WORK PLAN ADDENDUM FOR CHICORA TANK FARM CNC CHARLESTON SC
2/14/2013
RESOLUTION CONSULTANTS

WORK PLAN ADDENDUM
for
CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA

FINAL
REV 0

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Southeast
BRAC Program Management Office, SE
4130 Faber Place Drive
North Charleston, South Carolina 29405

Comprehensive Long-Term Environmental Action Navy
Contract Number N62470-11-D-8013

CTO # JM29

Prepared by:

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February 2013

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List of Acronyms and Abbreviations

ADVENT	ADVENT Environmental, Inc.
BRAC	Base Realignment and Closure
BTEX	Benzene, toluene, ethyl benzene and total xylenes
CLEAN	Comprehensive Long-term Environmental Action, Navy
CNC	Charleston Naval Complex
CTF	Chicora Tank Farm
CTO	Contract Task Order
DO	Dissolved Oxygen
EDB	1, 2-dibromethane
GCAL	Gulf Coast Analytical Laboratories, Inc.
IDW	Investigation-Derived Waste
LTM	Long term monitoring
MS	Matrix spike
MSD	Matrix spike duplicate
NAVFAC SE	Naval Facilities Engineering Command, Southeast
ORP	Oxidation-Reduction Potential
PAH	Polynuclear aromatic hydrocarbon
PMO	Program Management Office
QA	Quality assurance
QC	Quality control
SCDHEC	South Carolina Department of Health and Environmental Control
SOP	Standard Operating Procedure
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound

1. PROJECT BACKGROUND

Resolution Consultants, Inc., (Resolution Consultants) has been contracted by the Department of the Navy, Naval Facilities Engineering Command Southeast (NAVFAC SE) to perform long term monitoring (LTM) at the Chicora Tank Farm (CTF) located at the Charleston Naval Complex (CNC), Charleston, South Carolina. A site features map is provided as Figure 1. This Work Plan Addendum was prepared under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract Number N62470-11-D-8013, Contract Task Order (CTO) Number JM29. This submittal is an addendum to the Work Plan submitted to NAVFAC SE by ADVENT Environmental, Inc., (ADVENT) under Contract Number N62467-06-D-0125, Project 08-538. The original Work Plan was submitted to NAVFAC SE in August 2008 and is included as Appendix A.

2. SCOPE OF WORK

This site is regulated under the South Carolina Department of Health and Environmental Control's (SCDHEC) Resource Conservation and Recovery Act (RCRA) program. Resolution Consultants will perform semi-annual groundwater sampling at six monitoring wells (MW2, MW21R, MW33, MW34R, MW31, and MW32). Groundwater sampling activities will be performed in accordance with the South Carolina Department of Health and Environmental Control (SCDHEC) and Resolution Consultants Standard Operating Procedures (SOPs), as well as the procedures outlined in the ADVENT Work Plan. The applicable Resolution Consultants SOPs are included as Appendix B.

Under this CTO, two rounds of groundwater sampling will be conducted at six monitoring wells (MW2, MW21R, MW33, MW34R, MW31, and MW32) in February 2013 and August 2013 (Figure 1). Collected groundwater samples will be shipped to Gulf Coast Analytical Laboratories, Inc. (GCAL) located in Baton Rouge, Louisiana. GCALs SCDHEC Laboratory Certification number is 73006001. The samples will be analyzed for BTEX and naphthalene by EPA Method 8260B, polynuclear aromatic hydrocarbons (PAHs) by EPA method 8270 and 1, 2-dibromethane (EDB) by EPA Method 8011.

2.1 Groundwater Sample Collection

Groundwater samples will be collected at each of the six monitoring wells in general accordance with the procedures outlined in Resolution Consultants SOP 3-14 (Appendix B). Prior to collecting groundwater samples, depth to groundwater will be measured to the nearest 0.01 foot using an oil/water interface probe or equivalent at 19 well locations. Monitoring wells to be measured for depth to groundwater include MW2, MW3, MW4, MW5, MW8, MW9, MW11, MW20, MW21R, MW22R, MW23, MW24, MW25, MW30, MW31, MW32, MW33, MW34R, and MW35. Water levels will be recorded on a Resolution Consultants Water Level Measurement form. The depth to water at each well will be used to establish the groundwater potentiometric surface, which is used to determine the groundwater flow direction.

Low-flow purging and sampling of the monitoring wells will be performed using a peristaltic pump with Teflon®-lined polyethylene tubing. New Teflon®-lined polyethylene tubing will be used at each well to eliminate the potential for cross-contamination. If a monitoring well is purged dry, the sample will be collected when the well has recharged to a sufficient volume.

Field measurements will be collected during sampling activities to include the amount of water purged, pH, temperature, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, depth to water, and purge rate. All field data and sampling activities will be documented on appropriate forms.

2.2 Sample Identification

Primary groundwater samples for this project will follow the nomenclature historically used by Advent. Primary groundwater samples will be designated with the site name (i.e., CTF), followed by the well identification. For example, a groundwater sample collected from MW-2 will be labeled as CTF-MW2. QA/QC samples will be denoted by adding a character(s) extension to the end of the sample ID. A hyphen will precede the extension. The extensions to be used are as follows:

-a	=	field duplicate
-c	=	trip blank
-ms	=	matrix spike
-msd	=	matrix spike duplicate

2.3 Investigation-Derived Waste Handling

Liquid investigation-derived waste (IDW) generated during sampling decontamination fluids, will be handled in accordance with Resolution Consultants SOP-3-05. Liquid IDW may be generated during the well purging and sampling process. Purge water and decontamination water, if generated, will be containerized in 55-gallon drums. Data resulting from analyses performed on samples collected during each groundwater sampling event will be used for waste characterization. As a result, samples of containerized liquid IDW will not be collected for analysis. Liquid IDW will be shipped to a permitted waste disposal facility if necessary. Waste classified as personal protective equipment will be disposed as solid waste.

2.4 Quality Control/Quality Assurance Samples

A trip blank will be included in all shipments containing samples for volatile organic analyses. One duplicate and one matrix spike (MS)/matrix spike duplicate (MSD) sample will be collected for each matrix per field event. No equipment rinsate blanks or field blanks samples will be collected.

2.5 Reporting

Following each sampling event (February 2013 and August 2013), a draft Semi-Annual LTM Report will be submitted to the Navy for review. Following Resolution Consultants' approved response to the Navy's comments, a final version will be distributed to the Navy, SCDHEC, and CH2MHill, Inc.

Each LTM report will include sample collection field sheets, chain of custody forms, laboratory analytical result tables, a table of sample results above detection limits, and a table of field duplicate results. A figure indicating well locations and the results of the sampling event will also be included. The report will also address the activities and findings of the groundwater monitoring and address recommendations for future sampling. The recommendations will include an optimization evaluation to address monitoring frequencies, plus analyte and well reduction or addition, as appropriate, based on the sampling data.

FIGURE 1

SITE FEATURES MAP

Legend

Monitoring Well to be Sampled

Monitoring Well

Chicora Tank Farm

0 40 80 120 160 Feet

Basemap Source: Esri World Imagery
http://services.arcgisonline.com/arcgis/services/World_Imagery

FIGURE 1
SITE FEATURES MAP
CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX, SC

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: SED	DATE: 2/14/2013
DRAWN BY: SCR	TASK ORDER NUMBER: JM29

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APPENDIX A

ADVENT WORK PLAN (August 2008)

WORK PLAN

MONITORED NATURAL ATTENUATION AT BUILDINGS 1279 AND 236 AND GROUNDWATER MONITORING AND CORRECTIVE ACTION PLAN FOR THE CHICORA TANK FARM

CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Prepared For:

NAVFAC

Naval Facilities Engineering Command – Southeast
North Charleston, South Carolina

Contract Number:

N62467-06-D-0125

Task Order:

0037

Prepared By:

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Prepared by:____________________
ADVENT-James W. Weeg, P.G.

Approved by:____________________
NAVFAC-Kathryn A. Stewart, P.E.

August 2008
ADVENT Project 08-538

FIGURES

APPENDICES

1.0 INTRODUCTION

ADVENT Environmental, Inc. (ADVENT) has been retained by Naval Facilities Engineering Command (NAVFAC) to conduct additional sampling and develop a corrective action plan (CAP) for the Chicora Tank Farm. This work will be performed by ADVENT under contract number: N62467-06-D-0125, Task Order: 0037.

The objectives for this project include:

- Perform one round of sampling and analysis of monitoring wells 1279MW001, 1279MW002, and 1279MW003, at Building 1279,
- Perform one round of sampling and analysis of monitoring wells 236MW001, 236MW002, and 236MW003, at Building 236,
- Perform two rounds of semi-annual sampling and analysis on twenty-nine (29) wells at the Chicora Tank Farm (CTF), and,
- Develop a Corrective Action Plan (CAP) for the CTF, dependant on the results of the 1st semi-annual round of sampling and analysis at the CTF.

Publications listed below were used in the development of this work plan and are referenced in the text by basic designation only.

- 29 CFR 1926 Safety and Health Regulations for Construction
- R.61-71 South Carolina Well Standards, April 26, 2002 R.61-92, Part 280 Underground Storage Tank Control Regulations, May 23, 2008
- South Carolina Risk Based Corrective Action for Petroleum Releases, May 15, 2001
- Initial Groundwater Assessment Guidance Document, March 15, 2000
- Tier II Assessment Guidance Document, March 15, 2000

installed by ADVENT in April 2004 as part of an IGWA conducted for NAFAC. Samples collected from the monitoring wells will be analyzed for BTEX, and Naphthalene by EPA Method 8260B; Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8270C; and Ethylene-Dibromide (EDB) by EPA Method 8011 (Table-2). Waste generated during the sampling activities at the site will be placed in appropriate containers and properly disposed of in accordance with applicable federal, state, and local requirements.

Once field work is complete, ADVENT will provide a Groundwater Monitoring Report for Building 236 reporting the findings and recommending any further action necessary.

Table-2
Bldg 236 Sampling Parameters

Parameter	Water	
	Method	MCL
Benzene	8260B	5 μg/L
Toluene	8260B	1,000 μg/L
Ethyl-benzene	8260B	700 μg/L
Total Xylenes	8260B	10,000 μg/L
Naphthalene	8260B	25 μg/L
Benzo (a) anthracene	8270C	10 μg/L
Benzo (b) flouranthene	8270C	10 μg/L
Benzo (k) flouranthene	8270C	10 μg/L
Chrysene	8270C	10 μg/L
Dibenz (a,h) anthracene	8270C	10 μg/L
Ethylene Di-Bromide (EDB)	8011	0.05 μg/L

2.3 Semi-annual Sampling at the Chicora Tank Farm

ADVENT will perform a one-time brush clearance on the Chicora Tank Farm (CTF) site. Once the site is clear, ADVENT will locate and assess the functionality of the twenty nine (29) monitoring wells known to be on the site. Assuming functionality of all wells, ADVENT will sample a total of twenty nine (29) monitoring wells semi-annually for one year. Samples collected from the monitoring wells will be analyzed for BTEX, and Naphthalene by EPA Method 8260B; Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8270C; and Ethylene-Dibromide (EDB) by EPA Method 8011 (Table-3).

3.0 SUBMITTALS

ADVENT will prepare Groundwater Monitoring Reports summarizing each completed work element. A photographic record of the work will be compiled for historical purposes and included in each report. One (1) draft copy of the each Groundwater Monitoring Report will be provided to BRAC PMO SE for review. Once approved, three (3) final copies of each report will be submitted to BRAC PMO SE.

Pending analytical results from the first round of sampling at the Chicora Tank Farm, ADVENT will develop a CAP for the site. One (1) draft copy of the CAP will be provided to BRAC PMO SE for review. Once approved, three (3) final copies of the plan will be submitted to BRAC PMO SE.

After all signatures (both the Contractor's and the Navy's) have been affixed to all signature pages in the final deliverables, ADVENT will provide two (2) CD copies of the final deliverable for each site. Adobe Acrobat software shall be used to convert word-processing files to searchable portable document format (PDF). Final GIS drawings shall also be provided in PDF format and shall be produced for a 600 dpi (dots per inch) minimum monochrome pdf writer printer driver; if drawings include signatures, electronically sign and seal the GIS drawings prior to converting to final PDF format. Sketches, photos, or forms not available in electronic format may be scanned for conversion to PDF format.

The entire final deliverable (both word processing documents and GIS drawings, etc.) including the Work Plan, Health and Safety Plan, Environmental Protection Plan, QA/QC Plan, Monitoring Reports, and Corrective Action Plan shall be combined into a single CD. There shall be one .pdf file for each document, letter, common file folder, or report.

Each CD shall be labeled with activity name, document title, contract number, and final document approval date.

4.4 Site Health and Safety Manager/Officer

Mr. Chris Brown will serve as the Site Health and Safety Manager/Officer. Mr. Brown has 3 years of experience in the requirements for site health and safety in relation to environmental projects.

minimum of 10 feet from the limits of sampling activities. The Site Health and Safety Officer (SHSO) will determine the perimeters of these zones based on field conditions and operational security.

5.4 Security

During the performance of work, a barrier preventing unintentional entrance of the general population into the work zone will isolate the work area at the site. The Project Manager will be responsible for establishing the barrier prior to start of work.

5.5 Ignition Sources

Two (2) 10-pound ABC fire extinguishers will be readily available on the work site. The fire extinguishers will be located no closer than 25 feet and not more than 75 feet from the work area.

Prior to performing work that might involve the release of flammable or hazardous vapors, vehicular and personnel traffic will be routed away from the immediate area. All sources of ignition, including smoking, welding, burning, or other work that might be a source of ignition, will be eliminated from the work area where flammable vapors may be present or likely to travel. This will include insuring all openings into surrounding structures are secured so as not to allow any flammable vapors to build up inside.

5.6 Personnel and Equipment Decontamination

Equipment will be decontaminated as needed before exiting the work zones. Decontamination procedures will be performed by wiping, sweeping, and/or scrubbing with water if needed to remove oil, or oily dirt, sand, and mud from coveralls, gloves, boots, tools, and equipment. Efforts will be made to minimize the use of water. Sampling equipment will be decontaminated in accordance with ADVENT work and test procedures (Appendix C).

6.0 SCOPE OF ACTIVITIES

Field Work procedures will include:

- Labor, materials, necessary permits, laboratory tests and reports.
- Groundwater sampling.
- Disposal of waste generated by the project in accordance with applicable federal, state, and local regulations.

6.1 Groundwater sampling

A total of thirty five (35) monitoring wells will be sampled and analyzed as part of the SOW. Each monitoring well will be purged using low-flow methods to establish stabilization parameters for the well.

Each of the permanent monitoring wells will be sampled unless free product is present on the groundwater surface. If free product is present and thicker than 0.01 feet, a groundwater sample will not be collected nor will dissolved oxygen measurements be collected.

IDW associated with purging and sampling of the permanent monitoring wells will be containerized in 55-gallon drums. The samples analyzed as part of the assessment process will be used for waste characterization purposes. Based on the results of the analyses, the drums and their contents will be properly disposed of.

The groundwater samples from each monitoring well will be submitted to a South Carolina certified laboratory for analysis. Industry standard quality assurance and quality control methods will be followed for shipping (sample labels, sealed sample containers, completed chain of custody forms, shipments to the laboratory on ice).

Figures

Projection: Clarke 1866 UTM Zone 17N
Map Scale: 1:18,000
Created by: JWW, 10/06/05

Figure-1
Site Location Map
Former CNC
Charleston, South Carolina

ADVENT

Legend

hospital_route

0 0.2 0.4 0.8 1.2 1.6
Miles

N
W E
S

Figure-2
Hospital Route Map
Former CNC
Charleston, South Carolina

ADVENT

Projection: NAD 1927 UTM Zone 17N
Map Scale: 1:40,000
Created by: JWW, 10/06/05

Appendix B

Environmental Protection Plan

APPENDIX B

ENVIRONMENTAL PROTECTION PLAN

1.0 INTRODUCTION

The purpose of the Environmental Protection Plan (EPP) is to outline the methods and responsibilities for protecting natural resources and the environment. To accomplish this goal, ADVENT will comply with applicable federal, state, and local environmental regulations.

1.1 References

a. 49 CFR 261.2 Protection of Environment

b. Erosion and Sediment Reduction Act of 1983

c. Storm Water Management and Sediment Reduction Act of 1991 (48-14-0, ET. Seq.)

2.5 Fish and Wildlife Resources

Fish and wildlife will not be unnecessarily disturbed. Stream flows and other significant native habitats will be protected.

2.6 Temporary Construction

Temporary construction facilities such as haul roads, work areas, structures, foundations, and stockpiles of excess or waste materials will be removed. Erosion control measures will be removed once the site has been stabilized by methods such as seeding, mulching, etc.

2.7 Wetland Areas

It is not anticipated that field work will be performed in wetland areas. ADVENT will not disturb any wetland area without authorization. Approval may be required by an affected state or local agency, or the Army Corps of Engineers.

4.0 PROTECTION OF SURFACE SOIL, VEGETATION, AND SURFACE WATERS

4.1 Ground Cover

Burn off of ground cover will not be permitted.

4.2 Erodible Soils

All earthworks will be brought to a final grade. Side slopes and back slopes will be protected immediately upon completion of rough grading. Protection against erosion will prevent any sedimentation of nearby creeks or streams.

4.3 Temporary Measures

The following methods will be used to prevent erosion and control sedimentation if significant disturbance is necessary.

4.3.1 Mechanical Retardation and Control of Runoff

Significant disturbance of the site during the activities is not anticipated. However, if significant surface disturbance occurs, the scope of work changes to require ADVENT to mechanically retard and control the rate of runoff from the site. This method includes building of diversion ditches, benches, plastic sheeting, hay bales and berms to retard and divert runoff to protected drainage courses. These erosion control measures will be maintained throughout the project to minimize environmental impact. Sound engineering and good work practices will be used to ensure the protection of the environment. During the land disturbing activity, good environmental practices utilizing non-erodible material such as silt fencing and hay bales will be installed.

5.0 POLLUTION DERIVED FROM OPERATIONS

5.1 Control and Disposal of Solid Wastes

Solid wastes will be collected, placed in containers, and regularly emptied at intervals to prevent the attraction of rodents or disease vectors. Debris and garbage will be disposed of in compliance with applicable laws and regulations.

5.2 Manage and Dispose of Hazardous Waste

Procedures and requirements for the generation, management, transportation, and disposal of hazardous waste, as defined in the Resource Conservation and Recovery Act (RCRA), are described in each site specific Work Plan.

5.3 Recycling Program

ADVENT recycles scrap metals, some batteries, fluorescent light bulbs, paper, and aluminum. ADVENT's personnel will minimize the amount of waste generated by utilizing site-specific work plans and good work practices. Containers will be located throughout the work place by the PM if deemed necessary.

7.0 DRAINS

No one will dump any foreign material into the storm drains. Prior approval is required to dump Investigation Derived Waste (IDW) into the sanitary sewage system.

Appendix A

Site Specific Health and Safety Plan

Appendix C
ADVENT Work and Test Procedures

Approved by:	LOW FLOW PURGING AND SAMPLING	SOP No.: 21
____________		Rev. 0
July 18, 2008		Page 1 of 4

SCOPE

The following SOP is to be used as a guideline for Low-Flow purging and sampling of groundwater monitoring wells. The objective of this methodology is to ensure that samples collected in a low-flow environment are collected in a manner that promotes collection of representative samples and accurate data.

EQUIPMENT

- Low-Flow Pump (capable of rates <0.5 L/min)
- In-line Water Quality Measurement Device (e.g., flow-through cell)
- Tubing, type defined in the site Quality Assurance Project Plan (QAPP), e.g., PVC, Teflon-lined, Teflon tubing, etc.
- Water level measuring device (Interface Probe/Depth to Water Gauge)
- 1 Liter Graduated Cylinder

REFERENCES

Puls, Robert W. and Barcelona, Michael J., 1996, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, Ground Water Issue (EPA/540/S-95/504), U.S. Environmental Protection Agency

PROCEDURE

Groundwater monitoring wells are purged for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of valatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clays seals or backfill, and surface infiltration.

Purging Recommendations

Low-flow purging should be done with the pump intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well could cause increased entrainment of solids which have collected in the well over time. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of reducing the potential for

Equipment Calibration

Prior to sampling, all sampling devices and monitoring equipment should be calibrated according to the manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP). **Calibration of pH should be performed with at least two buffers which bracket the expected range. DO calibration must be corrected for local barometric pressure readings and elevation.**

Water Level Measurement and Monitoring

A water level measuring device should be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity stabilization. **Measure well depth after sampling is completed.** The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

Filtration

Based on laboratory analysis methods, and parameters to be analyzed, it may be necessary to filter the sample. In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere.

Filters must be pre-rinsed following manufacturer's recommendations. **If there are no recommendations for rinsing, pass through a minimum of 1-liter of groundwater following purging, and prior to sampling.**

Sampling, Sample Containers, and Preservation

Once parameter stabilization is reached, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as previously discussed.

Water samples should be collected directly into the sample container from the pump tubing. Immediately after a sample bottle has been filled, it must be preserved as specified in the site QAPP.

APPENDIX B

RESOLUTION CONSULTANTS SOPs

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.

<u>Purging Equipment and Methods</u>

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

<u>Sampling Light, Non-Aqueous Phase Liquids (LNAPL)</u>

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).

<u>Sampling Dense, Non-Aqueous Phase Liquids (DNAPL)</u>

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.

Environmental Protection Agency, United States (EPA). 1982. *Handbook for Sampling and Sample Preservation of Water and Wastewater.* EPA-600/4-82-029. Cincinnati: EPA Office of Research and Development, Environmental Monitoring and Support Laboratory.

EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.

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

EPA. 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Method (SW-846)*. 3rd ed., Final Update IIIA. Office of Solid Waste. Online updates at: http://www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

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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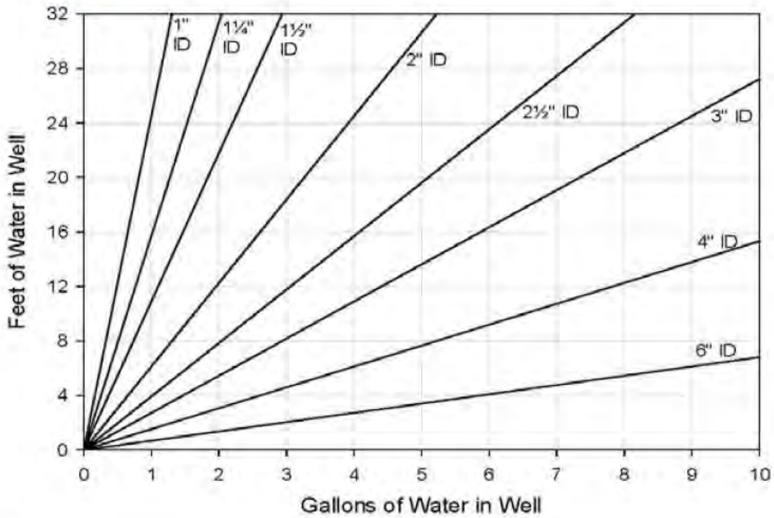
Purge Volume Computation

Well ID:



Volume / Linear Ft. of Pipe		
ID (in)	**Gallon**	**Liter**
¼	0.0025	0.0097
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 ______________

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Investigation Derived Waste Management

Procedure 3-05

1.0 Purpose and Scope

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

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

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

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

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

2.0 Safety

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

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

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

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

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

4.3 The **Field Manager** is responsible for ensuring that all IDW is managed according to this procedure.

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

5.0 Equipment and Supplies

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

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

6.0 Procedure

The following procedures are used to handle the IDW.

6.1 Drum Handling

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

6.1.2 Recycled drums should not be used for hazardous waste, PCBs or other regulated shipments. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system versus longer-term drum storage.

6.1.3 For long-term IDW storage at other project locations, the DOT approved drums with removable lids are recommended. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids.

6.1.4 If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

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

6.2 **Labelling**

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

6.2.2 For situations where the waste characteristics are known, the waste containers should be packaged and labelled in accordance with state regulations and any federal regulations that may govern the labelling of waste.

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

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

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

- Description of waste (i.e., purge water, soil cuttings);
- Generator information (i.e., name, address, contact telephone number);
- EPA identification number (supplied by on-site client representative);
- Date when the waste was first accumulated.

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

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

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

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

6.2.8 Each container of waste generated shall be recorded in the field notebook used by the person responsible for labelling the waste. After the waste is disposed of, either by transportation off-site or disposal on-site in an approved disposal area, an appropriate record shall be made in the same field notebook to document proper disposition of IDW.

6.3 **Types of Site Investigation Waste**

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

Solid Waste

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

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

Liquid Waste

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

Personal Protective Equipment

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

6.4 **Waste Accumulation On-Site**

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

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

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

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

6.5 **Waste Disposal**

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

6.5.2 All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. All wastes classified as hazardous will be disposed of at a licensed treatment storage and disposal facility or managed in other approved manners.

6.5.3 In general, waste disposal should be carefully coordinated with the facility receiving the waste. Facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements.

6.6 **Regulatory Requirements**

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

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

6.7 **Waste Transport**

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

7.0 Quality Control and Assurance

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

8.0 Records, Data Analysis, Calculations

8.1 Maintain records as required by implanting the procedures in this SOP.

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

9.0 Attachments or References

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

Department of Energy, United States (DOE). 1994. *The Off-Site Rule*. EH-231-020/0194. Office of Environmental Guidance. March.

1999. *Management of Remediation Waste under the Resource Conservation and Recovery Act (RCRA)*. Office of Environmental Policy and Assistance. 20 December.

Department of the Navy (DON). 2001. *Department of the Navy Installation Restoration Manual. 2001 Update.* Draft. Alexandria, VA: Naval Facilities Engineering Command. August.

2007. *Navy Environmental and Natural Resources Program Manual.* OPNAV Instruction 5090.1c . October.

Environmental Protection Agency, United States (EPA). 1991. *Management of Investigative-Derived Wastes During Site Inspections*. Office of Emergency and Remedial Response. EPA/540/G-91/009. May.

1992a. *Guidance for Performing Site Inspections under CERCLA*. EPA/540/R-92/021. Office of Emergency and Remedial Response. September.

1992b. *Guide to Management of Investigative-Derived Wastes*. Quick reference fact sheet. OSWER Dir. 9345.3-03FS. Office of Solid Waste and Emergency Response. January.

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

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

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

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

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

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

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

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