CDM

RAC2
EPA Region 2

Final Quality Assurance Project Plan

Tutu Wellfield Site
Long Term Response Action
St. Thomas, U.S. Virgin Island

EPA Contract No. EP-W-09-002
WA 003-RALR-021D

April 2009

CDM

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New York, New York 10038
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April 14, 2009

Ms. Caroline Kwan
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway - 20th Floor
New York, NY 10007-1866

PROJECT: RAC2 Contract No.: EP-W-09-002
Work Assignment No.: 003-RALR-021D

DOC. CONTROL NO.: 3220-003-00052

SUBJECT: Final Quality Assurance Project Plan
Long Term Response Action
Tutu Wellfield Site
St. Thomas, U.S. Virgin Islands

Dear Ms. Kwan:

CDM Federal Programs Corporation (CDM) is pleased to submit the above-referenced document for the Long Term Response Action at the Tutu Wellfield Site in St. Thomas, U.S. Virgin Islands as partial fulfillment of Subtask 5.2 of the Statement of Work.

If you have any questions regarding this submittal, please contact me at your earliest convenience at (212) 785-9123.

Very truly yours,

CDM FEDERAL PROGRAMS CORPORATION

Demetrios Klerides

Demetrios Klerides
Project Manager

PSO:

Enclosure

cc: F. Rosado, EPA Region 2
L. Mauel, EPA Region 2
W. Sy, EPA Region 2
S. Syedali, USVI DPNR
D. Klerides, CDM
E. Gallerie, CDM
J. Oxford, CDM
RAC2 Document Control

RESPONSE ACTION CONTRACT
FOR REMEDIAL RESPONSE, ENFORCEMENT OVERSIGHT,
CRITICAL REMOVAL ACTIVITIES AT SITES OF RELEASE OR
THREATENED RELEASE OF HAZARDOUS SUBSTANCES
IN EPA REGION 2

Final Quality Assurance Project Plan

Tutu Wellfield Site
Long Term Response Action
St. Thomas, U.S. Virgin Islands
Work Assignment No. 003-RALR-021D

U.S. EPA CONTRACT NO. EP-W-09-002
Document Control No.: 3220-003-00052
April 14, 2009

Prepared for:
U.S. Environmental Protection Agency
290 Broadway
New York, New York 10007-1866

Prepared by:
CDM Federal Programs Corporation
125 Maiden Lane, 5th Floor
New York, New York 10038

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FINAL QUALITY ASSURANCE PROJECT PLAN (QAPP)
for
Tutu Wellfield Superfund Site
Long Term Response Action
St. Thomas, US Virgin Islands

US Environmental Protection Agency (EPA) Region 2

Prepared by: CDM Federal Programs Corporation (CDM)
125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123

Date: April 14, 2009

CDM Project Manager: Demetrios Klerides, P.E.
Signature Demetrios Klerides

CDM QA Manager: Doug Updike
Signature Jennifer Oxford for

EPA Project Manager: Caroline Kwan
Signature Caroline Kwan

CDM RAC II Program Manager: Jeanne Litwin
Signature J Litwin

EPA Region 2 Hazardous Waste Support Section: Linda Mauel
Signature ______ for Linn

Document Control Number: 3220-003-00052

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project:	Tutu Wellfield Superfund Site Long Term Response Action
Site Location:	St. Thomas, US Virgin Islands
Operable Unit:	Not Applicable (N/A)
Contractor Name:	CDM
Contractor Number:	EP-W-09-002
Contract Title:	Response Action Contract Region 2
Work Assignment Number:	N/A
Regulatory Program:	CERCLA
Approval Entity:	EPA Region 2
Is QAPP Generic or Project Specific:	Project Specific
Dates of scoping sessions:	11/19/08 and 11/21/08

Dates and Titles of QAPP Documents Written for Previous Site Work, if Applicable:
Final Data Quality Assurance Project Plan, Tutu Wellfield Superfund Site: August 19, 2003

Organizational Partners (stakeholders) and Connection with Lead Organization:
United States Virgin Islands (USVI) Department of Planning and Natural Resources (DPNR)

Data Users:
CDM, EPA Region 2, USVI DPNR

Required QAPP elements and required information that are not applicable to the project, and an explanation for their exclusions:
N/A

QAPP Worksheet #2
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QAPP Worksheet #3
Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address
Fernando Rosado	Project Officer	EPA	(212) 637-4346	(212) 637-3966	rosado.fernando@epa.gov
Caroline Kwan-Appleman	Remedial Project Manager (RPM)	EPA	(212) 637-4275	(212) 637-3966	kwan.caroline@epa.gov
Linda Mauel	Hazardous Waste Support Section Chief	EPA	(732) 321-6766	(732) 321-4381	mauel.linda@epa.gov
William Sy	QA Officer	EPA	(732) 632-4766	(212) 637-3966	sy.william@epa.gov
Syed Syedali	Program Manager	USVI DPNR	(340) 773-1082	(340) 692-9794	syedali.syed@vidpnr-dep.org
Demetrios Klerides, PE	Site Manager	CDM	(212) 377-4535	(212) 785-6114	kleridesd@cdm.com
Ellen Gallerie, PE	Project Engineer	CDM	(212) 377-4525	(212) 785-6114	gallerieee@cdm.com
Jeniffer Oxford	Regional QA Coordinator (RQAC)/ Project QA Officer	CDM	(212) 377-4536	(212) 785-6114	oxfordjm@cdm.com
Jeanne Litwin	RAC 2 Program Manager	CDM	(212) 377-4524	(212) 785-6114	litwinj@cdm.com

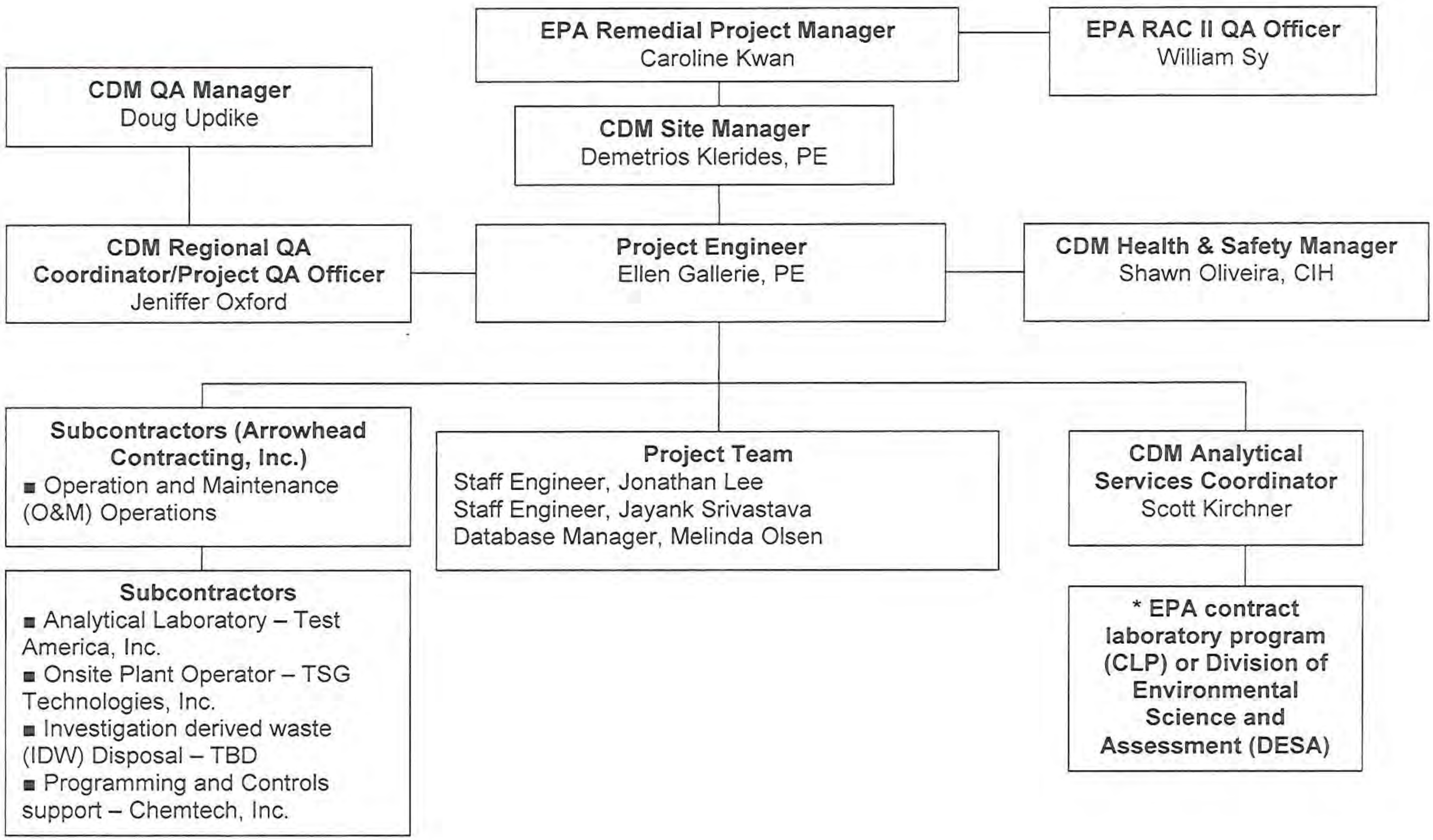
QAPP Worksheet #4

Project Personnel Sign-Off Sheet

Organization: All

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Demetrios Klerides	CDM Site Manager	(212) 377-4535		
Ellen Gallerie	CDM Project Engineer	(212) 377-4525		
Jonathan Lee	CDM Staff Engineer	(212) 377-4529		
Jayank Srivastava	CDM Staff Engineer	(212) 377-4392		
Greg Wallace	LTRA Subcontractor Project Manager	(913) 814-9997		
Chris Guenther	LTRA Subcontractor Field Technician (FT)	(340) 227-2166		
Bob Peterson	LTRA Subcontractor Operator	(340) 776-7766		

QAPP Worksheet #5
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of Contact with EPA RPM	CDM Site Manager (SM)	Demetrios Klerides	(212) 377-4535	All information about the project will be sent to Caroline Kwan by the SM. Field changes will be discussed with the EPA RPM prior to implementation.
Manage long term response action (LTRA) activities	CDM Project Engineer	Ellen Gallerie	(212) 377-4525	Act as liaison to SM concerning LTRA Activities performed by the Subcontractor.
Facilitate Database Setup and Data Management Planning	CDM Project Engineer	Ellen Gallerie	(212) 377-4525	Provide sample location, sample identification (ID), and analysis information to LTRA Subcontractor prior to sample collection. Provide information on sample and analytical reporting groups, and types of report tables required for project.
QAPP Changes in the Field	CDM Project Engineer	Ellen Gallerie	(212) 377-4525	Notified by LTRA subcontractor immediately and complete a Field Change Request (FCR) form and/or corrected worksheets. Send FCR forms to RQAC.
	LTRA Subcontractor	TBD	N/A	Notify CDM SM, Project Engineer and Analytical Services Coordinator (ASC) of delays or changes to field work.
Booking of Analytical Services	LTRA Subcontractor	TBD	N/A	Submit request to Project Engineer and/or ASC before the timeframe below.
	CDM Analytical Services Coordinator (ASC)	Scott Kirchner	(732) 225-7000	Book DESA and CLP analytical services through Regional Sample Control Center (RSCC) 3 weeks prior to sampling.
Notification of Analytical Issues	CDM ASC	Scott Kirchner	(732) 225-7000	Notify LTRA subcontractor and CDM project engineer of any sample collection/ shipment issues. Notify RSCC, DESA laboratory or subcontract labs to initiate corrective action.

QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Field Corrective Action	CDM RQAC, auditor, and Field Team	TBD	TBD	Corrective actions may also be identified by the SM, CDM project engineer or LTRA Subcontractor. LTRA Subcontractor initiates corrective action on identified field issues immediately or within RQAC recommended timeframe.
Analytical Services Support	CDM ASC	Scott Kirchner	(732) 225-7000	Act as liaison with RSCC for CLP laboratories, with John Birri for DESA.
	LTRA Subcontractor	TBD	TBD	Act as liaison with CDM for subcontract laboratory (ies).
Facilitate Data Management	LTRA Subcontractor	TBD	TBD	Provide electronic sample ID, locations and analyses of collected samples. Transmit completed sample tracking information to project engineer by the completion of each sampling case.
	CDM project engineer	Ellen Gallerie	(212) 377-4525	Provide electronic CLP sample ID, locations and analyses of collected samples to database manager for input to EQuIS.
Reporting of Issues Relating to Analytical Data Quality (including ability to meet reporting limits, and usability of data)	CDM ASC	Scott Kirchner	(732) 225-7000	Communicate to SM/CDM project engineer issues relating to sampling handling, shipment, and analysis.
	CDM Data Assessor	Scott Kirchner	(732) 225-7000	Communicate to SM as appropriate. Document situation and effect in a data quality report prepared as part of submittal of LTRA reports.
Release of Analytical Data	CDM ASC	Scott Kirchner	(732) 225-7000	Receive and review data packages before data is used. Inform project team of data receipt and status of data.
Site Health and Safety Issues	LTRA Subcontractor Site Health and Safety Officer	Scott Siegwald	N/A	Make decisions regarding health and safety issues and upgrading personal protective equipment (PPE). Communicate to PM, FT, and rest of field staff as appropriate.

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Demetrios Klerides, PE	CDM SM	CDM	Oversee project and responds to EPA RPM.	B.S. Civil Engineering, M.E. Environmental Engineering; over 23 years experience
Greg Wallace	LTRA Subcontractor Project Manager	Arrowhead Contracting, Inc.	Directing overall operation, maintenance, monitoring, and management of groundwater treatment systems	B.S. Geology, 25 years experience related to performance, supervision, and management of comparable treatment system operations
Jeniffer Oxford	CDM QA Coordinator/ Project Chemist	CDM	Oversee adherence to QA requirements	B.S., Natural Sciences; 7 years experience in analytical chemistry; 15 years experience in environmental science
Shawn Oliveira	CDM Health and Safety Manager	CDM	Oversees adherence to Health and Safety requirements	B.S. Chemistry; M.S. Environmental Engineering; Certified Safety Professional (#18988), Certified Industrial Hygienist (CIH)
Scott Kirchner	CDM ASC	CDM	Communicate with EPA RSCC, DESA laboratory; oversee data management, validation and data packages from CLP and DESA laboratories.	B.S. Chemistry, Environmental Science Certified Hazardous Materials Manager, 19 years experience
Ellen Gallerie, PE	CDM Project Engineer	CDM	Act as liaison to SM concerning LTRA Activities performed by the Subcontractor.	B.S. Civil Engineering; 8 years experience
Jonathan Lee	CDM Staff Engineer	CDM	Assist project engineer in LTRA activities	B.S. Chemical Engineering; 5 years experience
Jayank Srivastava	CDM Staff Engineer	CDM	Assist project engineer in LTRA activities	B.S. Mining Engineering, M.S. Environmental Engineering 1 year experience
Bob Peterson	LTRA Subcontractor Plant Operator	TSG (Arrowhead Subcontractor)	Directing and performing the day to day operations, maintenance, monitoring and management of groundwater treatment systems	A.A. Liberal Arts, 23 years experience in construction management, environmental remediation, aquifer storage recovery, and water resources engineering
Chris Guenther	LTRA Subcontractor FT	TSG (Arrowhead Subcontractor)	Assisting the operator in executing day to day operations, maintenance, and monitoring of treatment system and associated facilities	B.S. General Biology, Over 1 year of operations and maintenance experience for Tutu Wellfield treatment systems

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Scott Siegwald, CIH, CSP, CHMM	LTRA Subcontractor Health and Safety Officer[1]	Arrowhead Contracting, Inc.	The authority to command sufficient resources to safely perform the work	B.S. Environmental Science, M.S. Environmental Engineering, Over 15 years experience of developing and implementing safety programs for a variety of construction/environmental construction and remediation projects
TBD	LTRA Subcontractor Health and Safety Professional[1]	TBD	Responsible for evaluating hazards of the site and controls and documenting them in the site safety plan	Minimum 3 years of experience in developing safety and health programs at hazardous waste sites, CIH or certified safety professional (CSP)
TBD	LTRA Subcontractor Site Health and Safety Coordinator[1]	TBD	Responsible for day to day industrial hygiene support, including air monitoring, training and site safety inspections	Completion of training required by Occupational Safety and Health Administration (OSHA) standard 29 Code of Federal Regulations (CFR) 1910.120 paragraph (e), for supervisory personnel
Scott Meeks	LTRA Subcontractor Data Validator	Arrowhead Contracting, Inc.	Responsible for validating all laboratory data that is performed by the LTRA Subcontractor's laboratory	B.S. Chemical Engineering, 20 years experience with regulatory requirements related to remediation of hazardous waste sites.
Steve Lucas, PE	LTRA Controls Programming Support	Chemtech, Inc.	Responsible for assisting with timely diagnosis, modifications, and/or repairs to program controls for GWTFs #1 and #2	B.S. Chemical Engineering, 19 years experience in design and implementation of systems for soil and groundwater remediation, wastewater treatment design, and air, wastewater, and stormwater discharge permitting.
Bryant Kroutch, PE	Quality Control Manager	Arrowhead Contracting, Inc.	Responsible for overall implementation of the LTRA Subcontractor's QC program	B.S. Petroleum Engineering, 22 years experience QA/QC manager experience.

Note:
1. An individual can fill as many roles as he or she is qualified.

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
All Field Activities	40-hour OSHA Training and Annual 8 hour refresher	40 hour - EPA or vendor	various	All CDM and LTRA subcontractor personnel that will be onsite	CDM staff, subcontractors	CDM Health and Safety (H&S) database, CDM project files and on site or LTRA Subcontractor office, as appropriate
All Field Activities	Site Supervisor Training	H&S Manager	various	Site H&S officer	Site H&S officer	CDM H&S database, CDM project files and on site or LTRA Subcontractor office, as appropriate
Sample Collection	Trained in EPA CERCLA sampling methods, and field testing procedures	On-site training	various	All personnel that performs sample collection	All personnel that performs sample collection	CDM and Onsite
Sample Analysis	Trained in EPA analytical methods	Laboratory and vendor training	various	Subcontract laboratory personnel - TBD	Laboratory personnel	Laboratory
Data Validation	Data validation RAS and non-RAS data	EPA and/or subcontractor training	various	Data validators	EPA/LTRA Subcontractor Data Validators	EPA /CDM/LTRA Subcontractor office
Data Review/ Assessment	None, performed by experienced chemists	N/A	various	CDM chemists	All personnel used for project data review	EPA /CDM/LTRA Subcontractor office
QA Audits	EPA G-7 auditor training	CDM	various	CDM auditors	Jeniffer Oxford, RQAC and designated field auditors	CDM

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Self Assessments (SA)	SA training	CDM Quality Assurance Coordinators (QACs)	various	project personnel	project personnel	CDM
Operation and Maintenance	Minimum 5 years experience related to performance, supervision, and management of comparable treatment system operations	N/A	various	N/A	LTRA Subcontractor Project Manager	CDM
Operation and Maintenance	Minimum 5 years of operation and maintenance experience for comparable treatment systems	N/A	various	N/A	LTRA Subcontractor Operator	CDM
Operation and Maintenance	Minimum 1 year of operations and maintenance experience for comparable treatment systems	N/A	various	N/A	LTRA Subcontractor Field Technician	CDM

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Projected Date(s) of Sampling: 1/6/08 – 4/30/14 **Project Manager:** Demetrios Klerides	**Site Name:** Tutu Wellfield Superfund Site **Site Location:** St. Thomas, USVI

Date of Session: 11/19/08
Scoping Session Purpose: Discuss submitted LTRA work plan letter

Name	Affiliation	Phone #	E-mail Address	Project Role
Demetrios Klerides	CDM	(212) 377-4535	kleridesd@cdm.com	Site Manager
Jeanne Litwin	CDM	(212) 377-4524	litwinj@cdm.com	RAC II Program Manager
Fernando Rosado	EPA	(212) 637-4346	rosado.fernando@epa.gov	Project Officer
Deborah Butler	EPA	(212) 637-3367	butler.deborah@epa.gov	Contracting Officer
Caroline Kwan-Appleman	EPA	(212) 637-4275	kwan.caroline@epa.gov	Remedial Project Manager

Comments/Decisions: none

Action Items:

- EPA to approve the submitted LTRA work plan letter
- CDM to submit draft QAPP by the end of the contract

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Projected Date(s) of Sampling: 1/6/08 – 4/30/14 **Project Manager:** Demetrios Klerides	**Site Name:** Tutu Wellfield Superfund Site **Site Location:** St. Thomas, USVI

Date of Session: 11/21/08
Scoping Session Purpose: Discuss field and analytical services teaming advisory committee (FASTAC) policy

Name	Affiliation	Phone #	E-mail Address	Project Role
Demetrios Klerides	CDM	(212) 377-4535	kleridesd@cdm.com	Site Manager
Caroline Kwan-Appleman	EPA	(212) 637-4275	kwan.caroline@epa.gov	Remedial Project Manager

Comments/Decisions:

The influent and effluent water samples and effluent air samples collected as part of the treatment facility operation, maintenance, and monitoring will be analyzed by the LTRA Subcontractor's subcontract laboratory. Scheduling the process monitoring sampling through the FASTAC process would require a significant effort because the process sampling is on-going and is performed on a weekly basis. In addition, using a subcontract laboratory allows the plant operator greater flexibility in performing the sampling/O&M activities for the week to account for unexpected plant shutdowns due to equipment failure or other plant alarms including severe weather or power outages that frequently occur in the Virgin Islands.

The FASTAC policy will be utilized for samples collected during annual sampling events.

Action Items:

CDM will submit an Analytical Request Form requesting that the process sampling be performed by the LTRA Subcontractor's subcontract laboratory.

QAPP Worksheet #10
Problem Definition

Introduction
CDM Federal Programs Corporation (CDM) has been tasked to perform LTRA activities under the Response Action Contract (RAC) 2 for the EPA, Region 2 at the Tutu Wellfield Superfund Site (the site) located in St. Thomas, Virgin Islands. The purpose of this work assignment is to continue the ongoing LTRA activities in accordance with the specifications and general technical provisions of the Record of Decision (ROD) (EPA 1996).

Problem Summary
A Remedial Investigation/Feasibility Study (RI/FS) (G&M 1995, 1995a), a ROD (EPA 1996), a Remedial Design (CDM 2002), Remedial Action (RA) construction (CDM 2004) and approximately five years of facility operations and site wide monitoring (CDM 2004a, 2005, 2005a, 2005b, 2006, 2006a, 2006b, 2006c, 2006d, 2007, 2007a, 2007b, 2008) have been completed for the Tutu Wellfield Superfund Site. The ROD identified soil and groundwater contaminated with VOCs including chlorinated solvents, benzene, toluene, ethylbenzene, and xylene. The ROD indicated that these contaminants pose unacceptable human health and/or ecological risks or exceed regulatory standards and therefore must be remediated.

Site Description
The information below briefly summarizes the characteristics of the site as it relates to the LTRA activities. Further information on the physical characteristics of the site, local demographics, site history, and nature and extent of contamination is provided in the following documents:

- Draft Final Remedial Investigation/Feasibility Study Report (G&M 1995, 1995a)
- Final (100%) Remedial Design Curriculum Center SVE System (CDM 2001)
- Final Remedial Design for Site-wide Groundwater (CDM 2002)
- Final Interim Remedial Action Report (CDM 2004)
- Remedial Action Progress Reports (CDM 2004a, 2005, 2005a, 2005b, 2006, 2006a, 2006b, 2006c, 2006d, 2007, 2007a, 2007b, 2008)

The Tutu Wellfield site is located on the eastern end of St. Thomas, U.S. Virgin Islands, in the Anna's Retreat section. The site is situated within the upper Turpentine Run surface drainage basin. This basin, which covers approximately 2.3 square miles, trends roughly north-south and is bounded by the steep slopes of the surrounding hills. The site contains a variety of commercial establishments, schools, churches, and residential units. According to the 1990 U.S. Census Bureau data, approximately 20 percent of the island's population lives in the Anna's Retreat section of the island. The site location is provided on Figure 1.

Site History
Investigation work began at the Tutu Wellfield Site in 1987 in response to complaints from local residents of an odor emanating from their groundwater supply wells. Subsequent groundwater sampling by the EPA Technical Assistance Team revealed the presence of chlorinated volatile organic compounds (CVOCs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) contaminants in the groundwater above Federal maximum contaminant levels (MCLs) for drinking water supply. EPA closed the contaminated supply wells, made arrangements to provide an alternate drinking water supply to the affected residents, and initiated investigations to identify the sources of the contamination.

A Hazard Ranking System package was prepared, and the site was proposed for addition to the National Priorities List (NPL) in February 1992. RI/FS activities were completed at the site by the Tutu Environmental Investigation Committee from 1992 to 1995. The Tutu Wellfield site was added to the NPL on September 29, 1995. The results of the remedial investigations identified four sources of CVOCs and/or BTEX. The four

QAPP Worksheet #10
Problem Definition

sources were located at the Curriculum Center, Texaco Service Station, Esso Service Station, and O'Henry Dry Cleaners and created a northern contamination plume and a southern contamination plume. The source locations and CVOC plumes are shown on Figure 2.

The Northern Plume originates at the Curriculum Center property, which is located near the intersection of Routes 38 and 384 within the upper northeast reaches of the Turpentine Run Basin Aquifer. The Curriculum Center building and property were previously occupied from 1971 to 1978 by LAGA Industries, Ltd (LAGA), a textile manufacturing business. The plant included an industrial size dry cleaning process that utilized tetrachloroethene (PCE) as the dry cleaning solvent. Spent PCE and cooker residue were routinely disposed of at an outdoor pit north of the building. The Northern Plume (>10 micrograms per liter [µg/l] CVOCs) extends site-wide to the lower reaches of the Tutu Valley and is historically believed to have co-mingled with the Southern Plume. Based upon the measured and observed convergent nature of groundwater flow within the Tutu valley, lateral dispersion of contaminants in this zone appears to be limited to a narrow strip along controlling faults and fractures. Vertically, the hydrogeology and contaminant distribution near the Curriculum Center can broadly be subdivided into two zones:

- An upper, more productive zone, extending from the water table (15 to 30 feet below ground surface [bgs]) to a depth of approximately 80 feet
- A lower, less productive zone, extending from approximately 80 to 140 feet bgs

Contaminant transport is believed to be controlled by advection, with a discrete plume (>1,000 µg/l CVOCs) extending from north of the Curriculum Center to just north of the Texaco service station (approximately 500 feet). The Northern Plume is also co-mingled with BTEX plumes that originate from the Texaco and Esso Service Stations.

The Southern Plume originates near O'Henry. Around the O'Henry facility, there is a noticeable and measurable change in regional groundwater flow direction, from south to southeast. This change is believed to be controlled by regional fault and fracture zones along Turpentine Run, which "channel" groundwater flow toward the lower reaches of Turpentine Run and ultimately the Mangrove Lagoon. The Southern Plume CVOC contamination therefore travels within a relatively narrow zone along the southeast-northwest trending Turpentine Run.

It is estimated that the productive zone in this area of the aquifer extends from approximately 25 to 80 feet bgs. Historic pumping of private supply wells in this area, including the Eglin I, II, and III (commercial), Harthman (residential/commercial), Harvey (residential), and Steele (residential) wells, facilitated the spreading of dissolved-phase CVOCs from O'Henry.

A review of the most recent groundwater data indicates that groundwater CVOC concentrations are decreasing in the Southern Plume area, excluding a localized area proximal to the Steele well.

The ROD for the site was signed on August 5, 1996. The ROD, issued by EPA, specified the following major remedial activities to address soil and groundwater contamination at the Tutu Wellfield site:

- Installation of groundwater recovery wells to hydraulically control and remediate the CVOC/BTEX source areas and plumes exceeding Federal MCLs for drinking water.
- Natural attenuation of low concentration CVOC contaminants (<100 µg/l total CVOCs) at the plume fringe areas.

QAPP Worksheet #10
Problem Definition

- A soil remedy to address multiple locations containing unsaturated zone BTEX/CVOC source materials using a combination of *in-situ* soil vapor extraction (SVE), excavation and *ex-situ* SVE, and/or onsite or offsite disposal.

EPA issued separate Unilateral Administrative Orders (UAOs) to Texaco and Esso in May 1998 and to O'Henry in May 1999. Texaco completed construction and initiation operation of an on-site SVE and groundwater treatment system (Texaco plant) and a downgradient groundwater treatment system (Vitelco plant) in early 1998. After conducting a pulsing period, the SVE and groundwater treatment system at the Texaco plant were shut down in July 2003. Monitored natural attenuation (MNA) activites have been conducted at the Texaco site since system shut down and remain on-going. In January 2007, an enhanced bioremediation application was conducted at the site to further reduce the source area groundwater concentrations.

O'Henry completed a removal action in March 1995 to address CVOC contaminated soils. O'Henry completed a pre-design investigation of the unsaturated zone soils and fractured bedrock in November 2000. The results of the pre-design investigation did not identify the presence of unsaturated source materials exceeding the ROD cleanup goals/objectives. O'Henry's investigation report and corresponding No Further Action recommendation were approved by EPA in July 2001.

Esso groundwater and soil treatment system construction was completed in February 1999, and the systems were operated from April 1999 to November 2001 and from June 1999 to August 2001, respectively. Esso completed soil excavation/source removal activities from November 2001 to April 2002. Operation of a groundwater "hot-spot" remediation system was conducted from October 2002 to April 2005. MNA activities have been conducted at the site since May 2005 and remain on-going.

EPA funded remediation of the Curriculum Center soil and site-wide groundwater remedies under the EPA Response Action Contract in September 2003. Site construction was completed in March 2004 and LTRA activities remain on-going. As part of the site construction, two groundwater treatment facilities (GWTF#1 and GWTF#2) and a SVE system were constructed.

GWTF #1 was constructed to achieve hydraulic control and remove contaminant mass from the saturated-zone source of CVOC groundwater contamination. The treatment system consists of three groundwater extraction wells, an equalization tank and transfer pumping system, bag filters, a low-profile air stripper and an offgas treatment system (granular activated carbon [GAC] adsorption followed by potassium permanganate [PP] oxidation). Chemical feed systems were also included for sequesterant/biocide injection and pH adjustment. RW-7 and RW-9 were screened across the shallow, productive portion of the aquifer from 30 to 80 feet bgs and 40 to 60 feet bgs, respectively, where contaminants are lower in concentration and most mobile. RW-6 is screened across a non-productive portion of the aquifer from 80 to 130 feet bgs, where contaminants are highest in concentration and least mobile. The facility discharges to the Territorial Pollutant Discharge Elimination System (TPDES) outfall located approximately 300 feet west of the treatment facility at a storm sewer system inlet. The location of facility #1 is shown on Figure 2.

GWTF#2 was constructed downgradient of the Northern Plume to achieve hydraulic control and remove contaminant mass. The treatment system, located near the Grace Gospel Church property, consists of two groundwater extraction wells, an equalization tank and transfer pumping system, bag filters, a low-profile air stripper. Chemical feed systems were also included for sequesterant/biocide injection and pH adjustment. RW-1 is

QAPP Worksheet #10
Problem Definition

screened from 150 to 200 feet bgs and RW-1S and is screened across the shallower, more productive zone from 60 to 120 feet bgs. The TPDES outfall is located approximately 150 feet southwest of the treatment facility at a storm sewer system inlet. The location of facility #2 is shown on Figure 2.

An SVE system was constructed at the Curriculum Center to remediate the unsaturated zone source of the CVOC groundwater contamination. The system includes two SVE wells (SVE-1 and SVE-7), a moisture knockout tank, and a blower and utilized the same offgas treatment system as the groundwater treatment system. The location of SVE-7 coincides with RW-7, which was constructed as a dual-phase extraction well.

Due to a significant decrease in SVE influent concentrations since system startup and achievement of asymtotic conditions, the SVE system was shutdown in April 2006. A pulsing period was initiated prior to system shutdown to confirm that the CVOC soil vapor concentrations would not significantly rebound after initial shutdown. The offgas system was also shutdown in April 2006 because it was no longer required to meet the air discharge criteria.

The ongoing LTRA activities are described in the project objectives described below.

Project Description

The objective of the LTRA activities is to collect sufficient analytical data and field measurements to ensure proper operation and maintenance of the groundwater treatment system and compliance, and to monitor remedial progress. This QAPP pertains to activities performed as part of the LTRA site-wide groundwater remedy.

The following major activities will be performed in support of the project objectives:

- Operation of all equipment, systems, processes and appurtenances in accordance with the site documents and manufacturers specifications.
- Routine inspection and maintenance of all interior and exterior facilities, including all processes, equipment, controls, appurtenances, fencing, locks, vegetation, touch-up painting, well vault leaks, structural support systems, and building openings and access ways.
- Environmental sampling and monitoring to confirm achievement of remedial system performance requirements, confirm compliance with the USVI DPNR TPDES permit equivalency and Air Pollution Control permit equivalency, and obtain data for assessing remedial action (RA) progress and support decisions regarding treatment system operation and optimization.

Project Decision Conditions

- If results from the groundwater and facility monitoring meet the project data requirements defined in this QAPP, then the treatment system will continue to operate in accordance with the O&M manual (Arrowhead 2004).
- If there is a permit exceedance, the facility will shut down until the problem is remediated and the appropriate authorities are notified.
- Remedial progress will be reviewed on an annual basis and facility operation changes will be performed as required.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

Who Will Use the Data?
EPA, USVI DPNR, and CDM will use the data.

What Will the Data be Used For?
- To confirm achievement of remedial system performance requirements, as specified in the RA subcontract documents (i.e., specifications, drawings, approved RA Subcontractor submittals)
- To confirm compliance with the USVI DPNR TPDES permit equivalency and Air Pollution Control permit equivalency
- To obtain data for assessing RA progress and support decisions regarding treatment system O&M and optimization

What Type of Data is Needed?
The sampling program will include the following:
- Groundwater Monitoring Well Sampling – Trace VOCs (groundwater), field parameters - turbidity, temperature, Eh (oxidation-reduction potential), pH, dissolved oxygen (DO), and specific conductance; MNA parameters (ethane, ethene, nitrate, sulfate, chloride, at the southern plume wells only)
- Groundwater Treatment Facilities Sampling – TO-14a (air discharge stack), Trace VOCs (facility extraction wells, influent and effluent), Total suspended solids (TSS) (facility effluent), Total organic carbon (TOC) (facility effluent)
- Continuous Water Level Measurements - Continuous water levels from the extraction wells and six site monitoring wells
- Synoptic Water Level Measurements – Monthly elevations of groundwater table from site wide monitoring wells

How "good" do the data need to be in order to support the environmental decision?
The project-specific action limits and quantification limits for each sampled media are specified on Worksheet #15 for all contaminants of concern (COCs).The data will be used in order to meet permit discharge criteria and monitor remedial progress and facility operations. The LTRA Subcontractor will provide analytical services for all groundwater treatment facility process samples and for annual groundwater sampling event samples that are not accepted by laboratories associated with DESA, CLP or region specific analytical services contract laboratories. The subcontractor will comply with EPA's FASTAC policy for obtaining laboratory resources for the groundwater monitoring events. Data must meet the data quality objectives (DQOs) that have been specified for the site.

Where, when, and how should the data be collected?
The project schedule is presented in Worksheet #16. Site wide annual groundwater sampling will be collected once per year at the wells specified in Table 3 and shown on Figure 2. Sampling from monitoring wells will be collected in accordance with Appendix A. Process samples will be routinely collected for operation monitoring and permit compliance. The process samples will be sampled in accordance with Table 2 and the locations are provided on Figures 3 and 4. Worksheet #17 presents the sampling program design and rationale. Worksheet #18 presents the sampling locations and methods. Worksheet #21 provides the SOPs that govern the various types of sampling.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

Who will collect and generate the data?
LTRA Subcontractors will collect samples and field measurements during groundwater and facility monitoring. Analytical samples will be shipped to DESA, CLP, and/or subcontract labs for analysis. The subcontractor will properly sample and dispose of IDW.

How will the data be reported?
The LTRA Subcontractor will be responsible for data validation of all samples analyzed at the Subcontractor's laboratory. Samples analyzed by CLP, DESA, or specific analytical services contract laboratories will be validated by a contractor of the EPA. CLP and subcontract validated analytical data will be forwarded to CDM for evaluation and use in the RA progress reports. CDM will forward CLP validated analytical data to the subcontractor for use in the monthly O&M reports. Analytical data will be received in electronic and hard copy. Following completion of all laboratory analysis and data validation the data will be reported in the RA reports prepared by CDM. Analytical data will be uploaded to Environmental Quality Information Systems (EQuIS) version 5.3.2. The database query and reporting tools will be used to create databases as specified by the project team. The reports will be submitted to EPA for review. CDM will use Geographic Information Systems (GIS) and other graphics software to facilitate spatial analysis of data and to generate figures for reports and presentations.

How will the data be archived?
- Preliminary data (Form 1s) will be faxed or e-mailed to CDM within the specified turnaround time
- Data from subcontract laboratories will be received in electronic format specified in the contract and validated by subcontractor personnel
- Final CLP and subcontracted validated data will be submitted to CDM and the subcontractor in electronic format and hard copy consistent with CLP deliverables
- Electronic data will be input into the project's EQuIS database
- EPA will archive CLP laboratory raw data in its document control system.
- Hard copies of field data including field logs will be archived in the project files
- Hard copies of analytical data received by CDM will be archived in the project files for 10 years after contract expiration

QAPP Worksheet #12a
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TCL VOCs (Trace)
Concentration Level	Low

Sampling Procedure	Analytical Method	Data Quality Indicators (DQIs)	Measurement Performance Criteria[1] (MPC)	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Project-specific Low Flow SOP for Groundwater (App. A). For supply wells see worksheet #17e	SOM01.2 trace water	Precision	RPD ≤ 50%[2] ABS ≤ 5xCRQL	Field Duplicates[3]	S&A
		Accuracy/Bias	28-155%[6]	Deuterated monitoring compounds (DMC)	A
		Accuracy	4 ± 6 degrees Celsius[5]	Temperature Blank	S
		Sensitivity	≤ CRQLs[4]	Method Blank	A
		Completeness	≥ 90%	Data assessment	S&A
		Comparability	Similar Units (µg/L) Detection Limits meet project quantitation limit goals (PQLGs)[4]	Data Review - Compare results from each round	S&A

1. Analytical criteria are outlined in the CLP statements of work (SOWs). If a subcontract laboratory is utilized, analytical criteria will be outlined in the laboratory SOWS and SOPs.
2. RPDs (relative percent differences) will be calculated for all detected results. The absolute difference (ABS) will be calculated for results failing the RPD and where one result is detected and one is non-detect or results fall below the CRQL. The ABS will be compared to 5 times the CRQL.
3. Only the field duplicate results will be affected by data validation or data assessment actions resulting from failure to achieve these measurement performance criteria (MPCs).
4. See Worksheet #15a for sensitivity requirements and CRQL values.
5. See Worksheet #28a
6. MPC accuracy/bias values vary and more complete ranges are compound specific

QAPP Worksheet #12b
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Chloride, Nitrate, and Sulfate
Concentration Level	Low

Sampling Procedure	Analytical Method	Data Quality Indicators (DQIs)	Measurement Performance Criteria[1]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Project-specific Low Flow SOP for Groundwater (App. A). For supply wells see worksheet #17 e	Chloride EPA 325.2 Nitrate EPA 300.0/353.2 Sulfate EPA 375.4	Precision	RPD ≤ 50%[2] ABS ≤ 5xQL	Field Duplicates[3]	S&A
		Precision	RPD ≤ 20%	Analytical Replicates/ Duplicates[4]	A
		Accuracy/Bias	80-120%	LCS	S
		Accuracy	4 ± 6 degrees Celsius[6]	Temperature Blank	S
		Sensitivity	≤ QLs[5]	Method Blank	A
		Completeness	≥ 90%	Data Assessment	S&A
		Comparability	Similar Units (μg/L) Detection Limits meet PQGLs[5]	Data Review - Compare results from each round	S&A

1. Analytical criteria are outlined in the DESA SOPs and CLP statements of work (SOWs). If a subcontract laboratory is utilized, analytical criteria will be outlined in the laboratory SOWS and SOPs.
2. RPDs (relative percent differences) will be calculated for all detected results. The absolute difference (ABS) will be calculated for results failing the RPD and where one result is detected and one is non-detect or results fall below the CRQL. The ABS will be compared to 5 times the CRQL.
3. Only the field duplicate results will be affected by data validation or data assessment actions resulting from failure to achieve these MPCs.
4. Precision will be determined from the laboratory duplicate results.
5. See Worksheet #15b for sensitivity requirements and QL values.
6. See Worksheet #28b

QAPP Worksheet #12c
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TOC
Concentration Level	Low

Sampling Procedure	Analytical Method	Data Quality Indicators (DQIs)	Measurement Performance Criteria[1]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Project-specific Low Flow SOP for Groundwater (App. A). For supply wells see worksheet #17e	TOC EPA 415.1	Precision	RPD ≤ 50%[2] ABS ≤ 5xQL	Field Duplicates[3]	S&A
		Precision	RPD ≤ 20%	Analytical Replicates/Duplicates[4]	A
		Accuracy/Bias	80-120%	LCS	S
		Accuracy	4 ± 6 degrees Celsius[6]	Temperature Blank	S
		Sensitivity	≤ QLs[5]	Method Blank	A
		Completeness	≤ 90%	Data assessment	S&A
		Comparability	Similar Units (µg/L) Detection Limits meet PQGLs[5]	Data Review - Compare results from each round	S&A

1. Analytical criteria are outlined in the DESA SOPs and CLP statements of work (SOWs). If a subcontract laboratory is utilized, analytical criteria will be outlined in the laboratory SOWS and SOPs.
2. RPDs (relative percent differences) will be calculated for all detected results. The absolute difference (ABS) will be calculated for results failing the RPD and where one result is detected and one is non-detect or results fall below the CRQL. The ABS will be compared to 5 times the QL.
3. Only the field duplicate results will be affected by data validation or data assessment actions resulting from failure to achieve these MPCs.
4. Precision will be determined from the laboratory duplicate results.
5. See Worksheet #15b for sensitivity requirements and QL values.
6. See Worksheet #28c

QAPP Worksheet #12d
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TSS
Concentration Level	Low

Sampling Procedure	Analytical Method	Data Quality Indicators (DQIs)	Measurement Performance Criteria[1]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Project-specific Low Flow SOP for Groundwater (App. A). For supply wells see worksheet #17e	TSS - EPA 160.2	Precision	RPD ≤ 50%[2] ABS ≤ 5xQL	Field Duplicates[3]	S&A
		Precision	RPD ≤ 20%	Analytical Replicates/ Duplicates[4]	A
		Accuracy/Bias	80-120%	LCS	S
		Accuracy	4 ± 6 degrees Celsius[6]	Temperature Blank	S
		Sensitivity	≤ QLs[5]	Method Blank	A
		Completeness	≤ 90%	Data Assessment	S&A
		Comparability	Similar Units (mg/L) Detection Limits meet PQGLs[5]	Data Review - Compare results from each round	S&A

1. Analytical criteria are outlined in the DESA SOPs and CLP statements of work (SOWs). If a subcontract laboratory is utilized, analytical criteria will be outlined in the laboratory SOWS and SOPs.
2. RPDs (relative percent differences) will be calculated for all detected results. The absolute difference (ABS) will be calculated for results failing the RPD and where one result is detected and one is non-detect or results fall below the QL. The ABS will be compared to 5 times the QL.
3. Only the field duplicate results will be affected by data validation or data assessment actions resulting from failure to achieve these MPCs.
4. Precision will be determined from the laboratory duplicate results.
5. See Worksheet #15b for sensitivity requirements and QL values.
6. See Worksheet #28d

QAPP Worksheet #12e
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Ethane and Ethene
Concentration Level	Low

Sampling Procedure	Analytical Method	Data Quality Indicators (DQIs)	Measurement Performance Criteria[1]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Project-specific Low Flow SOP for Groundwater (App. A). For supply wells see worksheet #17e	Ethane and Ethene EPA RSK 175	Precision	RPD ≤ 50%[2] ABS ≤ 5xQL	Field Duplicates[3]	S&A
		Precision	RPD ≤ 20%	Analytical Replicates and Duplicates[4]	A
		Accuracy/Bias	50-150%	LCS	S
		Accuracy	4 ± 6 degrees Celsius[6]	Temperature Blank	S
		Sensitivity	≤ QLs[5]	Method Blank	A
		Completeness	≥ 90%	Data assessment	S&A
		Comparability	Similar Units (mg/L) Detection Limits meet PQGLs[5]	Data Review - Compare results from each round	S&A

1. Analytical criteria are outlined in the DESA SOPs and CLP statements of work (SOWs). If a subcontract laboratory is utilized, analytical criteria will be outlined in the laboratory SOWS and SOPs.
2. RPDs (relative percent differences) will be calculated for all detected results. The absolute difference (ABS) will be calculated for results failing the RPD and where one result is detected and one is non-detect or results fall below the QL. The ABS will be compared to 5 times the QL.
3. Only the field duplicate results will be affected by data validation or data assessment actions resulting from failure to achieve these MPCs.
4. Precision will be determined from the laboratory duplicate results.
5. See Worksheet #15b for sensitivity requirements and QL values.
6. See Worksheet #28e
LCS = Laboratory Control Samples

QAPP Worksheet #12f
Measurement Performance Criteria Table

Matrix	Air
Analytical Group	VOCs
Concentration Level	Low

Sampling Procedure	**Analytical Method**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**[1]	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Air Test Samples	TO-14A	Precision	RPD ≤ 50%[2]	Field Duplicates[3]	S&A
		Accuracy/Bias	90-110%	Audit Standard	A
		Accuracy/Bias	65-135%	Laboratory Control Sample	S
		Sensitivity	≤ QLs[5]	Method Blank	A
		Completeness	≤ 90%	Data assessment	S&A
		Comparability	Similar Units (ppbv) Detection Limits meet PQGLs[5]	Data Review - Compare results from each round	S&A

1. Analytical criteria are outlined in the EPA Headquarters Air Contract statements of work (SOWs). If a CDM subcontract laboratory is utilized, analytical criteria will be outlined in the laboratory SOWS and SOPs.
2. RPDs (relative percent differences) will be calculated for all detected results.
3. Only the field duplicate results will be affected by data validation or data assessment actions resulting from failure to achieve these MPCs.
4. Precision will be determined from the analytical replicate or duplicate results.
5. See Worksheet #15c for sensitivity requirements and QL values.

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	Data Source (Originating Organization, Report Title, and Date)	How Data Will Be Used	Limitations on Data Use
Data Collected during remedial investigation	RI performed by Geraghty and Miller on behalf of the Tutu Environmental Investigation Committee from 1992 to 1995	Remedial Investigation Report	Data was used for determination of potential source areas and range of groundwater plume. Data used for determining effectiveness of treatments	None – data have been validated.
Data Collected during pre-design investigation	Pre-Design Investigation performed by CDM on behalf of EPA, 1998 to 1999	Final Pre-Design Report	Data was used to define soil and groundwater contamination and to collect hydrologic and geologic information Data used for determining effectiveness of treatments	None – data have been validated.
Data Collected during remedial action and Operation and Function Period	RA performed under guidance of EPA Removal Branch, 2003 to 2005	Remedial Action Report	Data was used for monitoring site soil and groundwater contamination. Data used for determining effectiveness of remedy and monitoring facility operations	None – data have been validated.
Data collected during multiple long-term response actions	Long-term Response Action, 2005 to present	CDM on behalf of EPA	Data was used for monitoring site soil and groundwater contamination. Data used for determining effectiveness of remedy and monitoring facility operations	For data collected by CDM for VOC analyses, only COC have been validated. Includes PCE, trichloroethene, cis-1,2-dichloroethene, vinyl chloride, benzene, toluene, ethylbenzene, o-xylene, and mp-xlyene.
	Long-term Response action, 1999 to present	Forensic Environmental Services on behalf of Esso Service Station		
	Long-term Response action, 1998 to present	Mactec Engineering & Consulting on behalf of Texaco Service Station		

QAPP Worksheet #14
Summary of Project Tasks

Operation and Maintenance Tasks:
The LTRA Subcontractor, under direction of CDM, will perform operation, monitoring, and maintenance activities of the groundwater treatment facilities and will properly dispose of all generated waste from the facilities. This shall include daily manual readings from flow meters, temperature gauges, pressure gauges, pH meters and all other pertinent data collection activities to ensure the proper operation of the groundwater treatment facilities. The subcontractors will provide all labor, equipment, materials, replacement parts, and incidentals required to perform routine O&M of groundwater treatment systems and to perform non-routine maintenance/replacement of defective equipment and installations. The subcontractor shall operate the groundwater treatment systems at greater than 95 percent up time per quarter, including the time required for routine O&M, and excluding downtime due to conditions beyond the Subcontractor's control such as power outages or weather. Continuous operation data will also be collected using the programmable logic control (PLC). A monthly O&M report will be prepared by the LTRA Subcontractor to be submitted to CDM. The report will be submitted within 60 days of the closing date for the reporting period. The subcontractor shall perform all general maintenance of the site grounds.

Sampling Tasks: Sampling tasks performed by the subcontractor are summarized below:
Groundwater
Site-wide annual groundwater monitoring samples will be collected once per year using the low flow groundwater purging and sampling method as described in Appendix A. Samples will be collected with a Grundfos Redi-flo 2 pump in accordance with Table 3. All groundwater well samples will be analyzed for trace VOCs. Only COC VOCs are required to be analyzed. The compounds for which analysis is required are tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, vinyl chloride, benzene, toluene, ethylbenzene, o-xylene, and m/p-xlyene. Additionally, samples at 5 wells (Delegard, Laplace, RD-3, Smith, and Steele) will be analyzed for chloride, sulfate, nitrate, TOC, ethane and ethene. Trip blanks will be collected for each cooler of shipment and analyzed for VOCs and ethane/ethene. Field rinsate blanks will be collected each day of contamination and analyzed for VOCs. Field duplicates will be sampled at a rate of 1 per 20 samples per event for all analyses. The well locations are shown on Figure 2.

Process Water
Sampling for laboratory analysis will be performed once per week from the effluent lines for TOC and TSS and once per month for VOCs of facility extraction wells, influent line and effluent line for permit compliance and process monitoring. Only COC VOCs are required to be analyzed. The compounds for which analysis is required are tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, vinyl chloride, benzene, toluene, ethylbenzene, o-xylene, and m/p-xlyene. The schedule is provided in Table 2 and the locations are shown in Figures 3 and 4.
- TOC and TSS: 2 locations (GW1-EFF, GW2-EFF), weekly
- Trace VOCs: 7 locations (GW1-INF, GW1-EFF, GW2-INF, GW2-EFF, RW-9, RW-7, RW-6), monthly

Air
Groundwater Treatment Facility Offgas Samples will be collected once per month for VOCs for permit compliance. Only COC VOCs are required to be analyzed. The compounds for which analysis is required are tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, vinyl chloride, benzene, toluene, ethylbenzene, o-xylene, and m/p-xlyene.
- 1 location, monthly
- 12 samples per location per year

QAPP Worksheet #14
Summary of Project Tasks

Continuous Water Level Measurements
Continuous water level monitoring will be conducted to monitor site-wide groundwater conditions. Continuous water level measurements will be monitored at six monitoring wells (DW-2, MW-3, MW-16, MW-21D, RD-11, and RD-14) and four extraction wells (RW-1, RW-1S, RW-7, and RW-9)(Figure 2) using continuous level transducers. Further description provided in Worksheet #17c.

Synoptic Water Level Measurements
Groundwater levels will be used to monitor site-wide groundwater elevations. Synoptic water level elevation measurements will be collected monthly from the wells as shown in Table 3. Further description provided in Worksheet #17d.

Quality Control Tasks:
Groundwater Sampling:
Groundwater will have the following QC samples analyzed: field duplicates, trip blanks, field rinsate blanks, and temperature blanks, where required.

Process Sampling:
Water sampling will have the following QC samples analyzed: field duplicates, trip blanks, and temperature blanks, where required.

Air sampling will have the following QC samples analyzed: field duplicates

A summary of quality control samples is provided in Worksheet #20.

Secondary Data:
Secondary data listed in Worksheet #13 will be reviewed and used to plan sample locations, but will not be added to the project database.

Data Management Tasks:
Analytical data will be imported into the EQuIS database after validation. Field measurements will also be added to the database.

Analytical data will be loaded into CDM's EquIS database.
- Form I preliminary data will be e-mailed or faxed to CDM within the specified turn-around-time.
- Data from subcontract laboratories will be received in electronic format specified in the contract and validated by subcontractor personnel.
- All final laboratory data will be submitted to CDM in electronic format consistent with CLP deliverables. The ASC will review all analytical data.
- Hard copies of analytical data received by CDM will be archived in project file.
- Electronic data will be uploaded into the CDM Database system.
- Electronic data will be consistent with EPA Region 2 requirements for electronic data deliverable (EDDs).
- Electronic analytical data will be archived on CDs and copies of CDs will be forwarded to the USEPA.

CDM's project engineer is responsible for tracking samples from the point of field collection to submittal for laboratory analysis and the subsequent

QAPP Worksheet #14
Summary of Project Tasks

data validation and data management efforts. The sample handling and custody requirements, including field logs and generation of sample paperwork, sample labels and custody seals (TSOP 1-2) discussed in Worksheets #26 and #27, will be followed. The laboratory QA requirements including laboratory audits and contract compliance screening will be followed according to procedures described below and in Worksheet #23. The ASC will receive non-RAS data from the LTRA subcontractor who will track it through the data validation process. For non-routine analytical services (non-RAS) data, the ASC will submit the electronic "ANSETS Data Requirement" form (Appendix C) to the RSCC by the first day of each month for the previous month's sampling. RAS data will be validated by DESA or the EPA; EPA will be responsible for tracking and maintaining custody of the laboratory data packages through the data validation process. When non-RAS data packages are received from the laboratory, the ASC will initiate a non-RAS Data Package Chain-of-Custody Form. All transfers of the data package from one individual to the next must be recorded on the custody record. The data package itself must remain under lock and key when not undergoing processing. Data validation performed by the subcontractor will be in accordance with the procedures described in Worksheets #35 and #36 of this QAPP. Once the data is validated, it will be input into CDM's database.

Forms2Lite, a project-specific electronic spreadsheet, will be developed for sample tracking purposes prior to field activities. The tracking system will be initiated in the field during sample collection and will be updated during the sample analysis and data validation phases. The data will be entered by project staff and then checked by the ASC for accuracy. This tracking system will ensure that no data is lost during the data management process.

The following information is recorded in the tracking system:
Sample Number
I. Area of Concern
II. Sample Matrix
III. SDG Number
IV. CLP Case No.
V. CLP No.
VI. Analytical Parameter
VII. Collection Date
VIII. Shipment Date
IX. Date Received from Lab
X. Date Submitted for Data Validation
VI. Name of Data Validator
VII. Date of Data Validation Completion
VIII. Database Entry Date
IX. Database QC Date
X. Comments (i.e., MS/D designation, duplicate samples).

Analytical data collected during the field effort will be entered into an EQuIS database management system. This management system will include both location and environmental data. The database management system will provide data storage, retrieval, and analytical capabilities. The system

QAPP Worksheet #14
Summary of Project Tasks

will be able to meet a full range of site and media sampling requirements since it will be able to interface with a variety of spreadsheet, word processing, statistical, and graphics software packages.

To facilitate the use of the database, CDM will provide the laboratories with a detailed format specification for the delivery of analytical data in an EDD. Once it is uploaded into the database, validated analytical data will be organized, formatted, and input into the database for use in the data evaluation phase. A 100 percent quality control check will be performed to ensure accuracy on all hand-entered data (i.e., data qualifiers added by CDM validators on subcontract laboratory data, sample field notations).

Data tables that compare the results of the various phases of sampling efforts will be prepared and evaluated. Data will be evaluated to monitor facility operations, confirm permit compliance, and monitor RA progress. Analytical data results will interface with graphics packages to illustrate contaminants detected. As a quality control check, reports, tables, and graphical figures will be compared to the sample tracking system for errors and omissions. CDM will provide EPA with final analytical data on electronic media.

Data management will utilize personal computers (PC), local area networks (LAN), and electronic communications (ex: the World Wide Web) to support the database management system software. CDM will set up PC stations on which the database management system and commercial software will run in compliance with those software licensing requirements. CDM will take reasonable care to protect the data and will perform periodic backups to prevent wholesale loss of project data. Control of the computer hardware and software will be as per CDM quality procedure (QP) 4.1.

A backup system has been installed for facility hard drives to prevent loss of PLC data due to hardware failure, which can occur due to frequent power outages/fluctuations that occur onsite.

After the CLP data has been validated, the package is returned to the EPA RPM. CLP data packages forwarded to the CDM ASC will then have copies made of the Region 2 chain-of-custody/data transfer log, validated Form Is, data validation assessment and data validation checklist for distribution to the project staff. The original CLP data package with all associated forms is retained by EPA for archival. Non-CLP data packages received from the LTRA Subcontractor will first be validated by the subcontractor, and then returned to CDM. Copies of the non-CLP data packages will be submitted to EPA during project close-out.

Sampling Plans and Reports
The LTRA subcontractor is required to submit a Sampling, Analysis and Monitoring Plan and Quality Assurance Project Plan SAMP/QAPP.
The QA/QC procedures contained in the LTRA Subcontractor's SAMP/QAPP shall be in accordance with U.S. EPA Region 2 requirements, and it shall utilize and make reference to the procedures in UFP-QAPP to the extent practical. The LTRA Subcontractor's SAMP/QAPP will be reviewed by CDM's project manager and RAC 2 QA coordinator. CDM will submit comments to the LTRA Subcontractor, and the LTRA Subcontractor will submit a revised SAMP/QAPP for approval by CDM. This procedure will continue until final approval is given by CDM.

Based on sampling results, CDM will prepare RA reports to be submitted to the EPA. The RA reports will include a detailed summary and analysis of remedy performance, including the following:

QAPP Worksheet #14
Summary of Project Tasks

- Tabulated summary tables for groundwater data and field measurements
- Tabulated summary table of compliance sampling and monitoring results to demonstrate conformance with USVI TPDES permit discharge criteria and air permit discharge criteria
- Tabulated/graphed summary of GWTFs performance, including average flow rates and cumulative volume of groundwater extracted, mass removal rates and cumulative mass removed, and percent operational uptime
- Groundwater elevation iso-contour maps and capture zone estimates
- Groundwater contamination iso-concentration maps
- Graphs for updated groundwater contamination concentration trend analyses
- Written summary, assessment, and discussion of remedial action progress for the reporting period
- Recommendations regarding future O&M activities

To support the RA report submittals, the LTRA subcontractor will submit monthly O&M reports to CDM. The O&M reports will include, but is not limited to, summary of operation and maintenance activities, average flow rates, volume of treated water, waste disposal information, level of labor effort, monitoring data and measurements, technical support activities, health and safety activities, and utility use quantities and cost. Monthly operation and maintenance (O&M) reports shall undergo a technical review prior to submission to the Contractor. The review shall be performed by a qualified reviewer to ensure technical accuracy and conformance with the requirements herein. All calculations, tables, charts, analytical data, and data sheets shall be checked by an independent reviewer.

Documentation and Records:
Information regarding samples will be recorded in site field logs. Any changes that are made to the field logs shall be initialed and dated. Documents will be maintained in the project files and/or the RAC II document control system. Monitoring well purge water data forms will be completed for each sample collected. Chain-of-Custody (COC) and airbills will also be completed for each sampling event.

Field Change Requests:
In the event that anticipated conditions are different from those encountered once the field work is under way, it may be necessary to implement a deviation from the approved QAPP. When such changes are required, the proposed change will be documented on a FCR Form by the CDM project engineer and approved by CDM's SM. An e-mail copy of the FCR form will be sent to the EPA RPM and will serve as documentation of communication with EPA. A copy of the FCR Form is included in Appendix C. A copy of the FCR will be kept on site along with the approved QAPP. A copy of the FCR form will be distributed to the authorizing parties, the field staff, and the CDM RQAC in order to keep all staff informed of the change and to allow RQAC oversight of any changes.

When significant field changes occur, the QAPP will be revised. Modifications will be carried out via revised pages to the QAPP. Minor changes will be made through formal memoranda from the CDM SM to the EPA RPM and will be included as addenda to the QAPP. The complete sign-off procedure will be followed if, in the judgment of the CDM SM, major revisions to the QAPP are required. All revisions to the QAPP will be subject to CDM's internal review process. All such changes will be approved by EPA prior to their implementation.

QAPP Worksheet #15a
Reference Limits and Evaluation Table-Groundwater

Volatile Organic Compounds – SOM01.2	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit Goal (µg/L)	Analytical Method			Achievable Laboratory Limits[3]	
				MDLs	CRQLs µg/L	Option	MDLs	QLs
Tetrachloroethene[1]	127-18-4	1	1	N/A	0.5	Trace	TBD	TBD
Trichloroethene[1]	79-01-6	1	1	N/A	0.5	Trace	TBD	TBD
cis-1,2-Dichloroethene[1]	156-59-2	1	1	N/A	0.5	Trace	TBD	TBD
trans-1,2-Dichloroethene[1]	156-60-5	1	1	N/A	0.5	Trace	TBD	TBD
Vinyl chloride[1]	75-01-4	1	1	N/A	0.5	Trace	TBD	TBD
Benzene[2]	71-43-2	5	1	N/A	0.5	Trace	TBD	TBD
Toluene[2]	108-88-3	50	1	N/A	0.5	Trace	TBD	TBD
m/p xylene[2]	1330-20-7	25	1	N/A	0.5	Trace	TBD	TBD
o-xylene[2]	1330-20-7	25	1	N/A	0.5	Trace	TBD	TBD
Ethylbenzene[2]	100-41-4	700	1	N/A	0.5	Trace	TBD	TBD

1. Project Action Limit was determined as the most stringent of the drinking water MCL, and the TPDES permit. A ND result is required for the TPDES permit and it is assumed a detection limit of 1 ppb based on the current method at the time of the permit issuance (EPA Method 8260).
2. Project Action Limit was determined as the most stringent of the drinking water MCL, and the TPDES permits issued for the Esso and Texaco service stations.
3. DESA and CLP laboratory limits are not available and the subcontractor laboratory will submit achievable limits at a later date. The FASTAC decision process will be used for annual groundwater sampling event. Facility process samples will be analyzed by a LTRA Subcontract laboratory.

CAS: chemical abstract service
CRQL: contract required quantitation limit
MDL: method detection limit
N/A: not applicable
ND: non-detect
QL: quantitation limit
ppb: parts per billion

TBD: to be determined
µg/L: microgram per liter

QAPP Worksheet #15b
Reference Limits and Evaluation Table-Groundwater

Parameter	Project Action Limit[1,2,3] (mg/L)	Project Quantitation Limit Goal (mg/L)	Analytical Method		Achievable Laboratory Limits[4]	
			MDLs	Typical Quantitation Limits mg/L	MDLs	QLs
Chloride	25	5	N/A	1	TBD	TBD
Ethane, Ethene	0.01	0.001	N/A	0.001 – 0.01	TBD	TBD
Nitrate	1	0.25	N/A	0.1	TBD	TBD
Sulfate	20	5	N/A	1	TBD	TBD
Total Organic Carbon	20	10	N/A	1-2	TBD	TBD
Total Suspended Solids	40	10	N/A	4	TBD	TBD

Notes:
1. Project action limits for chloride, ethane, ethane, nitrate, and sulfate were determined by the limits required to monitor natural attenuation of the groundwater plume.
2. Project action limit for total suspended solids was determined based on TPDES permit for the site.
3. Project action limit for total organic carbon was based on the most stringent of the TPDES permit for the site and the limit required to monitor natural attenuation of the groundwater plume.
4. DESA and CLP laboratory limits are not available and the subcontractor laboratory will submit achievable limits at a later date. The FASTAC decision process will be used for annual groundwater sampling event. Facility process samples will be analyzed by a LTRA Subcontract laboratory.

MDL: method detection limit
mg/l: milligram per liter
N/A: not applicable
ND: non-detect
QL: quantitation limit
TBD: to be determined

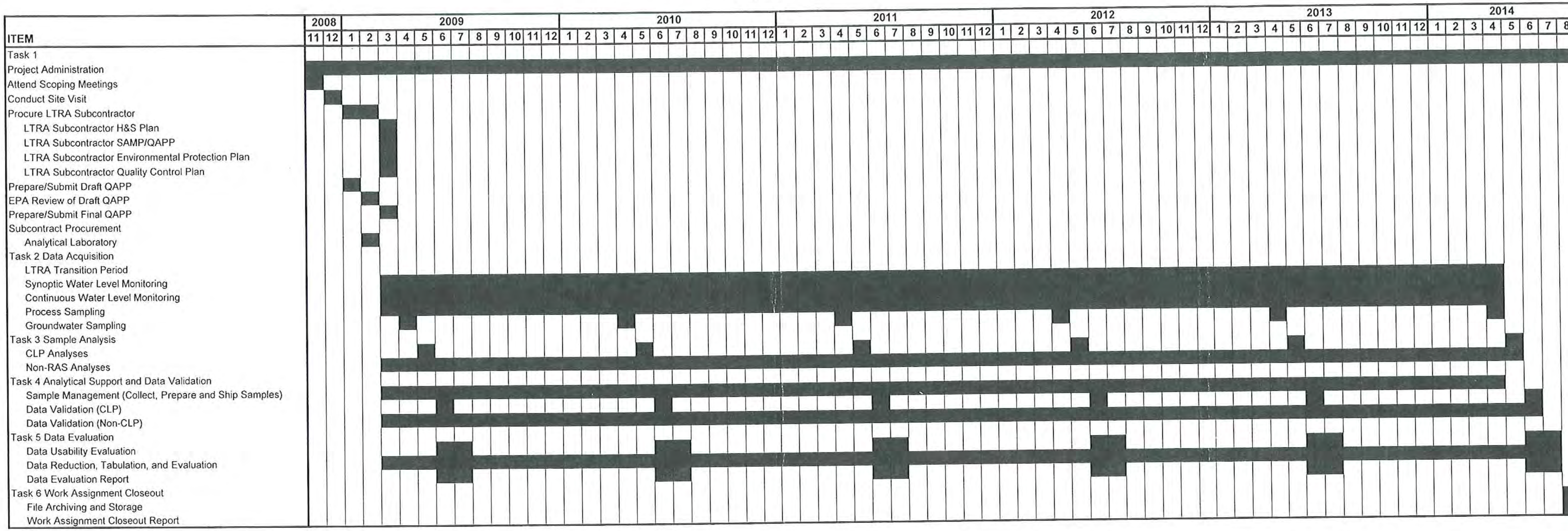
QAPP Worksheet #15c
Reference Limits and Evaluation Table-Air

Volatile Organic Compounds – TO-14a	CAS Number	Project Action Limit[1] (ppbv)	Project Quantitation Limit Goal (ppbv)	Analytical Method			Achievable Laboratory Limits[2]	
				MDLs	QLs	Option	MDLs	QLs
Tetrachloroethene	127-18-4	1,500	0.2	N/A	N/A	N/A	TBD	TBD
Trichloroethene	79-01-6	500	0.2	N/A	N/A	N/A	TBD	TBD
cis-1,2-Dichloroethene	156-59-2	75,000	0.2	N/A	N/A	N/A	TBD	TBD
trans-1,2-Dichloroethene	156-60-5	N/A	0.2	N/A	N/A	N/A	TBD	TBD
Vinyl chloride	75-01-4	50	0.2	N/A	N/A	N/A	TBD	TBD
Benzene	71-43-2	N/A	0.2	N/A	N/A	N/A	TBD	TBD
Toluene	108-88-3	N/A	0.2	N/A	N/A	N/A	TBD	TBD
m/p xylene	1330-20-7	N/A	0.2	N/A	N/A	N/A	TBD	TBD
o-xylene	1330-20-7	N/A	0.2	N/A	N/A	N/A	TBD	TBD
Ethylbenzene	100-41-4	N/A	0.2	N/A	N/A	N/A	TBD	TBD

1. Project Action Limit was determined by the issued permit for the Site.
2. The subcontractor laboratory will submit achievable limits at a later date.
3. Samples will be analyzed by a LTRA Subcontract laboratory.

CAS: chemical abstract service
CRQL: contract required quantitation limit
MDL: method detection limit
N/A: not applicable
QL: quantitation limit
ppbv: parts per billion by volume

QAPP Worksheet #16
Project Schedule Timeline Table



QAPP Worksheet # 17
Sampling Design and Rationale

The purpose of the LTRA is to confirm that the RA objectives are met. The purpose of the LTRA is to ultimate restore the groundwater contaminant levels to below the Federal MCLs. To achieve this, the RA objectives specifically include GWTF#1 achieving hydraulic control and providing contaminant mass removal from the saturated-zone CVOC source area, and GWTF#2 achieving hydraulic control of the Northern Plume. In addition, process sampling will ensure both facilities achieve treatment requirements for groundwater effluent discharge to surface water in accordance with DPNR TPDES permit equivalency and air permit criteria. For the Southern Plume, groundwater sampling will be performed to monitor natural attenuation of the plume.

Groundwater level monitoring is used to monitor the extraction well captures zones, monitor the effects of the rain events on the aquifer, and to assess changes in groundwater conditions. The purpose of the groundwater level measurements is to monitor drawdown and capture zone of the groundwater extraction wells, which is required, to maintain hydraulic control of the 100 µg/L CVOC plume. In addition, the continuous water levels in six site-wide monitoring wells will monitor the effect of rain events on site-wide water levels. Water level measurements will also be used to monitor the impacts of remedial pumping on downgradient groundwater levels, because extracted groundwater is discharged to the storm drainage system rather than back to the aquifer.

The LTRA, which will be performed by the LTRA subcontractor, includes performing routine GWTF operation, maintenance, and monitoring at greater than 95 percent uptime; performing site-wide groundwater monitoring; providing laboratory services and equipment for sampling, sampling analysis and field measurements; data validation; and properly handling, characterizing, and disposing generated waste from the GWTFs. All work will be performed in accordance with the LTRA subcontract specifications.

The major elements of the LTRA include:

- Operate, monitor, and maintain the groundwater treatment facilities in accordance with the RA objectives and permit discharge criteria
- Perform groundwater monitoring in site-wide monitoring wells
- Collect continuous water levels from select monitoring wells and monthly synoptic water level measurements from monitoring wells

The field program will include:

- Mobilization **(Worksheet 17a)**
- Operation and Maintenance of GWTFs **(Worksheet 17b)**
- Hydrogeological Assessments
    - Continuous Water Level Measurements **(Worksheet 17c)**
    - Synoptic Water Level Measurements **(Worksheet 17d)**
- Groundwater Sampling **(Worksheet 17e)**
- Process Sampling **(Worksheet 17f)**
- Decontamination Procedures **(Worksheet 17g)**
- IDW **(Worksheet 17h)**

QAPP Worksheet # 17a
Sampling Design and Rationale
Mobilization

Site Preparation
All site workers will become familiar with the groundwater treatment facility operations, the locations of the extraction wells, monitoring wells, and supply wells at the Site.

Access Support
Required access to public areas and private property has been obtained during previous phases of the project. No additional access is required at this time. If additional access is required in the future, EPA will be respsonsible for obtaining site access. CDM will assist EPA with site access.

Field Planning Meetings
Each field team member, operator and the project manager will review all project plans. A kickoff meeting and conference call was held on March 6, 2009 to discuss the planned LTRA activities. The attendees included Demetrios Klerides (CDM), Jonathan Lee (CDM), Ellen Gallerie (CDM), Greg Wallace (Arrowhead), Scott Siegwald (Arrowhead), Bob Peterson (TSG), and Chris Guenther (TSG). Supplemental meetings/conference calls may be conducted as required by any changes in site conditions or to review field operation procedures during the LTRA period.

Field Equipment and Supplies
Equipment and supplies needed for the LTRA, that are ordered, rented, and purchased by CDM are governed by CDM's Quality Procedures 2.1 *Procuring Measurement and Test Equipment* and 5.3 *Equipment Inspection*. This will also include staging and transferring all equipment and supplies to and from the site. Measurement and Test Equipment forms will be completed for all new equipment rented or purchased by CDM that will be utilized to collect field measurements. One photo-ionization detector (PID) and transducers located in the extraction wells and in six monitoring wells are government owned and are currently onsite. All other sampling equipment needs to be supplied by the subcontractor. All field equipment will be inspected for acceptability, and instruments calibrated as required prior to use. Equipment will meet requirements as specified in Worksheet #22.

QAPP Worksheet # 17b
Sampling Design and Rationale
Operation, Maintenance, and Monitoring

The LTRA Subcontractor shall operate and maintain the groundwater treatment systems and shall perform groundwater treatment system performance/compliance monitoring. The LTRA Subcontractor shall provide all labor, equipment, replacement parts, and incidentals required to perform routine O&M of groundwater treatment systems and to perform non-routine maintenance/replacement of defective equipment and installations in accordance with the Site O&M Manual (Arrowhead 2004) and project specifications. The LTRA Subcontractor shall operate the groundwater treatment systems at greater than 95 percent up time per quarter, including the time required for routine O&M, and excluding downtime due to conditions beyond the Subcontractor's control such as power outages or weather. The LTRA Subcontractor is also responsible for performing maintenance activities around the site grounds.

The LTRA Subcontractor shall perform sampling and field measurements to monitor groundwater treatment system performance, compliance with discharge permit requirements, and remedial progress. Manual readings of process parameters will be collected daily to ensure proper operation of the systems. The LTRA Subcontractor will record and maintain all standard and essential information for effective and efficient operation, maintenance, and management of groundwater treatment systems, that include, but is not limited to, pH, flow rates, temperature, and pressure readings. Field data forms provided in Appendix C indicate the minimum information needed to be collected.

Operation

General requirements for operation include the following:

- Provide competent staff to operate all equipment, systems, processes, and appurtenances for GWTF #1 and #2 in accordance with project specifications, equipment manufacturer's specifications and O&M instructions, and the O&M Manual (Arrowhead 2004).
- Extraction wells RW-7, RW-9 and RW-1S shall be operated to maintain a set groundwater elevation in the extraction well. The set groundwater elevation shall be as specified by CDM.
- At GWTF #1, extraction well RW-7 shall be operated on a continuous basis. Extraction well RW-9 shall be operated in addition to RW-7 when the set groundwater elevation cannot be maintained by sole operation of the RW-7 extraction well pump, which can occur during heavy rain events. Extraction well RW-6 shall be operated once per week at a flow rate of 2 gpm, until the extraction well pump shuts down due to low water conditions in the well. Each time RW-6 is operated, the extraction well pump typically runs for approximately 1 to 1 ½ hours.
- At GWTF#2, extraction well RW-1S shall be operated on a continuous basis. Extraction well RW-1 is not expected to operate during the LTRA period.
- Procure all equipment, spare parts, supplies, and services required for operation, maintenance, monitoring, and management of the treatment systems.
- Manage and maintain an inventory of equipment, supplies, and tools required for continuous operation with minimal downtime.

QAPP Worksheet # 17c
Sampling Design and Rationale
Continuous Water Level Measurements

Continuous water level measurements will be collected during the LTRA period. Water level and barometric pressure readings will be measured using an In-situ TROLL® data logger or Solinst Levelogger® Gold, and will be operated according to manufacturer's instructions. The In-situ TROLL data logger® is located in MW-3. The Solinst Levelogger® Gold is located in DW-2, MW-16, MW-21D, RD-11 and RD-14. Continuous water level measurements will be monitored at six monitoring wells (DW-2, MW-3, MW-16, MW-21D, RD-11, and RD-14) and four extraction wells (RW-1, RW-1S, RW-7, and RW-9)(Figure 2). Daily rainfall measurements will also be obtained from a local weather station for the life of the contract to determine the effects of rain events on the groundwater levels.

Field Procedures for these Activities are detailed in:

- TSOP 1-6 Water Level Measurement, Section 5.3.4 Continuous Recording Method
- TSOP 1-10 Field Measurement of Organic Vapors, Section 5.1 Direct Reading Measurement, if required by Health and Safety Plan
- TSOP 5-1 Control of Measurement and Test Equipment (for equipment purchased or rented by CDM)
- Worksheet 17g Decontamination Procedures

QAPP Worksheet # 17d
Sampling Design and Rationale
Synoptic Water Level Measurements

Groundwater levels will be used to monitor site-wide groundwater elevations. Synoptic water level elevation measurements will be collected monthly from the wells as described in Table 3.

Water level measurements will be collected from conventional monitoring wells using an electronic water level indicator, at the surveyors mark on the inner casing. Water level measurements collection times will be coordinated with water level measurement collection events performed by Texaco and Esso potentially responsible parties to ensure all the wells are collected within 1 to 2 days of each other when possible. Synoptic water levels will be compared to previous readings in the field to prevent false readings from being recorded.

Field Procedures for these Activities are detailed in:

- TSOP 1-6 Water Level Measurement, Section 5.2 Water Level Measurement Using Electronic Water Level Indicators (and manufacturer's instructions)
- TSOP 1-10 Field Measurement of Organic Vapors, Section 5.1 Direct Reading Measurement, if required by Health and Safety Plan
- Worksheet 17g Decontamination Procedures

QAPP Worksheet # 17e
Sampling Design and Rationale
Groundwater Sampling

Annual site wide groundwater sampling events will be collected as follows. The purpose of sampling is to update groundwater contamination iso-concentration contours for the site-wide plume and to monitor remedial progress of treatment facilities. Samples will be collected from 30 wells at locations shown on Figure 2 and listed on Table 3. The monitoring wells will be collected using the low flow groundwater purging and sampling procedure described in Appendix A and will be purged with a Grundfos Redi-flo2 submersible pump or equivalent. Sampling will use teflon lined polyethylene tubing with tubing dedicated for each well. Groundwater sampling and field water quality measurements from private wells, which are not accessible for sampling in accordance with the above SOP, shall be purged using the existing pump. A minimum of three well volumes will be purged before sampling and purging will continue until water quality parameters stabilize, as described in Appendix A. For wells Delegard, Laplace, RD-3, Smith, and Steele, the samples will be collected for VOCs, TOC, nitrate, sulfate, chloride, and ethane/ethane to monitor MNA in the southern plume. For the remaining wells, samples will be collected for VOCs only. All samples sent to an analytical laboratory shall be analyzed with a 14 day turn-around-time as determined by FASTAC.

DO, Eh, turbidity, pH, temperature, and conductivity will be measured in the field. A flow-through cell will be used when measuring oxygen-sensitive field parameters.

Field Procedures for these Activities are detailed in:

- Appendix A — Site-Specific Low Flow Groundwater Purging and Sampling Procedure
- TSOP 1-2 — Sample Custody
- TSOP 1-6 — Water Level Measurement, Section 5.2.3 Water Level Measurement Using Electronic Water Level Indicators (and manufacturers instructions)
- TSOP 1-10 — Field Measurement of Organic Vapors, Section 5.1 Direct Reading Measurement, if required by Health and Safety Plan
- TSOP 2-1 — Packaging and Shipping Environmental Samples
- TSOP 2-2 — Guide to Handling Investigation Derived Waste
- Worksheet 17g — Decontamination Procedures
- Worksheet 18 — Sampling Locations and Methods/ SOP Requirements

QAPP Worksheet # 17f
Sampling Design and Rationale
Process Sampling

Process monitoring sampling will be used to confirm achievement of remedial system performance requirements, confirm compliance with the U.S. Virgin Islands Department of Planning and Natural Resources (DPNR) TPDES permit equivalency and Air Pollution Control permit equivalency, and obtain data for assessing remedial action (RA) progress and support decisions regarding treatment system operation and optimization. Process aqueous samples for TOC and TSS will be collected once per week at two locations; GW1-EFF and GW2-EFF. Process aqueous samples for VOCs will be collected once per month at 7 locations. The locations are GW1-INF, GW1-EFF, GW2-INF, GW2-EFF, RW-9, RW-7, and RW-6. However, if well RW-9 is not in operation, samples from RW-7 and RW-9 will not be required. The locations are presented in Figures 3 and 4. Samples will be collected from a tap off the process line. The volume of water in sample ports will be purged prior to sample collection.

Air samples will be collected from the effluent air line from the process line of groundwater treatment facility #1 in accordance with TSOP 1-8. The samples will be collected directly from the treatment system sample port using SUMMA canisters. Flow controllers are not required. Air-tight connection between the SUMMA canister and sample port shall be made using hose barbs and polyethylene tubing (or equal).

All samples wiil be sent to the LTRA Subcontractor's subcontract analytical laboratory shall be analyzed with a 14 day turn-around-time.

Field Procedures for these Activities are detailed in:

- TSOP 1-2 Sample Custody
- TSOP 1-10 Field Measurement of Organic Vapors, Section 5.1 Direct Reading Measurement, if required by Health and Safety Plan
- TSOP 1-8 Volatile Organic Compound Air Sampling Using USEPA Method TO-15 with SUMMA® Canister
- TSOP 2-1 Packaging and Shipping Environmental Samples
- TSOP 2-2 Guide to Handling Investigation Derived Waste
- Worksheet 17g Decontamination Procedures
- Worksheet 18 Sampling Locations and Methods/ SOP Requirements

QAPP Worksheet # 17g
Sampling Design and Rationale
Decontamination Procedures

Field decontamination will be performed on all personnel and equipment as required. Personnel decontamination procedures will be implemented to prevent worker exposure to site contaminants. Equipment decontamination procedures will be implemented to prevent cross-contamination of environmental samples and prevent off-site migration of contaminants as a result of site investigation activities. Decontamination will be performed in accordance with the LTRA Subcontractor's H&S plan.

Personal Protective Equipment
Personal protective equipment decontamination will be in accordance with the LTRA Subcontractor's H&S plan.

Field Monitoring Equipment
Instruments should be cleaned per manufacturer's instructions. The electronic water level indicators, well sampling equipment, and water quality parameter probes cannot be rinsed with solvents or acids. The electronic water level indicators will be decontaminated with a non-phosphate detergent, tap water rinse, and a final distilled/deionized water rinse prior to use at each well. The water quality parameter probes will be rinsed prior to and after each use with deionized/distilled water only.

Sampling Apparatus, General Considerations
All sampling apparatus must be properly decontaminated prior to its use in the field to prevent cross-contamination. Equipment should be decontaminated after usage (once a day or between sampling points). Decontamination water will be disposed of in accordance with Worksheet #17h. Decontamination of pumps used for groundwater sampling shall be performed in accordance with procedures set forth in Appendix A. This will be performed for equipment used during monthly level measurements as well.

While performing decontamination activities, phthalate-free gloves should be used to prevent phthalate contamination of the sampling equipment that could result from the interaction of the gloves with the organic solvents.

QAPP Worksheet # 17h
Sampling Design and Rationale
Investigation Derived Waste

Investigation Derived Waste (IDW)
The LTRA Subcontractor will be responsible for the removal and proper disposal of all IDW, including groundwater extracted during sampling, decontamination water, PPE and waste associated with the operation, maintenance, and monitoring of the GWTFs as required by federal, territorial, and local regulations and in accordance with subcontract requirements and the QAPP. Waste samples will be collected and analyzed by a laboratory to characterize the waste. Field procedures for this activity are detailed in TSOP 2-2: Guide to Handling Investigation Derived Waste. Site specific requirements are included below.

Sampling of Waste

- Liquid and solid waste disposal sampling shall be performed by collecting representative composite samples from each waste stream that may be potentially hazardous, or as required by the EPA-approved disposal facility. Liquid waste samples shall be collected using a decontaminated bailer, pipette, or equivalent method approved by CDM. Sampling will be sufficient to characterize potentially hazardous wastes, as specified disposal facility requirements, and all applicable federal and territory regulations. Liquid and solid waste disposal sampling shall be performed by collecting representative composite samples from each waste stream.

Segregation of Waste Materials

- The Subcontractor shall be responsible for segregating all Federal regulated wastes generated as a result of operation activities. Waste materials shall be segregated, at a minimum, as potentially hazardous waste and non-hazardous waste. Wastes from each process shall be containerized separately so as to containerize like waste streams.
- Solid wastes resulting from cleanup of chemical spills shall be segregated as hazardous waste.
- PPE, packaging and shipping materials, general debris, and other materials not in contact with contaminated groundwater shall be segregated as non-hazardous. Tank sediment and bag filter sediment will also be segregated as non-hazardous based on previous sampling results.
- Wastewater that is suitable for treatment by the GWTFs in accordance with the permit discharge criteria shall be segregated for treatment at the GWTFs.
- Wastewater that is not suitable for treatment by the GWTFs in accordance with the permit discharge criteria shall be segregated for offsite transportation and disposal as hazardous.

Handling and Storage of Waste

- All non-hazardous waste, hazardous solid waste and wastewater and other potential federal or territory regulated wastes shall be segregated, handled and stored in accordance with the RCRA standards, applicable federal and territory regulations.
- Decontamination water, treatment process residuals, environmental sampling derived waste and any other wastes for disposal shall not be stored at the site unless the storage is solely for the purpose of accumulating sufficient quantities of the waste to facilitate proper disposal or treatment. Waste shall not be stored onsite for more than 90 days. If temporary storage is required, storage must be accomplished in a manner that does not constitute placement or disposal of hazardous waste or constitute a RCRA storage unit. Storage must be in

QAPP Worksheet # 17h
Sampling Design and Rationale
Investigation Derived Waste

accordance with applicable federal and territory regulations.

- Solid wastes shall be containerized in 55-gallon drums (Department of Transportation [DOT] 17E or 17H) for offsite disposal in a manner that prevents accidental spills and releases. This shall include, but not be limited to, ensuring that containers remain closed when not in use.
- All wastewater that is suitable for treatment by the GWTFs in accordance with the permit discharge requirements shall be treated onsite at the GWTFs. All wastewater that is not suitable for treatment by the GWTFs in accordance with the permit discharge requirements shall be containerized in 55-gallon drums for offsite disposal in a manner that prevents accidental spills and releases. This shall include, but not be limited to, ensuring that wastewater containers remain closed when not in use.
- The drums shall be placed on polyethylene sheeting or equivalent and shall be stored in a manner that will prevent puncture and accidental release prior to shipment off site. Secondary containment shall be provided for drums containing liquid hazardous waste.

QAPP Worksheet #18
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number[1]	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)[4]	Sampling SOP Reference	Rationale for Sampling Location
Annual Groundwater Sampling – 30 locations	Groundwater[2]	Table 1	TCL trace VOCs	Trace	30 (1 per location) 2 Field Duplicates	Appendix A (For supply wells see worksheet #11)	See Worksheet #17e
Annual Groundwater Sampling – 5 locations	Groundwater[2]	Table 1	Chloride, Sulfate, Nitrate, TOC, Ethene/Ethane	Low	5 (1 per location) 1 Field Duplicate	Appendix A	See Worksheet #17e
Process Sampling – 2 locations[3]	Aqueous	NA	TSS, TOC	Low	104 (52 per location) 6 Duplicates	NA	See Worksheet #17f
Process Sampling – 7 locations[3]	Aqueous	NA	TCL trace VOCs	Trace	84 (12 per location) 5 Duplicates	NA	See Worksheet #17f
Process Sampling – 1 location[3]	Air	NA	TCL VOCs	Low	12 (1 location) 1 Duplicate	TSOP 1-8	See Worksheet #17f

1. See Worksheet #17 for a description of the sampling activities
2. Groundwater samples will also be measured for field parameters: pH, dissolved oxygen, oxidation-reduction potential, turbidity, temperature, and conductivity.
3. Sample locations are shown in Figures 3 and 4.
4. Estimated number of samples is based on one annual event for the annual groundwater sampling. Estimated number of samples is based on one year for process sampling.

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concen-tration Level	Analytical/ Preparation Method/SOP Reference[1]	Minimum Sample Volume	Containers[2] (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3](preparation/ analysis)
Aqueous	TCL VOCs (trace)	Trace	SOM01.2	80 ml	3 X 40 ml vials with Teflon septum	HCl to pH<2; Cool to 4 degrees C. No head space or air bubbles. Avoid air and light	14 days
Air	VOCs	Low	TO-14A	--	SUMMA Canister – 6 L	NA	30 days
Aqueous	Chloride	Low	325.2	50 ml	1-125 ml polyethylene bottle	1 polyethylene bottle	28 days
Aqueous	Ethane and Ethene	Low	RSK 175	40 ml	3 X 40 ml vials with Teflon septum	HCl to pH<2; Cool to 4 degrees C. No head space or air bubbles. Avoid air and light	14 days
Aqueous	Nitrate	Low	353.2	100 ml	1-250 ml polyethylene bottle	Cool to 4 degrees C	48 hours
Aqueous	Sulfate	Low	375.4	100 ml	1-250 ml polyethylene bottle	Cool to 4 degrees C	28 days
Aqueous	TOC	Low	415.1	50 ml	1-250 ml polyethylene bottle	H_2SO_4 to pH<2; Cool to 4 degrees C	28 days preserved
Aqueous	TSS	Low	160.2	100 ml	1-250 ml polyethylene bottle	Cool to 4 degrees C	7 days

mL milliliter
H_2SO_4 Sulfuric Acid
C Celsius
HCl Hydrochloric Acid

1. SOP reference numbers are laboratory specific. This information is maintained by EPA and is not available to EPA contractors.
2. Aqueous VOC vials must be filled to capacity with no headspace or air bubbles.
   The field team will consolidate the sample bottles dependent on the type of preservation and laboratories assigned to the wet chemistry analyses.
3. Holding times are from date of collection.

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Task	Matrix	Analytical Parameters	Environmental Samples	Field Duplicates	Field Blanks[1]	Trip Blanks[2]
Annual Site-wide Groundwater Sampling	GW[3]	Trace VOCs	30	2	5	5
		Chloride	5	1	-	-
		Sulfate	5	1	-	-
		Nitrate	5	1	-	-
		TOC	5	1	-	-
		Ethene/Ethane	5	1	-	1
GWTF Process Sampling	Air[4]	VOCs	12	1	-	-
	AQ[4]	Trace VOCs	84	5	-	12
		TOC	104	6	-	-
		TSS	104	6	-	-

Notes:
1: Field blanks are collected at a frequency of 1 per day per decontamination event. The actual number of field blanks may be different due to timing of the number of decontamination events and days for sampling.
2: Trip blanks (for VOCs and ethene/ethane only) are collected at a frequency of 1 per day per cooler of VOCs. Numbers may vary.
3: Estimated numbers are based on a per sampling event basis.
4: Numbers based on yearly basis.

AQ: Aqueous
GW: groundwater
GWTF: Groundwater treatment facility
MS/D: Matrix spike/duplicate
TOC: Total Organic Carbon
TSS: Total Supended Solids
VOC: Volatile Organic Compound

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
1-2	Sample Custody, Rev. 5, 3/31/07	CDM	NA	Y	RAC II-Specific clarification applies
1-6	Water Level Measurement, Rev. 6, 3/31/07	CDM	Section 4 of TSOP	N	
1-8	Vapor Sampling using a SUMMA Canister, Rev. 5, 3/31/07	CDM	NA	Y	RAC II-Specific clarification applies. This TSOP will be used for samples that will be analyzed using the TO-14a method
1-10	Field Measurement of Organic Vapors, Rev. 4, 3/31/07	CDM	Section 4 of TSOP Mini-RAE	N	Will be implemented if required by Health and Safety Plan
2-1	Packaging and Shipping Environmental Samples, Rev. 3, 3/31/07	CDM	Section 1.3 of TSOP	Y	RAC II-Specific clarification applies. In addition, vermiculite will not be used and coolers will not be returned to a CDM office but rather to the GWTFs.
2-2	Guide to Handling of Investigation-Derived Waste, Rev. 5, 3/31/07	CDM	NA	Y	See worksheet #17h
5-1	Control of Measurement and Test Equipment, Rev. 8, 3/31/07	CDM	NA	Y	RAC II-Specific clarification applies. Only applicable to government owned equipment purchased by CDM.
N/A	Site-Specific Low Flow Groundwater Purging And Sampling Procedure	CDM	Grundfos Redi-flo 2	N	See worksheet #17e for supply well sampling requirements

Notes:
1. Additional modifications to SOPs are noted within QAPP worksheets.
2. Required documentation may be recorded in field logs in place of logbooks.

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Mini RAE PLUS Classic (PGM-76) Toxic Gas Monitor with 11.7 electron volt (eV) lamp	Calibration checked at the beginning and end of day	As needed in field; semi-annually by supplier	Measure known concentration of Isobutylene 100 parts per million (ppm) (calibration gas)	Upon receipt, Successful operation	Calibrate am, check pm	± 10% of the calibrated value	Manually zero meter or service as necessary and recalibrate	FT	Manufacturers specifications
Horiba U-20XD with flow through cell	Calibrate at the beginning of the day and check calibration at the end of the day	Performed before shipment and as needed	Measure solutions with known values (National Institute for Standards and Technology (NIST) traceable buffers and conductivity calibration solutions)	Upon receipt, Successful operation	Daily, before each use	pH: ± 0.05 Specific Conductivity:± 5 micro Siemens (µS) DO ± 0.02 ppm Temp.: ±0.3^{0}C	Recalibrate or service as necessary	FT	Manufacturers specifications
In-Situ Mini TROLL® 30 psig level transducer with HP IPAQ 2215 PDA and Pocket-Situ	Manufacture Calibration only	Performed by manufacture or prior to shipping	Manufacture Calibration only	Check instrument is in working order	Performed by manufacture or prior to shipping	Pass/Fail	Return to rental company for replacement	FT	Manufacturers specifications
3001 LT Level Logger Gold M10/F30 part #108081 with Level Loader Gold	Manufacture Calibration only	Performed by manufacture or prior to shipping	Manufacture Calibration only	Check instrument is in working order	Performed by manufacture or prior to shipping	Pass/Fail	Return to rental company for replacement	LTRA Subcontractor	Manufacturers specifications
Water Level Meter	N/A	None	Check daily, before each use	Check instruments are in working order	Check daily before each use	Pass/Fail	Return to rental company for replacement	LTRA Subcontractor	Manufacturers specifications

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Facility Equipment	N/A	In accordance with manufacturer's specifications and O&M manual					Service as necessary or return to company for replacement	LTRA Subcontractor	Manufacturers specifications

QAPP Worksheet #23
Analytical SOP References Table

Reference Number[1]	Title, Revision, Date, and/or No.	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Project Work Modified (Y/N)
Organic Methods						
SOM01.2	Multi-Media, Multi-Concentration, Organic Analytical Service for Superfund. EPA 2005, ammended 4.11.2007	Definitive	TCL VOC[2] (trace)	Gas Chromatograph/Mass Spectrometer (GC/MS)	DESA, CLP or subcontract laboratory for annual GW events & subcontract laboratory for Process Samples	N
TO-14A	Determination of VOCs in ambient air	Definitive	VOC[2]	Gas Chromatography	Subcontract laboratory	N
Wet Chemistry Methods						
325.2	MCAWW. Revised 1983	Definitive	Chloride	Colorimeter, automated	DESA or Subcontract laboratory	N
RSK 175	Analysis of Dissolved MEE in Groundwater	Definitive	Ethane and Ethene	Gas Chromatograph	Subcontract laboratory	N
352.2	MCAWW. Revised 1983	Definitive	Nitrate	Colorimeter, automated	DESA or Subcontract laboratory	N
375.3, 375.4	MCAWW. Revised 1983	Definitive	Sulfate	Gravimetric (balance, oven)/ Spectrophotometer	DESA or Subcontract laboratory	N
415.1, 415.2	MCAWW. Revised 1983	Definitive	TOC - aqueous	Balance, carbonaceous analyzer/ blender, Carbon analyzer	DESA or subcontract laboratory for annual GW events & subcontract laboratory for Process Samples	N
160.2	MCAWW. Revised 1983	Definitive	TSS	Balance, oven	Subcontract laboratory	N

1. CLP laboratories SOPs are reviewed through EPA. DESA laboratory specific SOPs will apply and not these generic SOPs whenever the DESA laboratory is able to perform the analyses. LTRA subcontract laboratory specific SOPs are not available at this time and will be submitted at a later date
2. Only COC VOCs are required to be analyzed.

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[1]	SOP Reference[2]
Instruments used for EPA CLP analyses follow the calibration frequencies outlined in each method SOP.						
GC, GC/MS	Initial Calibration; 5 point standards	After instrument set up or when daily 12-hour calibration check fails	All target compounds, initial relative standard deviation (RSD) ≤ 10% or 20% and $R^3 > 0.995$	Inspect system; correct problem; re-run failed calibration and any associated samples	Lab analyst / QA officer - TBD	TBD
	Continuing Calibration Verification (CCV)	Daily; every 12-hours of analysis	%D ≤15%			
	Calibration Standards Verification	Each lot of standards	As per lab established control limits	Inspect system; correct problem; re-run standard and affected samples		
GC/MS	Tuning	Daily; every 12-hours of analysis	Response factors and relative response factors as method specified	Inspect system; correct problem; re-run standard and affected samples	Lab analyst / QA officer - TBD	TBD
Colorimeter	Initial Calibration; 4 - 9 point standards	Every 3 months; every 6 months for method 300. or as per lab SOP	90-110 % recovery	Re-check; re-calibrate	Lab analyst / QA officer - TBD	TBD
	Calibration check (Cal Check)	Every 10 samples and at end of analytical run	80-120 % recovery	Re-check; re-calibrate and rerun all samples analyzed after last valid Cal Check	Lab analyst / QA officer - TBD	TBD
Carbon Analyzer	Calibration and correction actions as per manufacturer's instructions. No samples shall be analyzed if instrument exceeds the acceptance criteria.				Lab analyst / QA officer - TBD	TBD

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[1]	SOP Reference[2]
Infra red or UltraViolet Spectro-photo meter	Initial Calibration; 5 point standards	Every 3 months or when other unresolved QC failure occurs	90-110 % recovery	Re-check; re-calibrate	Lab analyst / QA officer - TBD	TBD
	Calibration check	Every 10 samples and at end of analytical run	80-120 % recovery	Re-check; re-calibrate and rerun all samples analyzed after last valid cal check		
pH meter	Daily buffer checks (2 point bracketing sample pH)	Before use/per batch; other checks as per rental company and manufacturer's recommendations	± 0.1 pH units or ± 0.05 pH units	Recheck; replace buffer solutions and recheck. If still fails perform instrument check or place out of service	Lab analyst / QA officer - TBD	TBD
Thermometer	Calibration	Quarterly; serviced annually	See instrument manual	Replace defective thermometer	Lab analyst / QA officer - TBD	TBD
Balance	Calibration verification	Daily -.before use	See instrument manual	Troubleshoot as per equipment manual/call for repair	Lab analyst / QA officer - TBD	TBD
	Mass check	Daily - before use	See instrument manual			
	Temperature check	Annually	± 2°C	Troubleshoot as per equipment manual/call for repair	Lab analyst / QA officer – TBD	

1. The FASTAC decision process will be used for procuring laboratory services for annual GW events. CLP, DESA and subcontract laboratory's calibration and/or method SOPs will be utilized to meet calibration criteria. For process sampling, subcontract laboratory will be used. Specific instrument information (Manufacturer and model) is not available at this time.
2. TBD - Reference SOP depends on the laboratory assignment. EPA maintains the CLP laboratory SOP information. If a subcontract laboratory is needed, CDM will submit their SOP as a field change request.
3. R represents the correlation coefficient

QAPP Worksheet #25
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
For the DESA /CLP laboratories, analytical instrument maintenance, testing and inspection information and availability of spare parts are not available since the FASTAC decision process will be utilized for analytical services.								
For the LTRA subcontractor's lower tier laboratory, the procured laboratory's SOP and QA manual will detail these requirements.								

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection: The subcontractor will collect all samples. Sample numbers will be assigned as described below. A coding system will be used to identify each sample collected during the duration of the project. This coding system will provide a tracking record to allow retrieval of information about a particular sample and ensure that each sample is uniquely identified. Each sample is identified by a unique code which indicates the sample type, sample number, and, in some cases, sample depth. A sample numbering system is described below which provides a unique identifier for all samples that will be collected during the site field investigation. The total number and types of samples collected are detailed in Worksheet #18. **Sitewide Annual Groundwater Well Samples** The groundwater monitoring well samples collected will be designated according to the well names as shown on Figure 2 and listed on Table 3 followed by the date it was collected as YYQQ. For example, the sample MW-1D-Y5Q4 represents sample collected at MW-1D during year 5 (2009) and during the 4th quarter (April). All annual groundwater samples, wells will be collected in April of that year. Trip blanks will be named using TB-YYMMDD where YY is the year, MM is the month, and DD is the day. For example, a trip blank collected on April 28, 2009 will be named as TB-090429. Likewise, a field blank will be named using FB-YYMMDD. **Process Samples - Aqueous** The aqueous process samples collected will be designated according to the sample locations as shown on Figures 3 and 4 and named in Worksheet #17f followed by EFF or INF representing effluent or influent, and then the date of collection in the order YYMMDD. For example, GW1-EFF-080605 represents a sample collected from the effluent of treatment facility #1 on 6/5/08. **Process Samples – Air** The air samples collected will be designated according to the location as shown on Figure 3 followed by the date of sample collection. For example, an air sample collected from the effluent of GWTF #1 on January 3, 2009 will be designated as VAP-EFF-090103.
SAMPLE PACKAGING Sample Packaging (Personnel/Organization): Qualified subcontract personnel will perform the sample packaging. Sample packaging will follow TSOP 1-2 and TSOP 2-1; their RAC II clarifications; and the CLP Guidance for Field Samplers, January 2007, with the exception that: sample tags and vermiculite will not be used. Forms II Lite is mandatory and will be assigned to experienced field personnel. Please note that due to elevated temperatures in the region, extra ice should be placed in the cooler to ensure that the temperature requirements are met.
Coordination of Shipment (Personnel/Organization): LTRA Subcontractor FT, CDM Project Engineer, or CDM ASC coordinator Type of Shipment/Carrier: Priority Overnight Shipping/TBD. Samples for Saturday delivery will have the airbills checked for Saturday delivery.

QAPP Worksheet #26
Sample Handling System

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): Laboratory Sample Custodian - TBD as per FASTAC for groundwater monitoring events, subcontract laboratory for process samples. The CLP Laboratory assignment sheet will indicate the laboratory sample custodian, and if a subcontract laboratory is required. The laboratory project officer will notify subcontractor of the sample custodian.

Sample Custody and Storage (Personnel/Organization): TBD as per FASTAC for groundwater monitoring events, subcontract laboratory for process samples

Sample Preparation (Personnel/Organization): TBD as per FASTAC for groundwater monitoring events, subcontract laboratory for process samples

Sample Determinative Analysis (Personnel/Organization): TBD as per FASTAC for groundwater monitoring events, subcontract laboratory for process samples

SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): All samples will be shipped to a CLP laboratory, DESA or a subcontract laboratory via priority overnight (FedEx).

Sample Extract/ Digestate Storage (No. of days from extraction/digestion): Refer to Worksheet #19 for holding time requirements

Biological Sample Storage (No. of days from sample collection): Not Applicable

SAMPLE DISPOSAL

Personnel/Organization: Laboratory responsible for analysis will dispose of samples

Number of Days from Analysis: 90 days

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):
Packaging for all shipments will be performed according to the EPA Contract Laboratory Program (CLP) Guidance for Field Samplers, Final (EPA 2007) and TSOP 2-1. To maintain a record of sample collection transfer between field personnel, shipment, and receipt by the laboratory, the applicable sample chain-of-custody paperwork (TSOP 1-2) is completed for each shipment (i.e., cooler) of packed sample bottles or summa cannisters. The team member actually performing the sampling is personally responsible for the care and custody of the samples collected until they are transferred properly. The field technician will review all field sampling activities to confirm that proper custody procedures were followed during the field work. Subcontractor personel relinquishing the sample to the courier will sign the chain of custody record.

All courier receipts and/or paperwork associated with the shipment of samples will serve as a custody record for the samples while they are in transit from the field to the laboratory. Custody seals should remain intact during this transfer.

Coolers are secured with nylon fiber tape and at least two custody seals are placed across cooler openings. Since custody forms are sealed inside the sample cooler and custody seals remain intact, commercial carriers are not required to sign the chain-of-custody form. For summa cannister shipments, the summa cannister will be shipped in a box secured with nylon fiber tape and at least two custody seals placed across the box openings. No custody seals are required on the summa cannister itself. Examples of custody seals are included in TSOP 1-2.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):
When the samples are delivered to the laboratory, signatures of the laboratory personnel receiving them will be completed in the appropriate spaces on the chain-of-custody record. This will complete sample transfer.

It will be each laboratory's responsibility to maintain internal logbooks and records that provide a custody record throughout sample preparation and analysis. To track field samples through data handling, the subcontractors responsible for sampling will maintain photocopies of all chain-of-custody forms.

Sample Identification Procedures:
Refer to Worksheet #26.

Chain-of-custody Procedures:
The subcontractors responsible for sampling will follow TSOP 1-2, Sample Custody, for chain-of-custody procedures.

QAPP Worksheet #28
QC Samples Table

Duplicates
Field duplicate samples are collected and analyzed to assess the overall precision of the field sampling technique. Duplicate samples, of a similar matrix, will be collected at a rate of five percent or at least one per every 20 samples. These duplicates will be submitted "blind" to the laboratories by using sample numbers that differ from their associated environmental samples. For groundwater samples collected during the annual site-wide groundwater event, duplicate samples will be collected on a per event basis. For process samples, duplicate samples will be collected based on an ongoing sample count basis.

Duplicate samples will be collected by alternately filling bottles for the same analysis. Duplicate air samples will be co-located.

Trip Blanks
A trip blank will be prepared by the LTRA subcontract team at the start of each day on which aqueous samples will be collected for analysis of VOCs and ethane/ethene. Trip blanks are used to determine whether on site atmospheric contaminants are seeping into the sample vials, or if any cross-contamination of samples is occurring during shipment or storage of sample containers. A trip blank consists of demonstrated analyte-free water sealed in 40-ml Teflon septum vials with no headspace (including bubbles) in the vials. Trip blank water will be considered analyte-free when analysis results for VOC analysis are below Contract Required Quantitation Limits (CRQL). Certification of blank water quality will be kept on site and will be filed in the RAC 2 project files once field work is completed.

Trip blanks are to be kept in close proximity to the samples being collected and will be maintained at 4 degrees Celsius (°C) and handled in the same manner as the other VOC or ethane/ethene aqueous samples. Preservation of trip blanks is presented on Worksheet # 19. One trip blank will be included with each daily shipment that contains aqueous samples collected for VOC analysis and one trip blank will be included with each daily shipment that contains aqueous samples collected for ethane/ethene analysis. Trip blanks will be analyzed by the same VOC method as the associated set of VOC samples.Trip blanks will be analyzed by the same ethane/ethene method as the associated set of ethane/ethane samples.

Field Blanks
One field blank will be collected for each equipment type per decontamination event and will be analyzed for the same constituents as the environmental samples. Field blanks, also known as "rinsate blanks" or "equipment blanks," are used to assess the effectiveness of equipment decontamination. Field blanks will be collected before the use of the decontaminated equipment for sampling. The frequency for field blanks is one a minimum of 1 per day for each equipment type and for each sample matrix. Field blanks are generated by pouring demonstrated analyte-free water over or through the decontaminated sampling tool. The definition of demonstrated analyte-free water is discussed in the previous section. Field blanks will be collected in a way that will minimize potential contamination from the ambient air. The use of the same aliquot of water on all equipment associated with a particular matrix for the required analyses is permissible. However, a separate field rinse blank must be collected for each piece of equipment associated with a particular sample matrix that will be analyzed for VOCs. Preservation of field blanks is specified on Worksheet # 19. Field blanks will accompany the set of samples collected by the decontaminated sampling equipment and will be kept at 4°C.

QAPP Worksheet #28
QC Samples Table

Cooler Temperature Indicators One cooler temperature indicator or "temperature blank" will be placed in each cooler containing samples (solid and aqueous) being sent to the laboratory for analysis. The temperature blank will consist of a sample container filled with non-preserved water (potable or distilled). The container will be labeled "COOLER TEMPERATURE INDICATOR" and dated.

QAPP Worksheet #28-a
QC Samples Table

Matrix: Aqueous

Analytical Group/Concentration Level: Trace TCL VOC

Sampling SOP: Tutu Wellfield Site Low-flow Groundwater SOP (App. A) for groundwater sampling only

Analytical Method / SOP Reference: SOM01.2

Sampler's Name/ Field Sampling Organization: TBD/TBD

Analytical Organization: DESA, EPA CLP or Subcontract lab (FASTAC will be followed)

No. of Sample Locations Annual Site wide sampling event: 30 well locations and 5 samples per location, Process Sampling: 7 Locations and 1 sample per location per month

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field rinsate blank	1 per decontamination event per matrix; or 1 per day	≤ CRQL	Verify results; reanalyze	Laboratory analyst/LTRA PM	Contamination – Accuracy/bias	CRQL
Trip blank	1 per cooler containing VOC	≤ CRQL	Verify results; reanalyze	Laboratory analyst/ LTRA PM	Contamination – Accuracy/bias	CRQL
Temperature blank	1 per cooler	≤ 6 degrees C; ≤ 10 degrees C for data validation	Inform field crew to use adequate coolant	Laboratory analyst/ LTRA PM	Accuracy/bias	≤ 10 degrees Celsius
Method blank	1 per 12 hours per instrument	≤ CRQL	Per SOM01.2	Laboratory analyst	Contamination – Accuracy/bias	≤ CRQL
Field Duplicate*	1 per 20 samples per matrix	None	Data assessor to inform SM if RPD or ABS exceeds MPC*	LTRA PM	Homogeneity/Precision	RPD ≤ 50% ABS ≤ 5X CRQL
DMC	Each Sample and Standard	28-155[1]	Per SOM01.2	Laboratory analyst	Accuracy	As per method

The number of QC samples are listed on Worksheet 20
ABS applied when sample or duplicate results are detected below contract required quantitation limit (CRQL) or up to 5 times the CRQL.
* This will be documented on Field Duplicate Comparison Table in the data quality report. See worksheet 37 for Usability Assessment

LCS = Laboratory control sample MPC = measurement performance criteria ABS = absolute value RPD = relative percent difference

1. QC acceptance limits vary and more complete ranges are compound specific

QAPP Worksheet #28-b
QC Samples Table

Matrix: Aqueous (groundwater)

Analytical Group/Concentration Level: Nitrate, Sulfate, Chloride (Method 300 series)/ Low

Sampling SOP: Tutu Wellfield Site Low-flow Groundwater SOP (App. A)

Analytical Method / SOP Reference: See worksheets 19 & 23

Sampler's Name/ Field Sampling Organization: TBD/TBD

Analytical Organization: DESA or Subcontract lab (FASTAC will be followed)

No. of Sample Locations: 5 locations, 5 samples per location

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Temperature blank	1 per cooler	≤ 6 degrees C; ≤ 10 degrees C for data validation	Inform field crew to use adequate coolant	Laboratory analyst/LTRA PM	Accuracy/bias	≤ 10 degrees Celsius
Preparation blank	Per Method 300 Series	≤ CRQL	Per Method	Laboratory analyst	Contamination – Accuracy/bias	≤ QL
Field Duplicate[1]	1 per 20 samples per matrix	None	Data assessor inform SM if RPD or ABS exceeds MPC*	LTRA PM	Homogeneity/Precision	RPD ≤ 50% ABS ≤ 5X QL
Laboratory Duplicate	1 per 20 samples	RPD < 20%	Per Method	Laboratory analyst	Precision	RPD ≤ 20%
LCS	1 per 20 samples	80-120%	Per Method	Laboratory analyst	Accuracy	80-120%

The number of QC samples are listed on Worksheet 20
ABS applied when sample or duplicate results are detected below QL or up to 5 times the QL.
* This will be documented on Field Duplicate Comparison Table in the data quality report.
1. See worksheet 37 for Usability Assessment

LCS = Laboratory control sample   MPC = measurement performance criteria ABS = absolute difference RPD = relative percent difference

QAPP Worksheet #28-c
QC Samples Table

Matrix: Aqueous (groundwater)
Analytical Group/Concentration Level: TOC
Sampling SOP: See Worksheet 17f
Analytical Method / SOP Reference: EPA 415.1
Sampler's Name/ Field Sampling Organization: TBD/TBD
Analytical Organization: DESA or Subcontract lab (FASTAC will be followed)
No. of Sample Locations: Process Sampling: 2 locations, 2 samples per location per week

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Calibration blank	1 per sample run	≤ QL	Verify results; reanalyze; recalibrate if still outlying	Laboratory analyst	Contamination – Accuracy/bias	≤ Criteria on Worksheet 15
Temperature blank	1 per cooler	≤ 6 degrees C; ≤ 10 degrees C for data validation	Inform field crew to use adequate coolant	Laboratory analyst/ LTRA PM	Accuracy/bias	≤ 10 degrees Celsius
Field Duplicate*	1 per 20 samples	None	Data assessor to inform SM if RPD OR ABS exceeds MPC	LTRA PM	Homogeneity/ Precision	RPD ≤ 50% ABS ≤ 5X QL
Laboratory Duplicate	1 per 20 samples	RPD ≤ 20%	Flag outliers	Laboratory Analyst	Precision	RPD ≤ 20%
Carbonate-bicarbonate standard	1 per batch	± 10% of true value	Re-prep and re-analyze; recalibrate if still outlying	Laboratory analyst	Contamination – Accuracy/bias	± 20% of true value
LCS	1 per batch	80 – 120%			Accuracy/bias	80 – 120%

The number of QC samples are listed on Worksheet 20
ABS applied when sample or duplicate results are detected below QL or up to 5 times the QL.
* This will be documented on Field Duplicate Comparison Table in the data quality report. See worksheet 37 for Usability Assessment

LCS = Laboratory control sample MPC = measurement performance criteria ABS = absolute difference RPD = relative percent difference

QAPP Worksheet #28-d
QC Samples Table

Matrix: Aqueous (groundwater)
Analytical Group/Concentration Level: TSS
Sampling SOP: See Worksheet 17f
Analytical Method / SOP Reference: EPA 160.2
Sampler's Name/ Field Sampling Organization: TBD/TBD
Analytical Organization: DESA or Subcontract lab (FASTAC will be followed)
No. of Sample Locations: Process Sampling: 2 location, 2 samples per location per week

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Preparation Blank (PB)	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	Laboratory analyst	Accuracy/Sensitivity	No analyte > QL
Temperature blank	1 per cooler	≤ 6 degrees C; ≤ 10 degrees C for data validation	Inform field crew to use adequate coolant	Laboratory analyst/ LTRA PM	Accuracy/bias	≤ 10 degrees Celsius
Field Duplicate*	1 per 20 samples per matrix	None	Data assessor to inform SM if RPD OR ABS exceeds MPC	LTRA PM	Homogeneity/Precision	RPD ≤ 50% ABS ≤ 5X CRQL
Laboratory Duplicate	1 per 20 samples	None	Flag outliers	Laboratory analyst	Precision	RPD ≤20%
LCS	After calibration, every 20 samples and at end of day	None	Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	Laboratory analyst	Accuracy	80-120%R
Detection Limit Verification Standard	1 per sample run	± 20% of true value		Laboratory analyst	Accuracy/bias	± 20% of true value

The number of QC samples are listed on Worksheet 20
ABS applied when sample or duplicate results are detected below CRQL or up to 5 times the CRQL.
* This will be documented on Field Duplicate Comparison Table in the data quality report. See worksheet 37 for Usability Assessment

LCS = Laboratory control sample MPC = measurement performance criteria ABS = absolute difference RPD = relative percent difference

QAPP Worksheet #28-e
QC Samples Table

Matrix: Aqueous (groundwater)
Analytical Group/Concentration Level: Ethane/Ethene
Sampling SOP: Tutu Wellfield Site Low-flow Groundwater SOP (App. A)
Analytical Method / SOP Reference: RSK 175
Sampler's Name/ Field Sampling Organization: TBD/TBD
Analytical Organization: DESA or Subcontract lab (FASTAC will be followed)
No. of Sample Locations: 5 locations, 5 samples per location

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Blank	1 per decon event per matrix; or 1 per day	≤ CRQL	Verify Results; reanalyze	Laboratory analyst/ LTRA PM	Contamination – Accuracy/bias	≤ Criteria on Worksheet #12
Trip Blank	1 per cooler	≤ QL	Verify Results; reanalyze	Laboratory analyst/ LTRA PM	Contamination – Accuracy/bias	≤ QL
Temperature Blank	1 per cooler	≤ 6 °C ≤ 10 °C for data validation	Inform field crew to use adequate coolant	Laboratory analyst/ LTRA PM	Accuracy/bias	≤ 10 °C
Method Blank	Daily	≤ QL	Used to adjust background levels. No corrective action required	Laboratory analyst	Contamination – Accuracy/bias	≤ QL
Calibration check	Pre-analysis at end of day	15% of true value	Verify / reanalyze	Laboratory analyst	Accuracy/bias	NA
Field duplicate	1 per 20 samples per matrix	None	Data assessor to inform SM if RPD or ABS exceeds MPC*	LTRA PM	Homogeneity/ Precision	RPD ≤ 50% ABS ≤ 5X CRQL
Laboratory duplicate	1 per 20 samples	RPD < 20%	Verify results re-prepare and reanalyze	Laboratory analyst	Precision	RPD ≤ 20%
LCS	Each batch	50-150%	Per method	Laboratory analyst	Accuracy	As per method

The number of QC samples are listed on Worksheet 20
ABS applied when sample or duplicate results are detected below CRQL or up to 5 times the CRQL.
* This will be documented on Field Duplicate Comparison Table in the data quality report. See worksheet 37 for Usability Assessment

LCS = Laboratory control sample MPC = measurement performance criteria ABS = absolute value RPD = relative percent difference

QAPP Worksheet #28-f
QC Samples Table

Matrix: Air
Analytical Group/Concentration Level: VOCs
Sampling SOP: TSOP 1-8
Analytical Method / SOP Reference: TO-14A
Sampler's Name/ Field Sampling Organization: TBD/TBD
Analytical Organization: DESA, CLP or Subcontract lab (FASTAC will be followed)
No. of Sample Locations: 1 location and 60 samples

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	Per TO-14A	≤ QL	Per TO-14A	Laboratory analyst	Contamination – Accuracy/bias	≤ QL
Field Duplicate*	1 per 20 samples per matrix	None	Data assessor to inform SM if RPD or ABS exceeds MPC	LTRA PM	Homogeneity/Precision	RPD ≤ 50%
Audit Standard	Per TO-14A	Per TO-14A	Per TO-14A	Laboratory analyst	Accuracy	90-110 %
LCS	1 per 20 samples	± 35%	Flag outliers	Laboratory analyst	Accuracy	± 35%

The number of QC samples are listed on Worksheet 20
ABS applied when sample or duplicate results are detected below CRQL or up to 5 times the CRQL.
* This will be documented on Field Duplicate Comparison Table in the data quality report. See worksheet 37 for Usability Assessment

LCS = Laboratory control sample MPC = measurement performance criteria ABS = absolute difference RPD = relative percent difference

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
Forms II Lite Traffic Reports/ COC Records	Equipment Calibration and Maintenance Log	Sample Receipt, Custody and Tracking Logs	Field Sampling Audit Plans, Reports and Checklists	M&TE (measurement and testing equipment) Forms
Airbills	Field Data Collection Logs	Standards Tracking Logs	Office Audit Plans, Reports and Checklist	Technical/QA Review Forms
Sample Tracking Log/Sheets	PID Logs, if applicable	Sample Disposal and Waste Manifests	Corrective Action Reports	Purchase Requisition Forms
Field logs/logbooks	Water Quality Data Logs	Sample Preparation Logs	Analytical sample results	Telephone Logs
Chain of Custody Forms	Photographs	Corrective Action Reports	Subcontract Laboratory certifications	Electronic Data Deliverables
Field Change Request Forms	Water Level Measurement logs	Corrective Action Forms	Subcontract Laboratory QA Plan (on file with EPA and CDM)	Electronic PLC Files
Custody Seals	Groundwater treatment facility data collection logs	Data Packages (Case Narratives, Sample Results, QC Summaries and Raw Data (detailed in CLP SOPs).	QC Audit Reports	Subcontract Documents (Contract, Scopes of Work, Bid Sheet)
ANSETS Forms	Inspection and maintenance records	Trip Reports	Data Validation SOPs	Electronic Transducer data
N/A	Spill incident reports	N/A	Data Validation Reports	Subcontract Laboratory SOPs
N/A	N/A	N/A	Data Package Completeness Checklist Validated Data Reports	Non-Conformance Reports

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
N/A	N/A	N/A	Self Assessment Checklist	Manufacturer's literature, certificates, and warranties for all new procured government owned equipment
N/A	N/A	N/A	Data Quality Assessments	RA Progress Reports
N/A	N/A	N/A	N/A	Monthly O&M Reports
N/A	N/A	N/A	N/A	LTRA Subcontractor Plans including SAMP/QAPP

QAPP Worksheet #30
Project Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations / ID Number	Analytical SOP[1]	Data Package Turnaround Time	Laboratory / Organization (name, address, contact person & telephone number)	Backup Laboratory / Organization[2] (name, address, contact person & telephone number)
Groundwater well Sampling							
Aqueous	TCL VOCs (trace)	Trace	Figure 2 & Table 3/ worksheet #26	SOM01.2	14 days	DESA or CLP laboratory Contact: Adly Michael: (732) 906-6161	LTRA Subcontract laboratory Contact: TBD
Process Monitoring Sampling							
Aqueous	TCL VOCs	Trace	Figures 3 and 4 & Table 2/ worksheet #26	SOM01.2	14 days	Subcontract laboratory Information TBD	N/A
	Wet chemistry (see worksheet 19 for list)	Low		Various (Worksheet #19)	See Worksheet #19		
Air	VOC	Low		TO-14A	14 Days		

1. Please note that the required quantitation limits and CLP method options are detailed on worksheet 15
2. One of the subcontractor's laboratories will be used if DESA or CLP does not have capacity or cannot be used (process samples)

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation) [1]	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Health and Safety	Once if warranted	External	EPA	Shawn Oliveira or designee (H&S Manager, CDM)	Demetrios Klerides (SM)	Demetrios Klerides (SM)	Shawn Oliveira or designee, SSHO
Field Audit	Once	External	LTRA Subcontractor	Approved field auditor	Greg Wallace (LTRA Subcontractor PM)	Greg Wallace (LTRA Subcontractor PM)	Subcontractor's QA Manager
Field Audit	Once	Internal	CDM	Approved field auditor	Demetrios Klerides (SM)	Demetrios Klerides (SM)	Jeniffer Oxford, RQAC
Office Audit	Once	Internal	CDM	Approved CDM QA Staff	Demetrios Klerides (SM)	Demetrios Klerides (SM)	Jeniffer Oxford or designee, SM
Laboratory Audit	Once if warranted	Internal	CDM	Approved laboratory auditor	Laboratory QA manager or Director (TBD)	Laboratory Auditor, Laboratory Staff	Laboratory Auditor, Laboratory Manager
Laboratory Audit	Once if warranted	External	LTRA Subcontractor	Approved laboratory auditor	Laboratory QA manager or Director (TBD)	Laboratory Auditor, Laboratory Staff	Laboratory Auditor, Laboratory Manager
QAPP	Annually	Internal	CDM	Ellen Gallerie (project engineer, CDM)	Demetrios Klerides (SM)	Demetrios Klerides (SM)	Jeniffer Oxford

Notes:
All CDM auditors are pre-approved and trained by CDM's QA Director or headquarter QA specialist. A list of approved auditors grouped by their location and areas of expertise is included in the CDM Auditor's Handbook and on the CDM intranet. A person is selected to perform a specific audit based on their education, experience, qualifications, professional credentials and competence as compared to the tasks to be audited. Office audits are only conducted by the office QA Coordinator. Under most circumstances, field and laboratory audits are conducted by the office QA Coordinator, however, if the QA Coordinator is unable to conduct the audit, the QA Coordinator will designate an approved alternate based on the required area of expertise. Audits performed by the LTRA Subcontractor or the LTRA Subcontractor's lower tier subcontractors will be performed by an auditor designated by the LTRA Subcontractor's (or lower tier subcontractor's) QA program. If an auditor is not specified by the QA program, the auditor's qualifications will be submitted to CDM for approval by CDM's site manager and QA Coordinator.

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Health and Safety	Audit checklist	Demetrios Klerides (SM) LTRA Subcontractor H&S Manager	Notify by phone immediately Report 1 week after audit	Memorandum and checklist	Shawn Oliveira, CDM Health and Safety Manager	Dependent on nature of identified issues and required corrective action
Field Audit	Field Audit Report (LTRA Subcontractor)	Greg Wallace (LTRA Subcontractor PM) Demetrios Klerides (SM) Ellen Gallerie (Project Engineer)	Provide summary of findings to field team on day of audit; Draft Report due within 10-15 days	Corrective Action Plan provided to CDM	Jeniffer Oxford, CDM RQAC Coordinator; Doug Updike, CDM QA Manager; Demetrios Klerides, CDM SM; Ellen Gallerie, CDM project engineer	H&S manager or QA manager will determine and document on corrective action notice
Field Audit	Field Audit Report	Ellen Gallerie (Project Engineer) Demetrios Klerides (SM) Greg Wallace (LTRA Subcontractor PM)	Provide summary of findings to field team on day of audit; Draft Report due within 10-15 days	Corrective Action Plan	Jeniffer Oxford, CDM RQAC Coordinator; Doug Updike, CDM QA Manager	
Office Audit	Office Audit Report	Demetrios Klerides (SM) Ellen Gallerie (Project Engineer)	Provide summary of findings to SM on day of audit; Draft Report due within 10-15 days	Memorandum	Jeniffer Oxford, CDM RQAC, Doug Updike, CDM QA Manager	
QAPP	Memorandum	Demetrios Klerides (SM) Ellen Gallerie (Project Engineer)	Draft Report due 30 days	Memorandum and/or FCRs	Jeniffer Oxford, CDM RQAC,	

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Field Change Requests	As needed	Promptly – prior to initiation of change or as requested by EPA.	Ellen Gallerie, CDM project engineer	QAPP recipients
QAPP Addendums	As needed	As per client request	CDM project engineer	QAPP recipients
Field Audit Report	Once	15 days (draft) and 30 days (final) after audit	Field Auditor	Demetrios Klerides, SM Bob Goltz, Program Manager, Jeanne Litwin, Deputy Program Manager Doug Updike, QA Manager, Caroline Kwan, EPA RPM William Sy, EPA QA
Office Audit Report	Once	15 days (draft) and 30 days (final) after audit	Jeniffer Oxford, (RQAC) or designee	
Corrective Action Reports	As required on CA request	As per corrective action request	QA Auditor	
Data Usability Assessments	With each Measurement Report	Prior to data evaluation	Scott Kirchner (ASC)	Caroline Kwan, EPA RPM Other EPA and stakeholders as directed by the EPA RPM Demetrios Klerides, SM
Trip Reports	For each assigned case	7 days after sampling	LTRA Subcontractor (TBD)	Adly Michael, EPA RSCC Ellen Gallerie, CDM PE Scott Kirchner, CDM ASC Jeniffer Oxford, RQA

QAPP Worksheet #34
Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of custody	Form will be internally reviewed upon completion and verified against field logs, laboratory report and QAPP. Review will be conducted with completion of each measurement report.	Both	Environmental Services Assistance Team (ESAT), EPA or LTRA Subcontractor validator LTRA subcontractor, Scott Kirchner (ASC) - CDM
Field Logs/Logbooks	Field logs/logbooks will be reviewed for accuracy and completeness and placed in project file.	Internal	Ellen Gallerie – CDM Project Engineer
		External	LTRA subcontractor
Laboratory Logbooks	Laboratory logbooks will be reviewed for accuracy and completeness and placed in project file.	External	LTRA subcontractor, if lab states so
Field and Laboratory data and QC Report	Data validation reports, QAPP, FCRs and outputs of the EQuiS database will be used to prepare the project data quality and usability assessment report. The data will be evaluated against project DQOs and measurement performance criteria, such as completeness.	Internal	Scott Kirchner (ASC) - CDM
Field Sampling Procedures	Evaluate whether field sampling procedures were followed with respect to equipment and proper sampling support using audit and sampling reports, field change request forms and field logs/logbooks.	External	LTRA subcontractor
		Internal	Ellen Gallerie – CDM Project Engineer
Laboratory Data	All laboratory data will be verified by the laboratory performing the analysis for completeness and technical accuracy prior to submittal to EPA. Subsequently, EPA or its contractor will evaluate the data packages for completeness and compliance for RAS data. Non-RAS data will be verified by the subcontractor laboratory performing analysis for completeness and technical accuracy prior to submittal to LTRA subcontractor.	External	Laboratory manager or QA Officer - TBD ESAT, EPA or LTRA subcontractor validator
EDDs	Determine whether required fields and format were provided.	Internal	Melinda Olsen - CDM
QAPP	All planning documents will be available to reviewers to allow reconciliation with planned activities and objectives.	Internal	All data users

QAPP Worksheet #35
Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Methods	Records support implementation of the SOP - sampling and analysis	EPA (ESAT, CLP or DESA) The subcontractor will be responsible for the validation of subcontract laboratory generated data.
IIa	Chain of Custody	Examine traceability of data from sample collection to generation of project reported data. Provides sampling dates and time; verification of sample ID; and QC sample information.	
IIb	Data Narrative	Determine deviations from methods and contract and the impact.	
IIb	Audit Report	Reports used to validate compliance of field sampling, handling and analysis activities with the QAPP.	
IIb	Project Quantitation Limit Goals	Achieved as outlined in the QAPP and that the laboratory successfully analyzed a standard at or near the QL.	
IIb	Field and Lab data and QC report	A summary of all QC samples and results will be verified for measurement performance criteria, completeness and 10 percent verified to field and laboratory data reports from vendors. A report on the meeting the established criteria shall be prepared within 30 days of receipt.	
IIb	Data Package	Used to perform data validation on 100 percent of all CLP data. Any subcontractor analyzed data will be validated by the subcontractor. A report shall be prepared within 30 days of data receipt (final data package). Ensure that all analytical procedures were followed. Corrective actions will be taken and documented when applicable per specific methods. Deviations will be documented. Data will be qualified in accordance with specific methods.	

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Date Validator (Title, Organization)
IIa /IIb	Monitoring Wells Groundwater Samples	TCL VOCs (Trace)	Low	Region II - Data Validation Guidelines SOP HW-34, rev 1	DESA, EPA or LTRA Subcontractor per FASTAC
IIa /IIb	Monitoring Wells Groundwater Samples	Wet Chemistry[1]	Low	DESA or LTRA subcontract data validation SOP	DESA, EPA or LTRA Subcontractor per FASTAC
IIa /IIb	Process Monitoring Sampling Aqueous	Wet Chemistry[2]	Low	LTRA subcontract data validation SOP	LTRA Subcontractor
IIa /IIb	Process Monitoring Sampling Aqueous	TCL VOCs (Trace)	Low	Region II - Data Validation Guidelines SOP HW-34, rev 1	LTRA Subcontractor
IIa /IIb	Process Monitoring Sampling Air	VOCs	Low	Region II - Data Validation Guidelines SOP HW-18	LTRA Subcontractor

1. Wet chemistry includes: nitrate/nitrite, ethane and ethene, sulfate, chloride, and TOC

2. Wet chemistry includes: TOC and TSS

QAPP Worksheet #37
Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

The Data Usability Assessment will be performed by a team of personnel at CDM. The Data Usability Assessment is only required for the COCs (tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, vinyl chloride, benzene, toluene, ethylbenzene, o-xylene, and mp-xlyene) analyzed during the annual groundwater sampling events. Demetrios Klerides, SM, will be responsible for information in the Usability Assessment. He will also be responsible for assigning task work to the individual task members who will be supporting the Data Usability Assessment. Note that the Data Usability Assessment will be conducted on validated data. The results of the Data Usability Assessment will be presented in the data evaluation report. After the Data Usability Assessment has been performed, data deemed appropriate for use will then be used in the RA progress reports. The following items will be assessed and conclusions drawn based on their results.

<u>Precision</u> – Results of laboratory duplicates will be assessed during data validation and data will be qualified according to the data validation procedures cited on Worksheet #36. Field duplicates will be assessed by matrix using the RPD for each pair of results reported above CRQL or QL for organic and inorganic analyses. RPD acceptance criteria, presented in Worksheet #12, will be used to access field sampling precision. Absolute difference will be used for low results as described in worksheets 12 and 28. A discussion summarizing the results of laboratory and field precision and any limitations on the use of the data will be described.

<u>Field duplicates</u> - The site manager will review the extent of exceedance of the field duplicate criteria. For groundwater, the sample results will be flagged according to the data validation protocol. This information will be included in the data assessment report. The data assessor will review the data validation report. If the field duplicate comparison is not included, it will be performed by the assessor.

<u>Accuracy/Bias Contamination</u> – Results for all laboratory blanks will be assessed as part of the data validation. During the data validation process the validator will qualify the data following the procedures described on Worksheet #36. A discussion summarizing the results of laboratory accuracy and bias based on contamination will be presented and any limitations on the use of the data will be described.

<u>Overall Accuracy/Bias</u> – The results of instrument calibration will be reviewed and data will be qualified according to the data validation procedures cited on Worksheet #36. A discussion summarizing the results of laboratory accuracy and any limitations on the use of the data will be described.

<u>Sensitivity</u> – Data results will be compared to criteria provided on Worksheet #15. A discussion summarizing any conclusions about sensitivity of the analyses will be presented and any limitations on the use of the data will be described.

<u>Representativeness</u> – A review of adherence to the sampling plan, field procedures and the results of project QA audits will be performed in order to assess the representativeness of the sampling program. Data validation narratives will also be reviewed and any conclusions about the representativeness of the data set will be discussed.

<u>Comparability</u> – The results of this study will be used in conjunction with existing data to make qualitative and quantitative assessments of the data to be used to produce the Site reports. Extensive existing data from the LTRA activities from 2004 through 2008 will be used for comparability. In addition, comparability will be met if the sample collection and analytical procedures are determined to have been followed or did not affect the values reported. Comparability of data

QAPP Worksheet #37
Usability Assessment

will be ensured through the use of standard collection procedures and EPA-approved analytical methods, enabling the current data to be comparable with existing data sets generated using similar methods.

Reconciliation – The DQIs presented in Worksheet #12 will be examined to determine if the measurement performance criteria (MPC) were met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of major impacts observed from data validation then the data quality indicators will be assessed against their MPCs. Based on the results of these assessments, the quality of the data will be determined, and subsequently, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the DQIs were met and whether project goals were achieved. As part of the reconciliation of each objective, conclusions will be drawn and any limitations on the usability of any of the data will be described.

Data validation reports will be reviewed to determine the quality of the data and potential impacts on data usability. Field duplicates will be evaluated against the MPCs outlined in worksheet #12. Non-compliant data will be discussed in the usability report.

Completeness - The planned samples indicated in the QAPP and the number of samples in each analytical fraction that are rejected will be used to calculate the completeness of the obtained data set.

The following equations will be used to evaluate data usability:

1. To calculate field duplicate precision: $RPD = 100 \times 2 |X1 - X2| / (X1 + X2)$ where X1 and X2 are the reported concentrations for each duplicate or replicate

2. To calculate completeness: $\% \text{ Completeness} = V/n \times 100$ where V= number of measurements judged valid; n = total number of measurements made and $\% \text{ Completeness} = C/x \times 100$ where C= number of samples collected; x = total number of measurements planned

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

CDM will determine if quality control data is within specifications (MPC) though the data review and data assessment validation process IIb.

3. Identify the personnel responsible for performing the usability assessment: Scott Kirchner, ASC or designee

4. 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:

A usability report will describe the rationale for the data used and present any data limitations. The report will include a discussion of the accuracy, precision, representativeness, completeness and comparability of the data set and deviations from planned procedures and analysis and the impact on the project objectives. Tables will be prepared, including: collected samples and parameters analyzed; detections in field and trip blanks; and comparison of field duplicates.

QAPP Worksheet #37
Usability Assessment

The procedures described above will be used to ensure that the data generated will meet the data quality objectives. The data generated will be used to complete the following steps

- Confirming the achievement of remedial system performance requirements
- Confirming compliance with the USVI DPNR TPDES permit equivalency and air Pollution Control permit equivalency
- Assessing RA progress and support decisions regarding treatment system operation and optimization

Glossary of Abbreviations

ABS	absolute difference
ARAR	applicable or relevant and appropriate requirement
ASC	analytical services coordinator
ASQ	American Society for Quality
bgs	below ground surface
BOA	basic ordering agreement
BTEX	benzene, toluene, ethylbenzene and xylene
^0C	degrees Celsius
CA	corrective action
CCV	continuous calibration verification
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	code of federal regulations
CIH	certified industrial hygienist
CLP	contract laboratory program
COC	chain of custody
COC	contaminant of concern
CSP	certified safety professional
CRQL	contract required quantitation limits
CVOC	chlorinated volatile organic compound
DESA	Division of Environmental Science and Assessment
DO	dissolved oxygen
DOT	Department of Transportation
DQI	data quality indicator
DQO	data quality objective
DPNR	Department of Planning and Natural Resources
EDDs	electronic data deliverables
EFF	effluent
Eh	oxidation reduction potential
EPA	United States Environmental Protection Agency
EQuIS	Environmental Quality Information Systems
ESAT	Environmental Services Assistance Team
eV	electron volt
FASTAC	Field and Analytical Services Teaming Advisory Committee
FCR	field change request
FS	feasibility study
FT	field technician
GAC	granular activated carbon
GC/MS	gas chromatograph/mass spectrometer
GIS	geographic information system
G&M	Geraghty & Miller
GWTF	groundwater treatment facility
H&S	health and safety
HCl	hydrochloric acid
H_2SO_4	sulfuric acid
ID	identification
IDW	investigation derived waste
INF	influent
L	liter
LAGA	LAGA Industries, Ltd
LAN	local area network
LCS	laboratory control sample

LTRA	long term response action
MCL	maximum contaminant level
MDL	method detection limit
mL	milliliter
MNA	monitored natural attenuation
MPC	measurement performance criteria
MS/D	matrix spike/duplicate
N/A	not applicable
NPL	National Priorities List
O&M	operation and maintenance
OSHA	Occupation Safety and Health Administration
PC	personal computer
PCE	tetrachloroethene
PE	professional engineer
PID	photoionization detector
PLC	programmable logic controller
PM	project manager
PP	potassium permanganate
PPE	personal protective equipment
PQLG	project quantitation limit goals
PQO	project quality objective
QA	quality assurance
QAC	quality assurance coordinator
QAPP	quality assurance project plan
QC	quality control
QP	quality procedure
QL	quantitation limit
RA	remedial action
RAC	response action contract
RAS	routine analytical services
RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
RPM	remedial project manager
RQAC	regional quality assurance coordinator
RSCC	Regional Sample Control Center
RSD	relative standard deviation
SA	self assessment
SCBA	self contained breathing apparatus
SDG	sample delivery group
SM	site manager
SOP	standard operating procedures
SOW	statement of work
SVE	soil vapor extraction
TBD	to be determined
TOC	total organic carbon
TPDES	territorial pollutant discharge elimination system
TSOP	technical standard operating procedure
TSS	total suspended solids
µg/L	micrograms per liter
UAO	unilateral administrative orders
USVI	United States Virgin Islands
UV	ultraviolet
VOC	volatile organic compound

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Tables

Table 1
Monitoring Well Construction
Tutu Wellfield Site, St. Thomas, U.S. Virgin Islands

AREA	NAME	X (FT)	Y (FT)	GS (FT AMSL)	TOC (FT AMSL)	TOS (FT AMSL)	BOS (FT AMSL)	TOS (FT BGS)	BOS (FT BGS)
Curriculum Center/ Facility #1	BP-1	1036261	187500	202.67	202.67	162.67	143.87	40	58.8
	BP-2	1036260	187490	202.64	202.64	162.64	142.34	40	60.3
	BP-3	1036259	187481	202.71	202.71	162.71	143.03	40	59.68
	IW-1	1036258	187503	202.79	202.79	127.79	107.69	75	95.1
	IW-1S	1036251	187508	202.85	202.85	162.85	146.23	40	56.62
	IW-2	1036266	187505	202.94	202.94	127.94	112.17	75	90.77
	IW-2S	1036266	187510	203.77	203.77	163.77	143.22	40	60.55
	MW-13	1036477	187456	237.00	236.31	176.01	155.81	60.3	80.5
	MW-13D	1036482	187472	236.67	236.60	136.67	116.67	100.0	120.0
	MW-14	1036105	187330	196.04	196.12	170.84	150.84	25.2	45.2
	MW-15	1035990	187260	178.95	178.95	163.95	142.75	15.0	36.2
	MW-16	1036252	187463	203.00	202.33	177.73	157.73	24.6	44.6
	MW-17	1035930	187249	177.18	177.18	168.68	163.68	8.5	13.5
	MW-1D	1036193	187187	195.14	195.14	125.14	105.14	70.0	90.0
	RD-10	1036152	187556	196.48	199.18	116.48	91.48	80.0	105.0
	RD-11	1036241	187503	202.45	202.46	117.45	92.45	85.0	110.0
	RD-12	1036479	187450	235.46	236.71	105.46	80.46	130.0	155.0
	RD-13	1036233	187163	195.62	196.41	95.62	70.62	100.0	125.0
	RD-9	1036280	187458	203.79	204.41	118.79	93.79	85.0	110.0
	RW-6	1036230	187477	202.17	201.04	122.17	72.17	80.00	130.00
	RW-7	1036262	187464	203.11	202.56	173.11	123.11	30.00	80.00
	RW-8	1036257	187467	202.75	202.75	152.75	97.52	50	105.23
	RW-9	1036255	187460	202.27	202.27	162.77	141.97	39.5	60.3
Texaco	MW-2	1035828	187162	178.31	178.15	171.31	151.31	7.0	27.0
	MW-3	1036085	187129	181.85	181.84	171.45	151.45	10.4	30.4
	MW-4	1035938	187050	175.69	175.66	168.69	148.69	7.0	27.0
	MW-4D	1035944	187045	175.99	176.02	128.29	104.99	47.7	71.0
	MW-5	1035972	186910	187.24	187.09	168.24	148.24	19.0	39.0
	MW-6D	1035799	186786	171.26	171.01	126.26	106.26	45.0	65.0
	MW-6R	1035804	186802	171.44	171.17	168.74	148.74	2.7	22.7
	MW-7	1035989	186667	180.30	180.13	164.90	144.90	15.4	35.4
	RD-5	1036163	186948	189.91	194.00	156.91	146.91	33.0	43.0
	Tillett	1035975	186771	186.00	186.00	177.00	88.00	9.00	98.00
	TT-1	1036009	187002	179.00	179.03	169.03	149.03	10.0	30.0
	TT-3D	1036076	187137	183.50	181.75	140.50	130.50	43.0	53.0
	TT-5	1036106	187027	182.50	182.34	172.50	152.50	10.0	30.0
	TT-6	1035804	186672	169.00	169.18	165.50	155.50	3.5	13.5
Esso	CHT-1	1035815	186506	167.95	167.70	149.45	139.45	18.5	28.5
	CHT-3	1035795	186321	162.87	161.86	139.87	129.87	23.0	33.0
	CHT-4	1035766	186515	166.00	166.95	147.95	137.95	19.0	29.0
	CHT-7D	1035740	186233	159.00	158.29	138.29	34.29	20.0	124.0
	DW-1	1035805	186496	167.52	167.16	102.52	87.52	65.0	80.0
	MW-10	1035794	186280	161.36	161.50	145.76	125.76	15.6	35.6
	MW-10D	1035799	186278	161.52	161.38	106.42	86.42	55.1	75.1
	MW-25	1035632	186489	166.34	166.34	141.34	121.34	25.0	45.0
	MW-8	1035812	186494	167.54	167.54	162.04	142.04	5.5	25.5
	MW-9	1035694	186368	162.32	162.26	148.22	128.22	14.1	34.1
	MW-9S	1035700	186377	162.47	162.37	153.77	143.77	8.7	18.7
	PW-1	1035787	186345	167.31	166.00	155.31	129.00	12.00	38.31
	SW-10	1035721	186286	160.65	160.42	150.65	120.65	10.0	40.0
	SW-1R	1035815	186345	166.69	166.47	154.69	129.47	12.00	37.22
	SW-2R	1035782	186371	167.95	167.70	153.95	128.70	14.00	39.25
	SW-8R	1035758	186344	167.34	167.11	155.34	130.11	12.00	37.23
	SW-9	1035797	186262	160.46	160.46	150.46	120.46	10.0	40.0

Table 1
Monitoring Well Construction
Tutu Wellfield Site, St. Thomas, U.S. Virgin Islands

AREA	NAME	X (FT)	Y (FT)	GS (FT AMSL)	TOC (FT AMSL)	TOS (FT AMSL)	BOS (FT AMSL)	TOS (FT BGS)	BOS (FT BGS)
Facility #2	DW-2	1035682	185937	148.00	147.73	82.73	67.73	65.0	80.0
	Eglin-1	1035604	185826	144.00	146.65	-	-	-	-
	Eglin-3	1035678	185692	152.00	155.17	95.50	-150.00	56.50	302.00
	MW-11D	1035532	186025	153.11	153.22	100.11	78.81	53.0	74.3
	MW-12D	1035791	186063	161.58	161.81	101.08	81.08	60.5	80.5
	MW-19	1035617	186036	148.78	148.78	136.78	131.78	12.0	17.0
	RD-4	1036003	185650	211.74	212.28	-31.26	-51.26	243.0	263.0
	RD-7	1035769	185996	164.36	164.00	94.36	84.36	70.0	80.0
	RW-1	1035799	186102	160.60	160.61	10.60	-39.40	150.00	200.00
	RW-1S	1035799	186091	161.11	161.11	105.11	41.11	56	120
	SW-4	1035573	186137	152.00	152.96	147.96	117.96	5.0	35.0
	SW-6	1035680	185936	148.00	147.60	142.60	112.60	5.0	35.0
Southern Plume	Delegard	1036722	183972	71.00	70.00	41.00	1.00	30.00	70.00
	Laplace	1035995	185151	114.00	114.23	94.00	34.00	20.00	80.00
	MW-21D	1035965	185348	123.48	123.48	47.48	27.48	76.0	96.0
	PZ-4	1037142	183823	59.11	61.34	51.61	41.61	7.5	17.5
	RD-1	1035773	184965	135.95	136.11	40.95	30.95	95.0	105.0
	RD-14	1036181	184610	86.67	89.21	6.67	-43.33	80.0	130.0
	RD-2	1037256	183680	55.93	57.56	-2.07	-12.07	58.0	68.0
	RD-3	1037247	183682	56.05	57.95	36.05	26.05	20.0	30.0
	RD-6	1036264	184528	82.69	85.08	52.69	27.69	30.00	55.00
	RD-8	1035367	185440	141.70	142.46	81.70	71.70	60.0	70.0
	Smith	1036154	184697	90.00	90.00	85.00	30.00	5.00	60.00
	Steele	1035647	185420	177.00	179.33	152.00	62.00	25.00	115.00

Notes:

1. Horizontal coordinates are based on Puerto Rico Coordinate Virgin Island Extension State Plane North American Datum 1927. Vertical elevations are based on the National Geodetic Vertical Datum 1929.

Acronyms:

AMSL - above mean sea level
BGS - below ground surface
BOS - bottom of screen
Esso - Esso Standard Oil, U.S.A., Inc.
FT - feet
GS - ground surface
GW - groundwater
Texaco - Texaco Caribbean, Inc.
TOC - top of casing
TOS - top of screen

Table 2
Sampling and Monitoring Schedule
Tutu Wellfield Site, St Thomas, U.S. Virgin Islands

System or Wells	Sampling and/or Monitoring Activity	Location	Sampling Frequency					Monitoring or Mesurement Frequency						GW Samples							GW Monitoring Parameters						Air Samples	Field Measurements						Water Levels	Notes
			Weekly	Monthly	Quarterly	Semi-Annual	Annual	Daily	Weekly	Monthly	As Required	Quarterly	Continuous	VOCs	TOC	TSS	Nitrate	Sulfate	Chloride	Ethane/Ethene	pH	DO	Conductivity	Temperature	Turbidity	ORP	TO-14a	VOCs-PID	Pressure/ Vacuum	Temperature	Flow	pH	Level		
GWTF #1	Extraction well RW-6 sampling and monitoring	RW influent sample port		•							•			•							•	•	•	•		•									
	Extraction well RW-7 sampling and monitoring	RW influent sample port		•							•			•							•	•	•	•		•									
	Extraction well RW-9 sampling and monitoring	RW influent sample port		•							•			•							•	•	•	•		•									
	GW influent (combined) sampling and monitoring	EQ tank effluent sample port		•							•			•							•	•	•	•		•									
	GWT system monitoring and field measurements	Gauges, meters, instruments						•																					•	•	•	•	•		
	GWT system monitoring and field measurements	Meters											•																		•	•			
	Treated water effluent-TPDES permit sampling and monitoring (monthly)	Air stripper effluent sample port		•										•																					1
	Treated water effluent-TPDES permit sampling and monitoring (weekly)	Air stripper effluent sample port	•						•						•	•															•	•			1
	Off-gas treatment system, air permit sampling	Stack sample ports		•																							•								2
GWTF #2	Extraction well RW-1 sampling and monitoring	RW influent sample port		•							•			•							•	•	•	•		•									
	Extraction well RW-1S sampling and monitoring	RW influent sample port		•							•			•							•	•	•	•		•									
	GW influent (combined) sampling and monitoring	EQ tank effluent sample port		•							•			•							•	•	•	•		•									
	GWT system monitoring and field measurements	Gauges, meters, instruments						•																					•	•	•	•	•		
	GWT system monitoring and field measurements	Meters											•																		•	•			
	Treated water effluent-TPDES permit sampling and monitoring (monthly)	Air stripper effluent sample port		•										•																					1
	Treated water effluent-TPDES permit sampling and monitoring (weekly)	Air stripper effluent sample port	•						•						•	•															•	•			1
GW Monitoring Wells	Site-wide GW, annual sampling	For list of wells, see Table 01730-3					•							•	•		•	•	•	•	•	•	•	•	•	•									3
	Site-wide GW, continuous water levels	For list of wells, see Table 01730-3											•																					•	
	Site-wide GW, monthly water levels	For list of wells, see Table 01730-3								•																								•	

Notes:
1. Per U.S. Virgin Islands DPNR TPDES Permit Equivalency No VID982272569, effective March 1, 2004
2. Per DPNR Air Pollution Control Permit Conditions, dated July 22, 2003
3. Sampling for TOC, nitrate, sulfate, chloride, and ethane/ethene applies to Southern Plume wells only. See Table 01730-3.

Acronyms:
DO - dissolved oxygen
DPNR - Department of Planning and Natural Resources
EQ - equalization
GW - groundwater
GWT - groundwater treatment
GWTF - groundwater treatment facility
ORP - oxidation reduction potential
PID - photo-ionization detector
RW - recovery well
TOC - Total Organic Carbon
TPDES - Territorial Pollutant Discharge Elimination System
TSS - total suspended solids
VOC - volatile organic compound

Table 3
Site-wide Groundwater Monitoring Schedule
Tutu Wellfield Site
St. Thomas, U.S. Virgin Islands

AREA	WELL	SAMPLING [3,5]		WATER LEVEL MEASUREMENT		
	LOCATION	Annual	Notes	Continuous	Monthly	Notes
Curriculum	BP-1				X	
Center/	BP-2				X	
GWTF #1	BP-3				X	
	IW-1				X	
	IW-1S				X	
	IW-2				X	
	IW-2S				X	
	MW-17				X	
	MW-1D	X			X	
	MW-13				X	
	MW-13D	X			X	
	MW-14	X			X	
	MW-15	X			X	
	MW-16			X[7]	X	
	RW-8				X	
	RD-9	X			X	
	RD-10				X	
	RD-11			X[7]	X	
	RD-12				X	
	RD-13	X			X	
Texaco	MW-2	X				
	MW-3			X[7]	X	
	MW-4					
	MW-4D					
	MW-5					
	MW-6R					
	MW-6D	X				
	MW-7	X				
	RD-5	X				
	TT-1					
	TT-3D					
	TT-5					
	TT-6	X				
	Tillett	X				
Esso	CHT-1					
	CHT-3					
	CHT-4					
	CHT-7D					
	DW-1					
	MW-8	X				
	MW-9					
	MW-9S					
	MW-10					
	MW-10D	X				
	MW-25	X				
	P-1					
	SW-1R					
	SW-2R					
	SW-8R					
	SW-9					
	SW-10					

Table 3
Site-wide Groundwater Monitoring Schedule
Tutu Wellfield Site
St. Thomas, U.S. Virgin Islands

AREA	WELL LOCATION	SAMPLING [3,5]		WATER LEVEL MEASUREMENT		
		Annual	Notes	Continuous	Monthly	Notes
GWTF #2	DW-2	X		X[7]	X	
	MW-11D	X			X	
	MW-12D	X			X	
	MW-19				X	
	RD-4				X	
	RD-7	X			X	
	SW-6				X	
	Eglin I				X	
	Eglin III	X	6			
Southern Plume	Delegard	X	4,6			
	Laplace	X	4,6			
	MW-21D	X		X[7]	X	
	PZ-4				X	
	RD-1	X			X	
	RD-2	X			X	
	RD-3	X	4		X	
	RD-6	X			X	
	RD-8	X			X	
	RD-14			X[7]	X	
	Smith	X	4,6			
	Steele	X	4,6			

Notes:

1. Not used
2. Not used
3. Sampling includes VOCs, unless otherwise noted.
4. Sampling includes VOCs, TOC, nitrate, sulfate, chloride, and ethane/ethene (intrinsic biodegradation parameters).
5. Field measurements shall be taken for water level, turbidity, DO, temperature, conductivity, pH, and ORP at all wells during sampling.
6. Active supply well.
7. Continuous water levels will be collected by transducers.

Acronyms:

DO - dissolved oxygen
GWTF - groundwater treatment facility
O&M - operations and maintenance
ORP - oxidation reduction potential
RA - remedial action
TOC - total organic carbon
VOC - volatile organic compound

Legend

Groundwater Monitoring Well Total CVOC Concentrations (ug/L)

- 0 - 9.99
- 10 - 99.99
- 100 - 499.99
- 500 - 999.99
- 1,000 - 1,060
- Not Sampled

128.57 — Posted Groundwater Elevation (feet above mean sea level)

170 — Groundwater Elevation Iso-contours (feet above mean sea level)

April 2008 Groundwater Total CVOC Concentration Iso-contours (ug/L)

Baseline (April 2004) Groundwater Total CVOC Concentration Iso-contours (ug/L)

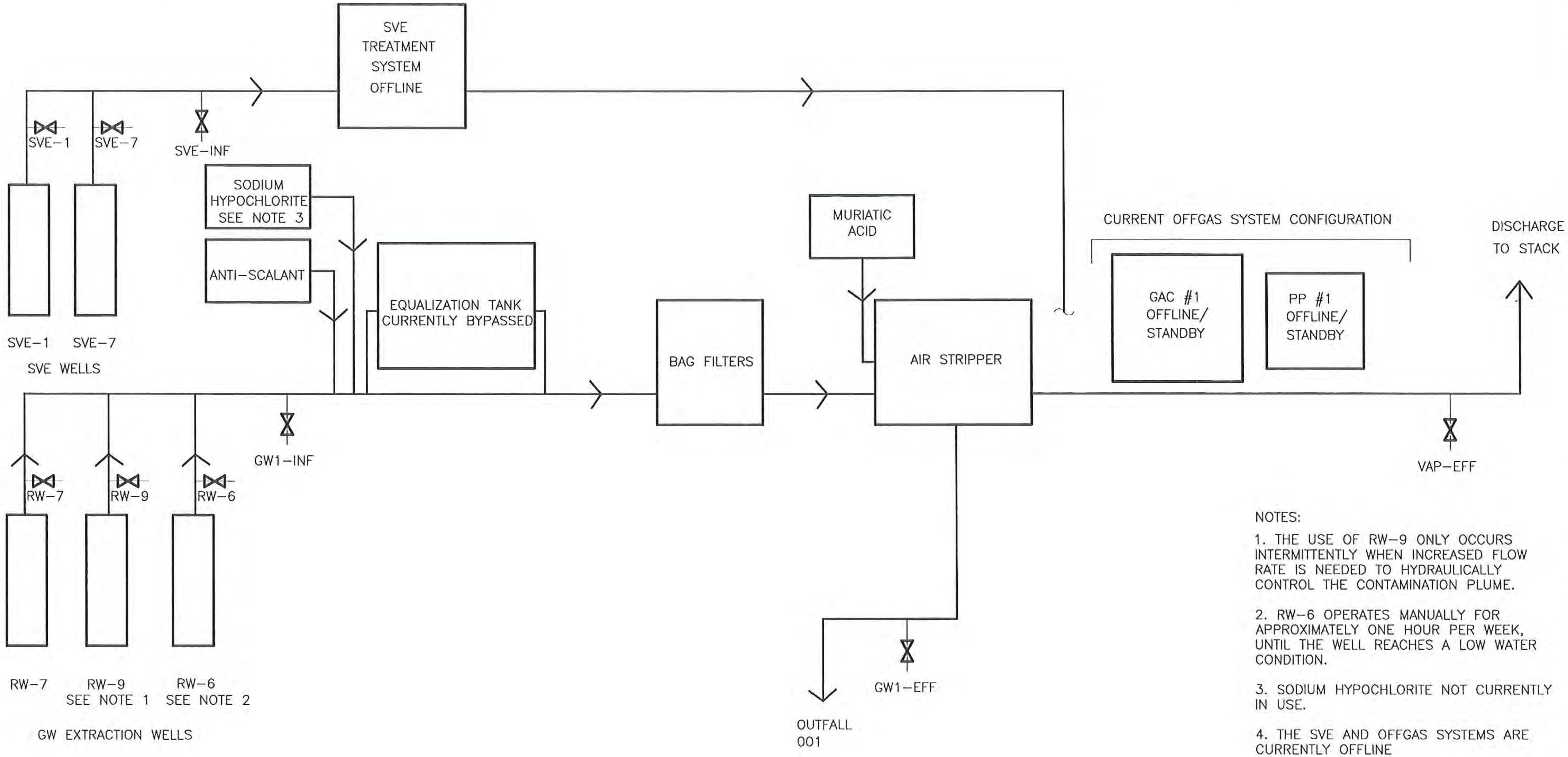
Flow Direction Arrow

Notes:
1. Groundwater samples were collected in April 2008.
2. Groundwater elevations were recorded in April 2008.
3. Only the groundwater elevations from wells spanning the productive zone were used to develop groundwater elevation iso-contours.

0 75 150 300 Feet

Figure 2
Site-Wide Groundwater Elevations and CVOC Concentrations
Quality Assurance Project Plan
Tutu Wellfield Site, St Thomas, USVI

CDM



NOTES:

1. THE USE OF RW-9 ONLY OCCURS INTERMITTENTLY WHEN INCREASED FLOW RATE IS NEEDED TO HYDRAULICALLY CONTROL THE CONTAMINATION PLUME.

2. RW-6 OPERATES MANUALLY FOR APPROXIMATELY ONE HOUR PER WEEK, UNTIL THE WELL REACHES A LOW WATER CONDITION.

3. SODIUM HYPOCHLORITE NOT CURRENTLY IN USE.

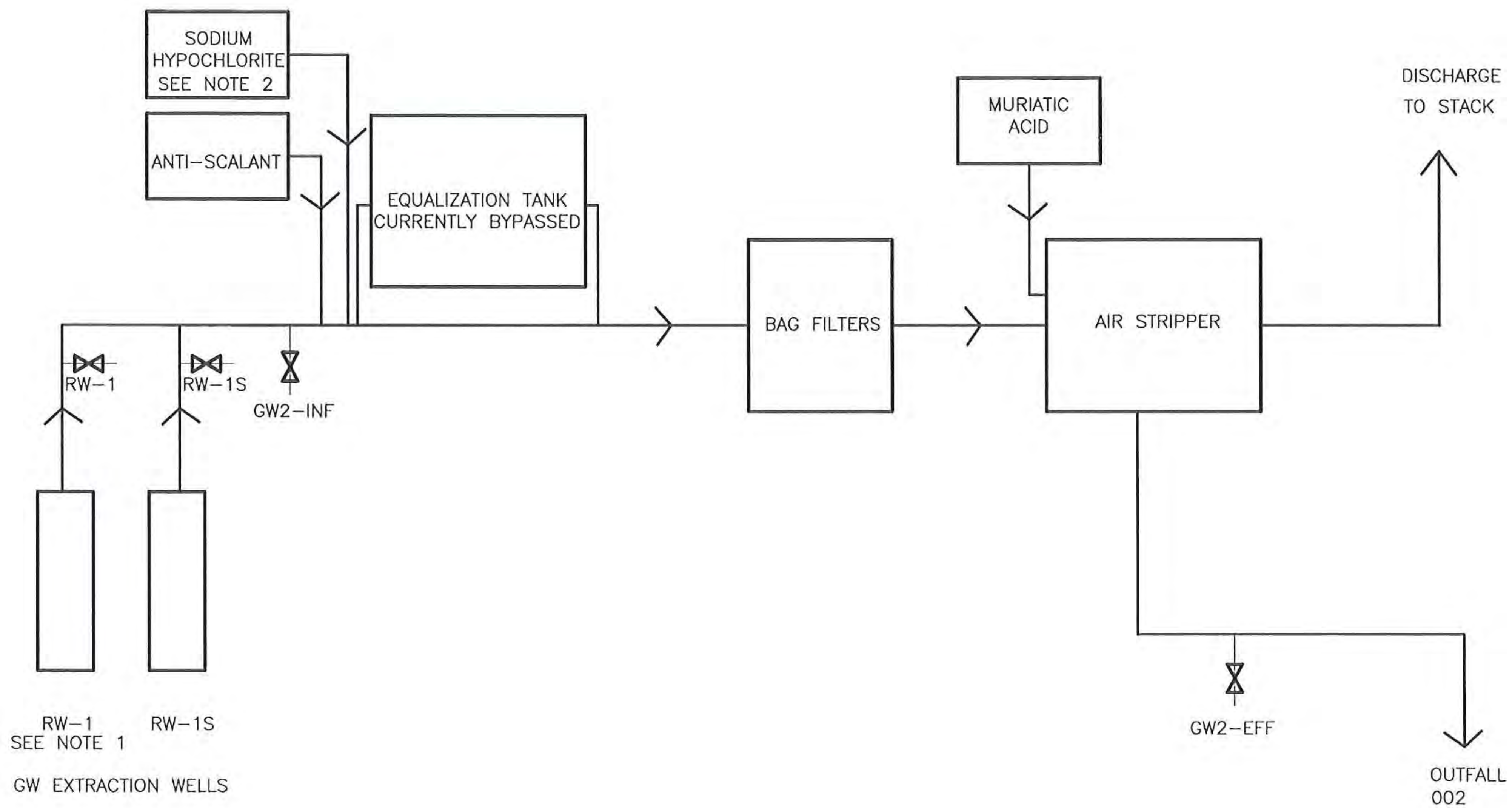
4. THE SVE AND OFFGAS SYSTEMS ARE CURRENTLY OFFLINE

LEGEND

AVG - AVERAGE
GAC - GRANULAR ACTIVATED CARBON UNIT
GPD - GALLONS PER DAY
GW - GROUNDWATER
MAX - MAXIMUM
PP - POTASSIUM PERMANGANATE UNIT
RW - RECOVERY WELL

Figure 3
Groundwater Treatment Facility #1 Schematic and Sample Locations
Quality Assurance Project Plan
Tutu Wellfield Site, St. Thomas, USVI

CDM



NOTES:

1. RW-1 IS CURRENTLY NOT IN USE AND IS NOT LIKELY TO BE USED IN THE FUTURE.

2. SODIUM HYPOCHLORITE NOT CURRENTLY IN USE.

LEGEND

GPD – GALLONS PER DAY
GW – GROUNDWATER
RW – RECOVERY WELL

Figure 4
Groundwater Treatment Facility #2 Schematic and Sample Locations
Quality Assurance Project Plan
Tutu Wellfield Site, St. Thomas, USVI

CDM

Figures

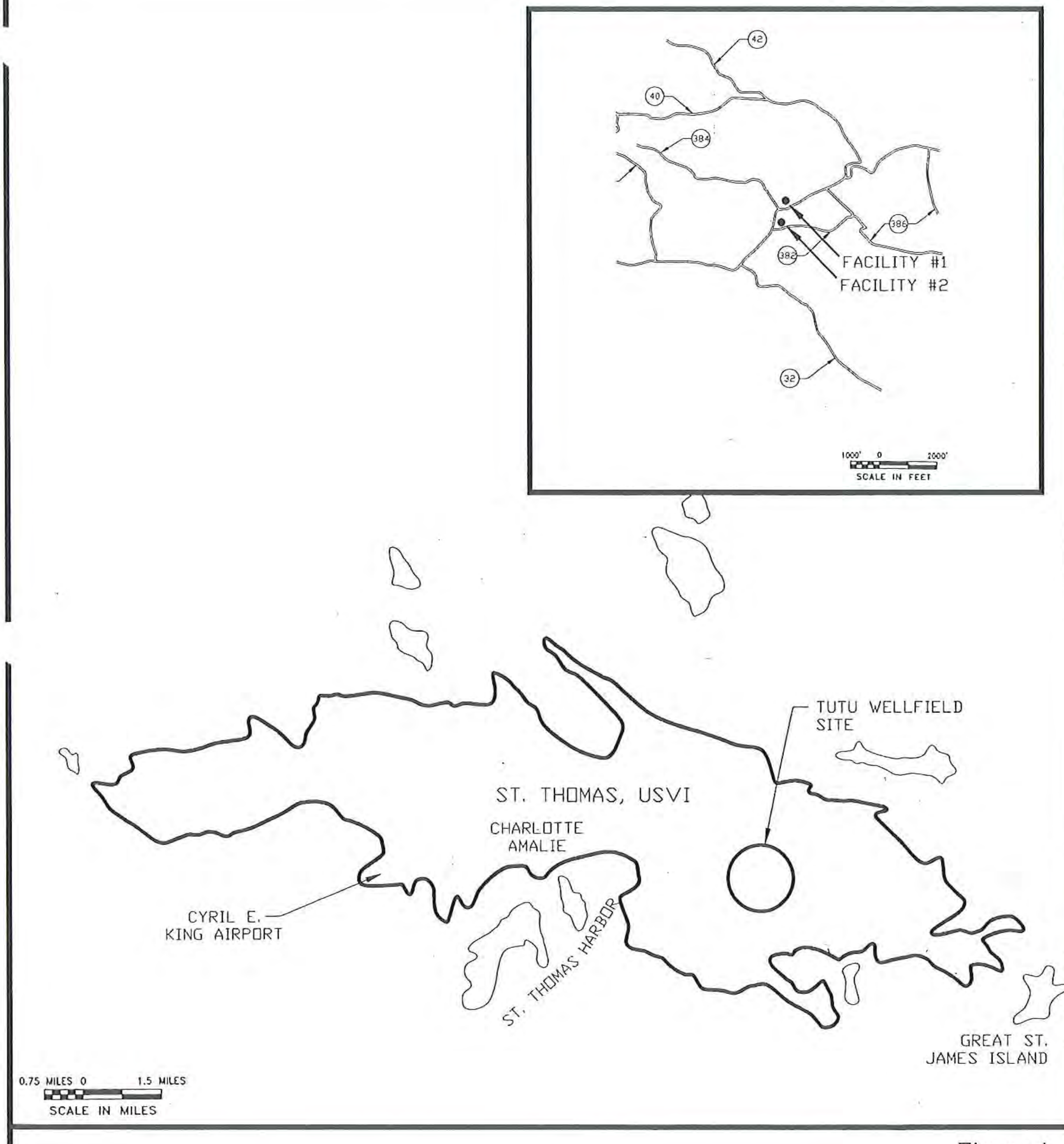


Figure 1
Site Location
Quality Assurance Project Plan
Tutu Wellfield Site, St. Thomas, USVI

CDM

Appendix A

Site-Specific Low Flow Groundwater Purging and Sampling

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUNDWATER SAMPLING PROCEDURE
LOW STRESS (LOW-FLOW) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II preferred method for collecting groundwater samples from monitoring wells at the Tutu Wellfield Site. The procedure minimizes stress on the formation and minimizes disturbance of sediment in the well. The procedure applies to monitoring wells that have well casing with an inner diameter of 2.0 inch or greater. It is appropriate for groundwater samples that will be analyzed for volatile and semi-volatile organic compounds (VOC and SVOC), pesticides, polychlorinated biphenyls (PCB), metals, wet chemistry parameters, and microbiological and other contaminants in association with any EPA program.

This procedure does not address the collection of non-aqueous phase liquid (NAPL) samples and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The goal of the Low Stress Purging and Sampling procedure is to collect samples that are representative of groundwater conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that allows a maximum drawdown of 0.3 foot.

Sampling at such a low flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing a filtered sample from the same well. Second, it minimizes aeration of the groundwater during sample collection, which improves the sample quality for VOC analysis. Third, in most cases it significantly reduces the volume of groundwater purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of a key indicator parameter to stabilize; c) cascading of water and formation of air bubbles in the tubing; and d) cross-contamination.

For wells with insufficient yield (i.e., low recharge rate of the well), care should be taken to avoid loss of pressure in the tubing line, cascading through the sand pack, or pumping the well dry. Purging should be interrupted before the water level in the well drops below the top of the pump. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

If a key indicator parameter fails to stabilize after 4 hours, one of two options should be considered: a) continue purging in an attempt to achieve stabilization; or b) discontinue purging, collect samples, and document attempts to reach stabilization in the log book. The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

For cascading and air bubbles in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 inch ID) to ensure that the tubing remains filled with liquid during sampling.

An item that should be checked on a daily basis, is the water within the cooling chamber of the submersible pump. This chamber should always be filled with demonstrated analyte-free water and any leakage from this chamber should be immediately brought to the attention of the person(s) responsible for equipment maintenance so that the appropriate seals can be replaced. Operating the pump with insufficient water in this cooling chamber could result in the pump overheating and/or pump failure. The analyte-free water should be replaced on a daily basis in order to facilitate the mechanical operation of the pump.

IV. EQUIPMENT

- ☐ **Approved site-specific Quality Assurance Project Plan (QAPP).** Generally, the target depth corresponds to just above the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake.
- ☐ Well construction data, location map, field data from last sampling event.
- ☐ Polyethylene sheeting.
- ☐ Photo Ionization Detector (PID), if required by health and safety plan.
- ☐ Adjustable rate, positive displacement groundwater sampling pump constructed of stainless steel.
- ☐ Interface probe or equivalent device for determining the presence or absence of NAPL.
- ☐ Teflon-lined polyethylene tubing to collect samples for organic and inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- ☐ Electronic water level measuring device, 0.01 foot accuracy.
- ☐ Flow measurement supplies (e.g., graduated cylinder and stop watch).
- ☐ Power source (generator).
- ☐ Monitoring instruments for indicator parameters. Redox potential (Eh) and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Temperature, pH and specific conductance may be monitored with an in-line monitor. A nephalometer is used to measure turbidity.
- ☐ Decontamination supplies (see Section VII, below).
- ☐ Logs/Logbook (see Section VIII, below).
- ☐ Sample bottles.
- ☐ Sample preservation supplies (as required by the analytical methods).
- ☐ Sample tags or labels, chain of custody.
- ☐ Other supplies as specified in the EPA approved field sampling plan/QAPP.

V. SAMPLING PROCEDURES

<u>Pre-Sampling Activities</u>

1. Start at the well known or believed to have the least contaminated groundwater and proceed systematically to the well with the most

contaminated groundwater. Check well for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID or FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one.

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled before any purging begins. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment which has accumulated at the bottom of the well. Record the observations in the log book.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to a depth midway within the screen interval for that well. The pump intake must be kept at least two feet above the bottom of the well to prevent disturbance and resuspension of any sediment or DNAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well with a rate that varies from 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every three to five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every three to five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    $\pm$0.1 for pH
    $\pm$3% for specific conductance (conductivity)
    $\pm$10 mv for redox potential
    $\pm$10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

    If pH adjustment is necessary for sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 mls). Groundwater purged from the well prior to sampling can be used for this purpose.

13. Collect Samples: Collect samples at flow rates of between 100 and 250 ml/min or such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. Samples should be collected at the same flow rate at which the indicator parameters stabilized. VOC samples must be collected first, at the lower rate, and directly into pre-preserved sample containers. All sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for re-sampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance was consulted when preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC and ethane/ethene samples at frequency of one per sample cooler containing VOCs and/or ethane/ethene.

- Field duplicate.
- Trip blank (VOCs and ethane/ethene only)

In addition, an equipment blank will be collected at a rate of once per day or per decontamination event, whichever is less. However, this is not necessary if equipment is dedicated to the well.

Groundwater samples should be collected systematically beginning at wells known or believed to have the lowest level of contamination and proceeding in order to wells known or believed to have the highest level of contamination.

VII. DECONTAMINATION

Sampling equipment must be decontaminated thoroughly each day before use (daily decon) and after each well is sampled (between-well decon). As noted above, wells should be sampled in order from the least contaminated to the most contaminated. Pumps should not be removed from the well between purging and sampling operations. All non-disposable equipment, including the pump (support cable and electrical wires which are in contact with the sample) will be decontaminated as described below.

17. Prior to Sampling Event Decon

Please Note: Steps D through K should only be performed once (for each pump that is to be used) before the commencement of a particular sampling event by a person qualified to disassemble pumps.

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and thoroughly flush other equipment with potable water.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and thoroughly flush other equipment with fresh detergent solution. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

D) Disassemble pump.

E) Wash pump parts (inlet screen, shaft suction interconnector, motor lead assembly, stator house): Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water for five minutes.

G) Rinse the pump parts with demonstrated analyte-free water.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water for five minutes.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Thoroughly rinse impeller assembly with demonstrated analyte-free water.

18. Daily and Between-Well Decon

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and thoroughly flush other equipment with fresh detergent solution. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

D) Final Rinse: Operate pump in a deep basin of analyte-free water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOGS/LOGBOOK

A field log book or field logs must be kept each time ground water monitoring activities are conducted in the field. The field log book or log should document the following:

- ☐ Well identification number and physical condition.
- ☐ Static water level depth, date, time, and measurement technique.
- ☐ Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- ☐ Well sampling sequence and time of sample collection.
- ☐ Types of sample bottles used and sample identification numbers.

- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

EPA, 1998, EPA Region II, Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, March 16.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

Appendix B

CDM Technical Standard Operating Procedures

1-2	Sample Custody*
1-6	Water Level Measurement
1-8	Vapor Sampling using a SUMMA Cannister
1-10	Field Measurement of Organic Vapors
2-1	Packaging and Shipping of Environmental Samples*
2-2	Guide to Handling of Investigation Derived Waste
5-1	Control of Measurement and Test Equipment

* Includes RAC II Contract-Specific Clarification

CONTRACT-SPECIFIC CLARIFICATION

SOP No.: 1 - 2
Revision: 4
Date: October 10, 2004

SOP Title: **SAMPLE CUSTODY**

QA Review: JBuford

Approved and Issued: JLitwin 11/1/04
Program Manager Signature/Date

Contract No.: RAC II Client: EPA Region II

Reason for Clarification: Make SOP EPA Region II – Specific
Add Forms II Lite Procedures; Sample tags requirement not applicable.

1.0 OBJECTIVE, add (to page 1 of 7):

For the RAC II contract, the sample custody paperwork will also be supplied to the U.S. Environmental Protection Agency (EPA) Region II Regional Sample Contract Laboratory Program (CLP) Coordinator and the Contract Laboratory Analytical Service Support (CLASS) contact. This will include the combination forms generated using the EPA Field Operations Records Management System II Lite (FORMS II Lite™) software and the hand written combination traffic reports & chain of custody records (TR/COCs).

All samples sent through the CLP system are required to be recorded on the FORMS II Lite™ generated combination TR/COC records. Use of hand written TR/COCs must be approved by EPA Regional Sample Control Center (RSCC) prior to use.

4.0 REQUIRED SUPPLIES, add (to page 2 of 7):

If using the FORMS II Lite™ software the following additional equipment will be required:

- FORMS II Lite™ Software
- Computer
- Printer

5.0 PROCEDURES

5.1 Chain-of-Custody

Field Custody, on page 2 of 7 under item 2, replace:

"Complete sample label or tags for each sample, using waterproof ink.", with, "Complete sample labels for each sample using indelible ink or pre-printed labels."

Add, before 5.2 Sample Labels and Tags (on page 5 of 7):

CONTRACT-SPECIFIC CLARIFICATION

SOP Title: **SAMPLE CUSTODY**

SOP No.: 1 - 2
Revision: 4
Date: October 10, 2004

Procedure for Generating EPA's FORMS II Lite™ Combination Forms

FORMS II Lite™ is used to automate printing of sample documentation in the field and facilitate electronic capture of data prior to and during field sampling activities. FORMS II Lite™ can be populated with the general site information, laboratory information, CLP case number, sample locations, CLP sample numbers, analysis, preservatives, etc. prior to the sampling event. Sample labels can then be generated from FORMS II Lite™.

The following is a list of items required to be entered into FORMS II Lite™:

- Site spill number
- Region number, sampling entity, sampler name and signature
- Type of activity
- Date shipped, courier and air bill number
- Analytical laboratory name, address and contact
- Case number
- CLP sample number
- Sample description (media type)
- Sample concentration (low, medium, high)
- Sample type (composite, grab)
- Preservative used
- Turn-around time (for organic analysis only)
- Routine Analytical Services (RAS) fraction(s)
- Date and time of sample collection
- Sampler's initials
- Corresponding CLP inorganic CLP sample number, if applicable
- Field QC sample information (information regarding trip or field blanks but not reference to duplicate samples)
- Whether shipment for case is complete
- Sample designated for matrix spike laboratory QC purposes

The procedures for generating the FORMS II Lite™ combination forms are similar to preparing the CLP RAS combination forms detailed in the next section. The difference is the information will be entered into the FORMS II Lite™ software and the combination forms will be printed out on site instead of filling in the combination forms in by hand.

Detailed procedures for using the FORMS II Lite™ software are provided in the FORMS II Lite™ User's Guide supplied with the software.

After completing the day's sampling, the date, time and field QC sample information are entered into the FORMS II Lite™ software. Samples are assigned to the traffic reports, shipping information is entered and the traffic reports are printed. The software generates a Region and a Laboratory copy of the TR/COC record. The Laboratory copies of the TR/COC records are signed and placed in a zip-lock bag taped to the inside cooler lid and shipped with the samples to the laboratory. The Region copies of the TR/COC records are submitted to the RSCC and to CLASS along with the sampling trip report. Examples of TR/COC records that FORMS II Lite™ generates for the Laboratory copies (Figures C1 and C2) and the Region copies (Figures C3 and C4) are attached to this Contract-Specific Clarification. A copy of the sampling trip report is made and retained for the CDM RAC II files.

Procedure for Completing EPA CLP RAS Combination Forms

A combination Organic or Inorganic TR/COC record is a four-page carbonless form (Figures C5and C6). The information that must be entered in the combination forms is detailed in the *Contract Laboratory Program (CLP) Guidance for Field Samplers* (EPA/540/R-00/003). A copy of this guidance is to be on site. Field quality control blanks and matrix spike samples will be noted on the combinations forms.

Each sample will be assigned a CLP identification number that will be written or pre-printed on the sample label and affixed in the field to each container for CLP analysis. This unique number, which is recorded on the combination form, is used by EPA to identify the sample. Notations will be made if the sample is to be used as the matrix spike/matrix spike duplicate (organics), matrix spike/duplicate (inorganics), a field (rinsate) blank or trip blank. The same information required to be entered into FORMS II Lite™ is also required on hand written combination Organic or Inorganic TR/COC.

After completing the day's sampling, the bottom two copies of each completed combination form are placed in a zip-lock bag taped to the inside cooler lid and shipped with the samples to the laboratory. The top copy is submitted to the RSCC and the second copy is submitted to CLASS along with the sampling trip report. A copy of each combination form is made and retained for the CDM RAC II files.

5.2 Sample Labels and Tags, (on page 5 of 7)

It should be noted that sample tags are no longer required for Region II CLP samples. Therefore, Figure 2 on page 6 of 7 is not applicable.

7.0 REFERENCES, add (on page 7 of 7):

Environmental Protection Agency (EPA). 1989. *Region II CERCLA Quality Assurance Manual.* Revision 1. EPA Monitoring Management Branch of the Environmental Services Division. October 1989.

_______. 2002. *FORMS II Lite™ User's Guide, Version 5.1.*

_______. 2004. *Contract Laboratory Program (CLP), Guidance for Field Samplers.* EPA-R-00-003. Final. EPA-540-R-00-003. August.

Sample Custody	SOP 1-2 Revision: 5 Date: March 2007

Prepared: David O. Johnson

Technical Review: S. Budney

QA Review: Jo Nell Mullins

Approved: E-Signed by Michael C. Malloy VERIFY authenticity with ApproveIt

Signature/Date

Issued: E-Signed by P. Michael Schwan VERIFY authenticity with ApproveIt

Signature/Date

1.0 Objective

Because of the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This SOP is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements shall be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (see Section U-1).

2.0 Background

2.1 Definitions

Sample - A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record - A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label - A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag - A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes).

3.0 General Responsibilities

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork.

Field Sample Custodian - The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Supplies

- Chain-of-custody records (applicable client or CDM forms)
- Sample labels and/or tags
- EPA Field Operations Records Management System II Lite™ (FORMS II Lite™) software (if required)
- Printer paper
- Custody seals
- Clear tape
- Computer
- Printer

5.0 Procedures

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations before the actual fieldwork. As few people as possible shall handle samples.

2. Complete sample labels or tags for each sample using waterproof ink.

3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

   - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.

   - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.

   - If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, a chain-of-custody record shall be filled out for each cooler documenting only samples contained in that particular cooler.

3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record and field logbook in accordance with TSOP 4-1, *Field Logbook Content and Control.*

Procedure for Completing CDM Example Chain-of-Custody Record
The following procedure is to be used to fill out the CDM chain-of-custody record. The record provided herein (Figure 1) is an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA Contract Laboratory Program (CLP) or a subcontract laboratory or generated by FORMS II Lite™) is used to track the custody of samples, the custody record shall be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the "Remarks" box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier's airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time.
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter appropriate designation for laboratory quality control (e.g., matrix spike/matrix spike duplicate [MS/MSD], matrix spike/duplicate [MS/D]), or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the "Remarks" column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).
19. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy. The white copy is returned to CDM.

5.2 Sample Labels and Tags
Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM projects.

1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):

   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number or EPA CLP identification number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.

- Place a check to indicate composite or grab sample.
- Record the station (sample) location.
- Sign in the space provided.
- Place a check next to "yes" or "no" to indicate if a preservative was added.
- Place a check under "Analyses" next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for "laboratory sample number."
- Place or write additional relevant information under "Remarks."

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle. On 2.27 liter (80 oz.) amber bottles, the tag string may be looped through the ring-style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted, and relooped around the neck until the slack in the string is removed.

4. Double-check that the information recorded on the sample tag is consistent with the information recorded on the chain-of-custody record.

5.3 Custody Seals

Two custody seals must be placed on opposite corners of all shipping containers (e.g., cooler) before shipment. The seals shall be signed and dated by the shipper.

Custody seals may also be required to be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples* defines the requirements for packaging and shipping environmental samples.

6.0 Restrictions/Limitations

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure shall be followed.

For EPA CLP sampling events, combined chain-of-custody/traffic report forms generated with EPA FORMS II Lite™ or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA FORMS II Lite™ software may be used to customize sample labels and custody records when directed by the client or the CDM project manager.

7.0 References

U. S. Army Corps of Engineers. 2001. *Requirements for the Preparation of Sampling and Analysis Plan*, EM 200-1-3. Appendix F. February.

U. S. Environmental Protection Agency. Revised March 1992. *National Enforcement Investigations Center, Multi-Media Investigation Manual*, EPA-330/9-89-003-R. p.85.

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__________. 2002. *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/240/R-02/009. Section 2.2.3. December.

__________. 2004. *Contract Laboratory Program (CLP), Guidance for Field Samplers,* EPA-540-R-00-003. Final. Section 3.2. August.

Figure 1
Example CDM Chain-of-Custody Record

CDM

125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123
Fax: (212) 785-6114

CHAIN OF CUSTODY RECORD

PROJECT ID.	FIELD TEAM LEADER	LABORATORY AND ADDRESS	DATE SHIPPED
PROJECT NAME/LOCATION		LAB CONTRACT:	AIRBILL NO.

MEDIA TYPE
1. Surface Water
2. Groundwater
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other ____________

PRESERVATIVES
1. HCl, pH <2
2. HNO3, pH <2
3. NaOH, pH >12
4. H2SO4, pH <2
5. Zinc Acetate, pH >9
6. Ice Only
7. Not Preserved
8. Other ________________

SAMPLE TYPE
G = Grab
C = Composite

SAMPLE LOCATION NO.	LABORATORY SAMPLE NUMBER	PRESERVATIVES ADDED	MEDIA TYPE	SAMPLE TYPE	20__ DATE	TIME SAMPLED	ANALYSES (List no. of containers submitted)								REMARKS (Note if MS/MSD)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

SAMPLER SIGNATURES:

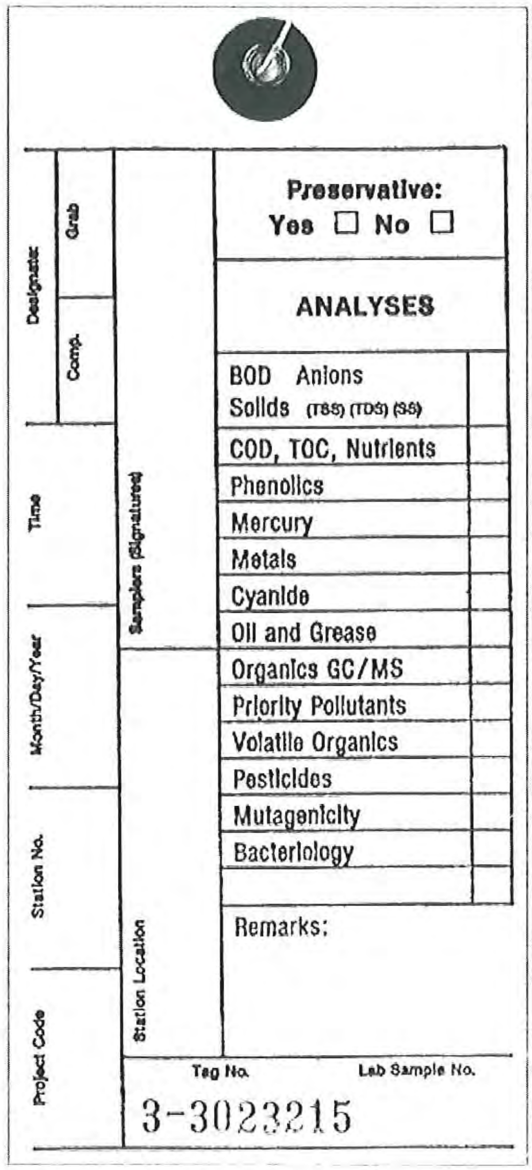
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	

COMMENTS:

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory; yellow copy retained by laboratory. Pink copy retained by samplers. 1/98

Note: If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Chantilly Graphics Department.

Figure 2
Example Sample Tag



Designate: Grab / Comp.

Time

Month/Day/Year

Station No.

Project Code

Samplers (Signatures)

Station Location

Preservative:
Yes ☐ No ☐

ANALYSES

BOD Anions
Solids (TSS) (TDS) (SS)
COD, TOC, Nutrients
Phenolics
Mercury
Metals
Cyanide
Oil and Grease
Organics GC/MS
Priority Pollutants
Volatile Organics
Pesticides
Mutagenicity
Bacteriology

Remarks:

Tag No. Lab Sample No.
3-3023215

Note: Equivalent sample labels or tags may be used.

Water Level Measurement	SOP 1-6 Revision: 6 Date: March 2007

Prepared: Del Baird

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1.0 Objective

Water level measurements are fundamental to groundwater and solute transport studies and are conducted during groundwater sampling events to calculate the amount of groundwater to be purged from the well. This standard operating procedure (SOP) defines the techniques and requirements for obtaining groundwater level measurements.

2.0 Background

2.1 Definitions

Water Level Indicator - A portable device for measuring the depth from a fixed point (which could be below, at, or above the ground surface) to the groundwater inside a well, borehole, or other underground opening.

Measurement Point - An easily located and clearly defined mark at the top of a well from which all water level measurements from that particular well are made. The measurement point shall be as permanent as possible to provide consistency in measurements.

Electrical Tape - A graduated plastic tape onto which a water-sensitive electrode is connected that will electronically signal the presence of water (as a result of circuit closure).

Immiscible Fluids - Two or more fluid substances that will not mix and, therefore, will exist together in a layered form. The fluid with the highest density will exist as the bottom layer, the fluid with the lowest density will exist as the top layer, and any other fluid layers will be distributed relative to their respective densities.

Discharge - The removal/release of water from the zone of saturation.

Recharge - The addition of water to the zone of saturation.

Static Water Level - The level of water in a well, borehole, or other underground opening that is not influenced by discharge or recharge.

Well Riser - A steel, stainless steel, or polyvinyl chloride pipe that extends into a borehole and is connected to the well screen or sealed at the bedrock surface in open-hole wells. The upper portion (approximately 3 to 5 feet) of the well riser is normally enclosed by an outer steel protective casing.

Protective Casing - A steel cylinder or square protective sleeve extending approximately 3 to 5 feet into the ground, surrounding the well riser. In flush-mounted wells, the protective casing will extend only high enough so that the well and protective casing can be enclosed by a Christy box or equivalent vault. In above-grade wells, the protective casing will extend above the ground surface approximately 2 to 3 feet. The protective casing protects the well riser.

2.2 Associated Procedures

- CDM Federal (CDM) SOP 4-1, *Field Logbook Content and Control*
- CDM SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

2.3 Discussion

The most common uses of static water level data are to determine the elevation of groundwater, the direction of groundwater flow, to identify areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relationships. Specific uses for water level data may include:

- Determine the change in water level due to distribution or rate of regional groundwater withdrawal
- Show the relationship of groundwater to surface water
- Estimate the amount, source, and area of recharge and discharge
- Determine rate and direction of groundwater movement

Static water level measurements shall be obtained from each well before purging, sampling, or other disturbance of the water table.

3.0 General Responsibilities

Project Manager - The project manager is responsible for ensuring that measurements are conducted in accordance with this procedure and any other SOP pertaining to site activities related to obtaining groundwater level measurements.

Field Team Leader - The field team leader is responsible for ensuring that field personnel obtain water level measurements in accordance with this and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

4.1 General

- Site-specific plans
- Field logbook
- Indelible black ink pens
- Permanent felt-tip marker (e.g., Sharpie)
- Personal protective equipment
- Decontamination equipment and supplies, including rinse bottles and deionized water
- Tap water and large beaker or bucket
- Water level meter

4.2 Measuring Devices

The equipment required to obtain water level measurements is dependent on the type of procedure chosen. Measurements may be made with a number of different devices and procedures. Measurements are taken relevant to a permanent measurement point on the well riser.

Electrical tapes are preferred over other devices such as steel tape because of the electrical tape's simplicity and ability to make measurements in a short period of time. Many types of electrical instruments have been devised for measuring water levels; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Examples of electrical tapes that are frequently used include the Slope Indicator Co.® and Solinst® electronic water level indicators. These instruments are powered by batteries that shall be checked before mobilization to the field.

Electrical tapes are coiled on a hand-cranked reel unit that contains the batteries and a signaling device that indicates when the circuit is closed (i.e., when the probe reaches the water). Electrodes are generally contained in a weighted probe that keeps the tape taut in addition to providing some shielding of the electrodes against false indications as the probe is being lowered into the hole. The electrical tapes are marked with 0.01-foot increments. Caution shall be exercised when using electrical tapes when the water contains elevated amounts of dissolved solids. Under these conditions, the signaling device will remain activated after the probe is removed from the water. When the water being measured contains very low amounts of dissolved solids, it is possible for the probe to extend several inches below the water level before activating the signaling device. Both of these conditions are related to the conductivity of the water and in some cases may be compensated for by the sensitivity control, if the device has this option. In groundwater with high conductivity the sensitivity control may need to be turned down, and in groundwater with low conductivity the sensitivity control may need to be turned up to get a proper depth to groundwater measurement.

5.0 Procedures

5.1 Preparation

The following steps must be taken when preparing to obtain a water level measurement:

- Assign a designated field logbook to record all field events and measurements according to CDM SOP 4-1. Document any and all deviations from SOPs and site-specific plans in the logbook and include rationale for the changes.
- Always exercise caution to prevent inappropriate or contaminated materials from entering an environmental well.
- Standing upwind from the well, open the groundwater well. Monitor the well with a photoionization detector, flame ionization detector, or equivalent vapor analyzer as soon as the cap is opened, as dictated by the site-specific health and safety plan.

For comparability, water level measurements shall always be referenced to the same vertical (elevation) datum marker, such as a U. S. Geological Survey (USGS) vertical and horizontal control point monument. The elevations calculated from the measurement of static water levels shall be referenced to mean sea level unless otherwise specified in the site-specific plans.

The measurement point must be as permanent as possible, clearly defined, marked, and easily located. Frequently, the top of the PVC riser is designated as the measurement point. However, since the top of the riser is seldom smooth and horizontal, one particular point on the riser pipe shall be designated and clearly marked. This can be accomplished by marking a point on the top of the riser pipe with a permanent marker. To avoid spilling liquids into the well, paints or other liquid marking materials shall not be used.

5.2 Water Level Measurement Using Electrical Water Level Indicators

The following steps must be followed when taking water level measurements using electrical tapes:

- Before lowering the probe into the well, the circuitry shall be checked by dipping the probe in tap water and checking to ensure that the signaling device responds to probe submergence. The probe shall then be lowered slowly into the well until contact with the water surface is indicated. The electrical tape reading is made at the measuring point. Take a second and third check reading to verify the measurement before completely withdrawing the tape from the well.
- Independent electrical tape measurements of static water levels using the tape shall agree within 0.01 foot for depths of less than about 200 feet. At greater depths, independent measurements may not be this close. For a depth of about 500 feet, the maximum difference of independent measurement using the same tape shall be within 0.1 foot.
- Decontaminate the electrical tape according to CDM SOP 4-5 before proceeding to the next well to minimize cross contamination.

It may be necessary to check the electrical tape length with a graduated steel tape after the line has been used for a long period of time (at least annually) or after it has been pulled hard in attempting to free the line. Some electrical tapes, especially the single line wire, are subject to becoming permanently stretched.

5.3 Other Water Level Measurement Methods

Although the method cited above (electrical water level indicator) for measuring water levels predominates in the environmental sector, there are a number of other methods available that may be well suited for a particular purpose.

5.3.1 Ultrasonic Method

The ultrasonic method electronically measures the amount of time it takes a sound wave to reach and reflect off the water surface and return to the ground surface. These instruments contain electronic microprocessors, capable of performing this measurement many times each second. The actual depth to water, as calculated by the microprocessor, is an average of many individual readings.

5.3.2 Pressure Gauge Method
This method, also called the air-line submergence method, uses a pressure gauge and is the preferred method for obtaining water level measurements in pumping wells. An air line constructed of semi-rigid tubing is inserted into the well below the water table. The tube end at the surface is connected to an air tank or compressor and pressure gauge. Filtered air is then forced through the tube and the resultant pressure is read in pounds per square inch (psi). This reading is converted to feet of water in the column and subtracted from the total tube length to give depth to water. Readings are then converted to groundwater elevation. Results are plotted on a field logging form. Calibration records and the exact procedures used must be maintained.

5.3.3 Acoustic Probe Method
The acoustic probe is an electronic device containing two electrodes and a battery-powered transducer. The probe is attached to a tape. The probe is lowered into the well until a sound is detected, indicating the electrodes in the probe have contacted the water surface. This method is similar to the electrical probe method discussed in Section 5.2.

5.3.4 Continuous Recording Method
The measurement of groundwater elevations within pumping or monitoring wells can be accomplished by the use of a mechanical or digital analog computerized continuous recording system and shall be performed according to specifications given by the manufacturer of each unit. In general, when using the mechanical or digital system, the pressure or electrical transducer is lowered into the well until it intersects the water surface. The actual depth to water is then measured by one of the methods described above and used to calibrate the continuous recorder.

The necessary adjustments and preparations are then completed according to the specifications given for each type of continuous recorder. Proper maintenance of continuous recording devices during water level monitoring shall be performed such that continuous, permanent records are developed for the specified period of time. Records shall be stored on mechanical graph paper or on a microprocessor. Frequent calibrations of equipment shall also be made during monitoring periods of long duration in accordance with the manufacturers' specifications.

6.0 Restrictions/Limitations
6.1 Groundwater and Miscible Fluids
Where water is rapidly dripping or flowing into a well, either from the top of the well or from fractures, obtaining an accurate reading may not be possible.

The effect of the water flowing into the well may interfere with an electronic water level measuring device, resulting in a false water level measurement. If water levels must be recorded in wells completed in aquifers that are recharging or discharging, the electronic water level indicator is the preferred measuring device, but shall be used with the awareness of possible false measurements. To minimize the effects of "splashing," a 1-inch pipe (decontaminated for environmental wells) may be lowered into the pumping well into which the water level indicator would be inserted. This will minimize the effect of "splashing" until the probe contacts the groundwater and protect the probe from becoming tangled in pump wiring or well spacers associated with downhole equipment such as submersible pumps.

6.2 Immiscible Fluids
For wells containing immiscible contaminants, the field personnel will need to use special procedures for the measurement of fluid levels. The procedure to follow will depend on whether layers are light immiscibles that form lenses floating on the top of the water table, or dense immiscibles that sink through the aquifer and form lenses over less permeable layers.

In the case of light immiscibles, measurements of immiscible fluid and water levels cannot be accomplished by using normal techniques. A conventional electrical tape often will not respond to nonconducting immiscible fluids.

Techniques have been specially developed to measure fluid levels in wells containing immiscible fluids, particularly petroleum products. A special paste or gel applied to the end of the steel tape and submerged in the well will show the top of the oil as a wet line and the top of the water as a distinct color change, or an interface probe can be used that will detect the presence of conducting and nonconducting fluids. Thus, if a well is contaminated with low density, nonconducting immiscible fluids such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, it will detect electrical conduction. Normally, a variation in an audible signal indicates the difference between phases.

Both of these methods have disadvantages. These methods are less effective with heavier and less refined petroleum products because the product tends to stick to the tape or probe, giving a greater product thickness measurement than it shall. Paste or gel cannot be used when sampling groundwater for the same constituents present in the paste or gel product.

Note that water levels obtained in this situation are not suitable for determining hydraulic gradients without further interpretation. To use such data for determining hydraulic gradients, the difference in density between the light immiscible phase and water has to be considered.

Measuring fluid levels in wells screened in lenses of dense immiscible fluids resting on a low permeability formation is somewhat easier, provided the immiscible fluid is nonconducting. The top of the dense layer can be identified by simply using an electrical sounder. As an electrical sounder passes from groundwater into the immiscible phase, the detection unit will deactivate because the fluid will no longer conduct electricity. A better method would be to use an interface probe as described above. The variation in the audible signal associated with the detection of differing phase liquids will also allow the user to obtain a groundwater depth and dense immiscible thickness measurement.

7.0 References

Camp Dresser & McKee Inc., et al. 1991. *Sampling and Analysis Procedures, Geophysical Survey Procedures*. May.

U. S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operations Methods*. EPA/540/P-87/001. December.

Weight, Willis D. and Sonderegger, John L., 2001. *Manual of Applied Hydrogeology*. Lewis Publishing Company. 187-190.

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Vapor Sampling Using a SUMMA® Canister

SOP 1-8
Revision: 5
Date: March 2007

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1.0 Objective

The purpose of this standard operating procedure (SOP) is to define requirements for collection of vapor using evacuated SUMMA® canister samplers.

2.0 Background

Collection of discrete or temporally composited air samples from designated locations on or near a hazardous waste site may be required to characterize and model the nature and extent of ambient or subsurface contamination. The method described in this SOP is adapted from U. S. Environmental Protection Agency Method TO-15 Second Edition 1999.

Two types of vapor samples can be collected with SUMMA canisters. The canister can be opened and allowed to fill over a short period to obtain a grab sample or filled slowly by using a flow controller to collect a time-integrated sample.

2.1 Definitions

Canister - Leak-free stainless steel pressure vessels of desired volume (e.g., 1 to 6 liters [L]), with valve and specially prepared (SUMMA) nonreactive interior surfaces. The canister is initially evacuated (under high vacuum) at the laboratory to approximately -30 inches of mercury (Hg). The canisters must be properly cleaned at the laboratory before each use by either ultra-pure humidified air in a series of evacuation/pressurization cycles or in a high temperature oven. The canister is then analyzed by GC/MS to verify cleanliness. ***Note***: Canisters previously used for the measurement of high-level contamination may not be suitable for indoor air monitoring, since they may not be able to be adequately decontaminated.

Particulate Matter Filter - 2-micrometer (µm) sintered stainless steel in-line filter. A separate laboratory-cleaned filter is used for each canister sample.

Stainless Steel Vacuum/Pressure Gauges - A gauge capable of measuring vacuum (0 to -30 inches Hg or -100 to 0 kilo pascals [kPa]) and pressure (0 to 30 pounds per square inch [psi] or 0 to 206 kPa) is needed to verify the initial canister vacuum and to measure sampling progress in the sampling system. Gauges shall be tested clean and leak tight.

Sampling Inlet Line/Connectors - Stainless steel, Teflon®, or polyethylene tubing (all usually ¼-inch diameter) and appropriate air-tight connectors (i.e., Swagelok® tube fittings) connect the canister to the sample inlet. A Swagelok fitting has four parts, the connector body, two ferrules, and the nut. The larger (cone-shaped) ferrule fits into the connector body, small diameter end first. The smaller end of the smaller ferrule fits on top of the cone ferrule, and the nut is screwed on top. The tubing fits through the nut and the two ferrules, and seats firmly in the connector. On newly created fittings, the nut shall be tightened with two wrenches, 1¼ turns past finger tight to compress the ferrules onto the tubing. (Swagelok makes an inspection gauge that fits between the nut and the connector body if a large number of critical connections are to be made). Connections that have been previously made up will only need a short tighten with the wrenches past finger tight.

Stainless Steel Shut-Off Valve - Leak free, for vacuum/pressure gauge.

Electronic Mass Flow Controller - This controller, used to collect composite samples, must be capable of maintaining a constant flow rate (±10 percent) over a sampling period of up to 24 hours and under conditions of changing temperature (20 to 40 degrees Celsius [°C]) and humidity.

Auxiliary Vacuum Pump - Continuously draws air through the inlet manifold at 10 L/minute or higher flow rate. The canister vacuum extracts a sample from the manifold at a lower flow rate, and excess air is exhausted. ***Note***: The use of higher inlet flow rates dilutes any contamination present in the inlet and reduces the possibility of sample contamination as a result of contact with active adsorption sites on inlet walls. The auxiliary pump and sampling manifold can also be used to purge vapor monitoring wells.

Elapsed Time Meter/Stopwatch - Measures duration of sampling.

2.2 Associated Procedures
- CDM Federal SOP 1-2, *Sample Custody*
- CDM Federal SOP 4-1, *Field Logbook Content and Control*
- CDM Federal SOP 1-10, *Field Measurement of Organic Vapors*

2.3 Discussion
Ambient air, emission source, or vapor monitoring well samples are collected to determine the type(s) and level(s) of contamination from airborne toxic organic compounds (often important to risk assessment), characterize subsurface vapor contamination, or evaluate vapor intrusion into buildings. These samples may be collected as part of an investigative plan, site-specific sampling plan, and/or as a screen for "hot spots," which may require more extensive sampling. Sampling will include necessary quality assurance/quality control (QA/QC) samples as documented in the project-specific QAPP, and a field blank shall accompany all sampled media.

3.0 Responsibilities
Site Manager - The site manager is responsible for ensuring that SUMMA canister sampling efforts are performed consistently with this procedure and other project-specific documents such as the QAPP, work plan, sampling plan, and the health and safety plan.

Field Team Leader - The field team leader is responsible for ensuring that field personnel collect vapor samples in accordance with this or the project-specific procedure in the field plan and that appropriate documentation is collected.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Required Equipment/Supplies
- Site-specific plans
- Adjustable wrenches (two 9/16-inch opened end wrenches for Swagelok fittings)
- Labels/canister tags (shall be attached to canister) and appropriate laboratory-supplied, individual canister-specific, chain-of-custody forms
- Field logbook or field forms
- Documentation for sample shipment
- Items listed in Section 2.1, Definitions, as applicable
- Sturdy shipping container(s)

5.0 Procedures
5.1 Preparation
1. The analysis of vapor samples collected in a canister will have very low detection limits. Canister preparation shall therefore be performed in clean air environments, away from any type of volatile organic contamination. The canisters are expensive, and, although relatively sturdy, valves and connections can be easily damaged. Do not over tighten valves. Use two wrenches to remove and reconnect line caps and attachments. Using a single wrench may cause excessive torque on the fitting/canister connection.

2. Check the number on the permanent label/tag attached to the canister against the laboratory-supplied chain-of-custody form. Verify that the canister number on the form agrees with the label. Note the date the canister was cleaned, preevacuated canister vacuum, and laboratory analysis verification, etc. The supplied paperwork will vary depending on the laboratory supplying the canister. The objective is to verify that the canister is the correct one, has been cleaned, and has been evacuated to a vacuum approximately -30" Hg.

3. In a clean environment, use two wrenches to remove the Swagelok cap from the end of the canister and attach a clean vacuum gauge. Verify that the gauge reads zero. Tighten the gauge fitting tightly with the wrenches. Open the canister valve, read the gauge, and record the reading on the chain-of-custody. SHUT THE VALVE TIGHTLY (turn clockwise). The vacuum reading shall agree closely (the field gauge may not be as accurate as the gauge in the laboratory) with the vacuum noted by the laboratory. If the field vacuum is more than 1 inch of Hg less than the laboratory vacuum, then the canister valve has leaked during the time since the canister was evacuated, and a portion of the canister has been filled with an unknown vapor sample. If the vacuum is not sufficient, replace the canister and document the change. If there are questions, call the laboratory that supplied the canister for guidance/to discuss further action.

4. If the two vacuum readings agree and the canister is suitable for use, verify that the valve is closed tightly, and remove the vacuum gauge. Attach a clean sample filter (supplied by the laboratory) and replace the Swagelok cap on the filter.

5. If required, build a sampling apparatus using appropriate tubing, connectors, or valves to connect the canister to the sampling location.

6. If a vacuum pump is to be used to purge a soil vapor monitoring well, insert a "tee" fitting between the well and the vacuum pump (upstream of the pump), and a line valve between the tee fitting and the pump. During purging, the line valve is opened and the third leg of the tee is capped, allowing the pump to pull air from the well without short-circuiting through the tee. If a portable photoionization detector, flame ionization detector, or other real-time instrument is to be used to take a field screening reading from the well, a second tee fitting shall be installed on the downstream side of the pump exhaust port. The probe of the instrument is inserted into one leg of the tee, while the other leg is allowed to vent, to prevent pressurizing the instrument and creating false readings.

5.2 Using a Flow Controller for Time-Integrated (Temporally Composited) Sampling

1. To ensure the correct time-integrated sampling rate, the flow controller must be calibrated for the planned sampling duration using a mass flow meter or bubble meter traceable to an American Society for Testing and Materials (ASTM) or National Institute of Standards and Technology (NIST) standard. This measurement will be made by actual calibration by the sampling team, or if calibrated by a laboratory, by checking calibration documentation.

   A flow control device is chosen to maintain a constant flow into the canister over the desired sample period. This flow rate is determined so the canister is filled (to about 88.1 kPa for subatmospheric pressure sampling or to about 1 atmosphere above ambient pressure for pressurized sampling) over the desired sample period. The flow rate can be calculated by

   $$F = \frac{P \times V}{T \times 60}$$

   where:

   F = flow rate, mL/minute
   P = final canister pressure, atmospheres absolute. P is approximately equal to

   $$\frac{\text{kPa gauge}}{101.2 \text{ kPa}} + 1$$

   V = volume of the canister, mL
   T = sample period, hours

   For example, if a 6-L canister is to be filled to 202 kPa (2 atmospheres) absolute pressure in 24 hours, the flow rate can be calculated by:

   $$F = \frac{2 \times 6{,}000}{24 \times 60} = 8.3 \text{ mL/minute}$$

2. The evacuated canister, flow controller (if required), vacuum gauge, particulate matter filter, and sample inlet need to be assembled (if not already pre-assembled by the offsite laboratory) using two open-end wrenches to tighten the tubing and sampling system components to the canister valve stem.

3. Data entries on the daily sample event data sheet (or equivalent) shall include serial numbers for all numbered sampling components, sample initiation time, sample identification number, sample collection time, separate entries for sub-atmospheric SUMMA canister pressures at sample initiation and completion, sampler initial(s), initiation date, collection date, and sample tag custody number.

5.3 Sample Collection

1. The sample system assembly is transported to the required sample location. Before collecting each sample, confirm that the canister number and sample identification corresponds to the correct sample location.

2. If using a vacuum pump to purge a vapor monitoring well or other space, begin preparing the canister when sufficient purging of the well has been accomplished. Attach a canister with the valve closed to the third leg of the tee upstream of the pump (discussed in 5.1), while the pump continues to pull vapor from the well. Do not connect the canister to the downstream side of the pump, since the pump may contain contaminants that may be introduced into the sample. The sample is drawn into the canister by the vacuum. When it is time to collect the sample, the valve between the canister and the pump is shut off, preventing backflow through the pump if the canister vacuum happens to be stronger than the pump.

3. When collecting a grab (not a temporally composited) sample, check the tightness of all fittings on the sampling apparatus and the connections on the canister. If sampling the ambient air or emission source, position the canister inlet in the intended environment with the inlet line pointed downward to prevent rainwater from entering the canister.

4. To initiate a sample event, gently open (counter clockwise) the canister valve until a hissing noise is heard. Note the initial vacuum reading on the gauge (attached to the canister with a tee) and that the vacuum level begins to drop. There are differing opinions on how long to allow for the canister to fill, and whether there is any negative effect of opening the valve rapidly. A good compromise is to adjust the valve so there is a slow hiss, allowing the canister to fill in about a half minute. The canister valve can be closed before the hissing stops and the vacuum gauge reaches 0 inches Hg. Record the final vacuum level on the chain-of-custody. Close the valve firmly, without overtightening.

5. Remove the canister from the sampling apparatus, remove the gauge and filter, and replace the canister cap. Do not use the same filter to collect another sample.

6. Record the final vacuum level, duration of sample collection, and any other pertinent sampling information of the chain-of-custody. Complete documentation on the daily event datasheet and the field logbook before leaving each sample location.

7. Place the canister in a sturdy container for shipping. Place all of the used filters in a plastic baggie and return them to the laboratory with the canisters.

6.0 Restrictions/Limitations

The nonreactive inner surface of the SUMMA canister may not be compatible for sampling atmospheres with high levels of chlorine or sulfur. Contact the analytical laboratory for guidance when these elements are suspected.

For 24-hour time-integrated sampling, sample flow rates through the vacuum gauge of the sample system may not remain stable (within the method flow rate tolerance) at vacuums less than 9 inches Hg (e.g., 8 inches Hg). Caution shall be taken in using 24-hour time-integrated samples where final vacuum is less than 4 inches Hg. Flow rates at this vacuum and below are not constant, yielding potentially nonrepresentative results during the latter portion of the sampling period. Any canister that has reached 0 inches Hg vacuum may not be a representative 24-hour sample.

Samples collected at vacuums above 10 inches Hg (e.g., when the canister valve is closed before the gauge reaches 10 inches Hg) may not contain enough sample volume to meet sample volume requirements for high-resolution gas chromatography/mass spectrometry analysis detection limits.

Ice crystals can block the flow controller or sampling apparatus at temperatures at or below freezing, Frequent monitoring of canister pressure is recommended during cold periods.

7.0 References

U. S. Environmental Protection Agency. 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition, *Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*. January.

Air Toxics LTD. Winter 1996. *In The Air*. Vol. 1, No. 1.

Field Measurement of Organic Vapors	SOP 1-10 Revision: 4 Date: March 2007

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1.0 Objective

The objective of this standard operating procedure (SOP) is to define the techniques and the requirements for the measurement of organic vapors in the field.

2.0 Background

2.1 Definitions

Photoionization Detector (PID) - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the photoionization of organic vapors.

Flame Ionization Detector (FID) - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the flame ionization of organic vapors.

2.2 Associated Procedures

- CDM Federal SOP 1-4, *Subsurface Soil Sampling*
- CDM Federal SOP 1-5, *Groundwater Sampling Using Bailers*
- CDM Federal SOP 1-6, *Water Level Measurement*
- CDM Federal SOP 1-8, *Volatile Organic Compound Air Sampling Using USEPA Method TO-15 with SUMMA Canister*
- CDM Federal SOP 3-1, *Geoprobe® Sampling*
- CDM Federal SOP 3-5, *Lithologic Logging*
- CDM Federal SOP 4-3, *Well Development and Purging*

2.3 Discussion

The measurement of organic vapors is a required step during numerous field activities. The primary purpose of such measurements is health and safety monitoring to determine if the breathing zone in a work area is acceptable or if personal protective equipment such as a respirator or a supplied air device is necessary for field personnel. In addition to health and safety monitoring, organic vapor measurement is also used in conjunction with sampling activities, including screening subsurface soil samples, soil vapor and indoor air sampling, and groundwater sampling, where measurements are useful for establishing approximate contaminant levels or ranges.

The two types of instruments most commonly used to measure organic vapors are PIDs and FIDs. Both instruments first ionize the gaseous compound and then measure the response, which is proportional to the concentration.

2.3.1 PID Operation

The PID is preferred when the compound of interest is an aromatic or chlorinated volatile organic compound (VOC). The PID ionizes the sampled vapors using an ultraviolet lamp that emits light energy at a specific electron voltage (eV - labeled on the lamp). The ultraviolet lamp produces photons that are absorbed by the sampled vapor molecule. The molecule becomes excited, producing a positively charged ion and emitting an electron. The number of electrons emitted is proportional to the concentration of the sampled gases. Every organic compound has a specific ionization potential in electron volts. The energy emitted by the lamp must be higher than the ionization potential of the compound for the compound to become ionized and emit an electron. If the ionization potential of the compound is higher than the eV of the lamp, there will be no response on the instrument. Therefore, the ionization potential of the known or suspected compounds shall be checked against the energy of the ultraviolet lamp to verify that the energy provided by the lamp is greater. Additionally, manufacturer's manuals shall be consulted to obtain the appropriate correction factors for known or suspected contaminants.

Water vapor in the vapor sample can interfere with the PID detector and cause the instrument to stop responding. This can be caused by using the PID on a rainy day or when sampling headspace samples that have been in the sun. If

moisture is suspected, the calibration gas shall be used to check the instrument response by inserting the gas as a check sample, not by recalibrating. If the response is lower than the gas level, then the probe and the ionization chamber shall be dried out before reusing the instrument.

Note: The ultraviolet lamp in the PID is sensitive to shock, especially when using the higher eV lamps. Therefore, they shall be handled and transported carefully.

The sampling probe shall not be inserted directly into soil samples or dusty areas, as the instrument vacuum will pull dirt into the ionization chamber. Under particularly dirty or dusty conditions, the lamp may become covered with a layer of dust. If dirty conditions are encountered, or if the instrument response seems to have decreased, then the lamp shall be cleaned. The instrument manual provides instructions on how to remove the instrument cover to access the lamp, and how to clean the screen in the ionization chamber and the surface of the lamp.

2.3.2 FID Operation
The FID is preferred when sampling for petroleum hydrocarbons and methane (landfill gases). It responds well to aromatic hydrocarbons but is not as convenient to use as the PID. The FID allows measurement of a wide variety of compounds, but in general its sensitivity is not as high as the PID for compounds where the PID is applicable.

The FID ionizes the vapor sample by burning it in a hydrogen/air flame, and measuring the response beyond what is caused by the hydrogen alone. This instrument requires a hydrogen supply, contained in a small tank in the instrument. This hydrogen, including the gas in the instrument tank, is considered a flammable gas and appropriate requirements must be adhered to when shipping. The instrument shall be emptied of hydrogen before shipping. Federal Express Hazardous Material shipping manifests must be completed when shipping the gas.

The hydrogen gas in the FID combustion chamber is ignited by pressing a red button on the side of the instrument, which sends electrical current to a small resistance coil igniter in the combustion chamber. This igniter is very sensitive, and if the red button is pressed for longer than 5 seconds, the coil will burn out and the instrument will be unusable unless another igniter is available. If the instrument will not light, check the electrical connections and switches for proper settings. Check that the pump is pumping, and allow fresh air to flow through the combustion chamber for several minutes before lighting. Check to see if the exhaust port of the combustion chamber is dirty.

3.0 Responsibilities
Site Manager - The site manager is responsible for ensuring that field activities are conducted in accordance with this procedure and any other SOPs pertaining to the specific activity.

Field Team Leader - The field team leader is responsible for ensuring that field personnel conduct field activities in accordance with this and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Required Equipment
- Site-specific plans
- Field logbook
- Waterproof black ink pen
- Personal protective clothing and equipment
- Photoionization detector or flame ionization detector
- Calibration gases in a range appropriate for the expected use
- 0.5 liter (16-ounce) or "Mason" type glass jar
- Hydrogen Canister and fill valve and hose (if using FID for a period of more than 1 day)

5.0 Procedures

5.1 Direct Reading Measurement

1. Connect the measurement probe to the instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer's manual.
2. Calibrate the instrument following the applicable manufacturer's manual
3. Make sure the instrument is reading zero and all function and range switches are set appropriately.
4. Insert the end of the probe directly into the atmosphere to be measured (e.g., breathing zone, monitoring well casing, split spoon, etc.) and read the organic vapor concentration in parts per million (ppm) from the instrument display. Apply the appropriate correction factor if necessary. Record the highest instrument response.
5. Immediately document the reading in the field logbook or on the appropriate field form.

5.2 Headspace Measurement

1. Connect the measurement probe to the instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer's manual.
2. Calibrate the instrument following the appropriate manufacturer's manual.
3. Make sure the instrument is reading zero and all function and range switches are set appropriately.
4. Fill a clean glass jar approximately half-full of the sample to be measured. Quickly cover the top of the jar with one or two sheets of clean aluminum foil and apply cap to seal the jar.
5. Allow headspace to develop for approximately 10 minutes. It is generally preferable to shake the sealed jar for 10 to 15 seconds at the beginning and end of headspace development.

Note: When the ambient temperature is below 0°C (32°F), the headspace development and subsequent measurement shall occur within a heated vehicle or building.

6. Remove the jar cap and quickly puncture the foil and insert the instrument probe to a point approximately one-half of the headspace depth. Do not let the probe contact the soil. If using a PID and there is condensation on the inside of the jar, only leave the probe in the jar long enough to obtain a reading. Remove the probe and allow fresh air to flow through the instrument to avoid excess water vapor to build up.
7. Read the organic vapor concentration in ppm from the instrument display. Apply the appropriate correction factor if necessary. Record the highest instrument response.
8. Immediately record the reading in the field logbook or on the appropriate field form.

6.0 Restrictions/Limitations

The two methods outlined above are the most commonly used for field measurement of organic vapors but do not apply to all circumstances. Consult project- or program-specific procedures and guidelines for deviations. Both the PID and FID provide quantitative measurement of organic vapors, but generally neither instrument is compound-specific. The typical reading range of the PID is 0 to 2,000 ppm, and the typical reading range of the FID is 0 to 1,000 ppm. The FID will measure methane while the PID will not. ***Note***: The presence of methane will cause erratic PID measurements. In methane rich environments, toxic organic vapors shall be monitored with an FID. If desired, a charcoal filter can be placed temporarily on the FID inlet probe, which will trap all organic vapors except methane. The filtered (methane only) reading can be subtracted from unfiltered (total organic vapors) to provide an estimate of non-methane organic vapors. The reading accuracy of both instruments can be affected by ambient temperature, barometric pressure, humidity, lithology, etc.

7.0 References

Martin Marietta Energy Systems, Inc. 1998. *Environmental Surveillance Procedures Quality Control Program*, ESH/Sub/87-21706/1.

CONTRACT-SPECIFIC CLARIFICATION

SOP No.: 2 - 1
Revision: 3
Date: October 20, 2004

SOP Title: **PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES**

QA Review: [signature]

Approved and Issued: [signature] 11/4/04
Program Manager Signature/Date

Contract No.: RAC II Client: EPA Region II

Reason for Clarification: Make SOP EPA Region II - Specific

1.3 REQUIRED EQUIPMENT

Add to the list of equipment:

- Paint can-type metal cans with lids, clean (optional)

1.4 PROCEDURES

Under Step 2, add:

Clean to the description of the cooler used to transport samples.

Under Step 4, add:

- If bubble wrap or other wrapping material will be placed around the labeled containers, write the sample number and analysis on the outside of the wrap, and then place wrapped container in a plastic zip-top bag and close the bag.

- If samples are determined to be of medium or high hazard by visual observation or instrument reading, or if the sample is known to contain dioxin, all such sample bottles will be placed in waterproof plastic bags and then placed in a metal can (paint can). Vermiculite will be used to secure the bottles within the metal can, and clips or tape will be used to permanently hold the can lid tightly in place. One bottle is packed per can. The metal cans will be labeled as the sample bottle is labeled. High level samples will not be cooled to 4^0 centigrade.

- Note: A labeled cooler temperature blank must be added to each cooler.

Under Step 4, remove the sentence:
"Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent".

CONTRACT-SPECIFIC CLARIFICATION

SOP Title: **PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES**

SOP No.: 2 - 1
Revision: 3
Date: October 20, 2004

Under Step 9, add:

At least two custody seals must be attached to each cooler at diagonally opposing corners.

Under Step 10, add:

The outside of the cooler must be marked "Environmental Samples" if the samples are designated "Low-Level."

Bills of Lading (DOT shipping papers) are required only for shipment of medium- or high-level samples. Shipment of medium- or high-level samples are as per the *Contract Laboratory Program (CLP) Guidance for Field Samplers* (June 2001).

8.0 REFERENCES

Remove:
U.S. Environmental Protection Agency, *Sampler's Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

Add:
U.S. Environmental Protection Agency. 2004. *Contract Laboratory Program (CLP) Guidance for Field Samplers,* Final. EPA-540-R-00-003. August.

Prepared:	Krista Lippoldt	**Technical Review:**	Chuck Myers
QA Review:	Jo Nell Mullins	**Approved:**	E-Signed by Michael C. Malloy VERIFY authenticity with ApproveIt
Issued:	E-Signed by P. Michael Schwan VERIFY authenticity with ApproveIt		*Signature/Date*
	Signature/Date		

1.0 Objective
The objective of this SOP is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 7.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipments. This SOP does not cover the requirements for packaging and shipment of equipment (including data loggers and self-contained breathing apparatus [SCBAs] or bulk chemicals that are regulated under the DOT, IATA, and ICAO.

1.1 Packaging and Shipping of All Samples
This standard operating procedure (SOP) applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 - Packaging and Shipping Samples Preserved with Methanol
Section 3.0 - Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 4.0 - Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 5.0 - Packaging and Shipping Samples Preserved with Nitric Acid
Section 6.0 - Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 7.0 - Packaging and Shipping Limited-Quantity Radioactive Samples

1.2 Background
1.2.1 Definitions
Environmental Sample - An aliquot of air, water, plant material, sediment, or soil that represents the contaminant levels on a site. Samples of potential contaminant sources, like tanks, lagoons, or non-aqueous phase liquids are normally not "environmental" for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR - Part 172.101 Appendix A.

Custody Seal - A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to the analytical laboratory.

Inside Container - The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

Outside Container - The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

Secondary Containment - The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass).

Excepted Quantity - Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside containers below which DOT, IATA, ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.

Limited Quantity - Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Performance Testing - Performance testing is the required testing of outer packaging. These tests include drop and stacking tests.

Qualified Shipper - A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*

1.2.3 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places both CDM and the individual employee at risk of serious fines. The analytical holding times for the samples must not be exceeded. The samples shall be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.3 Required Equipment

- Coolers with return address of the appropriate CDM office
- Heavy-duty plastic garbage bags
- Plastic zip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape
- Duct tape
- Vermiculite (or an equivalent nonflammable material that is inert and absorbent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contract laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- "This End Up" and directional arrow labels

*Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "environmental sample" and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager shall be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent. ***Note***: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of vermiculite (or equivalent) into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler shall reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals shall be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked **"THIS END UP"** and arrow labels that indicate the proper upward position of the container shall be affixed to the cooler. A label containing the name and address of the shipper (CDM) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Methanol

2.1 Containers

- The maximum volume of methanol in a sample container is limited to 30 ml.
- The sample container must not be full of methanol.

2.2 Responsibility

It is the responsibility of the qualified shipper to:

- Ensure that the samples undergoing shipment contain no other contaminant that meets the definition of "hazardous material" as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

2.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packing may consist of glass or plastic jars
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 3 flammable liquid labels
- Orientation labels
- Consignor/consignee labels

2.4 Packaging Samples Preserved with Methanol

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Total volume of methanol per shipping container must not exceed 500 ml.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

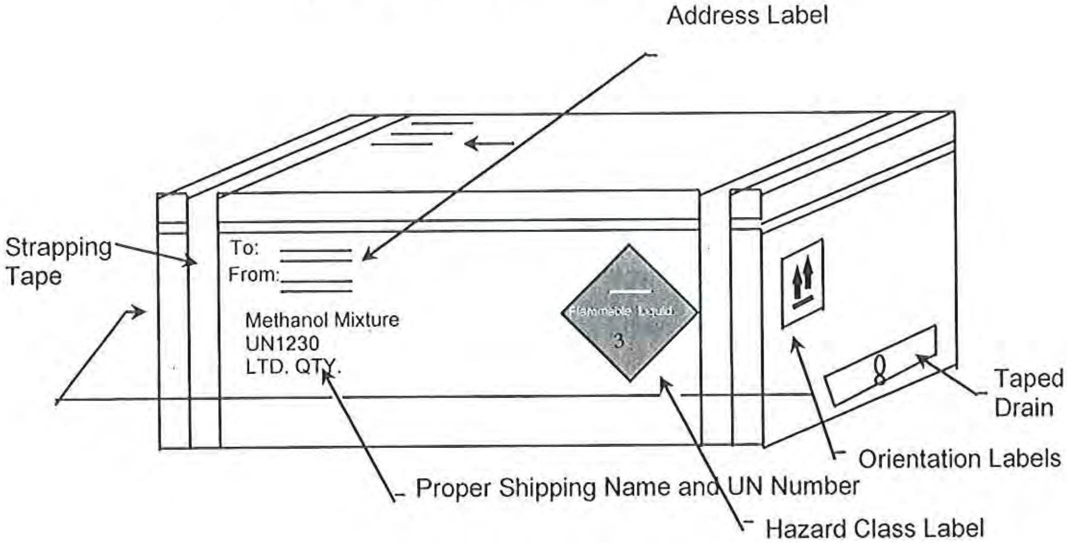
  Methanol Mixture
  UN1230
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Flammable Liquid label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: No marking or labeling can be obscured by strapping or duct tape.
Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

Figure 1
Example of Cooler Label/Marking Locations



3.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

3.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sodium Hydroxide Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
NaOH	30%	>12	0.08%		.25	0.5	1	2

5 drops = 1 ml

3.2 Responsibility

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

3.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

3.4 Packaging Samples Preserved with Sodium Hydroxide

Samples containing NaOH as a preservative that exceed the excepted concentration of 0.08 percent (2 ml of a 30 percent NaOH solution per liter) may be shipped as a limited quantity per packing instruction Y819 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- The total volume of sample in each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Sodium Hydroxide Solution
  UN1824
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.08 percent NaOH by weight may be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

4.0 Packaging and Shipping Samples Preserved with Hydrochloric Acid

4.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Hydrochloric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*		
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**
HCl	2N	<1.96	0.04%	.2	.5	1

5 drops = 1 ml

4.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packing may consist of glass or plastic jars no larger than 1 pint.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

4.4 Packaging Samples Preserved with Hydrochloric Acid

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (No more than 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)

- Total volume of sample inside each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Hydrochloric Acid Solution
  UN1789
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

  Note: Samples containing less than the exception concentration of 0.04 percent HCl by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

  Note: No marking or labeling can be obscured by strapping or duct tape.

  Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

5.0 Packaging and Shipping Samples Preserved with Nitric Acid

5.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Nitric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
HNO_3	6N	<1.62	0.15%		2	4	5	8

5 drops = 1 mg/L

5.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

5.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

5.4 Packaging Samples Preserved with Nitric Acid

Samples containing HNO_3 as a preservative that exceed the excepted concentration of 0.15 percent HNO_3 will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Nitric Acid Solution (with less than 20 percent)
UN2031
Ltd. Qty.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.15 percent HNO_3 by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

6.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

6.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sulfuric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
H_2SO_4	37N	<1.15	0.35%	.1	.25	0.5	1	2

5 drops = 1 ml

6.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

6.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

6.4 Packaging of Samples Preserved with Sulfuric Acid

Samples containing H_2SO_4 as a preservative that exceed the excepted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Sulfuric Acid Solution
  UN2796
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples containing less than the exception concentration of 0.35 percent H_2SO_4 by weight will be shipped as nonregulated or nonhazardous in accordance with the procedure described in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

7.0 Packaging and Shipping Limited-Quantity Radioactive Samples

7.1 Containers

The inner packaging containers that may be used for these shipments include:

- Any size sample container

7.2 Description/Responsibilities

- The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.
- The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, *Limited Quantities of Radioactive Materials*.
- The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.
- If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.
- The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.
- The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 mSv/hour (0.5 mrem/hour). These will be verified by dose and activity monitoring before shipment of the package.
- The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM will apply the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma). It shall be noted that these values are more conservative than the DOT requirements for removable surface contamination.
- The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive."
- The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

7.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Excepted quantities label
- Consignor/consignee labels

7.4 Packaging of Limited-Quantity Radioactive Samples

The following steps are to be followed when packaging limited-quantity sample shipments:

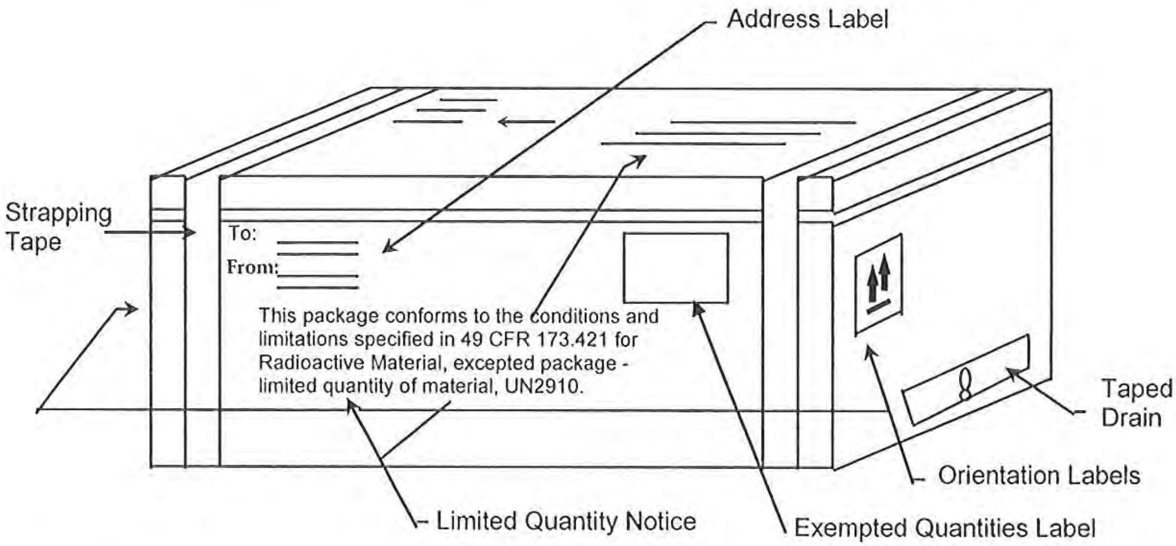
- The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place sufficient amount of vermiculite, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- Place a label marked Radioactive on the outside of the sealed bag.
- Enclose a notice that includes the name of the consignor or consignee and the following statement: ***"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."***
- Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing.
- The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler/package.
- Affix a completed Excepted Quantities label to the side of the cooler/package.
- Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of the cooler labeling/marking is shown in Figure 2.

Note: No marking or labeling can be obscured by strapping or duct tape.

- Complete the Shipment Quality Assurance Checklist (Appendix B).

Note: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of ^{235}U.
Note: A declaration of dangerous goods is not required.

Figure 2
Radioactive Material – Limited-Quantity Cooler Marking Example



8.0 References

U. S. Environmental Protection Agency. Region IV. February 1991 or current. *Standard Operating Procedures and Quality Assurance Manual.*

__________. 1996 or current. *Sampler's Guide to the Contract Laboratory Program*, EPA/540/R-96/032.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Shippers General Requirements for Shipments and Packagings*, 49 CFR 173.

Appendix A

Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity

Sample Packaging

Yes	No	N/A	
❑	❑	❑	The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
❑	❑	❑	The VOA vials are placed into a polyethylene bottle, filled with vermiculite, and tightly sealed.
❑	❑	❑	The drain plug is taped inside and outside to ensure control of interior contents.
❑	❑	❑	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
❑	❑	❑	The cooler weighs less than the 66-pound limit for limited-quantity shipment.
❑	❑	❑	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
❑	❑	❑	The chain-of-custody has been secured to the interior of the cooler lid.
❑	❑	❑	The cooler lid and sides have been taped to ensure a seal.
❑	❑	❑	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
❑	❑	❑	Section 1 has the shipper's name, company, and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
❑	❑	❑	Section 2 has the recipient's name and company along with a telephone number where they can be reached.
❑	❑	❑	Section 3 has the **Bill Sender** box checked.
❑	❑	❑	Section 4 has the **Standard Overnight** box checked.
❑	❑	❑	Section 5 has the **Deliver Weekday** box checked.
❑	❑	❑	Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
❑	❑	❑	Under the **Transport Details** box, the **Cargo Aircraft Only** box is obliterated, leaving only the **Passenger and Cargo Aircraft** box.
❑	❑	❑	Under the **Shipment Type**, the **Radioactive** box is obliterated, leaving only the **Non-Radioactive** box.
❑	❑	❑	Under the **Nature and Quantity of Dangerous Goods** box, the **Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions, and Authorization** have been filled out for the type of chemical being sent.
❑	❑	❑	The **Name, Place and Date, Signature, and Emergency Telephone Number** appears at the bottom of the FedEx Airbill.
❑	❑	❑	The statement "In accordance with IATA/ICAO" appears in the **Additional Handling Information** box.
❑	❑	❑	The **Emergency Contact Information** at the bottom of the FedEx Airbill is truly someone who can respond any time of the day or night.

Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Sub Risk	Quantity	Packing Instruction	Authorization
Hydrochloric Acid Solution	8	UN1789	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box × 0.5 L	Y807	Ltd. Qty.
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Sulfuric Acid Solution	8	UN2796	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Methanol	3	UN1230	II		1 plastic box × 1 L	Y305	Ltd. Qty.

Sample Cooler Labeling

Yes	No	N/A	
❑	❑	❑	The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container.
❑	❑	❑	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
❑	❑	❑	The name and address of the shipper and receiver appear on the top and side of the shipping container.
❑	❑	❑	The air waybill is attached to the top of the shipping container.
❑	❑	❑	**Up Arrows** have been attached to opposite sides of the shipping container.
❑	❑	❑	Packaging tape does not obscure markings or labeling.

Appendix B
Shipment Quality Assurance Checklist

Date: ____________ Shipper: __________________________ Destination: ______________________

Item(s) Description: ____

Radionuclide(s): ____

Radiological Survey Results: surface _______________mrem/hr 1 meter ___________________

Instrument Used: Mfgr: _______________________________ Model: ______________________

S/N: ____ Cal Date: ______________________

Limited-Quantity or Instrument and Article

Yes	No	
___	___	1. Strong tight package (package that will not leak material during conditions normally incidental to transportation).
___	___	2. Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.
___	___	3. Removable surface contamination less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma).
___	___	4. Outside inner package bears the marking "Radioactive."
___	___	5. Package contains less than 15 grams of ^{235}U (check yes if ^{235}U not present).
___	___	6. Notice enclosed in or on the package that includes the consignor or consignee and the statement, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**
___	___	7. Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:
___	___	8. On all air shipments, the statement **Radioactive Material, excepted package-limited quantity of material** shall be noted on the air waybill.

Qualified Shipper: ______________________ Signature: ________________________________

Guide to Handling Investigation-Derived Waste	SOP 2-2 Revision: 5 Date: March 2007

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1.0 Objective

This standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objectives for managing IDW during field activities include:

- Leaving the site in no worse condition than existed before field activities
- Removing wastes that pose an immediate threat to human health or the environment
- Proper handling of onsite wastes that do not require offsite disposal or extended aboveground containerization
- Complying with federal, state, local, and facility applicable or relevant and appropriate requirements (ARARs)
- Careful planning and coordination of IDW management options
- Minimizing the quantity of IDW

2.0 Background

2.1 Definitions

Hazardous Waste - Discarded material that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes - Discarded materials resulting from field activities such as sampling, surveying, drilling, excavations, and decontamination processes that, in present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, sludge, liquid, gaseous, or multiphase materials that may be classified as hazardous or nonhazardous.

Mixed Waste - Any material that has been classified as hazardous and radioactive.

Radioactive Wastes - Discarded materials that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

Treatment, Storage, and Disposal Facility (TSDF) - Permitted facilities that accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the U. S. Environmental Protection Agency (EPA) and appropriate state and local agencies.

2.2 Discussion

Field investigation activities result in the generation of waste materials that may be characterized as hazardous or radioactive waste. IDWs may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

Note: The client's representatives may not be aware of all potential contaminants. The management of IDW must comply with applicable regulatory requirements.

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that all IDW procedures are conducted in accordance with this SOP. The site manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

Project Manager - The project manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

Field Crew Members - Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the project manager's attention.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/project specific quality assurance plan.

4.0 Required Equipment

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required shall consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be onsite and inspected before commencing work.

4.1 IDW Containment Devices

The appropriate containment device (drums, tanks, etc.) will depend on site- or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 millimeters
- Department of Transportation (DOT)-approved steel containers
- Polyethylene or steel bulk storage tanks

Containment of IDW shall be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device shall be site-specific.

4.2 IDW Container Labeling

A "Waste Container" or "IDW Container" label or indelible marking shall be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported offsite are:

- Labels and markings that contain the following information: project name, generation date, location of waste origin, container identification number, sample number (if applicable), and contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container at least twice, on opposite sides.
- Containers that are 5 gallons or less may only require one label or set of markings.
- Labels or markings will be positioned on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistive material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the drum color.
- Labels will be secured in a manner to ensure the label remains affixed to the container.

Labeling or marking requirements for IDW expected to be transported offsite must be in accordance with the requirements of 49 CFR 172.

4.3 IDW Container Movement

Staging areas for IDW containers shall be predetermined and in accordance with site-specific and/or client requirements. Arrangements shall be made before field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation offsite onto a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage

Containerized IDW shall be staged pending chemical analysis or further onsite treatment. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. A secondary/spill container must be provided for liquid IDW storage and as appropriate for solid IDW storage.

5.0 Procedures

The three general options for managing IDW are (1) collection and onsite disposal, (2) collection for offsite disposal, and (3) collection and interim management. Attachment 1 summarizes media-specific information on generation processes and management options. The option selected shall take into account the following factors:

- Type (soil, sludge, liquid, debris), quantity, and source of IDW
- Risk posed by managing the IDW onsite
- Compliance with regulatory requirements
- IDW minimization and consistency with the IDW remedy and the site remedy

In all cases the client shall approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Collection and Onsite Disposal

5.1.1 Soil/Sludge/Sediment

The options for handling soil/sludge/sediment IDW are as follows:

1. Return to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

2. Spread around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).

3. Consolidate in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

4. Send to onsite TSDF - may require analytical analysis before treatment/disposal.

Note: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids

The options for handling aqueous liquid IDW are as follows:

1. Discharge to surface water, only when IDW is not contaminated.

2. Discharge to ground surface close to the well, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background upgradient wells is not a community concern or associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well.

3. Discharge to sanitary sewer, only when IDW is not contaminated.

4. Send to onsite TSDF - may require analysis before treatment/disposal.

Note: These options may require analytical results to obtain client and/or regulatory approval.

5.1.3 Disposable PPE

The options for handling disposable PPE are as follows:

1. Double-bag contents in nontransparent trash bags and place in onsite industrial dumpster, only if PPE is not contaminated.

2. Containerize, label, and send to onsite TSDF - may require analysis before treatment/disposal.

5.2 Collection for Offsite Disposal

Before sending to an offsite TSDF, analysis may be required. Manifests are required. In some instances, a bill of lading can be used for nonhazardous solid IDW (i.e., wooden pallets, large quantities of plastic sheeting). Arrangements must be made with the client responsible for the site to sign as generator on any waste profile and all manifests or bill of ladings; it is CDM's policy not to sign manifests. The TSDF and transporter must be permitted for the respective wastes. Nonbulk containers (e.g., drums) must have a DOT-approved label adhered to the container and all required associated placard stickers before leaving for a TSDF off site. These labels must include information as required in 49 CFR 172. Bulk containers (i.e., rolloffs, tanks) do not require container specific labels for transporting off site, but must include appropriate placards as required in 49 CFR 172.

5.2.1 Soil/Sludge/Sediment

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.2 Aqueous Liquids

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums with appropriate secondary containment) until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.3 Disposable PPE

When the final site remedy requires offsite treatment disposal, the IDW may be containerized and stored. The management option selected shall take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.3 Collection and Interim Management

All interim measures must be approved by the client and regulatory agencies.

1. Storing IDW onsite until the final action may be practical in the following situations:
   - Returning wastes (especially sludges and soils) to their onsite source area would require reexcavation for disposal in the final remediation alternative.
   - Interim storage in containers may be necessary to provide adequate protection to human health and the environment.
   - Offsite disposal options may trigger land disposal regulations under the Resource Conservation and Recovery Act (RCRA). Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.
   - Interim storage may be necessary to provide time for sampling and analysis.

2. Segregate and containerize all waste for future treatment and/or disposal.
   - Containment options for soil/sludge/sediment may include drums or covered waste piles in AOC.
   - Containment options for aqueous liquids may include mobile tanks or drums.
   - Containment options for PPE may include drums or roll-off boxes.

6.0 Restrictions/Limitations

Site Managers Shall Determine the Most Appropriate Disposal Option for Aqueous Liquids on a Site-Specific Basis. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soil at the site, whether the groundwater or surface water is a drinking water supply, and whether the groundwater plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. **Under No Circumstances Shall These Types of Materials Be Brought Back to the Office or Warehouse.**

7.0 References

Environmental Resource Center. 1997. *Hazardous Waste Management Compliance Handbook 2nd Edition.* Karnofsky (Editor).

Academy of Certified Hazardous Materials Manager. May 1999. *Hazardous Materials Management Desk Reference.* Cox.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

U. S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1.

_________. August 1990. *Low-Level Mixed Waste: A RCRA Perspective for NRC Licensees*, EPA/530-SW-90-057.

_________. May 1991. *Management of Investigation-Derived Wastes During Site Inspections*, EPA/540/G-91/009.

_________. January 1992. *Guide to Management of Investigation-Derived Wastes*, 9345.3-03FS.

_________. Region IV. November 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.*

Attachment 1
IDW Management Options

Type of IDW	Generation Processes	Management Options
Soil	■ Well/Test pit installations ■ Borehole drilling ■ Soil sampling	**Onsite Disposal** ■ Return to boring, pit, or source immediately after generation ■ Spread around boring, pit, or source within the AOC ■ Consolidate in a pit (within the AOC) ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal
Sludge/Sediment	■ Sludge pit/sediment sampling	**Onsite Disposal** ■ Return to boring, pit, or source immediately after generation ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal
Aqueous Liquids (groundwater, surface water, drilling fluids, wastewaters)	■ Well installation/development ■ Well purging during sampling ■ Groundwater discharge during pump tests ■ Surface water sampling ■ Wastewater sampling	**Onsite Disposal** ■ Pour onto ground close to well (nonhazardous waste) ■ Discharge to sewer ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite commercial treatment unit ■ Client to send to publicly owned treatment works (POTW) **Interim Management** ■ Store for future treatment and/or disposal
Decontamination Fluids	■ Decontamination of PPE and equipment	**Onsite Disposal** ■ Send to onsite TSDF ■ Evaporate (for small amounts of low contamination organic fluids) ■ Discharge to ground surface **Offsite Disposal** ■ Client to send to offsite TSDF ■ Discharge to sewer **Interim Management** ■ Store for future treatment and/or disposal
Disposable PPE and Sampling Equipment	■ Sampling procedures or other onsite activities	**Onsite Disposal** ■ Place in onsite industrial dumpster ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal

Adapted from U. S. Environmental Protection Agency, *Guide to Management of Investigation-Derived Wastes*, 9345-03FS, January 1992.

Control of Measurement and Test Equipment

SOP 5-1
Revision: 8
Date: March 2007

Prepared: Dave Johnson

Technical Review: Steve Guthrie

QA Review: Jo Nell Mullins

Approved: E-Signed by Michael C. Malloy VERIFY authenticity with ApproveIt

Signature/Date

Issued: E-Signed by P. Michael Schwan VERIFY authenticity with ApproveIt

Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to establish the baseline requirements, procedures, and responsibilities inherent to the control and use of all measurement and test equipment (M&TE). Contractual obligations may require more specific or stringent requirements that must also be implemented.

2.0 Background

2.1 Definitions

Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

2.2 Associated Procedures

- CDM Federal Technical SOP 4-1, *Field Logbook Content and Control*
- CDM Quality Procedures (QPs) 2.1 and 2.3
- Manufacturer's operating and maintenance and calibration procedures

2.3 Discussion

M&TE may be government furnished (GF), rented or leased from an outside vendor, or purchased. It is essential that measurements and tests resulting from the use of this equipment be of the highest accountability and integrity. To facilitate that, the equipment shall be used in full understanding and compliance with the instructions and specifications included in the manufacturer's operations and maintenance and calibration procedures and in accordance with any other related project-specific requirements.

3.0 Responsibilities

All staff with responsibility for the direct control and/or use of M&TE are responsible for being knowledgeable of and understanding and implementing the requirements contained herein as well as any other related project-specific requirements.

The project manager (PM) or designee (equipment coordinator, quality assurance coordinator, field team leader, etc.) is responsible for initiating and tracking the requirements contained herein.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Requirements for M&TE

- Determine and implement M&TE related project-specific requirements
- The maintenance and calibration procedures must be followed when using M&TE
- Obtain the maintenance and calibration procedures if they are missing or incomplete
- Attach or include the maintenance and calibration procedures with the M&TE
- Prepare and record maintenance and calibration in an equipment log or a field log as appropriate (Figure 1)
- Maintain M&TE records
- Label M&TE requiring routine or scheduled calibration (when required)
- Perform maintenance and calibration using the appropriate procedure and calibration standards
- Identify and take action on nonconforming M&TE

5.0 Procedures

5.1 Determine if Other Related Project-Specific Requirements Apply

For all M&TE:

The PM or designee shall determine if M&TE related project-specific requirements apply. If M&TE related project-specific requirements apply, obtain a copy of them and review and implement as appropriate.

5.2 Obtain the Operating and Maintenance and Calibration Documents

For GF M&TE that is to be procured:

Requisitioner - Specify that the maintenance and calibration procedures be included.

For GF M&TE that is acquired as a result of a property transfer:

Receiver - Inspect the M&TE to determine whether maintenance and calibration procedures are included with the item. If missing or incomplete, order the appropriate documentation from the manufacturer.

For M&TE that is to be rented or leased from an outside vendor:

Requisitioner - Specify that the maintenance and calibration procedures, the latest calibration record, and the calibration standards certification be included. If this information is not delivered with the M&TE, ask the procurement division to request it from the vendor.

5.3 Prepare and Record Maintenance and Calibration Records

For all M&TE:

PM or Designee - Record all maintenance and calibration events in a field log unless other project-specific requirements apply.

For GF M&TE only (does not apply to rented or leased M&TE):

If an equipment log is a project specific requirement, perform the following:

Receiver - Notify the PM or designee for the overall property control of the equipment upon receipt of an item of M&TE.

PM or Designee and User:

- Prepare a sequentially page numbered equipment log for the item using the maintenance and calibration form (or equivalent) (Figure 1).
- Record all maintenance and calibration events in an equipment log.

5.4 Label M&TE Requiring Calibration

For GF M&TE only (does not apply to rented or leased M&TE):

If calibration labeling is a project specific requirement, perform the following:

PM or Designee:

- Read the maintenance and calibration procedures to determine the frequency of calibration required.
- If an M&TE item requires calibration before use, affix a label to the item stating "Calibrate Before Use."
- If an M&TE item requires calibration at other scheduled intervals, e.g., monthly, annually, etc., affix a label listing the date of the last calibration, the date the item is next due for a calibration, the initials of the person who performed the calibration, and a space for the initials of the person who shall perform the next calibration.

5.5 Operating, Maintaining or Calibrating an M&TE Item

For all M&TE:

PM or Designee and User - Operate, maintain, and calibrate M&TE in accordance with the maintenance and calibration procedures. Record maintenance and calibration actions in the equipment log or field log.

5.6 Shipment

For GF M&TE:

Shipper - Inspect the item to ensure that the maintenance and calibration procedures are attached to the shipping case, or included, and that a copy of the most recent equipment log entry page (if required) is included with the shipment. If the maintenance and calibration procedures and/or the current equipment log page (if required) is missing or incomplete, do not ship the item. Immediately contact the PM or designee and request a replacement.

<u>For M&TE that is rented or leased from an outside vendor</u>:
Shipper - Inspect the item to ensure that the maintenance and calibration procedures and latest calibration and standards certification records are included prior to shipment. If any documentation is missing or incomplete, do not ship the item. Immediately contact the procurement division and request that they obtain the documentation from the vendor.

5.7 Records Maintenance

<u>For GF M&TE</u>:
PM or Designee - Create a file upon the initial receipt of an item of M&TE or calibration standard. Organize the files by contract origin and by M&TE item and calibration standard. Store all files in a cabinet, file drawer, or other appropriate storage media at the pertinent warehouse or office location.

Receiver - Forward the original packing slip to the procurement division and a photocopy to the PM or designee.

PM or Designee and User:
- Maintain all original documents in the equipment file except for the packing slip and field log.
- File the photocopy of the packing slip in the M&TE file.
- Record all maintenance and calibration in an equipment log or field log (as appropriate). File the completed equipment logs in the M&TE records. Forward completed field logs to the PM for inclusion in the project files.

<u>For M&TE rented or leased from an outside vendor</u>:
Receiver - Forward the packing slip to the procurement division.

User:
- Forward the completed field log to the PM for inclusion in the project files.
- Retain the most current maintenance and calibration record and calibration standards certifications with the M&TE item and forward previous versions to the PM for inclusion in the project files.

5.8 Traceability of Calibration Standards

<u>For all items of M&TE</u>:
PM or Designee and User:
- When ordering calibration standards, request nationally recognized standards as specified or required. Request commercially available standards when not otherwise specified or required. Or, request standards in accordance with other related project-specific requirements.
- Require certifications for standards that clearly state the traceability.
- Require Material Safety Data Sheets to be provided with standards.
- Note standards that are perishable and consume or dispose of them on or before the expiration date.

5.9 M&TE That Fails Calibration

<u>For any M&TE item that cannot be calibrated or adjusted to perform accurately</u>:
PM or Designee
- Immediately discontinue use and segregate the item from other equipment. Notify the appropriate PM and take appropriate action in accordance with the CDM QP 2.3 for nonconforming items.
- Review the current and previous maintenance and calibration records to determine if the validity of current or previous measurement and test results could have been affected and notify the appropriate PM(s) of the results of the review.

6.0 Restrictions/Limitations

On an item-by-item basis, exemptions from the requirements of this SOP may be granted by the Headquarters health and safety manager and/or Headquarters quality assurance director. All exemptions shall be documented by the grantor and included in the equipment records as appropriate.

7.0 References

CDM Federal Programs Corporation. 2007. *Quality Assurance Manual.* Rev. 11.

CDM Federal Programs Corporation. 2005. *Government Property Manual.* Rev. 3.

Figure 1

CDM
A subsidiary of Camp Dresser & McKee Inc.

Maintenance and Calibration

Date: Time: (a.m./p.m.)

Employee Name: ____________________ Equipment Description: ____________________

Contract/Project: ____________________ Equipment ID No.: ____________________

Activity: ____________________ Equipment Serial No.: ____________________

Maintenance

Maintenance Performed: ____________________

Comments: ____________________

Signature: ____________________ Date: ____________________

Calibration/Field Check

Calibration Standard: ____________________ Concentration of Standard: ____________________

Lot No. of Calibration Standard: ____________________ Expiration Date of Calibration Standard: ____________________

Pre-Calibration Reading: ____________________ Post-Calibration Reading: ____________________

Additional Readings: ____________________ Additional Readings: ____________________

Additional Readings: ____________________ Additional Readings: ____________________

Pre-Field Check Reading: ____________________ Post-Field Check Reading: ____________________

Adjustment(s): ____________________

Calibration: □ Passed □ Failed

Comments: ____________________

Signature: ____________________ Date: ____________________

Appendix C

Field Forms

1. Groundwater Sampling Purge Water Data Form
2. Multi-parameter Water Quality Instrumentation Calibration Log
3. Field Change Request (FCR) Form
4. ANSETS Data Requirement
5. System Runtime and Shutdown Log – GWTF#1
6. System Runtime and Shutdown Log – GWTF#2
7. Groundwater Influent Monitoring Data – GWTF#1
8. Groundwater Influent Monitoring Data – GWTF#2
9. Systems Monitoring Data – GWTF#1
10. Systems Monitoring Data – GWTF#2
11. Monthly Operations and Maintenance Activities – GWTF#1
12. Monthly Operations and Maintenance Activities – GWTF#2
13. Synoptic Groundwater Levels

Groundwater Sampling
Purge Water Data Form

Project No:

Site:

Well No.

Date:

Sampling Personnel:

Weather:

Sampling Method:

Notes:

Well Depth:

Depth to Water:

Height of Static Water Column:

Screen Length:

Measuring Point:

Casing Type:

Casing Diameter:

Time	pH	Temp °C °F	Cond. (mS/cm)	Turb. (NTU)	DisO2 (mg/L)	ORP (mV)	Purge Volume ml L Gal.	Depth to Water ft btoc ft bgs	Notes

Multi-parameter Water Quality
Instrumentation Calibration Log

Date: ____________________ Collected By: ____________________

Project Number: ____________________ Instrument Manufacturer: ____________________

Project Name: ____________________ Model: ____________________

Calibration Standard: ____________________

Notes: ____________________

Time	pH		Temp		Cond (mS/cm)		Turb (NTU)		DisO2 (mg/L)		Salinity (%)	TDS (g/L)	Specific Gravity	ORP (mV)	Notes
	Meter Reading	Calibration Standard	°C	°F	Meter Reading	Calibration Standard	Meter Reading	Calibration Standard	Meter Reading	Calibration Standard					

TUTU WELLFIELD SITE
FIELD CHANGE REQUEST (FCR) FORM

REQUEST NO: ______________________ DATE: ____________________

FCR TITLE: ____

DESCRIPTION: ____

____

____

REASON FOR DEVIATION: ____

____

____

____

RECOMMENDED/MODIFICATION: ____

____

____

IMPACT ON PROJECT OBJECTIVES: ____

____

____

____

Signatures:

______________________________	____________________
Field Technician (FT)	Date
______________________________	____________________
Subcontractor Project Manager (PM)	Date
______________________________	____________________
CDM Site Manager (SM)	Date

Distribution:
EPA Remedial Project Manager
CDM SM
CDM Quality Assurance Coordinator
Subcontractor PM
Field Team
Project File

United States
Environmental Protection
Agency

ANSETS Data Requirement

Date:		Sampling Start Date: Sampling End Date:	
Project Numbers			
Project Number:	Regional Account Number:	DAS Number:	Assoc. CLP Case No:
Site Information			
Site Name:		City:	State:
CERCLIS ID:	Operable Unit:	Action:	Funding Lead:
Responsible EPA Project Individual:		Sampling Organization:	

Analytical Services Information

If field analytical services are used during this project write "field analysis" in the Laboratory Name Column. If fixed laboratory is used write the name of the laboratory in the Laboratory Name Column. Please specify in this box all field analytical techniques used.	COST:

Laboratory Name (include location if multiple lab locations)	No. Samples	Matrix	Analysis	Requested Turnaround (Days)

Completed by:	Organization:	Date:

Table 1 - System Runtime and Shutdown Log - GWTF #1

Date	Run Time			System Shutdown		
	Start	Stop	Total Time (minutes)	Planned Maint.	Failure / Alarm	Description

Total Minutes Run Time
Total Available Minutes
Percent Uptime

Table 2 - System Runtime and Shutdown Log - GWTF #2

Date	Run Time			System Shutdown		
	Start	Stop	Total Time (minutes)	Planned Maint.	Failure / Alarm	Description

Total Minutes Run Time
Total Available Minutes
Percent Uptime

Table 3 - Groundwater Influent Monitoring Data - GWTF #1

Date	Time	RW-6 Influent			RW-7 Influent			RW-9 Influent			Combined Influent	
		Totalizer (gal.)	Flowrate (gpm)	Press. (psi)	Totalizer (gal.)	Flowrate (gpm)	Press. (psi)	Totalizer (gal.)	Flowrate (gpm)	Press. (psi)	Totalizer (gal.)	Flowrate (gpm)

Table 4 - Groundwater Influent Monitoring Data - GWTF #2

Date	Time	RW-1S Influent			RW-1 Influent			Combined Influent	
		Totalizer (gal.)	Flowrate (gpm)	Press. (psi)	Totalizer (gal.)	Flowrate (gpm)	Press. (psi)	Totalizer (gal.)	Flowrate (gpm)

Table 5 - Systems Monitoring Data - GWTF #1

Date	Transfer Pump Discharge Press. (psi)	Bag Filter Diff. Press. (psi)	Transfer Pump Flowrate (gpm)	Air Stripper Influent Totalizer (gal.)	A. S. Blower Inlet Vacuum (in. H2O)	A.S. Blower Flowrate (scfm)	A.S. Blower Disch. Press. (in. H20)	A.S. Blower Temperature (Deg. F)	A.S. Sump Press. (in. H2O)	Treated Water Effluent pH (pH units)

Table 6 - Systems Monitoring Data - GWTF #2

Date	Transfer Pump Discharge Press. (psi)	Bag Filter Diff. Press. (psi)	Transfer Pump Flowrate (gpm)	Air Stripper Influent Totalizer (gal.)	A. S. Blower Inlet (in. H2O)	A.S. Blower Flowrate (scfm)	A.S. Blower Disch. Press. (in. H20)	A.S. Blower Temperature (Deg. F)	A.S. Sump Press. (in. H2O)	Treated Water Effluent pH (pH units)

Table 7 - Monthly Operations and Maintenance Activities - GWTF #1

Operation and Maintenance Events	
Date	O & M Performed

Chemical Usage		
	Amount Batched	
Date	Muriatic Acid	Caltrol 100

Voltage / AMP Draws					
Date	Equipment				
	TP-1	TP-2	AS B-1	SVE B-2	HX-1
A-B / A					
A-C / B					
B-C / C					

Table 8 - Monthly Operations and Maintenance Activities - GWTF #2

Operation and Maintenance Events	
Date	O & M Performed

Chemical Usage		
	Amount Batched	
Date	Muriatic Acid	Caltrol 100

Voltage / AMP Draws		
Date	Equipment	
	TP-1	AS B-1
A-B / A		
A-C / B		
B-C / C		

Table 9 - Synoptic Groundwater Levels

GWTF #1			GWTF #2			Southern Plume		
Well	**Time**	**DTW**	**Well**	**Time**	**DTW**	**Well**	**Time**	**DTW**
BP-1			DW-2*			MW-21D*		
BP-2			MW-11D			PZ-4		
BP-3			MW-12D			RD-1		
IW-1			MW-19			RD-2		
IW-2			RD-4			RD-3		
IW-1S			RD-7			RD-6		
IW-2S			SW-6			RD-8		
MW-1D			Eglin-1			RD-14*		
MW-13			MW-3*					
MW-13D								
MW-14								
MW-15								
MW-16*								
MW-17								
RD-9								
RD-10								
RD-11*								
RD-12								
RD-13								
RW-8								

Date Collected:

* **Well with pressure transducer (continuous water level measurements)**