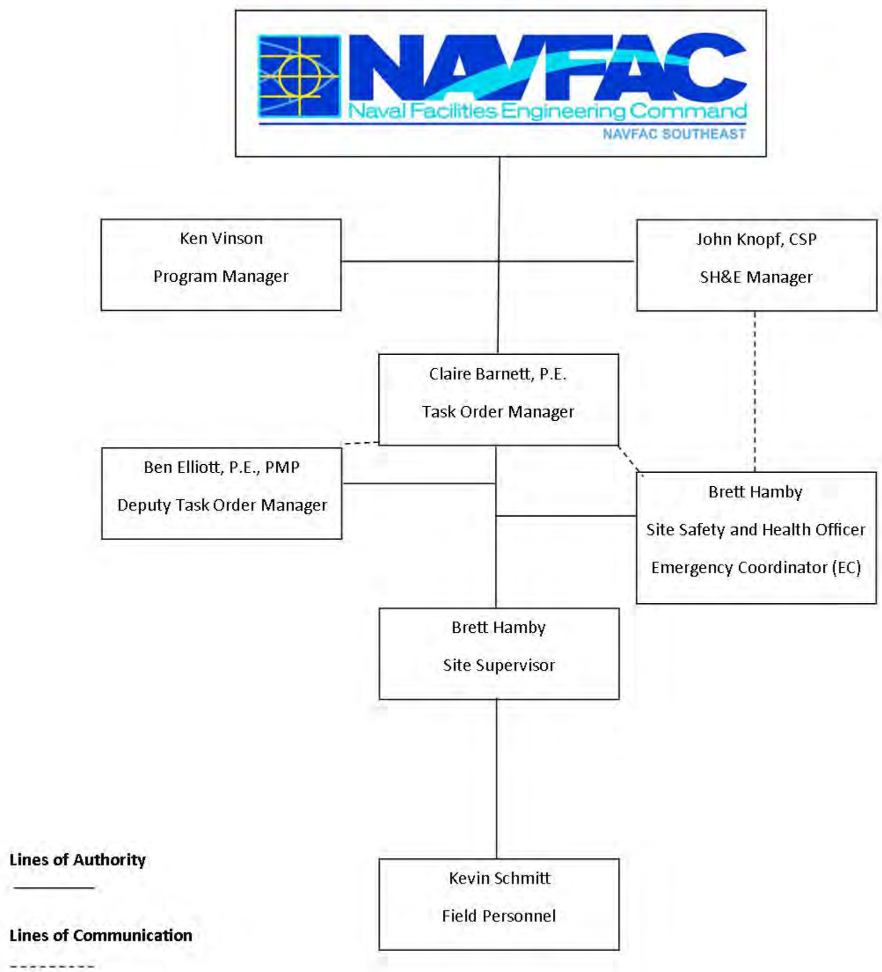

Figure 4-1 Safety Organization Chart

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- 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 Naval Facilities Command (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 [Brett Hamby]

The Resolution Consultants SSHO has more than 4 years of industrial hygiene and environmental, health, and safety related experience and will be onsite 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 who can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authority 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 Title 29 Code of Federal Regulations (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 contaminants 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 onsite investigation operations in accordance with the approved Work Plan and APP/SSHP. The Site Supervisor will coordinate all onsite personnel and equipment conducting investigation operations in a safe manner. The Site Supervisor will coordinate work with the TOM 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 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 to prevent incidents, injury, and/or exposure to themselves and their co-workers

- 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

- Follow 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

Everyone's conformance 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 who 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).

Proof of competency should will be provided when working around specialized dangerous operations such as excavation, welding, drilling, and confined space entry. Should the current scope of work change this table will be populated to reflect the work conditions.

Title	Inspection Role	Name	Proof of Competency
Not Applicable	Not Applicable	Not Applicable	Not Applicable

4.d. Competent Person Work Requirements

To complete investigation tasks, an OSHA-designated competent person must be onsite to perform the required daily inspections of equipment and/or operations. No work will be performed unless a designated competent person is present on the job site. The training requirements for competent persons are specified in the SH&E SOP 05-202-*Competent Person Designation.*

4.e. Pre-Task Safety and Health Analysis Requirements

AHAs 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, steps can be taken to eliminate, reduce, or control the hazards to an acceptable risk level. Guidelines for developing AHAs are in SH&E SOP 05-209-*Hazard Assessment and Project Planning*.

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 05-002-*Stop Work Authority for Unsafe Work*. Whenever the SSHO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, he shall seek immediate resolution with the appropriate supervisor. 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 has 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.f. Lines of Authority

Figure 4-1 illustrates the lines of authority for the personnel responsible for project safety.

4.g. 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.

First Violation: An oral warning will be given for the first violation of an 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 will 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.

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.

4.h. 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.

5. SUBCONTRACTORS AND SUPPLIERS

5.a. Subcontractor and Supplier Identification

Resolution Consultants will be using a subcontracted driller for the work during this phase.

5.b. Subcontractor and Supplier Safety Responsibilities

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 required PPE.

Resolution Consultants' SSHO will be responsible for ensuring subcontractor compliance with the APP/SSHP. Specific responsibilities of subcontractor employees include:

- Complying with the requirements of their Scope of Work
- Participating in development of a SSHP with AHAs for their work activities
- Maintaining a safe and healthy work environment
- Complying with the APP, contract requirements, laws, regulations, and Engineering Manual (EM) 385-1-1
- Reviewing the APP to ensure that the health and safety requirements of their specific tasks are satisfied
- Providing trained and experienced workers for the specific work activities
- Participating in the Daily Safety Tailgate Meetings
- Identifying additional training needs for unique tasks
- Enforcing company- and project-specific rules and procedures during work activities
- Reporting all incidents and participating in the investigations
- Participating in routine site inspection activities
- Ensuring all equipment brought to the site is in proper working order, is routinely inspected, and is 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. The SSHO will inspect these items upon receipt.

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. The SSHO will maintain the MSDSs and hazardous materials list.

6. TRAINING

6.a. New Hire Safety Orientation Training

Employees will receive safety and health orientation prior to the start of work. All orientation training will be documented in writing by date, name, content, and trainer. At a minimum, the training will 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

Training

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, onsite 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 contains project personnel HAZWOPER training and medical monitoring documentation.

Medical Monitoring

Resolution Consultants personnel performing onsite 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 employee's abilities to perform the assigned work shall be provided to the SH&E Manager or designated company Human Resources 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 restrictions or that would prevent him/her 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 onsite employee. Certification of medical surveillance program participation is in 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 onsite 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 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 cardiopulmonary resuscitation (CPR). Additional details on applicable emergency response training and procedures are in Section 9.b, Emergency Response Plans.

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7. 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 noted during the daily inspection 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 in chronological order. The log will be available, be updated daily, and will provide the following information:

- Date 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 NAS Corpus Christi — UST 9, Former Fuel Farms 217 and 244.

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 of 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).

8. ACCIDENT REPORTING

All accidents and incidents that occur onsite during any field activity will be promptly reported to the SSHO and the immediate supervisor in accordance with SH&E SOP 05-004-*Incident Reporting*. If any Resolution Consultants employee is injured and requires medical treatment, the Site Supervisor will contact the **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 Corporate SH&E Manager before the end of the following shift.

If a subcontractor's employee 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 300 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 05-603-*Incident Investigation and Review*. Copies of all subcontractor accident investigations, whether accomplished in accordance with their own procedures or SH&E SOP 05-004-*Incident Reporting*, will be provided to the SSHO within 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, emergency response personnel 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 day 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 after their occurrence. 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. 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 related to work activities occurs.

9. PLANS (PROGRAMS, PROCEDURES) REQUIRED BY THE SAFETY MANUAL

Based on the scope of site investigation activities, applicable safety plans, programs, and procedures to address risk and compliance requirements were identified and are described below.

9.a. Layout Plans

This section is not applicable to the tasks being performed for this project.

9.b. Emergency Response Plans

The Resolution Consultants site team will hold an emergency response plan (ERP) 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 onsite

The 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 onsite 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 onsite 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 onsite 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 offsite emergency units, as required
- Notifying the TOM and providing updates as conditions change
- Directing offsite emergency response personnel to the scene and providing assistance
- Implementing site control
- Completing 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 onsite emergency response personnel don the proper PPE, if needed
- Assisting onsite 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 offsite 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 offsite 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 offsite 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 to emergency responders:

- 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 onsite 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 installation requirements. Contact agencies, points of contact, and phone numbers are 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. Personnel training is in accordance with 29 CFR 1910.120(q)(6)(ii).

A first aid kit must be maintained onsite 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 the base and NAVFAC points of contact

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 immediately notify the base and NAVFAC points of contact of any spill or discharge. Resolution Consultants will make all regulatory notifications for Resolution Consultants generated 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 onsite 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 information such 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 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 on the safety bulletin board (maintained in site vehicle), and provided to the SSHO. All personnel will be trained on the emergency alert systems in place at the work site. The emergency contacts for the project are in Section H.14.5, Table H-8 of the SSHP. This includes a detailed hospital route map with approximate travel times and distances.

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 onsite 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 procedure is not applicable during this phase of work.

9.b.(6) Medical Support

Onsite medical support during project execution will be available from two or more individuals who are trained in First Aid, CPR, and blood borne pathogens. The following table lists the trained individuals and dates of First Aid and CPR training; copies of the certifications are in Appendix G. Onsite 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, personnel will be trained in the use of the Automated External Defibrillator.

Resolution Consultants Personnel	First Aid (Date of Completion)	CPR (Date of Completion)
Brett Hamby	May 2012	May 2012
Kevin Schmitt	TBD	TBD
Ben Elliott	March 2012	March 2012
Claire Barnett	December 2011	December 2011

Emergency medical support contact information is in the SSHP. Employees can contact emergency personnel by dialing 1-911. 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. For all job sites, emergency phone numbers can be found in the SSHP.

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 supervisor's job is to assess an employee's job performance to ensure that all necessary tasks are completed in accordance with specifications and deadlines, the supervisor's 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 don't 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**
  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 immediately be 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 onsite 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 onsite. 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 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 onsite. 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), onsite 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

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 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 (^oF) 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

An Access and Haul Road Plan is not applicable during this phase of work.

9.f. Respiratory Protection Program

This program is not applicable during this phase of work.

9.g. Health Hazard Control Program

The 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 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 are 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 a Resolution Consultants certified industrial hygienist (CIH), 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 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 PPE: Applicable to all phases of work
- Modified Level D PPE: Applicable to work activities involving exposure potential to biological hazards such as poisonous plants (poison ivy/oak) and/or insects (ticks)

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

PPE will be selected 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 continual 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 conditions 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 onsite 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 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 onsite 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 sound level (dBA) 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 is anticipated only during heavy equipment support activities 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., Day-Glo orange/green).

PPE Use

All site personnel will be given initial PPE-specific training. The SSHO will give this training 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 the applicable training form.

PPE Program Effectiveness

Based on the potential inhalation hazard and potential chemical exposures on this site, Level D PPE is considered adequate for the work that is to be accomplished at the site. If, after approval of this APP, work tasks are added to the Statement of Work, 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 to NAVFAC for approval. Upon approval, the amendment will be added to the APP/SSHP.

The SSHO will ensure PPE use complies with 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 procure a replacement.

The SSHO will be responsible for ensuring that PPE is in good, clean, working order prior to the initial PPE issuance. 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 MSDSs for each hazardous material. Details of the program are in SH&E SOP 05-507-*Hazardous Materials Communication WHMIS,* which includes the development of a site-specific Hazard Communication Plan, complete with inventory log, 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. MSDSs are requested from the suppliers at the time of order. If not available, then a recent MSDS will be downloaded from 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 onsite 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 onsite hazardous substances and copies of manufacturer developed MSDSs for each listed item.

An MSDS shall be available for every hazardous substance used or stored on each job site. Copies of all MSDSs will be maintained onsite as an appendix to the site-specific SSHP. All site personnel will be briefed on the location of the MSDSs and will have immediate access to examine MSDSs 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 on-going 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 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 an Hazardous Materials Identification System and/or National Fire Protection Association-type label
- Name and address of the manufacturer, importer, or other responsible party

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 CFR 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- or shop-specific details of the Hazard Communication Program, including an explanation of the labeling system and the MSDSs, and how employees can obtain and use the appropriate hazard information

- Information regarding hazardous substances to which the employee may be exposed, according to provisions of this section, for their physician to receive

- 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 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 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 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, groundwater, 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 program is not applicable during this phase of work.

9.j. Lead Abatement Plan

This program is not applicable during this phase of work.

9.k. Asbestos Abatement Plan

This program is not applicable during this phase of work.

9.l. Radiation Safety Program

This program is not applicable during this phase of work.

9.m. Abrasive Blasting

This program is not applicable during this phase of work.

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. For this project, Level D PPE will be utilized, thus providing minimal increase in the potential for heat stress. Level D PPE is defined as standard work clothes with sturdy work boots, long pants, short or long sleeve shirt as applicable, safety glasses, appropriate gloves, hard hats, and safety boots.

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 is 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 20 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 basically 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 20 minutes thereafter. Total liquid consumption should be about 1 to 2 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 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 caffeinated or alcoholic beverages. Heat stroke is 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. 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 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. To maintain workers' body fluids at normal levels, workers will be encouraged to drink, as a minimum, approximately 16 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 4- to 12-ounce cups and liquids will be provided onsite. Water will be the liquid provided. 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 2 to 6 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 overexertion 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 slow as 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 heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same
  - If the heart rate still exceeds 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 degrees Celsius [°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 (see Table 9-2).

Table 9-2
Permissible WBGT Heat Exposure Threshold Limit Values (TLV)

Work — Rest Regimen	Work Load 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 totally 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 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 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. At the site, the nearest heated environment will be the interior of the vehicles

- 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 to the tasks being performed for this project.

9.p. Night Operations Lighting Plan

This section is not applicable to the tasks being performed for this project.

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 onsite activities, the following practices will be used for fire prevention and protection:

- Smoking onsite 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 Supervisor when operations onsite begin.

- Accumulations of combustible scrap and debris onsite will be promptly removed and properly disposed.

- Care will be taken with all equipment to reduce the possibility of sparks or open flames.

- Electrical cords and plugs will be inspected prior to use; cords will be kept 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.

- The driller will be responsible for fire extinguishers on the site around drilling 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 (not greater than 5 gallons 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.

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 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.r. Wild Land Fire Management Plan

This program is not applicable during this phase of work.

9.s. Hazardous Energy Control Plan

This program is not applicable during this phase of work.

9.t. Critical Lift Plan

This program is not applicable during this phase of work.

9.u. 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, 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 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 will 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 recorded:

  — "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 toward 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 or work vehicle. 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.v. Float Plan

This program is not applicable during this phase of work.

9.w. Site-Specific Fall Protection & Prevention Plan

This program is not applicable during this phase of work.

9.x. Demolition Plan

This program is not applicable during this phase of work.

9.y. Excavation/Trenching Plan

This program is not applicable during this phase of work.

9.z. Emergency Rescue

This program is not applicable during this phase of work.

9.aa. Underground Construction Fire Prevention and Protection Plan

This program is not applicable during this phase of work.

9.bb. Compressed Air Plan

This program is not applicable during this phase of work.

9.cc. Formwork and Shoring Erection and Removal Plans

This program is not applicable during this phase of work.

9.dd. Precast Concrete Plan

This program is not applicable during this phase of work.

9.ee. Lift Slab Plans

This program is not applicable during this phase of work.

9.ff. Steel Erection Plan

This program is not applicable during this phase of work.

9.gg. Site Safety and Health Plan for Hazardous Toxic Radiological Waste Work

See the SSHP, Appendix H to this APP.

9.hh. Blasting Safety Plan

This program is not applicable during this phase of work.

9.ii. Diving Plan

This program is not applicable during this phase of work.

9.jj. Confined Space Program

This program is not applicable during this phase of work.

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10. RISK MANAGEMENT PROCESSES

Risk management processes are implemented to ensure 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 NAS Corpus Christi:

- Chemical
- Biological
- Physical

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 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 Regional SH&E Manager.

The specific AHAs identifying the project-specific task hazards and controls are in the SSHP, Appendix H to this APP. The following text discusses the major types of hazards.

Chemical Hazards

Chemical hazards include the materials found onsite during field tasks and those chemicals brought onsite 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 OSHA Permissible Exposure Limits and the ACGIH TLVs will not be exceeded. Occupational exposure limits for the laboratory chemicals in use at this project are listed in the MSDSs for each chemical.

Avoidance of "routine" exposure:

- Develop and practice safe habits
- Avoid unnecessary exposure to chemicals by any route
- Do not smell or taste chemicals
- Inspect gloves before use

Eating, smoking, etc.:

- Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where chemicals are present

- Wash hands before conducting these activities

- Storage, handling, or consumption of food or beverages from refrigerators used for samples holding is prohibited

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 that may be found onsite include insects; arachnids, such as spiders; ticks; mites; and plants. Several varieties of snakes and other wildlife are also common hazards in this area. 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.

Given the current site conditions, employee exposure to biological hazards is anticipated to be of a medium risk. If the SSHO deems it necessary to upgrade PPE based on changing site conditions, amendments to this APP will be made. 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). These areas will be adequately delineated and the plant locations will be fully disclosed to all onsite personnel. Modified Level D PPE may be required (per SSHP and AHAs) for work in these areas.

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 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 facilities. 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. Examples of common poisonous or irritating plant species are shown on 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 (New Jersey 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.

2. Wash the skin with water.

3. Take a regular shower with soap and warm 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 Technu-Wash, Cortaid and Lanacort, baking soda, Aveeno oatmeal bath, and calamine lotion.

Physical Hazards

Resolution Consultants has published safe work practice procedures with general guidelines to implement when executing fieldwork. These procedures apply to all activities and personnel working on field projects and operations.

During site activities, work areas will be continuously policed for 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 is in 05-307-*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 form 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 05-308-*Manual Lifting Field.*

Appendix A
OSHA 300 Form

OSHA's Form 300A

Summary of Work-Related Injuries and Illnesses

Year 2012

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.

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	0	0	0
(G)	(H)	(I)	(J)

Number of Days

Total number of days of job transfer or restriction	Total number of days away from work
0	0
(K)	(L)

Injury and Illness Types

Total number of... (M)

(1) Injury	0	(4) Poisoning	0
(2) Skin Disorder	0	(5) All other illnesses	0
(3) Respiratory Condition	0		

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 50 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

Establishment Information

Your establishment name EnSafe, Inc. (Corporate)

Street 5724 Summer Trees Drive

City Memphis State TN Zip 38134

Industry description (e.g., Manufacture of motor truck trailers)
Environmental and Safety Consultants

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)
8 7 4 4

Employment Information

Annual average number of employees 237

Total hours worked by all employees last year 436,098

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.

Michael A. Wood, CPA — Company executive

CFO — Title

(901) 372-7962 — Phone

1/21/2013 — Date

OSHA's Form 300
Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 2012

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name EnSafe, Inc. (Corporate)

City Memphis State Tennessee

Identify the person | **Describe the case** | **Classify the case**

(A) Case no.	(B) Employee's Name	(C) Job Title (e.g., Welder)	(D) Date of injury or onset of illness (mo/day)	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death (G)	Days away from work (H)	Remained at work: Job transfer or restriction (I)	Remained at work: Other record-able cases (J)	On job transfer or restriction (days) (K)	Away from work (days) (L)	(M) Injury (1)	Skin Disorder (2)	Respiratory Condition (3)	Poisoning (4)	All other illnesses (5)
MEM-01	Ryan Adamson	Environmental [illegible]	[illegible]	Clean [illegible]	S[illegible]				[illegible]			✓				
					Page totals	0	0	0	1	0	0	1	0	0	0	0

Deemed non work related by Occupational Physician

Using these categories, check ONLY the most serious result for each case. Enter the number of days the injured or ill worker was. Check the "injury" column or choose one type of illness.

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Injury (1) | Skin Disorder (2) | Respiratory Condition (3) | Poisoning (4) | All other illnesses (5)

Public reporting burden for this collection of information is estimated to average 14 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.

OSHA's Form 301
Injuries and Illnesses Incident Report

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary*, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by John Knopf

Title OCS - Corp. H&S Manager

Phone 901-387-4286 Date

Information about the employee

1) Full Name Ryan Adamson

2) Street 608 Wood Valley Circle

City Memphis State TN Zip

3) Date of birth

4) Date hired 6/3/2007

5) [x] Male
[ ] Female

Information about the physician or other health care professional

6) Name of physician or other health care professional
Jeffrey A. Diebach, M.D.

7) If treatment was given away from the worksite, where was it given?

Facility OrthoOne

Street 98 Market Center Drive

City Collierville State TN Zip 38017

8) Was employee treated in an emergency room?
[ ] Yes
[x] No

9) Was employee hospitalized overnight as an in-patient?
[ ] Yes
[x] No

Information about the case

10) Case number from the Log MEM-01 *(Transfer the case number from the Log after you record the case.)*

11) Date of injury or illness 12/5/2012

12) Time employee began work 7AM AM/PM

13) Time of event 10:30AM AM/PM [ ] Check if time cannot be determined

14) **What was the employee doing just before the incident occurred?** Describe the activity, as well as the tools, equipment or material the employee was using. Be specific. Examples: "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."
Ascending and descending stairs.

15) **What happened?** Tell us how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."
When employee was descending stairs he felt a pain in his right knee.

16) **What was the injury or illness?** Tell us the part of the body that was affected and how it was affected; be more specific than "hurt", "pain", or "sore." Examples: "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."
Tendonitis of the right knee.

17) **What object or substance directly harmed the employee?** Examples: "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, leave it blank.
Stairs

18) **If the employee died, when did death occur?** Date of death N/A

Appendix B
Resolution Consultants Safety and Health Policy Statement

Safety, Health, and Environmental Policy Statement

PURPOSE

The purpose of this policy is to:

- Establish and maintain a framework for a safe and healthy workplace for all Resolution Consultants and partners' employees and minimize our impact on the environment.
- Outline expectations relative to compliance with governing occupational safety, health and environmental legislation.

COMMITMENT

Resolution Consultants Is 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 are also committed to protecting and preserving the natural environment and communities in which we operate. We will actively seek to conserve energy, water and natural resources and to recycle and reduce waste where appropriate during the execution of our business activities. We and our partners will be good corporate citizens by striving to ensure that our facilities and operations do not pose unreasonable safety or environmental risks, and by participating in community-related activities that promote excellence in safety, health and environmental practices. 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. Resolution Consultants will plan and design its processes, facilities and projects in a manner that reduces risks and impacts during their entire life cycle, consistent with the direction and objectives of our clients.

OBJECTIVES

Our ultimate goals are simple:

- Prevent work-related injuries or illnesses
- Prevent damage to property and/or equipment from our activities
- Prevent adverse impacts to the environment from our ongoing projects or operations

IMPLEMENTATION

To guide the Implementation efforts required by this policy, the Management Committee will collaborate to establish Safety, Health and Environmental (SH&E) programs that reflect the following expectations and beliefs:

- SH&E performance will not be compromised for the sake of other business or client demands.
- All accidents are preventable.
- Compliance with all applicable safety, health and environmental rules and regulations at the local, state, provincial and national level is a minimal expectation; we will not be satisfied to simply meet SH&E compliance standards. Where no specific regulation exists, we will comply with our standards and appropriate industry practices.
- We will meet client requirements.
- Concern for employee health and safety will be evident and embedded into all phases of our work by design and through the business decisions that we make.
- We will report on performance using SH&E metrics designed to help achieve established goals.
- We will communicate to all affected employees their Individual SH&E obligations.
- We will incorporate input from employees, customers and partners to continuously improve our SH&E performance. We will periodically review and continually improve our processes to reflect feedback and experience, and ensure they remain relevant and appropriate to the organization.
- We will recognize those who contribute to their improved SH&E performance.

EMPLOYEE RESPONSIBILITIES

All employees will be responsible for:

- Conducting themselves in accordance with directives, standards and procedures established by the applicable SH&E program.
- Helping ensure their fellow employees and stakeholders have the knowledge, skills, and equipment necessary to protect themselves and others.
- 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 Management Committee:

Paul Banks

Steve Scott

Ginny Gray-Davis

Michael Wood

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.

5.0 Records

None.

6.0 Attachments

5-001 Safety Rules

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.

- 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

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.			
4.			
5.			
6.			
7.			
8.			
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20.			

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.

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).

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.

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

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

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

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.

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.

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.

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

- 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.

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.

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.

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

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

	Project Name:	Project Number:	Client:
	Supervisor:	Project Manager:	Location:
	THA Developed By:		Date:
SUMMARY OF CONTROLS	Task Name:		

Personal Protective Equipment (*check all that apply*)	Air Monitoring (reference HASP monitoring plan)			
CSA/ANSI Safety-Toed Boots (Leather or Rubber)	☐ No air monitoring required		☐ Air monitoring required (*see procedures below*)	
CSA/ANSI Safety Glasses or Goggles	Parameter	Location/Monitoring Interval	Response/Action Levels	Response Activity
CSA/ANSI-approved Hard Hat				
CSA/ANSI Type II/III Reflective Traffic Safety Vest				

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

	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		

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

- 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,

- 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** (red)
- **MED** (yellow)
- **LOW** (green)

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

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.

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.

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

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.

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.

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.

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.

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.

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^{o}C) shall be provided to workers if work is performed in air temperatures below 40^{o}F (5^{o}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^{o}F (0^{o} 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.

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:
    - o Proper rewarming procedures and appropriate first aid treatment.

- 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

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.									

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°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		100 min	2	-15° to -17°
0° to –4°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		100 min	2	75 min	2	-18° to -20°
-5° to –9°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		100 min	2	75 min	2	55 min	3	-21° to -22°
-10° to –14°	Normal Work Schedule		Normal Work Schedule		100 min	2	75 min	2	55 min	3	40 min	4	-23° to -25°
-15° to –19°	Normal Work Schedule		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		Cease Work		-32° to -34°
-30° to –34°	55 min	3	40 min	4	30 min	5	Cease Work		Cease Work		Cease Work		-35° to -37°
-35° to –39°	40 min	4	30 min	5	Cease Work		Cease Work		Cease Work		Cease Work		-38° to -39°
-40° to –44°	30 min	5	Cease Work		Cease Work		Cease Work		Cease Work		Cease Work		-40° to -42°
-44° & below	Cease Work		Cease Work		Cease Work		Cease Work		Cease Work		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.

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.

- 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.

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

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:

- 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.

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

- o Chemical names of hazardous ingredients, including, but not limited to, those in mixtures
- o An indication of the percentage, by weight or volume, which each ingredient of a mixture bears to the whole mixture
- o 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
- o 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
- o 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
- o Reactivity data, including stability, incompatibility, hazardous decomposition products, and hazardous polymerization
- o Procedures to be followed and precautions to be taken in cleaning up and disposing of materials leaked or spilled
- o Special protection information, including use of personal protective equipment, such as respirators, eye protection, and protective clothing, and ventilation or other control measures
- o Special precautionary information about handling and strong
- o 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.

5-511 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:

- 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.

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.

- 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

- 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

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**		
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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.

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.

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.

Appendix D
Site Safety and Health Officer Resume

RESOLUTION CONSULTANTS

Brett Hamby

Scientist

Professional History

Education

BS, Geosciences: Geology, Texas Tech University, 2008

Training and Certifications

Confined Space Entry, Attendant, and Supervisor Training (OSHA 29 CFR 1910.146)

Mr. Hamby is a geologist with three years' experience in environmental site assessments (ESAs), soil and groundwater sampling, miscellaneous fieldwork, data collection and management, and analysis/reporting.

Experience

Chemical Database Management, Aerospace Company; Grand Prairie, TX (2008-Present)
Role: Data Manager
Assist with management of chemical and raw material usage by obtaining, reviewing, and organizing information from Material Safety Data Sheets (MSDSs), SAP applications, Chemical Abstract Service (CAS) databases and purchasing records. Information is manipulated to assist client with preparation of their current and future TRI reports. Microsoft (MS) Excel and Access is used to organize and match up MSDS, CAS number and part number, as well as performing queries to produce specific information for the TRI report. Updates the MSDS database, SAP part numbers and the CAS table as needed to reflect the most recent data and materials being used.

Fin Press Investigation; Carrier Corporation (2009-Present); Tyler, TX
Role: Geologist
Installed 21 groundwater monitoring wells onsite to assess if soil and groundwater near a fin press machine were affected by the release of petroleum product. Assessments were conducted using hollow stem auger drilling methods.

Confidential Client; Houston, TX (2009-Present)
Role: Geologist
Conducts quarterly and annual groundwater monitoring for VOCs in support of site remediation activities associated with a VCP site. Participated in field effort to inject amendments into a shallow groundwater bearing unit to foster the growth of indigenous bacteria and emplace zero-valent iron to oxidize chlorinated solvents. Writes associated groundwater monitoring reports for submittal to TCEQ.

Operation and Maintenance of Groundwater Treatment System, Confidential Client, McGregor, TX (2011-Present)
Role: Operations and Maintenance Assistant
Performed standard operations and maintenance of a groundwater treatment system located on client's site. Aid with non-routine repairs when needed.

Rolling Hills Hospital, Acadia Healthcare (2012); Ada, OK
Role: Assessor
Conducted a Phase I ESA of 17-acre psychiatric hospital property in Ada, Oklahoma. The property is completed with an approximately 37,000-square-foot hospital building.

Municipal Setting Designation Application, Westdale Asset Management, Dallas, TX (2011-2012)
Role: Geologist
Aided in preparing a Municipal Setting Designation (MSD) Application to the City of Dallas for client. Maintain discussions with city personnel pertaining to completion of the MSD Application. Completed MSD Application form for the TCEQ and submitted for review.

Environmental Site Investigation Services, Federal Express Ground (2011); Hutchins, TX
Role: Geologist
Aided in completing a Site Investigation Services Report which included a land and boundary survey, a geotechnical survey, and a detailed site investigation report. Acquired bids from three separate contractors for each activity. Aided in completion of a Wetlands report and a Threatened and Endangered Species report for property. All activities were completed prior to client purchasing and developing proposed property.

Trucking Terminal, Swift Transportation (2011); Albuquerque, NM
Role: Assessor
Conducted a Phase I ESA of an 18-acre trucking terminal which included an approximately 21,000-square-foot terminal building and two 10,000-gallon diesel storage tanks.

Vacant Warehouse Suite, Aerospace Company (2011); Grand Prairie, TX
Role: Assessor
Conducted Phase I ESA of a 33,172-square-foot vacant warehouse suite as part of client's company policy prior to purchasing or leasing property.

2.21-Acre Property in Downtown Dallas, Terrapark IV LP (2010); Dallas, TX
Role: Assessor
Conducted Phase I ESA of a parking lot comprised of six contiguous tracts of land in downtown Dallas, which led to a Limited Phase II ESA.

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Vacant Warehouse, Sanmina SCI, (2009); Carrollton, TX
Role: Geologist
Conducted Phase I ESA of a 150,000-square-foot warehouse. The warehouse was formerly used to form sheet metal in to air conditioning unit casings and parts. Led to a limited Phase II ESA described below.

Hammer House Subsurface Investigation; Aeronautics Company (2010); Fort Worth, TX
Role: Geologist
Participated in sampling effort to assess if soil and groundwater near three hydraulic press pits were affected by hydraulic oil releases. Assessment activities were conducted using direct push technology, hollow stem auger and hand auger drilling methods. Soil borings were advanced around and inside press pits which required personnel to undergo confined space entry training.

Panama City – Bay County International Airport (2010); Panama City, FL
Role: Geologist
Participated in sampling efforts to assess if soil and groundwater for the entire 292-acre airport were affected by past airport activities. Assessments were conducted using direct push technology. Soil borings and temporary groundwater monitoring wells were installed on the tarmac, airplane maneuvering/storage areas, airplane hangars, and rental car terminals.

Leaking Petroleum Storage Tank Site; Helena Corporation (2009-2010); Electra, TX
Role: Geologist
Installed three monitor wells in a state highway right-of-way and onsite to assess if a nearby underground storage tank site had affected groundwater. Conducted quarterly groundwater sampling and wrote reports on Texas Commission on Environmental Quality (TCEQ) petroleum storage tank program forms.

Davis Farm Acquisition; Helena Corporation (2010); Floydada, TX
Role: Geologist
Performed subsurface investigation using an air rotary drill rig to collect soil samples to assess the property for possible contaminations prior to acquisition.

Leaking Petroleum Storage Tank Site; R+L Trucking (2010) Houston, TX
Role: Geologist
Installed three groundwater monitor wells in support of site investigation and closure activities associated with a diesel release at an operational trucking facility.

Bowles Life Center and Park; (2009); City of Grand Prairie, TX
Role: Assessor
Conducted Phase I ESA of 24.5-acre property, including 39,000-square-foot (SF) Life Center building, public swimming pool, playground, picnic pavilion, playground, City water well and associated water tower and surrounding land.

Press Pit Investigation; Sanmina SCI (2009); Carrollton, TX
Role: Geologist
Performed subsurface investigation using direct push technology drill rig to install and sample 10 soil borings and one temporary monitor well. Investigation was completed around hydraulic press pits inside a manufacturing building to assess whether oil had affected subsurface media.

Appendix E

Competent / Qualified Persons Proof of Competency

(Not Applicable)

Appendix F
HAZWOPER Training and Medical Monitoring Documentation

Appendix F.1
8-Hour Certificates

ENSAFE

Certificate of Training

Hazardous Waste Operations
Emergency Response

8 Hour Update

29CFR1910.120(e)(8)

EnSafe Memphis, TN

This is to certify that

Brett Hamby

Has successfully completed the above course title and all appropriate provisions within as described in 29 Code of Federal Regulations 1910.120. This certification is valid for one year after the date listed below.

John Knopf

Trainer Signature ______________________ *Date* 01-16-13 *Cert. #* 011613(08)DL

John Knopf, CSP

EnSafe Inc. 5724 Summer Trees Drive – Memphis, TN

ENSAFE

Certificate of Training

Hazardous Waste Operations
Emergency Response

8 Hour Update
29CFR1910.120(e)(8)
EnSafe Memphis, TN

This is to certify that

Claire Barnett

Has successfully completed the above course title and all appropriate provisions within as described in 29 Code of Federal Regulations 1910.120. This certification is valid for one year after the date listed below.

Trainer Signature ______________ *Date* 12-10-12 *Cert. #* 121012(05)MEM

John Knopf, CSP

EnSafe Inc. 5724 Summer Trees Drive – Memphis, TN

Appendix F.2

40-Hour Certificates

GEBCO ASSOCIATES

in cooperation with

THE UNIVERSITY OF NORTH TEXAS

certifies that

Brett Hamby

has successfully completed and passed the exam given on the final day for the Environmental Training Program entitled

40-Hour Hazardous Waste General Site Worker

Conducted at Fort Worth, Texas on March 9-13, 2009

This course meets the training requirements as specified by OSHA 29 CFR 1910.120 (e)(3)(i) & (iv).

GEBCO

President

Instructor: Dana Brown

Date of issue: 03/13/09

Certificate Number: 09035 8882

GEBCO's Training Programs are provided in cooperation with federal and state regulatory agencies, and fulfill all applicable requirements for accreditation.
GEBCO is licensed for Asbestos Training under the Texas Asbestos Health Protection Rules.

GEBCO Associates, LP * 4690 Diplomacy Road, Suite 120 * Fort Worth, TX 76155 * (817) 268-4006

HZ40

GERAGHTY
& MILLER, INC.
Environmental Services

Certificate of Completion

Presented To

Claire Barnett

In Recognition of Having Successfully Completed
the Prescribed Course of Study for

Hazardous Waste Site Activities
40-Hour Initial Health and Safety Training

Orlando, Florida | March 4-8, 1991

Richard M. Miller
President
American Ecology Services, Inc.

Kevin J. Donnelly
Course Director
Geraghty & Miller, Inc

This Certifies that

BEN ELLIOTT

454-47-4903

has completed the requirements for

40 HOUR GENERAL SITE WORKER TRAINING

in accordance with 29 CFR 1910.120 (e) (3) (i)

as set forth by Environmental Options, Inc.

This 15TH day of SEPTEMBER, 1995

Environmental Options, Inc.

Christopher J. Merrifield

Instructor

12573

SAIC®

Presented to:

Benjamin Elliott

For successfully completing:

DOT/IATA 2-HOUR COURSE

General Awareness Training as required by the Department of Transportation and International Air Transport Association

Limited Function Specific Training as required by the Department of Transportation and International Air Transport Association to address
- Sample shipping
- Shipping in support of environmental field operations

SAIC
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
151 Lafayette Avenue • Oak Ridge, TN 37830
An Employee-Owned Company

Certificate No.
02/24/04-11

J Crenshaw
Course Instructor

55✓

This Certifies that

BEN ELLIOTT

454-47-4903

has completed the requirements for

40 HOUR GENERAL SITE WORKER TRAINING

in accordance with 29 CFR 1910.120 (e) (3) (i)

as set forth by Environmental Options, Inc.

This 15TH day of SEPTEMBER, 1995

Environmental Options, Inc.

Christopher J. Merrifield

Instructor

12573

Appendix F.3
Medical Monitoring

www.lifesignsmd.com

January 24, 2012

Ensafe Corporation
Attn: Human Resources/Liz Carpenter
5724 Summer Trees Drive
Memphis, TN 38134

Re: Claire Barnett

Dear Liz,

We had the pleasure of seeing Claire Barnett on January 18, 2012 for a physical examination in conjunction with OSHA regulations.

I'm pleased to inform you I see no contraindications to her employment with the Ensafe Corporation, and she should be able to function in any capacity required of her including the use of a respirator should the need arise.

Sincerely,

Felix L. Caldwell, M.D.
Lifesigns of Memphis
/ay

Appendix F.4
Supervisor Certificates

HAZWOPER Management and Supervisor Training

EnSafe Inc. certifies that Claire Barnett has received his/her additional 8 hours management and supervisor training in accordance with OSHA 29 CFR 1910.120(e)(4). This training plus the previous 40 Hour HAZWOPER classroom training and 3 days supervised field experience or equivalent as evaluated by EnSafe Inc. qualifies the above named employee as a Hazardous Material / Hazardous Waste manager or supervisor.

John Knopf

April 18, 2013

EnSafe Corp. H&S Manager Date

HAZWOPER Management and Supervisor Training

EnSafe Inc. certifies that Brett Hamby has received his/her additional 8 hours management and supervisor training in accordance with OSHA 29 CFR 1910.120(e)(4). This training plus the previous 40 Hour HAZWOPER classroom training and 3 days supervised field experience or equivalent as evaluated by EnSafe Inc. qualifies the above named employee as a Hazardous Material / Hazardous Waste manager or supervisor.

John Knopf

April 18, 2013

EnSafe Corp. H&S Manager

Date

Appendix F.5
30-Hour OSHA Construction Safety and Health Certificates

OSHA Occupational Safety and Health Administration

[illegible]

This card acknowledges that the recipient has successfully completed a 30-hour Occupational Safety and Health Training Course in
Construction Safety and Health

Brett [illegible]

Eric Allen 07-13-2011
(Trainer name – print or type) (Course end date)

OSHA Occupational Safety and Health Administration

20-600067340

This card acknowledges that the recipient has successfully completed a 30-hour Occupational Safety and Health Training Course in

Construction Safety and Health

Kevin [illegible]

Eric Allen — 09-13-2013

(Trainer name – print or type) — (Course end date)

Appendix G
First Aid and CPR Trained Individuals

American Red Cross

This recognizes that

Brett Hamby

has completed the requirements for

CPR/AED-Adult

conducted by

North Texas Region

Date completed:

May 17, 2012

Valid for **2** year(s)

American Red Cross

This recognizes that

Brett Hamby

has completed the requirements for

First Aid

conducted by

Dallas Area Chapter

Date completed:

May 17, 2012

Valid for **2** year(s)

P.C. : 1-800-222-1222

redcross.org

Instructor's Signature

Jacqueline Zang.

Chapter

AMERICAN RED CROSS

NORTH TEXAS REGION

Holder's Signature

B H Hby

Stock No. 656798

redcross.org

Instructor's Signature

Jacqueline Zang.

Chapter

AMERICAN RED CROSS

NORTH TEXAS REGION

Holder's Signature

B H Hby

Stock No. 656798

American Red Cross

This recognizes that
Claire Barnett
has completed the requirements for
First Aid
conducted by
Ensafe Inc.
Date completed: **12/14/2011**
The American Red Cross recognizes
this certificate is valid from
completion date for: **2 Years**

American Red Cross

This recognizes that
Claire Barnett
has completed the requirements for
Adult CPR
conducted by
Ensafe Inc.
Date completed: **12/14/2011**
The American Red Cross recognizes
this certificate is valid from
completion date for: **2 Years**

Appendix H

Site Safety and Health Plan

APPENDIX H
SITE SAFETY AND HEALTH PLAN

SITE INVESTIGATION
UST SITE 9, FUEL FARMS 217 AND 244
NAVAL AIR STATION CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

Revision: 0

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
CTO JM45

May 2013

Table of Contents

Figures

Tables

Attachments

List of Acronyms

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
CRZ	Contaminant Reduction Zone
CSP	Certified Safety Professional
DPT	Direct push technology
EAP	Emergency Action Plan
EC	Emergency Coordinator
EZ	Exclusion Zone
^oF	degrees Fahrenheit
FF	Fuel Farm
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation-derived waste
NAS	Naval Air Station
PPE	Personal Protective Equipment
ppm	Parts per million
PST	Petroleum Storage Tank
SH&E	Safety, Health, and Environmental
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SSHO	Site Safety Health Officer
SZ	Support Zone
SWMU	Solid waste management unit
TLV	Threshold Limit Value
TOM	Task Order Manager
UST	Underground storage tank

SIGNATURE SHEET

This Site Safety and Health Plan (SSHP) was prepared for employees performing field activities at Naval Air Station (NAS) Corpus Christi, Texas. 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 NAS Corpus Christi, Corpus Christi, Texas. 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: 6 May 2013

1.a. Eric Allen, ASP
Safety, Health, & Environmental Representative
Resolution Consultants

Plan Review:

Claire Barnett

____________________________________ Date: 6 May 2013

1.B. Claire Barnett, P.E.
Task Order Manager
Resolution Consultants

Plan Concurrence:

John Knopf

____________________________________ Date: 6 May 2013

1.c. John Knopf, CSP
Safety, Health, & Environmental Manager
Resolution Consultants

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 onsite 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

Naval Air Station (NAS) Corpus Christi is in Nueces County, Texas, and lies approximately 140 miles southeast of San Antonio and approximately 25 miles south of the former Naval Station Ingleside, across Corpus Christi Bay. The installation encompasses 2,844 acres and lies within the corporate bounds of the City of Corpus Christi. NAS Corpus Christi is situated on the northern end of the Encinal Peninsula and is bounded on three sides by water; Oso Bay lies to the west, Corpus Christi Bay to the north, and Laguna Madre to the east. A barrier island (Mustang Island) lies east of Laguna Madre and separates Corpus Christi from the Gulf of Mexico. Residential neighborhoods and State Highway 358 bound the installation on the south.

H.2.2 Site Background and History

Resolution Consultants will be conducting a field investigation at two former fuel tank farms associated with Underground Storage Tank (UST) Site 9 at NAS Corpus Christi. UST Site 9 for this investigation is comprised of two former underground fuel storage facilities: Fuel Farm 217 (Solid Waste Management Unit [SWMU] Nos. 54 through 61) consists of eight 25,000-gallon USTs that were installed in 1940 in the eastern area of NAS Corpus Christi, less than 100 feet from the shore of Laguna Madre; and Fuel Farm 244 (SWMU Nos. 62 through 69) consists of eight 25,000-gallon USTs that were installed in 1940 near the Building 252 in the central part of NAS Corpus Christi.

The eight USTs associated with former Fuel Farm 217 (FF217) were active between 1945 and 1986 and were filled with sand and cement in 1987. Between 1977 and 1980, 7,000 gallons of aviation fuel are known to have been released to the environment from the FF217 USTs during three separate events; however, the specific tanks sourcing these spills are not identified in the record (USEPA, 1989).

The eight USTs associated with former Fuel Farm 244 (FF244) were active from the early 1940s until 1973 when they were filled with sand. There are no documented releases on file from FF244 (USEPA, 1989).

H.2.3 Previous Investigations

There are no known investigations on file for either fuel farm other than a brief mention in the 1984 *Initial Assessment Study of Naval Air Station Corpus Christi* report (Navy, 1984) and site status and tank content listings in the appendices to the 1988 *RCRA Facility Assessment Evaluation Preliminary Review Visual Site Inspection and Sampling Visit* report (USEPA, 1989). Since each fuel farm site was abandoned in place prior to the 1990's, neither site was formally listed or closed with the state of Texas Petroleum Storage Tank (PST) Program, the former fuel farms are now being investigated for potential closure under this program.

H.2.4 Potential Chemical Exposure

The chemicals of potential concern at the fuel farm sites are those associated with aviation/jet fuels — benzene, toluene, ethylbenzene, xylene, methyl tertiary butyl ether, total petroleum hydrocarbons, and polynuclear aromatic hydrocarbons.

H.3 ACTIVITY HAZARD ANALYSIS

During this initial site screening phase of work, Resolution Consultants will be performing a non-intrusive geophysical investigation of approximately 74,000 square feet at each of the two former fuel farm sites (FF217 and FF244) to identify UST locations, and overseeing and sampling 60 direct push technology (DPT) borings, taking soil and water samples from DPT sample locations around the associated site perimeters and pipelines with the intent of performing an initial screening for Texas PST Program applicability. The outcome of the initial screening should be a determination of whether or not a petroleum release can be identified for each site and a decision whether either site needs to be entered into the Texas PST Program prior to site closure.

Tasks that require an Activity Hazard Analysis (AHA) include the following:

- Geophysical Survey
- Soil Sampling (using DPT)
- Groundwater Sampling (collected from DPT boring)
- Mobilization/Demobilization

AHAs for the work tasks that will be conducted during this phase of work are in Attachment 3.

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 SSHP.

H.4.2 Resolution Consultants Safety, Health, and Environmental Manager [John Knopf, CSP]

The Safety Health and Environment (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 [Claire Barnett] and Deputy Task Order Manager [Benjamin Elliott]

The Task Order Manager (TOM) has overall management authority and responsibility for all site operations, including safety. The Deputy TOM (TOM designee) will act on behalf of the TOM as the designated local liaison for this effort. The TOM, in coordination with the TOM designee, will provide the Site Supervisor with work plans, staff, and budgetary resources that are appropriate to meet the safety needs of the project operations.

H.4.4 Site Supervisor [Brett Hamby]

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, or Deputy TOM, may act as the Site Supervisor while onsite.

H.4.4.1 Responsibilities

The Site Supervisor is responsible for:

- Discussing deviations from the work plan with the SSHO and TOM (or Deputy TOM)
- Discussing safety issues with the TOM (or Deputy TOM), SSHO, and field personnel
- Assisting the SSHO with the development and implementation of corrective actions for site safety deficiencies
- Assisting the SSHO with the implementation of this SSHP and ensuring compliance
- Assisting the SSHO with inspections of the site for compliance with this SSHP and applicable 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 (or Deputy TOM).

H.4.4.3 Qualifications

In addition to being Hazardous Waste Operations and Emergency Response (HAZWOPER)-qualified, the Site Supervisor is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with Title 29 Code of Federal Regulations (CFR) 1910.120 (e)(4).

H.4.5 Site Safety Health Officer [Brett Hamby]

H.4.5.1 Responsibilities

The SSHO is responsible for:

- Updating the 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.

- Being aware of changes in Resolution Consultants Safety Policies, Programmatic Health and Safety Plan, or SOPs.

- Monitoring the lost time incidence rate for this project and working to improve it.

- Inspecting the site for compliance with this SSHP and the SOPs using the appropriate audit inspection checklist provided by the SH&E Manager or designee.

- Working with the Site Supervisor and TOM (or Deputy 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).

- Contacting the SH&E Manager or designee for technical advice regarding safety issues.

- Providing a means for employees to communicate safety issues to management in a discreet manner (e.g., suggestion box, etc.).

- Determining emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.

- Checking that all site personnel and visitors have received the proper training and medical clearance prior to entering the site.

- Establishing necessary controlled work areas (as designated in this SSHP or other safety documentation).

- Presenting tailgate safety meetings and maintain attendance logs and records in accordance with SH&E SOP *5-210-Tailgate Safety Meeting Log* (Attachment 4).

- Discussing potential health and safety hazards with the Site Supervisor, the SH&E Manager or designee, and the TOM (or Deputy TOM).

- Selecting 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 (or Deputy TOM).

H.4.5.2 Authority

The SSHO has authority to:

- Verify that 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 (or Deputy 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 CFR 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 exposure has occurred above the Occupational Safety and Health Administration permissible exposure limit, employees may be required to receive supplemental medical testing to document 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 4). 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 TOM or Deputy TOM. Additional required training that is completed will be documented and tracked in the project files.

H.5.2.1 Competent Person Training Requirements

Work requiring a task specific competent person is required for drill rig DPT operations on this site. If new tasks are identified, the SSHO/Site Supervisor will assess the need for a competent person and be responsible for identifying the appropriate employee and area of competency. Table H-1 contains the required information for task-specific competencies.

Table H-1
Task-Specific Competent Persons

Employee Name	Organization	Area of Competency
To Be Determined	To Be Determined	Drilling

Note:
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 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 4) lists the general requirements for selection and usage of PPE. Table H-2 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are identified in the individual AHAs. By signing this SSHP the employee confirms that he/she has 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, the employee shall request that the TOM (or Deputy TOM)/SSHO provide the proper training before signing.

Table H-2
Personal Protective Equipment

Type	Material	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/cutoff jeans or sleeveless shirts
Additional PPE		
Leather Gloves	Leather	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.6.1 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 safer and more 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 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 1 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 NAS Corpus Christi Fuel Tank Farms are in Appendix F.4 of the APP.

H.8 EXPOSURE MONITORING AND AIR SAMPLING PROGRAM

No air monitoring program will be required during this phase of work. Should the scope of work change the information below will be used to govern the 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 to assure proper selection of engineering controls, work practices, and PPE so that employees are not exposed to levels that exceed permissible exposure limits, or published exposure levels, if there are no permissible exposure limits.

Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards to determine the appropriate level of employee protection needed onsite. Periodic monitoring shall be conducted when the possibility of an immediate danger to life or health 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-3 contains monitoring instruments, manufacturer information, and the substances that each instrument detects.

Table H-3
Monitoring Parameters and Equipment

Instrument	Manufacturer/Model*	Substances Detected
N/A	N/A	N/A

Notes:
N/A = Not applicable
*Or similar unit, as approved by the Resolution Consultants Health and Safety 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 that exceed the action levels in areas accessible to unprotected personnel are measured, necessary control measures (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 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 the monitoring results (volatile organic compounds and explosive atmosphere channels) specific to the contaminants of concern.

Table H-4 lists the monitoring procedures and action levels.

Table H-4
Monitoring Procedures and Action Levels

Parameter	Location and Interval	Response Level (Meter Units/ppm Above Background)	Response
N/A	N/A	N/A	N/A
		N/A	N/A

Notes:
N/A = Not applicable
ppm = Part per million

H.8.3 Monitoring Equipment Calibration

All instruments used will be calibrated according to the manufacturer instructions. . 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 offsite 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 or a Certified Safety Professional, will be responsible for specifying the monitoring required. Within 5 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.

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 4). The guidance presented in Table H-5 will be used in identifying and treating heat-related illness.

Table H-5
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 onsite treatment of the victim and proper transport to a medical facility.

H.9.1.1 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 degrees Fahrenheit (°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 (ACGIH) 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 4).

H.9.1.2 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-6).

Table H-6
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.9.1.3 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.9.1.4 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.9.1.5 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's 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 4).

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 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 onsite, with separate toilets maintained for each sex except where there are less than 5 total personnel onsite. For mobile crews where work activities and locations permit transportation to nearby toilet facilities onsite facilities are not required.

Washing Facilities: Employees will be provided washing facilities (e.g., buckets with water and Alconox) 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 a controlled work area. Personnel belonging to another organization onsite 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 SHSO 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

There are no additional client specific requirements; should this change, this plan will be updated.

H.10.2 Work Permit Requirements

There are no work permit requirements during this phase of work.

H.10.3 Material Handling Procedures

Manual material handling procedures are in SH&E SOP *5-308-Manual Lifting Field* (Attachment 4).

H.10.4 Drum, Container, Tank Handling

Liquid investigation-derived waste (IDW) generated during sampling, including decontamination fluids, will be handled in accordance with the UFP-SAP/QAPP. Wastewater will be generated by decontamination procedures. All aqueous IDW will be containerized in drums provided by the NAS Corpus Christi Public Works Department Part B facility.

NAS Corpus Christi personnel will pick up the filled drums and stage them at the designated waste accumulation area to await waste characterization analyses. Resolution Consultants will sample and characterize the waste. Based on waste characterization results, the facility will determine the appropriate management and disposal of the drummed water.

Drums will be handled according to all federal, state, and local environmental regulations.

H.10.5 Comprehensive AHA of Treatment Technologies

No treatment activities are expected during this phase 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 immediately 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 will not require the implementation of HAZWOPER work zones at this time. Should the scope change, the requirements will be amended to address HAZWOPER requirements.

If implemented, each HAZWOPER controlled work area will consist of the following three zones:

- *Exclusion Zone (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., 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.

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 an 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 Deputy TOM), 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

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 (or Deputy 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.

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 onsite 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 Material Safety Data Sheet (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 offsite 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.

The PPE to be used onsite is considered disposable and will be removed and containerized in the CRZ during decontamination activities. Suits and booties will be removed first, and gloves last.

1. 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, 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 offsite, the SS and/or SSHO will visually inspect them for signs of contamination. If contamination is present, the equipment must be decontaminated.

For equipment, use the following steps for decontamination:

1. Remove majority of visible gross contamination in EZ
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), who in within this project is the SSHO, will complete Table H-7 with site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

Table H-7
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 # (to be determined 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	Brett Hamby, Ben Elliott, Claire Barnett	
Site-Specific Spill Response Procedures	Chemicals brought onsite 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 (or Deputy TOM) who in turn will notify the account manager and the Department project representative.	

Figure H-1 contains the Emergency Response Flow Chart.

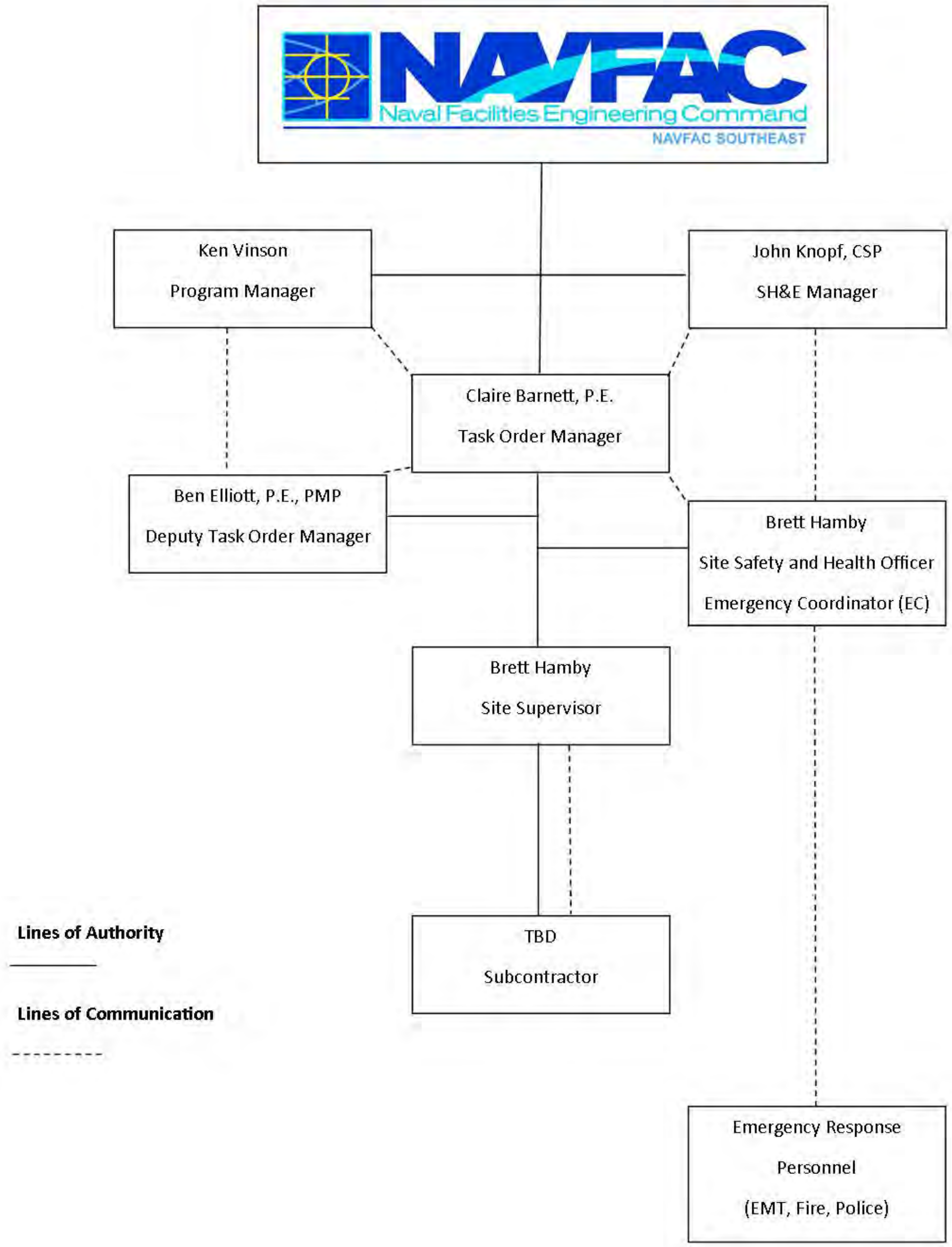

Figure H-1 — Personnel and Lines of Authority for Emergency Situations

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-8)
- 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, the EAP has been prepared for this project should such critical situations arise. The only significant type of onsite emergency that may occur is physical injury or illness to a member of the Resolution Consultants team. 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 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 are injured onsite will require an appropriate level of decontamination to ensure that medical personnel or emergency service workers are not exposed to chemical hazards posed onsite. 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. 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 in Attachment 5. Table H-8 lists the emergency contacts and their phone numbers.

Table H-8
Emergency Contacts

Emergency Coordinators/Key Personnel			
Name	**Title/Workstation**	**Telephone Number**	**Mobile Phone**
Mr. Arne Olsen	Navy RPM/NAVFAC SE	904-542-6159	904-654-3059
Ross Ybarra	NAS Corpus Christi Point of Contact	361-961-2170	361-658-9572
Ben Elliott	Deputy Task Order Manager	210-545-9527	512-635-4229
Brett Hamby	Site Supervisor	972-791-3222	940-577-5755
Brett Hamby	Site Safety Health Officer	972-791-3222	940-577-5755
Brett Hamby	Emergency Coordinator	972-791-3222	940-577-5755
John Knopf	Resolution Consultants Health & Safety Manager	901-372-7962	901-451-1464
Eric Allen	EnSafe CLEAN H&S contact	901-372-7962	901-359-6698
Herold Hannah	AECOM Regional SH&E Manager	412-904-3606	412-303-1199
Sean Liddy	AECOM District SH&E Manager		443-553-1403
Russ Reynolds	AECOM District SH&E Manager	864-234-3042	864-906-7309
Incident Reporting	**AECOM Personnel**	**800-348-5046 And John Knopf**	
	EnSafe Personnel	**Call John Knopf**	
Ann-Alyssa Hill	AECOM TDG/IATA Shipping Expert	804-515-8506	804-640-4815
Kevin Arick	EnSafe TDG/IATA Shipping Expert	901-372-7962	901-356-3525
Organization/Agency			
Name: NO NOT CALL 911 WHILE ON BASE!			**Telephone Number**
Police Department (Base Dispatch)			1-911
Fire Department (Base Dispatch)			1-911
Ambulance Service ***(EMT will determine appropriate hospital for treatment)***			1-911
Emergency Hospital ***(Use by site personnel is only for emergency cases)***			
Corpus Christi Medical Center			361-761-1200
7101 South Padre Island Drive			
Corpus Christi, TX 78412			
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 listed in the Table H-8 and should be used in the event of an emergency.

Attachment 1

SSHP Acknowledgement Form

SSHP Acknowledgement Form
JM46
Fuel Tank Farms-NAS Corpus Christi, Corpus Christi, Texas

Print Name	Signature	Organization	Date

Attachment 2

SSHP Revision Table

Site Health and Safety Plan
Revision History
NAS Corpus Christi; Fuel Tank Farms — Corpus Christi, Texas

Revision No.	Revision Date	Approved By (Initials)	Changes, Discussion
0			

Attachment 3
Activity Hazard Analyses

Activity Hazard Analysis (AHA)

Activity/Work Task: **Soil Sampling / Groundwater Sampling, DPT Drilling**	Overall Risk Assessment Code (RAC) (Use highest code)					**M**
Project Location: NAS Corpus Christi	**Risk Assessment Code (RAC) Matrix**					
Project Number: CTO JM46	**Severity**	**Probability**				
Date Prepared: 5/7/2013		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Eric Allen/ H&S Specialist	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Claire Barnett, P.E./ TOM	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.	**RAC Chart**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk** **H = High Risk**
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.	**M = Moderate Risk** **L = Low Risk**

Recommended PPE:
_X_ Safety Glasses With Sideshields _X_ Steel-Toed Boots _X_ Hard Hat _X_ Nitrile Gloves ___ Leather Gloves _X_ Hearing Protection ___ Flame Retardant Clothing

Job Steps	Hazards	Controls	RAC
General Physical Hazards	• Slip/Trip/Fall • Cold/Heat Stress • Biological Hazards • Cuts/Scrapes/Bruises • Manual lifting	• Level D PPE required. • Maintain a clean and organized work area. • Watch your step and ensure proper footing. • Provide drinking water and first aid kit. • Wear appropriate clothing for weather conditions. • 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 49lb. without assistance)	**L**
	• Adverse Weather	• Be aware of changing weather condition and provide appropriate weather gear. • 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
Mobilization / Site Set Up	• Slips, Trips, Falls	• 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. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces.	L
	• General equipment hazards • Overhead and underground utilities • Noise Hazard • Pinch points/swing radius • Chemical exposure potential • Eye Injury • Fire	• All equipment will be properly secured during transport. • All vehicles and equipment will comply with DOT requirements. • Never move the DPT rig with the mast upright. Ensure the sampling site foundation is stable and as level as possible. • Use a ground guide along with a functioning back-up alarm during equipment backing. • Confirm Utility Locations • Inspect vehicles and equipment daily (Checklists provided in HASP) • Maintain clean and organized work area. • Wear appropriate clothing and PPE, (no loose clothing or jewelry) • Earplugs and/or ear muffs required in EZ • Position the drill rig and personnel up wind of drilling location • Monitoring breathing zone with PID and upgrade PPE as required. • Avoid creating splash hazards while drilling. • Keep a safe distance from drill rig. • Use hand signals, keep clear of moving equipment, and ensure eye contact with operator prior to approaching. • Have fire extinguisher on site.	
	• Contact with utilities	• Inspect for buried and overhead utilities in the vicinity of the drilling location. Clearance will be required, as stipulated in the HASP.	
	• Traffic in adjacent roadway	• Use combination of vehicles, cones, traffic barriers, and caution tape	
Boring Process	• Cuts	• Wear appropriate work gloves to prevent cuts, lacerations	M
	• Dermal Contact	• Wear appropriate protective clothing to avoid dermal or personal clothing contact with sampled material.	

Job Steps	Hazards	Controls	RAC
	• Slips, Trips, Falls	• 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. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces.	
Sample collection and packaging	• Chemical exposure potential	• Follow proper decontamination procedures	L
	• Cuts/Scrapes	• Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar)	
	• Manual lifting of equipment	• Use proper lifting techniques and do not over-extend	
Rig decontamination	• High pressure water • Splash Hazard	• Spray away from body • Wear full-face shield, gloves, rubber boots, and Tyvek or other suitable attire.	L

Chemical Hazards and Monitoring Procedures	
Chemical Hazard(s) (list):	**BTEX, PAHs, Petroleum Hydrocarbons**
Applicable SSHP Section(s):	**H.2.4**
Monitoring Instrument(s):	**N/A**

Additional Safety Considerations

1. Ensure all personnel have read the HASP
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC). Ensure equipment has a working kill switch and back-up alarms, and follow equipment inspection procedures.
3. Ensure underground utilities are verified with facility, marked, markings maintained, and operator aware of location
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 saturated state of soils and regular precipitation. If visible emissions of dust observed, then dust suppression techniques will be implemented.
7. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
8. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate THAs 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 perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
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

Additional Safety Considerations
up, chock wheels. Use spotter when moving rig, check for overhead obstructions. 14. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc. 15. For equipment decontamination, triple rinse using distilled or deionized water and alconox for first rinse and distilled or deionized water for second and third rinses. Always clean materials between locations and at the site. Do not bring equipment back to the office without proper decontamination.

Additional Operational Safety Procedures	PPE
05-305, Hand & Power Tools 05-308, Manual Lifting 05-313, Wildlife, Plants, Insects 05-405, Drilling and Boring 05-406, Overhead Electrical Lines 05-417, Identifying Underground Utilities 05-508, Hazardous Materials and Sample Shipping 05-511, Heat Stress	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	Drilling to be performed by competent person as certified by employer.	Equipment will be inspected daily by drill rig operator. 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 THA. • I will conduct work at this site in accordance with the requirements of the THA. 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
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature

Activity Hazard Analysis (AHA)

Activity/Work Task: **Mobilization/ Demobilization**	Overall Risk Assessment Code (RAC) (Use highest code)	**L**
Project Location: NAS Corpus Christi (Former Gunnery Training Complex)	**Risk Assessment Code (RAC) Matrix**	
Project Number: CTO JM46		
Date Prepared: 5/7/2013		
Prepared by (Name/Title): Eric Allen/ H&S Specialist		
Reviewed by (Name/Title): Claire Barnett, P.E./ TOM		
Notes: (Field Notes, Review Comments, etc.) Seat Belts are to be worn at all times while traveling in vehicles.		

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)

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**E = Extremely High Risk**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**H = High Risk**
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.	**M = Moderate Risk** **L = Low Risk**

Job Steps	**Hazards**	**Controls**	**RAC**
General Physical Hazards	• Slip/Trip/Fall • Cold/Heat Stress • Biological Hazards • Cuts/Scrapes/Bruises • Manual lifting	• Level D PPE required. • Maintain a clean and organized work area. • Watch your step and ensure proper footing. • Provide drinking water and first aid kit. • Wear appropriate clothing for weather conditions. • Assess work area for poisonous plants and animals and communicate observations to avoid them. • Wear appropriate work gloves for task • Maintain 3 points of contact when climbing into vehicle • Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 49lb. without assistance)	**L**
	• Adverse Weather	• Be aware of changing weather condition and provide appropriate weather gear. • When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP)	
Driving	• Communication • Accident Prevention	• Do not use cellular phones while operating vehicles of any kind. • Always wear seatbelt when traveling in the vehicle to and from the site	**L**

Job Steps	Hazards	Controls	RAC
Loading and unloading the boat	• Slip/Trip/Fall • Drowning • Cuts/Scraps/Bruises	• Maintain a clear deck both on and off of the boat, and maintain three points of contact when at all possible. • Wear life jacket at all times when loading and unloading the boat. • Wear appropriate clothing for the current weather and working conditions.	L

Additional Safety Considerations
1. Ensure all personnel have read the HASP 2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC). 3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path. 4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate THAs 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 when possible. 7. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting. 8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

Additional Operational Safety Procedures	PPE
SH&E 308, Manual Lifting SH&E 313, Wildlife, Plants, Insects SH&E 607, Manual Lifting	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) •N/A

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements

None	None	None

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 THA.
- I will conduct work at this site in accordance with the requirements of the THA.

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
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
Print Name & Company	Date	Signature
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Print Name & Company	Date	Signature
Print Name & Company	Date	Signature

Attachment 4

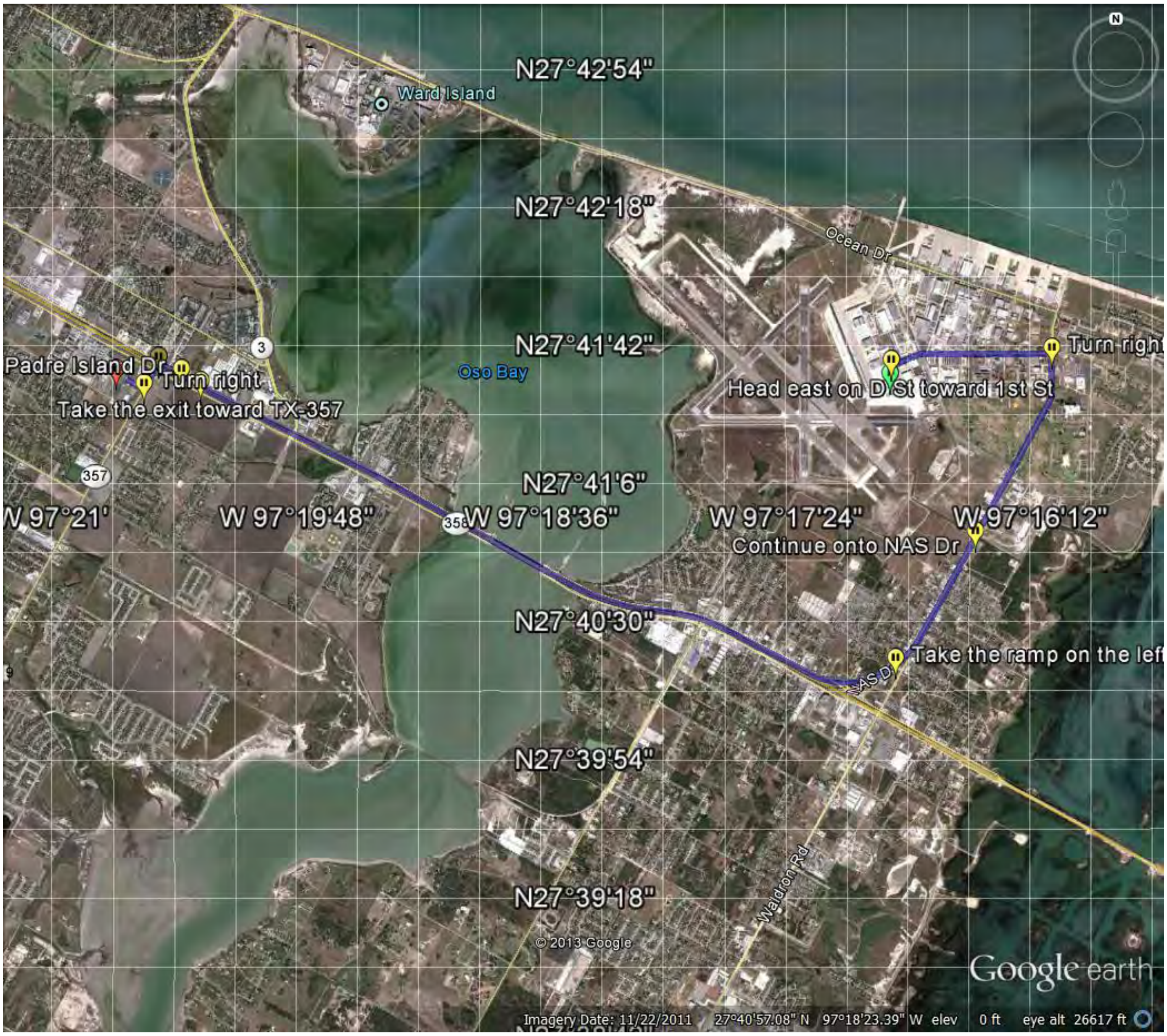
Resolution Consultants Safety

Standard Operating Procedures

(Refer to *Appendix C* of the APP)

Attachment 5

Route Map to Emergency Medical Facility



N.A.S.

Corpus Christi, TX

1. Head east on D St toward 1st St

2. Turn right onto Lexington Blvd

3. Continue onto NAS Dr

4. Take the ramp on the left onto TX-358 W

5. Take the exit toward TX-357 / Rodd Field Rd / Nile Dr

6. Merge onto S Padre Island Dr

7. Turn left onto Rodd Field Rd

8. Turn right onto Williams Dr

Destination will be on the right

Corpus Christi Medical Center-
7002 Williams Dr
Corpus Christi, TX 78412

Appendix I

Subcontractor Health and Safety Plan

(Not Applicable During Current Phase of Work)