

ALASKA RAILROAD CORPORATION

Corporate: P.O. Box 107500, Anchorage, AK 99510 • 327 Ship Creek Avenue, Anchorage, AK 99501



August 30, 2004

Jacques Gusmano, Project Coordinator
Alaska Operations Office
U.S. Environmental Protection Agency
222 West 7th Avenue, #19
Anchorage, Alaska 99513-7588

Re: Alaska Railroad Corporation, Anchorage Terminal Reserve RI/FS
Administrative Order on Consent EPA Docket No. CERCLA-10-2004-0065
Interim Action Work Plan for Northern Site Boundary Assessment

Dear Mr. Gusmano:

The Alaska Railroad Corporation (ARRC) agreed in Section 2.2.2.2 of the Statement of Work (SOW) under the subject consent order to develop a work plan for an interim action consisting of a groundwater and soil assessment at the northern site boundary to develop preliminary data regarding potential impacts from upgradient off-site sources. A proposed work plan for this interim action is enclosed. This work plan meets all the relevant requirements listed at Paragraph 42.b. of the consent order, including elements such as an interim action description and a sampling and analysis plan. The construction-related requirements listed in that paragraph such as providing a construction quality assurance plan are not relevant to a study such as this, and public involvement requirements have been and are being met through the public notice EPA provided in connection with the consent order issuance and through EPA/ ARRC development and implementation of a Community Involvement Plan for the overall consent order project.

We look forward to EPA review and approval of this proposed work plan for the northern site boundary assessment interim action. We will commence this study promptly upon receiving EPA approval. Please do not hesitate to contact me if you have any questions. My telephone number is (907) 265-2410.

Sincerely,

Ernest W. Piper
Project Coordinator

cc: Howard Orlean



DRAFT
Northern Boundary Assessment
Interim Action Work Plan

Alaska Railroad Corporation
Anchorage Terminal Reserve
U.S. EPA Docket No. CERCLA 10-2004-0065

Prepared by:

The RETEC Group, Inc.
2409 Research Blvd., Suite 106
Fort Collins, Colorado 80526

Prepared for:

Alaska Railroad Corporation
327 Ship Creek Avenue
Anchorage, Alaska 99501

August 30, 2004

DRAFT

Northern Boundary Assessment Interim Action Work Plan

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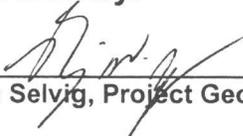
Prepared by:

The RETEC Group, Inc.
2409 Research Blvd., Suite 106
Fort Collins, Colorado 80526

Prepared for:

Alaska Railroad Corporation
327 Ship Creek Avenue
Anchorage, Alaska 99501

Prepared by:



Bjorn Selvig, Project Geologist

Reviewed by:



Chris Cosentini, Project Manager

August 30, 2004

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List of Acronyms

amsl	above mean sea level
ADEC	Alaska Department of Environmental Conservation
AOC	Administrative Order on Consent
ARRC	Alaska Railroad Corporation
BTEX	benzene, toluene, ethylbenzene, and xylenes
COCs	contaminants of concern
cfs	cubic feet per second
CSM	conceptual site model
DCA	1,1-dichloroethane
DGPS	Differential Geographic Positioning System
DO	Dissolved Oxygen
DQO	data quality objective
DRO	diesel range organics
EAFB	Elmendorf Air Force Base
EDR	Environmental Data Resources
EHS	environmental, health and safety
F	Fahrenheit
gpm	gallons per minute
GRO	gasoline range organics
HASP	Site Specific Health and Safety Plan
LUST	Leaking Underground Storage Tank
MCL	maximum contaminant level
mg/kg	milligrams per kilograms
NBAWP	Northern Boundary Assessment Work Plan
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration
OU	Operable Units
PAH	polyaromatic hydrocarbon
PPE	personal protective equipment
QAPP	quality assurance project plan
QA/QC	Quality Assurance/Quality Control
RETEC	The RETEC Group, Inc.
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RRO	Residual Range Organics
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TPH	total petroleum hydrocarbons

List of Acronyms

Site	Anchorage Terminal Reserve
µg/L	micrograms per liter
USGS	United States Geological Survey
U. S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	volatile organic compound

1 Introduction

This document is an interim action work plan developed under CERCLA Administrative Order on Consent (AOC) No. 10-2004-0065 between the U.S. Environmental Protection Agency (EPA), Region 10 and the Alaska Railroad Corporation (ARRC), under which ARRC has agreed to conduct a CERCLA/RCRA Remedial Investigation and Feasibility Study (RI/FS) at its Anchorage Terminal Reserve in Anchorage, Alaska (the Site). The AOC incorporates a Statement of Work (SOW) that includes an ARRC commitment to develop a work plan that can be implemented in 2004 to commence characterization at the northern boundary of the Site. Specifically, Section 2.2.2.2 of the SOW states as follows: *“Releases of solvents, fuel or other constituents from upgradient sources may enter the Site at its northern boundary. Respondent will develop a work plan for field work that can be conducted during 2004 to investigate and potentially identify some locations at Respondent-owned property along these boundaries where such releases may have occurred or be occurring. The work plan will include a summary of relevant existing information regarding releases from upgradient areas that may have affected or be affecting the Site, and include a sampling and analysis plan for groundwater and soil samples that will be obtained during the field work”*. This interim action work plan focuses on investigation of water quality across the north boundary of the Site as shown on Figure 1-1.

1.1 Background

The northern boundary of the Site is bordered by several upgradient facilities that have potential for current or historic releases to groundwater upgradient of the ARRC property. This work plan has been developed to meet SOW requirements and describes a proposed study to be conducted in 2004 for initial characterization of water quality and soil conditions along the northern Site boundary that might disclose impacts from upgradient sources.

1.2 Purpose

The primary purpose of work to be conducted under this Northern Boundary Assessment Work Plan (NBAWP) is to meet SOW objectives to provide an initial characterization during 2004 of shallow groundwater conditions and soils at the northern Site boundary that might indicate Site impacts from upgradient sources. Secondary purposes include generating these data in a manner allowing them to be incorporated into the overall RI/FS that ARRC will conduct for the Site as a whole. Sampling will be based on knowledge of historical processes, historical sample results, areas downgradient from known releases/spills, and previously documented springs and visual surveys of additional springs at the northern boundary that may be impacted by

upgradient sources. Documents used to identify potential upgradient sources are provided in Table 1-1. Sampling locations proposed in this interim action work plan consider results of previous investigations conducted in the North Bluff area. Results derived from this effort may be used to define needed additional investigations during the RI/FS process.

1.3 Objectives

To identify the data required to satisfy these objectives, data quality objectives (DQOs) were developed for groundwater and surface water data collection during this Interim Action based on the *Guidance for the Data Quality Objectives Process* (U.S. EPA, 2000a). The seven-step process that DQO guidance prescribes for planning data collection efforts was used to define the purpose of the data to be collected, determine how the data will be used, and determine the tolerable limit of analytical uncertainty.

Based on the DQO process, discussed further in Section 4.1, data collected during the Northern Boundary Assessment investigations will be adequate to meet the following objectives:

- Provide a limited and preliminary characterization of water quality and soil conditions at the northern Site boundary that may disclose that upgradient sources contribute to Site contaminants of concern (COCs)
- Refine the conceptual site model with respect to potential contaminant sources upgradient from the Site, and the potential migration pathways at the northern Site boundary
- Identify additional investigations at the northern Site boundary that may need to be conducted during the RI/FS

1.4 Document Organization

The environmental setting is summarized in Section 2. The summary of available data and historical documents regarding potential releases to the Site from upgradient sources is provided in Section 3. The Conceptual Site Model (CSM) is presented in Section 4; the scope of work is provided in Section 5; the sampling and analysis plan is presented in Section 6; health and safety topics are presented in Section 7; and a list of the references cited in this work plan is provided in Section 8. Appendix A includes standard operating procedures and Appendix B is the quality assurance project plan (QAPP).

2 Environmental Setting

The NBAWP includes the Northern Boundary of the Site situated along the crest of the North Bluff between Ocean Dock Road to the west and Reeve Boulevard to the east (Figure 1-1). The bluff face rises from the Ship Creek Valley to the North Bluff terrace. The ground surface elevation of the Ship Creek Valley ranges from approximately 30 feet above mean sea level (amsl) on the western boundary of the valley to approximately 70 feet amsl on the eastern boundary (Figure 1-1). From west to east, the top of the North Bluff ranges from 100 to 135 amsl.

2.1 Land Use/Property Ownership

Figure 1-1 shows the ARRC property boundary along the North Bluff area. The Northern Boundary of ARRC is bordered by a Government Hill residential area on the west and the EAFB on the east.

2.2 Topography

The face of the North Bluff is the most prominent topographic feature across the study area. It consists of a steep slope that rises approximately 70-feet above the Ship Creek valley floor. At the top of the slope, the topography is generally flat across the southern portion of EAFB and the Government Hill areas. The surface of the Ship Creek Valley gently slopes to the west and is generally flat lying across the ARRC yard with 10 to 20 feet of relief along the current Ship Creek channel.

2.3 Climate and Precipitation

Mean temperatures in the Anchorage area vary from about 10 to 33 degrees Fahrenheit (F) in the winter to 42 to 65 degrees F in the summer (National Oceanographic and Atmospheric Administration (NOAA), 2004). Precipitation for the area averages 15.7 inches per year with the highest rainfall rates occurring in August and September (WRCC, 2004).

2.4 Surface Water Hydrology

Drainage along the northern boundary/North Bluff area occurs as overland flow, and as discharges from springs that represent the surficial expression of groundwater along the North Bluff hillside. The locations and flow rates of the springs are discussed below. Spring water flows via drainage swales, ditches and storm sewers to Ship Creek. No tributary streams to Ship Creek are present along the northern ARRC property boundary.

2.4.1 Springs

During recent field reconnaissance, a total of 52 springs were identified on the North Bluff face between Ocean Dock Road and Reeve Boulevard. The springs were surveyed using a differential geographic positioning system (DGPS) and marked and labeled with wooden lath at their source. The distribution of the newly mapped springs (also referred to as seeps) along with the springs previously identified and sampled in past investigations, are shown on Figure 2-1. Flow rates and visual observations of the springs are provided in Table 2-1. The flows range from less than 0.5 gpm to 20 gpm. Total discharge of the mapped springs was approximately 178 gpm in August 2004. Several of the springs included on Figure 2-1 and Table 2-1 have been previously mapped in historic reports, particularly reports relating to OU5 (e.g., MWH, 2002; Weston, 2004). Where possible, the newly mapped springs are cross-referenced with the historic springs/seeps and noted in Table 2-1.

2.5 Local Hydrogeology

The valley floor consists of unconsolidated fluvial deposits, including the Ship Creek Alluvium and the underlying glacio-deltaic Bootlegger Cove Formation. The Ship Creek Alluvium deposits consist of sand and gravel with localized peat deposits incised into fluvial-glacial outwash deposits of the North Bluff. The glacial outwash deposits of the North Bluff (Naptowne Formation) formed after the advance of the Naptowne Glacier 10,000 to 12,000 years ago (Ulery and Updike, 1983; Shannon and Wilson, 1998). The Naptowne Formation outwash plain materials underlying EAFB consist of interbedded sand and gravel with minor coal seams and clay lenses and are in hydraulic communication with the Ship Creek Alluvium. The Bootlegger Cove Formation is a blue clay to silty-clay deposit up to 200 feet thick that acts as a confining unit between shallow groundwater in the Ship Creek Alluvium and the confined aquifer. The confined aquifer consists of over 500 feet of sand and serves as a municipal water supply under emergency conditions (USAF, 1994).

2.5.1 Groundwater Flow

The Ship Creek Alluvium and the Naptowne Formation contain unconfined groundwater that constitutes the shallow aquifer within the area. The shallow aquifer has a saturated thickness of 5 to 50 feet. The shallow aquifer groundwater flows from north to south across the northern Site boundary from EAFB/Government Hill toward Ship Creek as shown on the generalized potentiometric surface map [Figure 2-2] [USAF, 2004]). Within the Ship Creek Alluvium, the shallow aquifer flow shifts to a southwesterly direction discharging to Ship Creek (CH₂M Hill, 1999).

Published groundwater maps show that the gradient of the shallow aquifer across the Northern Boundary ranges from 0.012 to 0.013 ft/ft on the EAFB (USAF, 1994). The horizontal gradient steepens on the bluff face to about 0.033 (MWH, 2002) and ranges from 0.03 to 0.04 within the Ship Creek Alluvium (CH₂M Hill, 1998). The hydraulic conductivity of the surficial aquifer ranges from 1 to 150 feet per day (USAF, 1994).

3 Previous Investigations and Historical Data

This section summarizes the historical soil, groundwater, and surface water data collected within the Northern Boundary Area for the purpose of identifying potential sources of contamination. A list of existing documents and data reviewed to assess North Boundary conditions is provided in Table 1-1.

Past spills and potential releases at locations upgradient of the Site that may be relevant to this Northern Boundary Assessment are summarized on Figure 3-1. The locations of springs along the north boundary are shown on Figure 2-1. The spring locations on Figure 2-1 include sampled springs (called seeps) (MWH, 2001; 2002; Weston, 2004) and springs recently identified during reconnaissance work for this Work Plan.

The Tables and Figures provided with this Work Plan summarize existing information regarding spills and potential releases at upgradient locations that may have affected or could affect the Site. Further ARRC evaluation of potential Site impacts relating to any off-site sources, however, will not be warranted unless data collected during this Interim Action or the RI/FS indicate that releases from some or all of these upgradient sources have impacted the Site and the evaluation of such impacts is necessary for Site characterization, risk assessment or remedial alternatives analysis.

4 Conceptual Site Model for Northern Boundary

This section presents the CSM for the NBAWP. The purpose of the CSM is to present a framework for conveying what is known about potential sources of contaminants, COCs, releases and release mechanisms of contaminants, migration pathways, and data gaps (U.S. EPA, 1996a).

The environmental setting was summarized in Section 2 and data referenced to complete the CSM is referenced in this section. Potential contaminant sources, spill history, and identification of COCs relevant to the CSM are presented in Table 1-1.

4.1 Potential Upgradient Sources

Potential upgradient and off-site sources of contamination in the NBAWP include pipeline spills, possible leaking underground storage tank (LUST) sites, and past releases to surface water and groundwater from the EAFB OUs as listed in Table 1-1.

4.2 Contaminants of Concern

This section identifies the process of selecting COCs that will be used to identify possible upgradient source impacts in the surface water, ground water and soils in the northern Site boundary area that will be evaluated in this Interim Action. Potential COCs were derived through review of historic documents to determine a COC list. The resultant COC list helps focus the collection and evaluation of data, including the characterization of COCs that may drive risk and future remedial measures. The COC list includes the following types of contamination:

- VOCs (volatile organic compounds)
- SVOCs (semivolatile organic compound)
- TPH-GRO (Total Petroleum Hydrocarbons – Gasoline Range Organics)
- TPH-DRO (Total Petroleum Hydrocarbons – Diesel Range Organics)
- TPH-RRO (Total Petroleum Hydrocarbons – Residual Range Organics)

Proposed analytical methods for this investigation include the following: VOCs using U.S. EPA Method 8260, SVOCs using U.S. EPA Method 8270, and TPH-GRO, TPH-DRO, and TPH-RRO using ADEC Methods 101, 102, and 103, respectively. Target analyte lists for the methods above and reporting limits are provided in Tables 4-1, 4-2, and 4-3.

The screening of COCs does not determine cleanup criteria or endpoints for contaminants at the Northern Boundary; it merely serves as a method for focusing characterization of the upgradient Northern Boundary.

4.3 Hydrogeologic Model

A CSM showing the relationship of subsurface to surface groundwater interaction is provided on Figure 4-1. Groundwater under the EAFB area, North Bluff, and Ship Creek Valley are hydraulically connected and ultimately discharge to Ship Creek. Along the North Bluff face, numerous springs exist as surficial expressions of shallow groundwater. Contaminants that infiltrate to groundwater beneath EAFB, the pipeline corridor, or from USTs can resurface through the springs. In this setting, shallow groundwater in the northern Site boundary that might have been impacted by upgradient sources can be accessed via the springs.

4.4 Migration Pathways

This section discusses the potential migration pathways of COCs from upgradient sources to ARRC property, including known or suspected preferential pathways.

Preferential pathways may include, but are not limited to, the following:

- Groundwater discharge to surface water (springs and Ship Creek)
- Historic drainages, including the area that drains to Ship Creek
- Former and active utility corridors
- Former and active fuel, product, and gas pipelines, and their backfill

5 Investigation Scope of Work

This section summarizes the Northern Boundary Assessment Data Quality Objectives (DQOs) and corresponding proposed scope of work. A discussion of the field procedures and methods for the Northern Boundary Assessment is provided in Section 6.

5.1 Data Quality Objectives

This Interim Action Work Plan is intended to provide preliminary groundwater and soil data towards meeting the purpose and objectives outlined in Section 1. These preliminary data will be incorporated into the overall RI/FS and used to guide future field activities. In accordance with guidance provided by U.S. EPA in the *Advance Notice of Proposed Rulemaking* (U.S. EPA, 1996a), data gathering strategies should be tailored to reflect the DQOs. DQOs reflect the overall degree of data quality or uncertainty that the decision-maker is willing to accept during decision-making. DQOs are used to specify the quality of the data, usually in terms of precision, bias, representativeness, comparability, and completeness.

DQOs apply to the entire measurement system (e.g., sample locations, methods of collection and handling, field analysis, and laboratory analysis). DQOs are used to ensure that environmental data are scientifically valid, defensible, and of an appropriate level of quality given the intended use of the data (U.S. EPA, 1996b).

DQOs are intended to accomplish the following:

- Clarify the study objectives
- Define the most appropriate type of data to collect
- Determine the most appropriate conditions from which to collect data
- Specify tolerable limits on decision errors to establish quantity and quality of data (U.S. EPA, 2000)

The U.S. EPA's *Guidance for the Data Quality Objective Process* (U.S. EPA, 2000) was used to develop DQOs that are appropriate for this investigation. The Northern Boundary Assessment DQOs are presented in Table 5-1.

The Northern Boundary Assessment was structured so that the limited and preliminary data this Interim Action generates will not duplicate existing information regarding conditions at the northern Site boundary. The data resulting from this study will be useful in the near term to identify possible

impacts from off-site sources and also will be incorporated into the set of analytical data that will be evaluated in the overall RI/FS.

5.2 Groundwater and Soil Investigation

The proposed investigation is designed to collect groundwater and soil data from springs along the North Bluff having sufficient quantity and quality to achieve the following objectives:

- Characterize the COCs in selected springs as potential indicators of impacts from upgradient sources on northern Site boundary ground water
- Perform reconnaissance for the presence of upgradient-impacted springs, stained soils, or other evidence of Site contamination originating from upgradient sources
- Determine flow rates of the springs selected for evaluation

The following sections outline the proposed investigation, which is designed to optimize data collection to meet the Northern Boundary Assessment DQOs.

A total of 22 spring samples are proposed in the Northern Boundary Assessment, as summarized in Table 5-2. These sample locations are downgradient from potential source areas (i.e., areas of documented spills or discharges) with limited or no existing groundwater data, as shown on Figures 5-1a and 5-1b. The basis for selecting the proposed spring sample locations is provided in Table 5-2. Based on the judgment of the field geologist, soil samples will be co-located at 5 to 6 spring locations that exhibit odor or sheening. All spring water and soil samples collected will be analyzed for the COC list discussed in Section 4.2. The sample collection methods are discussed in Section 6.

6 Sampling and Analysis Plan

This section summarizes the field methods and procedures that will be used during the Northern Boundary Assessment. Where applicable, SOPs are referenced in the following sections to ensure consistent investigation methods, procedures, and documentation. The referenced SOPs are provided in Appendix A.

6.1 Field Activity Documentation

All field activities will be recorded on the appropriate field forms, as described in the following sections, and compiled in a project field notebook on a daily basis. Project field books will be used to record all field activities and document field personnel and visitors present. Field sampling forms are included in Appendix A. Health and safety topics, including daily safety meetings, will also be documented and compiled in a project field notebook.

6.2 Field Sampling Methods

The locations of all identified groundwater springs in the northern Site boundary are shown on Figure 2-1. A subset of these springs, located downgradient from potential source areas, will be sampled to assess groundwater quality and identify potential impacts from off-site sources. The springs to be sampled are identified on Figures 5-1a and 5-1b and are also listed on Table 5-1.

6.2.1 Field Reconnaissance

In August 2004, Hoefler Consulting Group, under guidance from The RETEC Group, Inc. (RETEC), conducted a field reconnaissance of the North Bluff to identify all the springs. As shown on Figure 2-1, a total of 52 springs were identified. The locations of these springs were measured using a Trimble Differential Geographic Positioning System (DGPS) unit. During the reconnaissance, field personnel estimated flow rates and made visual observations that included appearance/color of water, presence of algae, and presence of sheen. Table 2-1 lists the springs, coordinates, and field observations.

6.2.2 Spring Flow Gauging

Flow rates at the springs will be measured using a graduated bucket and a stopwatch. Flow rates will be measured at the same springs that will be sampled. This is the same method that was used to obtain the flow rate estimations presented in Table 2-1.

6.2.3 Groundwater Quality Sampling

Field/*In Situ* Measurements

At each sampling location, spring water will be measured *in situ* for the following parameters:

- pH
- Specific Conductivity
- Temperature
- Dissolved Oxygen (DO)
- Oxidation-Reduction Potential (ORP)

Measurements will be recorded on a field sampling form (included in Appendix A). Field measurements will be measured *in situ*, taking care not to disturb the ground surface or agitate the water.

The instrument(s) used for field measurements will be calibrated according to the manufacturer's instructions. Most instruments need to be calibrated daily to give accurate readings.

Dissolved Oxygen – Special Considerations

Collection of accurate DO measurements is difficult. However, field DO is also one of the most important field parameters. DO instruments are particularly sensitive to changes in temperature and barometric pressure, and should be calibrated daily.

Difficulty with DO measurements arises primarily for three reasons: 1) the membranes are easily ruptured or scratched during sampling and/or replacement leading to erroneous measurements, and 2) DO stabilizes very slowly making it difficult to decide what the true reading is. Yet a third problem with DO sensors is that the anodes can become tarnished and give inaccurate readings.

Before measuring DO, the correct procedure is to inspect the membrane carefully for any scratches, tears, or air bubbles. If any of these are observed, change out the membrane. If the silver anodes on the DO probe are tarnished, they need to be carefully polished with special polishing paper in the maintenance kit.

Generally, DO stabilizes after 4 to 5 minutes *in situ*. Primary evidence of a failing DO membrane is from unusual results. If previous readings have been similar and a reading is suddenly out of that range, it is likely the meter requires maintenance.

Analyses

After gauging and measurement of field parameters, a water sample will be collected from each location. Samples will be submitted for laboratory analysis of the following parameters:

- VOCs (EPA Method 8260)
- SVOC (EPA Method 8270)
- GRO (AK 101)
- DRO (AK 102)
- RRO (AK 103)

Sample Collection

Samples will be collected at the source of the spring. Because VOC and GRO constituents are especially susceptible to volatilization, steps will be taken during sample collection to minimize agitation and other factors that could increase volatilization. If possible, the sampling container will be submerged under the water while the container is filled. If this is not practical, then as much of the container as possible should be submerged. Care will be taken not to disturb soil, sediment, algae, or other plant material that could mix in with the sample water. The methods used to collect groundwater samples from the springs will be similar to methods commonly used to collect surface water samples. Refer to RETEC SOP 250 (included in Appendix A) for further guidelines. This Work Plan will take precedence over SOP 250 if there are any discrepancies.

Sample Nomenclature

Because all data for this project will be managed in a database, unique numbers are required for each sample. It is insufficient to name samples simply using the location name. Each sample will be named with the location name and an eight-digit date when the sample was collected, with a dash separating the sample name and date. The date format will be “mmddyy.” For example, a sample collected from spring SP 36 on September 19, 2004 would be labeled: SP 36-091904. Similarly, soil samples will be named in a similar manner, but will be followed by four more digits to designate the sample depth interval. A soil sample collected from the same location above from 2- to 4- feet below ground surface would be labeled: SO-36-091904-0204.

Staking Sample Locations

Sampling locations will be marked with a wooden lath and labeled, so they may be easily identified in the future.

6.2.4 Soil Sampling

Soil samples will be co-located at select spring locations. Soil samples will be collected only after the spring water has been sampled to prevent siltation to the water sample. Samples will be collected using a hand auger advanced into the soil directly below the spring. The soil will be logged in a field notebook and include description of grain size, color, odor, and/or staining (if present). The sample depth will be determined in the field at the discretion of the field geologist. Sample intervals that exhibit odor or possible hydrocarbon staining will be sampled preferentially over those that do not. Each soil sample will be analyzed for the VOCs, SVOCs, and the full suite of TPH ranges in the COC list (GRO, DRO, and RRO).

6.3 Field Quality Assurance Sampling

Quality assurance samples, including field blanks, blind duplicates, trip blanks, equipment blanks, matrix spikes, and matrix spike duplicates, will be collected and analyzed as discussed below.

The following quality assurance samples will be collected in accordance with the QAPP (Appendix B):

- **Springs.** One field blank, blind duplicate, and equipment blank for every 10 primary surface water samples collected
- **Soil.** One field blank, blind duplicate, and equipment blank for every 10 soil samples collected

In addition, one trip blank will be placed in each cooler to accompany the groundwater and soil samples during shipment to the receiving laboratory.

The quality assurance samples will be analyzed as follows:

- Equipment blanks, field blanks, and blind duplicate: full COC list
- Trip blanks: only the VOCs on the COC list

6.4 Sample Handling and Shipping

Following collection, all surface water samples will be sealed in laboratory-supplied containers and each container will be labeled with the following information:

- Project name

- Unique sample identification number and corresponding sample depth (if applicable)
- Date and time of collection
- Name of sampling technician
- Requested analyses
- Any method of preservation used

Samples collected for laboratory analyses will be packed on ice for sample preservation and transported in sealed coolers to the receiving laboratory via courier. Guidance for packing and shipping samples is provided in SOP 110 (included in Appendix A).

For each sample or set of samples shipped for laboratory analyses, a chain-of-custody form will be completed to accompany the samples. The chain-of-custody form will include the following information:

- Unique sample identification number
- Project name, location, and number
- Sample collection dates and times
- Name of sampling technician(s)
- Media type
- Number of containers per sample
- Signature of person relinquishing and receiving custody
- Requested analyses for each sample
- Any method of preservation used

A copy of the completed chain-of-custody form and any corresponding shipping receipt will be maintained for field records.

When filling out the chain-of custody-form the person collecting the sample shall do the following:

- Request routine turn around times from the analytical laboratory
- Request that the laboratory provide a Level III quality assurance/quality control (QA/QC) package with the analytical results
- Have the laboratory results sent to Susan Milcan in the RETEC Fort Collins office

6.5 Decontamination

Decontamination will be performed on all non-dedicated sampling equipment between sample locations.

Stainless steel sampling utensils and water sampling devices will be decontaminated at each sample location prior to sampling by rinsing with isopropyl alcohol and distilled or de-ionized water.

6.6 Investigation-Derived Waste Management

Spring sampling activities are anticipated to generate only minor amounts of waste, in the form of used personnel protective equipment (PPE). Investigation-derived PPE will be contained in garbage bags and stored on site for transport to the municipal landfill.

6.7 Surveying

Each proposed groundwater and soil sample location will be surveyed to establish vertical and horizontal control using a DGPS if the sampling location changes from the location surveyed during the area reconnaissance. The measuring point elevations and ground surface elevations will be surveyed to within 3 feet. The horizontal coordinates will be surveyed to within 1 foot.

7 Health and Safety

The field activities associated with this investigation will be conducted in accordance with the guidelines outlined in the *Site-Specific Health and Safety Plan* (HASP) (RETEC, 2004). The potential health and safety hazards associated with the field activities proposed in this Work Plan, and the respective precautionary health and safety guidelines, are addressed in the HASP. All personnel involved in the investigation will be required to review and comply with the HASP.

To perform field activities on site, all field personnel must wear a hard hat, safety glasses, orange reflective vest and steel-toed boots, and must provide a copy of their current Occupational Safety and Health Administration (OSHA) 40-hour training certificate and OSHA 8-hour refresher-training certificate. Additionally, all field personnel working on the ARRC project will have current Railroad Contractor Safety Orientation and RETEC On-Track Safety training. Field investigation personnel will be required to attend a preliminary site safety orientation to identify the hazards specific to working on site and daily safety meetings or project-specific tailgate safety meetings to discuss safety topics specific to the fieldwork being performed that day. All health and safety topics, including daily meetings, will be documented and compiled in a project field notebook.

ARRC also requires that task leaders obtain a daily pass and inform the railroad environmental, health and safety (EHS) manager and ARRC Project Coordinator, Ernie Piper, of daily activities.

8 References

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- U.S. EPA, 2000. *Guidance for the Data Quality Objectives Process*. EPA QA/G-4, U.S. EPA, Office of Environmental Information, EPA/600/R-96/055, August 2000.
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Tables

**Table 1-1 Document Database Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Date	Document Title	Author	Client	Area	Maps	Sampling Matrices				Laboratory Results	Contaminants Exceeding Cleanup Levels at North Bluff		
						Soil/Sed	Groundwater	Surface Water/Seeps	Soil/Sed		Groundwater	Seeps	
1994 (March)	Operable Unit 5, RI/FS, Volume 1-Text	Radian	USAF	OU5	Yes	✓	✓	✓	Yes	DRO, GRO, JP-4, BTEX, and PCBs	DRO, GRO, JP-4, BTEX, and PCBs	DRO, GRO, JP-4, BTEX, and PCBs	
1995 (February)	Record of Decision, Operable Unit 5		USAF	OU5	Yes	✓	✓	✓	Yes	DRO, GRO, VOCs, SVOCs, and metals	DRO, GRO, TCE, metals	DRO, GRO, TCE, metals	
1995 (March)	Operable Unit 3 RI/FS		USAF	OU3	Yes	✓	✓	✓	Yes	DRO, VOCs, PCBs, and metals	Cadmium and bis(2-ethylhexyl)phthalate	DRO, VOCs, PCBs, and metals	
1996 (February)	Preliminary Geotechnical Evaluation of the North Bluff of Ship Creek for Proposed Grading to Create a New Rail Siding	Shannon & Wilson	ARRC	RR	Yes				No				
1997 (April)	Site Characterization Defense Fuel Support Point	Shannon & Wilson	Defense Fuel Supply Center	Defense Fuels	Yes				Yes				
1997 (October)	Phase II Site Assessment 132/140 East Manor Avenue	Shannon & Wilson	Environmental Health Sciences	East Manor	Yes	✓			Yes	DRO, PCBs, Metals			
1998 (March)	Arctic Cooperation Facility Report of Findings	CH ₂ MHill	ARRC	RR	Yes	✓	✓	✓	Yes	DRO, GRO, RRO, BTEX, PAHs, VOCs	DRO, GRO, RRO, PAHs, VOCs, lead, benzene, toluene	DRO, RRO	
1998 (March)	Ship Creek Bluff Borrow Site Environmental Assessment Review	Shannon & Wilson	Fleming Brothers & ARRC	RR	No	✓			Yes				
1998 (March)	Environmental Assessment Summary Meeting with ADEC, Ship Creek Bluff Borrow Site	Shannon & Wilson	Fleming Brothers & ARRC	RR	No				No				
1998 (March)	Material Evaluation Report for Ship Creek Bluff Borrow Site	Shannon & Wilson	Fleming Brothers & ARRC	RR	No				No				
1998 (March)	Environmental Site Assessment, Ship Creek Bluff Borrow Site	Shannon & Wilson	Fleming Brothers & ARRC	RR	No				No				
1998 (December)	Phase III Environmental Site Assessment 132/140 East Manor Avenue	Shannon & Wilson	Environmental Health Sciences	East Manor	Yes	✓	✓		Yes	DRO, TCE	DRO		
1998 (December)	Environmental Restoration Five-Year Review Findings	USAF	Public	Basewide	Yes				No				

**Table 1-1 Document Database Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Date	Document Title	Author	Client	Area	Maps	Sampling Matrices			Laboratory Results		Contaminants Exceeding Cleanup Levels at North Bluff	
						Soil/Sed	Groundwater	Surface Water/Seeps	Soil/Sed	Groundwater	Soil/Sed	Groundwater
1999 (September)	Preliminary Sample Results from Ship Creek Bluff Borrow Site	Shannon & Wilson	Flamingo Brothers & ARRC	RR	No	✓			Yes	GRO		
2000 (August)	Basewide Environmental Monitoring Program, Groundwater and Surface Water Analytical Results for OU5, Round 1, 2000		USAF	Basewide	Yes		✓	✓	Yes			
2000 (December)	Additional Investigation and Limited Cleanup 132/140 East Manor Avenue	Shannon & Wilson	Environmental Health Sciences	East Manor	Yes	✓			Yes	DRO, TCE		
2000 (December)	Certification of Compliance with Institutional Controls		USAF	Basewide	Yes				No			
2001 (March)	Annual Report of Groundwater Sampling Activities, Basewide Environmental Monitoring Program, Volume 1 (Final)		USAF	Basewide	Yes		✓		Yes	BTEX, TCE		
2001 (June)	Corrective Action Plan, SERA IV, V, VI, and VIII Sites (Final)	Jacobs	3rd CES	Basewide	Yes				No			
2001 (October)	ARRC Borrow Site Borings B2 and B3	Shannon & Wilson	ARRC	RR	No	✓			No			
2001 (November)	Review of the OU5 RIFS	URS	3rd CES	OU5	Yes				Yes			
2001 (November)	North Ship Creek Railroad Yard Expansion Surface Water Study Data Report	Montgomery Watson Harza	ARRC	RR	Yes			✓	Yes			Lead
2001 (November)	Summary of Bluff Sample Results by ARRC October 1999 through October 2001	Lounsbury & Associates	ARRC	RR	Yes	✓			Yes	GRO, Benzene		
2001 (December)	North Ship Creek Railroad Yard Expansion Groundwater Investigation Work Plan	Montgomery Watson Harza	ARRC	RR	Yes				No			
2001 (December)	Additional Investigation 132/140 East Manor Avenue	Shannon & Wilson	Environmental Health Sciences	East Manor	Yes	✓		✓	Yes	Benzene		DRO
2002 (April)	North Ship Creek Railroad Yard Expansion Groundwater Investigation Report	Montgomery Watson Harza	ARRC	RR	Yes		✓		Yes			TCE

**Table 1-1 Document Database Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Date	Document Title	Author	Client	Area	Maps	Sampling Matrices			Laboratory Results	Contaminants Exceeding Cleanup Levels at North Bluff		
						Soil/Sed	Groundwater	Surface Water/Seeps		Soil/Sed	Groundwater	Seeps
2002 (April)	ARRC Ship Creek Yard Expansion-Existing Conditions and Alternatives for USAF Seepage Collection System	Montgomery Watson Harza	ARRC	RR	Yes				No			
2002 (July)	Groundwater Investigation Report for the North Ship Creek Rail Yard Expansion, Responses to U.S. Air Force Comments	Montgomery Watson Harza	ARRC	RR	Yes	✓		✓	Yes			
2002 (December)	Groundwater Investigation Report for the North Ship Creek Rail Yard Expansion, Responses to U.S. Air Force Well Locations	Montgomery Watson Harza	ARRC	RR	Yes				Yes			
2003 (January)	Environmental Property Transfer Assessment, 1010 Hollywood Drive, Parcel #1	T&R Environmental	AK Enfranchised Facilities	Hollywood Vista	No				No			
2003 (January)	Limited Phase II Environmental Site Assessment, Hollywood Vista, Tract 2	Shannon & Wilson	Muni of Anchorage	Hollywood Vista	Yes	✓		✓	Yes		GRO and DRO	
2003 (March)	2002 Annual Report, Basewide Environmental Monitoring Program, Volume 1-Text (Final)		USAF	Basewide	Yes			✓	Yes		Benzene, TCE, manganese	Benzene, TCE, manganese
2003 (March)	2002 Annual Report, Operable Unit 5, Wetland Remediation System (Final)		USAF	OU5	Yes			✓	Yes		Benzene, TCE	Benzene, TCE
2003 (August)	Ship Creek Storm Drain Sampling	Hart Crowser	ARRC	RR	Yes			✓	Yes			
2003 (November)	Five-Year Review, Second Five-Year Review Report		USAF	Basewide	Yes				No			
2004 (February)	Groundwater Monitoring Program Annual Update	3rd Wing Public Affairs	USAF	Basewide	Yes				Yes			
2004 (April)	Operable Unit 5 Quarterly Progress Report	3rd CES	USAF	OU5	No				Yes			
2004 (May)	OU5 Wetlands Monitoring and System Optimization, Final 2003 Annual Report	Weston Solutions	3rd CES and AFCEE	OU5	Yes			✓	Yes			Benzene, TCE, TAH, and TAqH

**Table 1-1 Document Database Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Date	Document Title	Author	Client	Area	Maps	Sampling Matrices			Contaminants Exceeding Cleanup Levels at North Bluff			
						Soil/Sed	Groundwater	Surface Water/Seeps	Laboratory Results	Soil/Sed	Groundwater	Seeps
2004 (June)	Remediation System Installation and Groundwater Monitoring Report Former Government Hill Texaco Station	Oasis Environmental		Government Hill	Yes		√		Yes		DRO, RRO	

**Table 2-1 Spring Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Spring ID	Date Surveyed	Flow Rate (GPM)	Previous ID	Northing (Y coordinate)	Easting (X coordinate)	Visual Observation	Comments
SP-01	8/2/2004	9	None	2640895.00	522374.88	Clear, No OVC	
SP-02	8/2/2004	0.5	None	2640926.44	522379.22	Clear, No OVC	
SP-03	8/2/2004	0.25	None	2640951.55	522318.73	brown mud, no discernible flow	
SP-04	8/2/2004		None	2641019.87	522103.07	Light brown algae, stagnant, slight organic sheen, no odor	
SP-05	8/3/2004	0.25	None	2640829.73	522462.76	Clear, No OVC	a trickle
SP-06	8/3/2004	1	None	2640817.68	522471.42	Clear, No OVC	
SP-07	8/3/2004	2.8	None	2640787.48	522544.09	Clear, No OVC	
SP-08	8/3/2004	0.25	None	2640769.71	522617.61	Clear, No OVC	a trickle
SP-09	8/3/2004	0.5	None	2640740.51	522643.40	Clear, No OVC	
SP-10	8/3/2004	0.5	None	2640733.07	522953.23	Clear, No OVC	fenced - can't access source, source may be 100 ft north of fence
SP-11	8/3/2004	6	None	2640875.25	523494.85	Clear, No OVC	
SP-12	8/3/2004	0.5	None	2640761.42	523609.10	Clear, No OVC	fenced - can't access source, source likely to be 100 ft north of fence
SP-13	8/3/2004	2	None	2640831.61	523789.42	Clear, No OVC	fenced - can't access source, source is about 300 feet north of fence at uncontrolled trash dump
SP-14	8/3/2004	9	None	2640752.72	523825.01	Clear, No OVC	Combined flow from these springs = 25 gpm, springs discharging along area 200 ft long
SP-15	8/3/2004	15	None	2640746.71	524108.22	Clear, No OVC, heavy yellow/green algae	
SP-16	8/3/2004	10	None	2640741.10	524222.08	Clear, No OVC, heavy yellow/green algae	
SP-17	8/3/2004	0.2	None	2640551.77	524238.33	Clear, No OVC, minor organic sheen	
SP-18	8/3/2004	0.2	None	2640561.35	524271.80	Clear, No OVC	
SP-19	8/3/2004	20	None	2640760.40	524540.49	Clear, No OVC, stagnant w/heavy yellow/green and white algae	100-foot long area
SP-20	8/3/2004	15	None	2640765.18	524728.52	Clear, No OVC, stagnant w/heavy yellow/green and white algae	Combined flow is 35 gpm 50-foot long area
SP-21	8/4/2004	0.5	None	2640559.29	524511.13	Clear, No OVC	2 springs within 20 feet of each other
SP-22	8/4/2004	0.5	None	2640569.30	524579.49	Clear, No OVC, brown algae, slight organic sheen	

**Table 2-1 Spring Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Spring ID	Date Surveyed	Flow Rate (GPM)	Previous ID	Northing (Y coordinate)	Easting (X coordinate)	Visual Observation	Comments
SP-23	8/4/2004	0.2	None	2640569.71	524601.16	Clear, No OVC	low flow
SP-24	8/4/2004	0.2	None	2640589.56	524655.58	Clear, w/heavy iron stained brown algae, septic odor, bubbles rise when setting survey stake	
SP-25	8/4/2004	2	None	2640608.65	525037.61	Clear with heavy iron staining & significant amount of organic sheen	50-foot long area
SP-26	8/4/2004	3	None	2640676.66	525384.29	Clear, No OVC	10+ springs across 180 foot long area, each having flow of about 3 gpm and combined flow of 20 gpm (estimate)
SP-27	8/4/2004	1	None	2640705.31	525784.10	Clear, No OVC	
SP-28	8/4/2004	0.5	None	2640760.69	526196.36	Clear, No OVC, brown & green algae	Face of slope is damp multiple sources within 20-foot area that flow into a small pond, flow is combined from 2 outflows from the ponded water
SP-29	8/4/2004	11.5	None	2640796.63	526413.05	Clear, No OVC, green & white algae	10+ sources across 100-foot face of knob SW of Corp of Engineers building with combined flow of 30 gpm
SP-30	8/5/2004	0.75	None	2640818.19	526567.38	Clear, minor organic sheen, some iron stained, some green algae, possible faint hydrocarbon odor	
SP-31	8/5/2004	2.5	None	2640785.16	526834.26	Clear, No OVC	6+ springs along 200-foot long area with combined flow of about 10 gpm
SP-32	8/5/2004	2	None	2640794.43	526891.17	Clear, No OVC	
SP-33	8/5/2004	5	MWH Seep 3	2640816.74	527053.78	Clear, No OVC	this site may be difficult to sample due to low flow
SP-34	8/5/2004	0.2	None	2640925.96	527177.06	Clear, No OVC, heavy iron staining, some organic sheen	Stagnant, low-lying area, needs a drive point well to sample
SP-35	8/5/2004		None	2640970.83	527294.68	possible slight solvent or fuel odor	
SP-36	8/5/2004	0.5	None	2641496.95	528406.81	odorless sheen that acts like non-organic	

**Table 2-1 Spring Summary
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Spring ID	Date Surveyed	Flow Rate (GPM)	Previous ID	Northing (Y coordinate)	Easting (X coordinate)	Visual Observation	Comments
SP-37	8/6/2004	1	None	2641673.77	528811.33	Clear, No OVC	
SP-38	8/6/2004	5	Seep 8?	2641648.27	528848.75	Clear, No OVC	2" pvc
SP-39	8/6/2004	5	None	2641659.38	528904.23	Clear, No OVC	4" pvc well - tipped, but functional
SP-40	8/6/2004	10	MWH OU5-SP03	2641717.91	528923.12	Clear, No OVC	2" pvc casing - functional
SP-41	8/6/2004	5	Seep 7	2641905.82	529223.45	Clear, no OVC, stagnant w/ green and brown algae	
SP-42	8/6/2004	5	None	2641963.97	529231.76	Clear, no OVC	2" pvc casing - functional
SP-43	8/6/2004	1	None	2642073.09	529305.85	Clear, no OVC	100 ft SSW of building 22 002
SP-44	8/6/2004	10	None	2642190.53	529346.09	Clear, no OVC, stagnant w/ green algae, organic sheen	20-foot long area
SP-45	8/6/2004	1	Seep 18	2642226.73	529349.34	Clear, no OVC, w/ yellow & brown algae	
SP-46	8/6/2004	5	Seep 17	2642277.17	529346.04	No OVC, dark brown algae, organic sheen, septic odor	
SP-47	8/6/2004	0.5		2642496.47	529911.47	No OVC, reddish brown muck	
SP-48	8/6/2004	1	Seep 9	2642463.01	529978.69	Clear, no OVC	10 ft west of multi-product line
SP-49	8/6/2004	0.5	Seep 10	2642458.74	530022.57	Clear, no OVC	between OU5 SP09 and SP10, 30 ft east of multi-product line and valve
SP-50	8/6/2004	5	Seep 14	2642425.82	530158.34	Clear, no OVC	
SP-51	8/5/2004		Seep 15	2641461.39	528363.55	gray sheen that coalesces like a fuel sheen and doesn't break apart like organic sheen, no odor	2" pvc well present in pooled water - good condition
SP-52	8/5/2004		None	2640985.00	527256.23		good condition

Notes:
OVC = Odor or Visible Contamination

Table 4-1 Volatile Target Analyte List
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK

CAS No.	Analyte	Reporting Limit µg/L	Reporting Limit µg/kg
75-71-8	Dichlorodifluoromethane	10	10
74-87-3	Chloromethane	10	10
75-01-4	Vinyl Chloride	10	10
74-83-9	Bromomethane	10	10
75-00-3	Chloroethane	10	10
75-69-4	Trichlorofluoromethane	10	10
75-35-4	1,1,-Dichloroethene	10	10
73-1.-1	1,1,2-Trichloro-1,2,2-trifluoroethane	10	10
67-34-1	Acetone	10	10
75-15-0	Carbon Disulfide	10	10
79-20-9	Methyl Acetate	10	10
75-09-2	Methylene Chloride	10	10
159-60-5	trans-1,2-Dichloroethene	10	10
1634-04-4	Methyl tert-Butyl Ether	10	10
75-34-3	1,1-Dichloroethane	10	10
156-59-2	cis-1,2-Dichloroethene	10	10
78-93-3	2-Butanone	10	10
67-66-3	Chloroform	10	10
71-55-6	1,1,1-Trichloroethane	10	10
110-83-7	Cyclohexane	10	10
56-23-5	Carbon Tetrachloride	10	10
71-43-2	Benzene	10	10
107-06-2	1,2-Dichloroethane	10	10
79-01-6	Trichloroethene	10	10
108-87-2	Methylcyclohexane	10	10
78-87-5	1,2-Dichloropropane	10	10
75-27-4	Bromodichloromethane	10	10
10061-01-5	cis-1,3-Dichloropropene	10	10
108-10-1	4-Methyl-2-pentanone	10	10
108-88-3	Toluene	10	10
10061-02-6	trans-1,3-Dichloropropene	10	10
79-00-5	1,1,2-Trichloroethane	10	10
127-18-4	Tetrachloroethene	10	10
591-78-6	2-Hexanone	10	10
124-48-1	Dibromochloromethane	10	10
106-93-4	1,2-Dibromoethane	10	10
108-90-7	Chlorobenzene	10	10
100-41-4	Ethylbenzene	10	10
1330-20-7	Xylene (total)	10	10
100-42-5	Styrene	10	10
75-25-2	Bromoform	10	10
98-82-8	Isopropylbenzene	10	10
79-34-5	1,1,2,2-Tetrachloroethane	10	10
541-73-1	1,3-Dichlorobenzene	10	10
106-43-7	1,4-Dichlorobenzene	10	10

Table 4-1 Volatile Target Analyte List
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK

		Reporting Limit	Reporting Limit
95-50-1	1,2-Dichlorobenzene	10	10
96-12-8	1,2-Dibromo-3-chloropropane	10	10
120-82-1	1,2,4-Trichlorobenzene	10	10

Table 4-2 Semi-volatile Target Analyte List
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK

CAS No.	Analyte	Reporting Limit µg/L	Reporting Limit µg/kg
100-52-7	Benzaldehyde	10	330
108-95-2	Phenol	10	330
111-44-4	bis(2-Chloroethyl)ether	10	330
95-57-8	2-Chlorophenol	10	330
95-48-7	2-Methylphenol	10	330
108-60-1	2,2'-oxybis(1-Chloropropane)	10	330
98-86-2	Acetophenone	10	330
106-44-5	4-Methylphenol	10	330
621-64-7	N-Nitroso-di-n-propylamine	10	330
67-72-1	Hexachloroethane	10	330
98-95-3	Nitrobenzene	10	330
78-59-1	Isophorone	10	330
88-75-5	2-Nitrophenol	10	330
105-67-9	2,4-Dimethylphenol	10	330
111-91-1	bis(2-Chloroethoxy)methane	10	330
120-83-2	2,4-Dichlorophenol	10	330
91-20-3	Naphthalene	10	330
106-47-8	4-Chloroaniline	10	330
87-68-3	Hexachlorobutadiene	10	330
105-60-2	Caprolactam	10	330
59-50-7	4-Chloro-3-methylphenol	10	330
91-57-6	2-Methylnaphthalene	10	330
77-47-4	Hexachlorocyclopentadiene	10	330
88-06-2	2,4,6-Trichlorophenol	10	330
95-95-4	2,4,5-Trichlorophenol	25	830
92-52-4	1,1'-Biphenyl	10	330
91-58-7	2-Chloronaphthalene	10	330
88-74-4	2-Nitroaniline	25	830
131-11-3	Dimethylphthalate	10	330
606-20-2	2,6-Dinitrotoluene	10	330
208-96-8	Acenaphthylene	10	330
99-09-2	3-Nitroaniline	25	830
83-32-9	Acenaphthene	10	330
51-28-5	2,4-Dinitrophenol	25	830
100-02-7	4-Nitrophenol	25	830
132-64-9	Dibenzofuran	10	330
121-14-2	2,4-Dinitrotoluene	10	330
84-66-2	Diethylphthalate	10	330
86-73-7	Fluorene	10	330
7005-72-3	4-Chlorophenyl-phenylether	10	330
100-01-6	4-Nitroaniline	25	830
534-52-1	4,6-Dinitro-2-methylphenol	25	830
86-30-6	N-Nitrosodiphenylamine (1)	10	330
101-55-3	4-Bromophenyl-phenylether	10	330
118-74-1	Hexachlorobenzene	10	330

**Table 4-2 Semi-volatile Target Analyte List
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

		Reporting Limit	Reporting Limit
1912-24-9	Atrazine	10	330
87-86-5	Pentachlorophenol	25	830
85-01-8	Phenanthrene	10	330
120-12-7	Anthracene	10	330
86-74-8	Carbazole	10	330
84-74-2	Di-n-butylphthalate	10	330
206-44-0	Fluoranthene	10	330
129-00-0	Pyrene	10	330
85-68-7	Butylbenzylphthalate	10	330
91-94-1	3,3'-Dichlorobenzidine	10	330
56-55-3	Benzo (a) anthracene	10	330
218-01-9	Chrysene	10	330
117-81-7	bis (2-Ethylhexyl) phthalate	10	330
117-84-0	Di-n-octylphthalate	10	330
205-99-2	Benzo (b) fluoranthene	10	330
207-08-9	Benzo (k) fluoranthene	10	330
50-32-8	Benzo (a) pyrene	10	330
193-39-5	Indeno (1,2,3-cd) pyrene	10	330
53-70-3	Dibenzo (a,h) anthracene	10	330
191-24-2	Benzo (g,h,l) perylene	10	330

**Table 4-3 Total Petroleum Hydrocarbon Target Analyte List
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

CAS No.	Analyte	Reporting Limit mg/L	Reporting Limit mg/kg
N/A	Gasoline Range Organics (GRO)	0.25	5
N/A	Diese Range Organics (GRO)	0.25	5
N/A	Residual Range Organics (GRO)	0.5	10

**Table 5-1 Data Quality Objectives
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the objectives of a site investigation, define the appropriate type of data to be collected, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support site remediation decisions. These preliminary DQOs have been developed for the Northern Boundary Assessment Interim Action Work Plan to guide assessment activities.

STEP 1: STATE THE PROBLEM

Team members include stakeholders from the U.S. EPA and ARRC supported by technical staff and other resources of The RETEC Group, Inc. (and other consultants). Decision-making will be the result of a collaborative process involving the team members conducted according to CERCLA and RCRA requirements. U.S. EPA holds ultimate decision making authority.

The 2004 Administrative Order on Consent (AOC) identifies the need to characterize the nature and extent of any release of hazardous substances and solid waste at the Anchorage Terminal Reserve (approximately 600-acre site) by performing a Remedial Investigation (RI) and to identify and evaluate alternatives for remedial action in a Feasibility Study (FS). Objectives of the order include protection of human health via exposure to contaminants at or from site soil, groundwater, surface water and sediment exposure, and protection of ecological receptors affected by potential water or sediment contamination in Ship Creek. The AOC recognizes that there are other potentially PRPs associated with or adjacent adjacent to the Site and states that *"it is the expectation of the Parties that other parties with potential environmental liability will contribute to certain elements or areas of work ..."* The potential third-party liabilities are currently undefined.

STEP 2: IDENTIFY THE DECISION

Decision Statement: Are enough data available to adequately define the nature of contamination migrating onto the Site from upgradient properties along the northern property boundary?

Adequate definition is required to characterize the nature of any contaminants migrating onto the Site from the north to identify potential upgradient sources whose owners and operators may be subject to investigative or remedial requirements to correct downgradient impacts at the ARRC Site..

Potential Decision Options:

- 1) *At the conclusion of the assessment, one decision could be that migration of contaminants from properties to the north of the Site have been adequately defined and sufficient data are available to identify any upgradient sources and assess the migration of contaminants onto the Site.*
- 2) *The conclusion of the assessment could be that the migration of contaminants from properties to the north of the Site is not adequately defined and further data collection is required to assess possible Site impacts from upgradient locations.*

STEP 3: IDENTIFY INPUTS TO THE DECISION

The following information is required to resolve the decision statement:

1. **Contaminant migration pathways.** The migration pathways that are currently being considered are contaminant transport via groundwater flow, groundwater to surface water flow (expressed as seeps/springs) and groundwater or surface water to soil.
2. **The nature and extent of contaminants that have migrated, or could potentially migrate, onto the Site.** Information will be obtained from (1) documentation prepared by, or on behalf of, property owners to the north of the Site and (2) sampling groundwater springs on ARRC property at the northern boundary of the ARRC Site. The analyses will be selected based upon the documented contamination in this general area, potential contamination in the area based on current and historical upgradient activities and operations, and documented environmental conditions downgradient within the Site. The analytical methods and reporting limits will comply with the applicable state and federal regulations.
3. **The migration rates of contamination migrating onto the Site.** Empirical data will be obtained by the following: (1) flow measurements of springs; (2) determination of groundwater flow rates including seasonal variations; (3) determination of surface water flow rates, (4) calculations of degradation and attenuation of the contaminants; (5) soil sampling; and (6) subsurface groundwater sampling to supplement that done at the springs.

**Table 5-1 Data Quality Objectives
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

4. The fate of contaminants potentially migrating onto the Site. The fate and transport of contaminants of concern that flow onto the Site will be determined using empirical measurements and modeling procedures to determine the net flux of contaminants onto the Site. This work is not proposed under this work plan; the work will be conducted after the nature and extent of contaminations, and areas with potentially significant impacts have been defined in the RI/FS.

This Interim Action Work Plan is intended to provide preliminary data towards responding to the decision statement. These preliminary data will be used to guide future field activities related to the decision statement.

STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

The spatial study boundary for the Northern Boundary Assessment Interim Action Work Plan is the North Bluff from Ocean Dock Road on the west to Reeve Boulevard on the east. The temporal boundary for work conducted under the work plan is a single period of field activity during late summer/early fall. The time required to respond to the decision statement will be developed in subsequent work plans.

STEP 5: DEVELOP A DECISION RULE

If chemical impacts or releases are identified at the Northern Boundary of the Site which could result in either unacceptable exposure to potential human or ecological receptors or impact Ship Creek as a significant ongoing source, then additional investigation will be conducted to further define the potential migration of contaminants into the impacted area from upgradient sources and identify those sources for potential further action by their owners and operators. The risk assessment will be used to target areas that will be evaluated as part of the Feasibility Study.

STEP 6: SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

The Northern Boundary Interim Action Work Plan is a limited investigation to provide preliminary information regarding background groundwater quality and areas with the potential for contaminant migration that could contribute to risk to human health or ecological receptors. Limits on decision errors will be more completely defined in subsequent investigation work plans.

Overall, the tolerable limits are defined as impacts above action levels in soil, groundwater, or surface water with the performance goals of the investigation being the definition of the concentrations of industrial related chemicals and understanding the potential for impacts in complete exposure pathways as defined in the Conceptual Site Model. The null hypothesis is that impacts to receptors are below risk-based levels; the alternate hypothesis is that impacts are above risk-based levels and corrective measures will be evaluated. The basis for selecting the number and location of soil, groundwater, surface water, and sediment sampling points is professional judgment with objectives of sufficient data to determine the statistical nature of exposure point concentrations for receptors. Since adequate data are not available to select decision error limits, these will be defined under the risk assessment through the use of the 95% upper confidence level for exposure point concentrations in the Study Areas, per U.S. EPA guidance.

STEP 7: OPTIMIZE THE DESIGN FOR OBTAINING DATA

The data collection design will be optimized by using all reasonably available historical data from the Site and adjacent properties to the north of the Site. The investigation area will be separated into study areas that contain distinctive environmental issues. The strategies for characterizing each study area will be documented through development of an optimized Remedial Investigation Work Plan. The data collection design will be reviewed and revised as necessary to satisfy the data needs of the risk assessment and subsequent work plans.

**Table 5-2 Proposed Scope of Work and Sampling Basis
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Spring ID	Rationale	Flow Rate (GPM)	Previous ID	Visual Observation	Comments
SP-02	Downgradient of former UST Sites	0.5		Clear, No OVC	
SP-04	Area with little or no background water quality data			Light brown algae, stagnant, slight organic sheen, no odor	
SP-07	Area with little or no background water quality data	2.8		Clear, No OVC	
SP-10	Area with little or no background water quality data	0.5		Clear, No OVC	
SP-12	Area with little or no background water quality data	0.5		Clear, No OVC	
SP-16	Area with little or no background water quality data	10		Clear, No OVC, heavy yellow/green algae	Combined flow from these springs = 25 gpm, springs discharging along area 200 ft
SP-19	Area with little or no background water quality data	20		Clear, No OVC, stagnant w/heavy yellow/green and white algae	100-foot long area Combined flow is 35 gpm 50-foot long area
SP-24	Area with little or no background water quality data	0.2		Clear, w/heavy iron stained brown algae, septic odor, bubbles rise when setting survey stake	
SP-26	Proximity to pipeline corridor	3		Clear, No OVC	10+ springs across 180-footlong area, each having flow of about 3 gpm and combined flow of 20 gpm (estimate)
SP-27	Proximity to pipeline corridor	1		Clear, No OVC	

**Table 5-2 Proposed Scope of Work and Sampling Basis
Northern Boundary Assessment Work Plan
ARRC Anchorage Terminal Reserve, Anchorage, AK**

Spring ID	Rationale	Flow Rate (GPM)	Previous ID	Visual Observation	Comments
SP-30	Proximity to pipeline corridor	0.75		Clear, minor organic sheen, some iron stained, some green algae, possible faint hydrocarbon odor, no sheen	10+ sources across 100-foot face of knob SW of COE building with combined flow of 30 gpm
SP-33	compare to previous results in OU5	5	MWH Seep 3	Clear, No OVC	
SP-34	Monitor Knob Area/ST-37 spill			Clear, No OVC, heavy iron staining, some organic sheen	this site may be difficult to sample
SP-35	Monitor Knob Area/ST-37 spill			possible slight solvent or fuel odor	Stagnant, low-lying area, needs a drive point well to sample
SP-36	sheen observed, suspect sheen is non-organic	0.5		odorless, colorless (light gray ?) sheen that acts like non-organic	
SP-40	compare to previous results in OU5	10	MWH OU5-SP03	Clear, No OVC	2" pvc casing - functional
SP-41	compare to previous results in OU5	5	Seep 7	Clear, no OVC, stagnant w/ green and brown algae	2" pvc casing - functional
SP-46	compare to previous results in OU5	5	Seep 17	No OVC, dark brown algae, organic sheen, septic odor	
SP-48	compare to previous results in OU5	1	Seep 9	Clear, no OVC	10 ft west of multi product line
SP-49	compare to previous results in OU5	0.5	Seep 10	Clear, no OVC	between OU5 SP09 and SP10, 30 ft east of multi product line and valve
SP-50	compare to previous results in OU5, furthest east side of study area, good flow	5	Seep 14	Clear, no OVC	
SP-51	near SP-36		Seep 15	gray sheen that coalesces like a fuel sheen and doesn't break apart like organic sheen, no odor	2" pvc well present in pooled water - good condition

Notes:

OVC - Odor or Visible Contamination

Appendix A

Standard Operating Procedures

SOP 110 Packing and Shipping Samples

SOP 250 Surface Water Sampling

RETEC Standard Operating Procedure (SOP) 110

Packing and Shipping Samples

1.0 Purpose and Applicability

The RETEC Group, Inc. (RETEC) SOP 110 describes proper packaging methods and shipment of samples to minimize the potential for sample breakage, leakage, or cross-contamination, and provide a clear record of sample custody from collection to analysis. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, Job Hazard Analysis (JHA), Safety Task Analysis Review (STAR), or Site-Specific Health and Safety Plan (HASP) will take precedence over the procedures described in this document.

The Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (1976) (RCRA) regulations (40 CFR Section 261.4 (d)) specify that samples of solid waste, water, soil, or air collected for the purpose of testing are exempt from regulation when any of the following conditions apply:

- Samples are being transported to a laboratory for analysis
- Samples are being transported to the collector from the laboratory after analysis
- Samples are being stored:
 - By the collector prior to shipment for analysis
 - By the analytical laboratory prior to analysis
 - By the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case

Samples collected by RETEC are generally qualified for these exemptions. RETEC SOP 110 deals only with these sample types. If you have any addition questions about shipping requirements contact the RETEC Environment, Health and Safety (EHS) Department.

2.0 Responsibilities

The field sampling coordinator is responsible for the enactment and completion of the chain-of-custody and the packaging and shipping requirements outlined here and in project-specific sampling plans.

3.0 Health and Safety

This section presents the generic hazards associated with packing and shipping samples and is intended to provide general guidance in preparing site-specific health and safety documents. The Site-Specific HASP, JHAs, and STARS will address additional requirements and will take precedence over this document. Note that packing and shipping samples usually requires Level D personal protection unless there is a potential for airborne exposure to site contaminants. Under circumstances where potential airborne exposure is possible respiratory protective equipment may be required based on personal air monitoring results. Upgrades to Level C will be coordinated with your Site Safety and Health Officer (SSHO) or EHS Coordinator.

Health and safety hazards with packing and shipping of samples include the following:

- Exposure to sample preservatives – Know the types of sample preservatives sent to you by the analytical laboratory. Understand the potential exposures (inhalation, ingestion skin contact) and use chemically impervious gloves to protect your hands from acids in particular.
- Anticipate the potential for spills – Glass containers are subject to breakage and if dropped on the floor will create a spill. Know how to contain the spill, have spill response materials available, and understand the proper disposal methods for spilled materials. Wear personal protective equipment (PPE) to clean up the spill as appropriate (Level C or D).
- Broken glass – Be aware of the possibility for broken glass in previously used coolers. Inspect the cooler before you place samples in it and clean out any broken glass safely (i.e. with a small brush).
- Coolers can be heavy – Use proper lifting techniques to pick up loaded coolers. Bend your legs and lift with a straight back to avoid a back injury.
- Do not use your teeth to cut tape to size, use a tape dispenser.

4.0 Supporting Materials

The following materials must be on hand and in sufficient quantity to ensure that proper packing and shipping methods and procedures may be followed:

- Chain-of-custody forms and tape
- Sample container labels
- Coolers or similar shipping containers

- Duct tape or transparent packaging tape
- Zip-lock type bags
- Protective wrapping and packaging materials
- Ice
- Shipping labels for the exterior of the ice chest
- Transportation carrier forms (Federal Express, Airborne, etc.)
- PPE as specified in the Site-Specific HASP
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants (including sample preservatives)
- A copy of the Site-Specific HASP

5.0 Methods and Procedures

All samples must be packaged so they do not leak, break, vaporize, or cause cross-contamination of other samples. Waste samples and environmental samples (e.g., groundwater, soil, etc.) should not be placed in the same shipping container. Each individual sample must be properly labeled and identified. A chain-of-custody record must accompany each shipping container. When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

All samples must be clearly identified immediately upon collection. Each sample bottle label (Figure 1) will include the following information:

- Client or project name, or unique identifier, if confidential
- A unique sample description
- Sample collection date and time
- Sampler's name or initials
- Indication of filtering or addition of preservative, if applicable
- Analyses to be performed

After collection, identification, and preservation (if necessary), the samples will be maintained under chain-of-custody procedures as described below.

5.1 Chain-Of-Custody

A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. Transfers of sample custody must be documented by chain-of-

custody forms (Figure 2). The chain-of-custody record will include, at a minimum, the following information:

- Client or project name, or unique identifier, if confidential
- Sample collector's name
- RETEC's mailing address and telephone number
- Designated recipient of data (name and telephone number)
- Analytical laboratory's name and city
- Description of each sample (i.e., unique identifier and matrix)
- Date and time of collection
- Quantity of each sample or number of containers
- Type of analysis required
- Date and method of shipment

Additional information may include type of sample containers, shipping identification air bill numbers, etc.

When transferring custody, both the individual(s) relinquishing custody of samples and the individual(s) receiving custody of samples will sign, date, and note the time on the form. If samples are to leave the collector's possession for shipment to the laboratory, the subsequent packaging procedures will be followed.

5.2 Packing for Shipment

To prepare a cooler for shipment, the sample bottles should be inventoried and logged on the chain-of-custody form. At least one layer of sorbent protective material should be placed in the bottom of the container. Be careful for any broken glass. A heavy-duty plastic bag, if available, should be placed in the shipping container to act as an inner container. As each sample bottle is logged on the chain-of-custody form, it should be wrapped with protective material (e.g., bubble wrap, matting, plastic gridding, or similar material) to prevent breakage. The protective material should be secured with tape. The sample should then be placed in a zip-lock type bag. Each sample bottle should be placed upright in the heavy-duty plastic bag inside the shipping container. Each sample bottle cap should be checked during wrapping and tightened, if needed. Avoid over tightening, which may cause bottle cap to crack and allow leakage. Additional packaging material, such as bubble wrap, should be spread throughout the voids between the sample bottles.

Most samples require refrigeration as a minimum preservative. To ensure that samples are received by the laboratory within required temperature limits, place cubed ice directly over packed samples, making sure that ice is present on all sides of each sample (a 2-inch layer of ice should be present on top of the samples prior to shipment).

If applicable, secure the inner heavy-duty bag with clear packing tape. This will prevent water from leaking out of the package, thus stopping shipment (package handling companies will not ship a leaking package).

Place the original completed chain-of-custody record in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container. Alternatively, the bag may be taped to the underside of the container lid. Retain a copy of the chain-of-custody record with the field records.

Close the top or lid of the cooler or shipping container and rotate/shake the container to verify that the contents are packed so that they do not move. Add additional packaging if needed and reclose. Place signed and dated chain-of-custody seal (Figure 3) at two different locations (front and back) on the cooler or container lid and overlap with transparent packaging tape. The chain-of-custody seal should be placed on the container in such a way that opening the container will destroy the tape. Packaging tape should encircle each end of the cooler at the hinges. Use proper lifting techniques when picking up the cooler.

Sample shipment should be sent via an overnight express service that can guarantee 24-hour delivery. Retain copies of all shipment records as provided by the shipper.

6.0 Quality Assurance/Quality Control

Recipient of sample container should advise shipper and/or transporter immediately of any damage to the container, breakage of contents, or evidence of tampering.

7.0 Documentation

The documentation for support of proper packaging and shipment will include RETEC or the laboratory chain-of-custody records and transportation carrier's airbill or delivery invoice. All documentation will be retained in the project files.

Sample Label

<p>The RETEC Group, Inc. 23 Old Town Square, Suite 250 Fort Collins, CO 80524-2473 www.retec.com (970) 493-3700 Phone (970) 493-2328 Fax</p>	
Sample I.D. _____	
Location _____	
Date _____ Time _____ Sampled By _____	
Test(s) _____	
Pres _____	

Figure 1

Chain of Custody Seal

Custody Seal	
Date _____	
Signature _____	
Seal No. _____	
The RETEC Group, Inc. 23 Old Town Square, Suite 250 Fort Collins, CO 80524-2473 www.retec.com (970) 493-3700 Phone (970) 493-2328 Fax	
	

Figure 3

RETEC Standard Operating Procedure (SOP) 250

Surface Water Sampling

1.0 Purpose and Applicability

The RETEC Group, Inc. (RETEC) SOP 250 describes the basic techniques and general considerations to be followed for the collection of Surface Water samples from rivers, lakes, and ponds. Specific details of actual sample collection are highly dependent upon local conditions as well as upon the purpose of the water quality study. Nevertheless, certain aspects of sample collection procedures are independent of project-specific variations.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, Job Hazard Analysis (JHA), Safety Task Analysis Review (STAR), or Site-Specific Health & Safety Plan (HASP) will take precedence over the procedures described in this document.

2.0 Responsibilities

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The field sampling coordinator will have the responsibility to oversee and ensure that all surface water sampling is performed in accordance with the project specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

3.0 Health and Safety

This section presents the generic hazards associated with surface water sampling and is intended to provide general guidance in preparing site-specific health and safety documents. The site-specific HASP, JHA, and STAR will address additional requirements and will take precedence over this document. Note that surface water sampling usually requires Level D personal protection unless there is a potential for exposure to airborne site contaminants.

Health and safety hazards include but are not limited to the following:

- Slip, trips, and falls in tall grasses over obstacles, and muddy conditions or side slopes near stream banks. Review terrain hazards prior to conducting these operations. Ensure there is a safe means of access/egress to the sampling location.

- Dermal exposure to potentially contaminated water. Ensure that proper personal protective equipment (PPE) is used to mitigate the impact of splashes of water to skin and/or eyes.
- Ergonomics. Use appropriate ergonomic techniques when inserting or retrieving equipment from the lake or stream to preclude injury to the arms, shoulders or back.

4.0 Supporting Materials

The following materials must be on hand in sufficient quantity to ensure that proper sampling procedures may be followed:

- Project specific sampling program
- Personal protection equipment as specified in the Project Health and Safety Plan
- Sample containers, labels, and preservatives
- Decontamination equipment and solutions
- Paper towels or chemical-free cloths
- Coolers and ice
- Field equipment as specified in the sampling program, the corresponding manufacturer's manuals, and the appropriate calibration standard
- Vertical or horizontal type samplers;
- Boat or raft
- Weighted tape measurer or rigid gage
- Field data sheets and field
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants
- A copy of the site-specific HASP

5.0 Methods and Procedures

The following describes methods and procedures required to collect representative Surface Water samples.

5.1 Sample Location Selection

Selecting a precise sampling location requires professional judgment and an understanding of the purpose of the study. Sampling locations where mixing is incomplete should be avoided if an average composition is required. Often areas of poor lateral or vertical mixing can be visually identified. For example, color or turbidity differences may be apparent immediately below the confluence of a tributary and the main river or at a wastewater discharge point. Use of a field conductivity meter is recommended for determining the uniformity of the water composition across the width and depth of the water body. Once the sampling point has been selected, it must be fixed by detailed description, maps, or with the aid of stakes, buoys, or other landmarks so that others can identify the sampling location.

5.2 Stream Sampling

In shallow streams (those which can be safely traversed on foot) the sample container can be filled directly with the flowing water. In deep rivers, a boat or raft will usually be required to obtain a representative sample. Unless otherwise specified in the project specific sampling plan, samples should be collected at the mid-depth section or deepest flow channel of the stream.

Stream depth and discharge need to be recorded. Stream depth can be determined using a depth sounder or by physical measurement with a heavily weighted flexible measuring tape or a rigid gage. Stream velocity measurements can be collected using a Marsh-McBirney Model 2000 portable flowmeter or similar instruments, and top setting wading rod at the gaging stations. The discharge at the gaging stations can be calculated by determining the mean flow velocity across a stream cross-section and multiplying this by the cross-sectional area as measured with a tape and the wading rod at that point. The top setting wading rod should be used to place the velocity sensor at 60 percent of total water depth as measured from the water surface. This is the same stream gaging method employed by the U.S. Geological Survey (1977). A vertical or horizontal type sampler should be used for collecting samples at a specific depth in the water column.

5.3 Lake and Pond Sampling

Water in lakes and ponds is generally poorly mixed and thermal stratification is frequently observed. Single samples can only represent the specific spot from which they were obtained. For many studies, samples collected at the inlet(s) and/or outlet(s) of the lake or pond are of the most interest. In other studies, a grid is established over the lake or pond and samples are collected at grid line intersections. As with deep rivers, a horizontal type sampler should be used for sample collection.

5.4 Sample Handling and Preservation

In general, the shorter the time lapse between sample collection and analysis, the more reliable the results will be. Certain water quality parameters, especially pH, temperature,

and dissolved oxygen, are so closely related to the environment of the water that meaningful results can only be obtained by in-situ field measurements.

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination. A representative sample will be placed in the sampling container. Sample containers shall be labeled with the following information:

- Client or project name, or unique identifier, if confidential
- Unique sample description (i.e., sampling point number and depth)
- Sample collection date and time
- Sampler's name or initials
- Analyses to be performed

These data shall be recorded on the Surface Water Sampling form (Figure 1) and/or field book.

Prior to transport or shipment, Surface Water samples may require preparation and or preservation. Field preparation may entail filtration, or preservation in the form of chemical additives or temperature control. Specific preservation requirements will be described in the project specific sampling plan.

Surface Water samples collected for dissolved metals analyses will be filtered prior to being placed in sample containers. Groundwater filtration will be performed using a peristaltic pump and a 0.45 micron water filter unless specified otherwise in the project specific sampling plan. For most dissolved metal analyses, pH adjustment of the sample is also required and shall be performed after filtration.

6.0 Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC sample per 20 field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project specific sampling plan.

7.0 Documentation

There are several documents that must be completed and maintained as part of the Surface Water Sampling procedure. The documents will provide a summary of the sample collection procedures and conditions, shipment method, the analyses requested, and the custody history. The documents may include:

- Field log book

- Surface Water Sampling forms
- Sample labels
- Chain of custody
- Shipping receipts
- Health and Safety forms (JHA, STAR, and/or site-specific HASP amendments)

The field record should be of sufficient detail to allow others to understand how and where samples were taken. All documentation will be retained in the appropriate project files.

8.0 References

U.S. Geological Survey, 1977, National Handbook of Recommended Methods for Water-Data Acquisition, U.S. Dept. of Interior, Virginia.

The RETEC Group, Inc. Groundwater Sampling Form

PROJECT _____
 WELL/SPRING NO. _____
 SAMPLERS _____

PROJECT NO. _____
 WELL OR SPRING? _____

1. WELL CONDITION CHECKLIST:

- a. Bump Posts _____ Pro.casing/lock _____ Surface pad _____
- b. Well visibility (paint) _____
- c. Well label _____

2. WATER LEVEL/SPRING FLOW MEASUREMENT:

DATE _____ TIME _____

WELL – WATER LEVEL MEASUREMENT

- a. Location of measuring point _____
- b. Depth of water table from measuring point _____
- c. Height of measuring point above ground surface _____
- d. Total depth of well below measuring point _____
- e. Length of water column (line 2d-2b) _____

SPRING – FLOW MEASUREMENT

- a. Flow rate _____
- b. Method of measurement _____

3. WELL PURGING:

DATE _____ TIME _____

WEATHER CONDITIONS

- a. Purge method _____
- b. Required purge volume at 3 well volumes _____

Pumping Duration	Volume Removed	pH	Sp Cond.	T(°C)	DO	ORP	Appearance

4. SAMPLE COLLECTION:

DATE _____ TIME _____

WEATHER CONDITIONS

- a. Collection method _____
- b. Meter calibration: _____
 multi-meter _____
 other _____

Sample information	pH	Sp Cond.	T(°C)	DO	ORP
Analysis/Method		Containers		Sample Prep./Preservation	
VOC's (EPA 8260)					
SVOCS (EPA 8270)					
GRO (AK 101)					
DRO (AK 102)					
RRO (AK 103)					

- d. Chain of custody form _____ COC tape _____
- e. Shipping container _____

5. COMMENTS:

Appendix B
Quality Assurance Project Plan

Quality Assurance Project Plan for Northern Boundary Assessment Interim Action Work Plan

Alaska Railroad Corporation

Anchorage Terminal Reserve

U.S. EPA Docket No. CERCLA 10-2004-0065

Prepared by:

**The RETEC Group, Inc.
2409 Research Blvd., Suite 106
Fort Collins, Colorado 80526**

Prepared for:

**Alaska Railroad Corporation
401 Ship Creek Avenue
Anchorage, Alaska 99501**

August 30, 2004

Quality Assurance Project Plan for Northern Boundary Assessment Interim Action Work Plan

Alaska Railroad Corporation

Anchorage Terminal Reserve
U.S. EPA Docket No. CERCLA 10-2004-0065

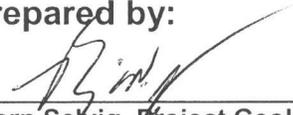
Prepared by:

The RETEC Group, Inc.
2409 Research Blvd., Suite 106
Fort Collins, Colorado 80526

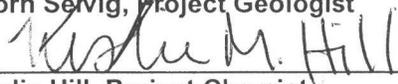
Prepared for:

Alaska Railroad Corporation
401 Ship Creek Avenue
Anchorage, Alaska 99501

Prepared by:



Bjorn Selvig, Project Geologist

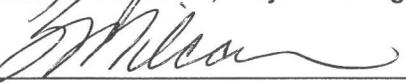


Leslie Hill, Project Chemist

Technically Approved by:



Christina Cosentini, Project Manager



Susan Milcan, RETEC Quality Assurance Manager

August 30, 2004

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List of Acronyms

ARRC	Alaska Railroad Corporation
ASTM	American Society for Testing and Materials
CFTL	Consultant Field Task Leader
CLP	Contract Laboratory Program
CPM	Consultant Project Manager
CQAM	Consultant Quality Assurance Manager
CTL	Consultant RI/FS Team Leader
DO	Dissolved Oxygen
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EIS	Environmental Information Systems
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information Systems
ICV	Initial Calibration Verification
LD	Laboratory Director
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LSC	Laboratory Sample Custodian
LPM	Laboratory Project Manager
LQAM	Laboratory Quality Assurance Manager
M&TE	Measuring and Test Equipment
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NBAWP	Northern Boundary Assessment Interim Action Work Plan
OSHA	Occupational Safety and Health Administration
ORP	Oxidation-Reduction Potential
PARCC	Precision, Accuracy (bias), Representativeness, Comparability, and Completeness
PQL	Practical Quantitation Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RETEC	The RETEC Group, Inc.
RI/FS	Remedial Investigation and Feasibility Study
RPD	Relative Percent Difference
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
TIM	Testing, Inspection, and Maintenance
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1 Introduction

This Quality Assurance Project Plan (QAPP) presents the project organization, objectives, activities, and quality assurance (QA) procedures that will be implemented while conducting an Interim Action at the North Boundary Assessment Area in Anchorage, Alaska. This QAPP was prepared following the United States Environmental Protection Agency (U.S. EPA) Guidance for Quality Assurance Project Plans (U.S. EPA, 2002) and the EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (U.S. EPA, 2001).

Changes to this QAPP will likely be necessary to accommodate changing regulatory requirements, technology, or project objectives. For example, the changes could include different analytical methods, lower or higher reporting limits, changes to the Analyte List, or different Quality Control (QC) criteria. These types of major changes will require the issue and approval of a revision of this document. Alaska Railroad Corporation (ARRC) will obtain approval from appropriate personnel prior to implementing any changes.

Section 1 pertains to project/task organization and schedule, the roles and responsibilities of project participants, and site background. This section also references a list of objectives to be addressed by this investigation and the data quality objectives (DQOs) necessary to effectively address the objectives. A description of tasks to be performed during the investigation and the measurement performance criteria and documentation needed to meet the DQOs are also referenced in this section.

Section 2 references the data generation and acquisition design and sampling methods for this investigation. Analytical methods and QC (field and laboratory) requirements are also presented in this section. Field and laboratory instrument calibration requirements, data acquisition, and data management requirements for this investigation are provided.

In Section 3, the assessment and oversight activities needed for the project are identified and the type(s) of audits to be performed are described. In addition, the type and frequency of reports to be prepared for this investigation are identified.

Section 4 presents ARRC's processes and criteria for the review and validation of the data collected during this investigation, as well as a description of how these analytical results will be reconciled with the DQOs.

1.1 Project/Task Organization

The project team for the Northern Boundary Assessment Interim Action Work Plan (NBAWP) includes:

- Regulatory Agencies – U.S. EPA Region 10 (U.S. EPA)
- Facility Owner – Alaska Railroad Corporation (ARRC)
- Project Consultant – The RETEC Group, Inc. (RETEC)
- Laboratory Contractor – Analytica, NCA, and SGS

The purpose of this section is to define the areas of responsibility and lines of authority for each organization and for the members of the QA/QC team. This will be used to establish lines of communication to facilitate the decision-making process during implementation of the QAPP. A project organization chart showing the relationships between the members of the project team and lines of communication is included as Figure 1-1. These descriptions provide all parties a clear understanding of the role that each participant plays in this project.

1.1.1 Regulatory Agency – U.S. EPA

The U.S. EPA is responsible for review and acceptance of the NBAWP. This includes ensuring that the Work Plan is in compliance with the agency's regulations and guidance documents. The U.S. EPA has the responsibility and authority to review and accept or reject the Work Plan.

1.1.2 Facility Owner – ARRC

ARRC has overall responsibility for site activities and investigations. ARRC also has the authority to accept or reject the NBAWP. ARRC representatives are shown on Figure 1-1.

1.1.3 Project Consultant –RETEC

As the Project Consultant, RETEC has the primary responsibility of designing and implementing the work plan so that it meets the project objectives. RETEC is also responsible for ensuring that QA/QC assessments associated with the project are completed. RETEC personnel will include the Project Manager, Remedial Investigation/Feasibility Study (RI/FS) Team Leader, Field Task Leader, Project QA Manager, Site Health and Safety Officer, and Data Users.

Consultant Project Manager (CPM)

The CPM, Chris Cosentini, is responsible for overall management of the RETEC team, and coordinating work and communication between RETEC, ARRC, and U.S. EPA.

Consultant RI/FS Team Leader (CTL)

The CTL, Chris Pearson, is responsible for planning and implementation of the work, and tracking the project budget.

Consultant Field Task Leader (CFTL)

The CFTL, Bjorn Selvig, is responsible for directing the field staff and assuring that the Work Plan and QAPP are being followed. The Field Task Leader is also responsible for educating field personnel on QA requirements and procedures.

Consultant Quality Assurance Manager (CQAM)

The CQAM, Sue Milcan, will:

- Be responsible for laboratory coordination for scheduled site work
- Assure that the specified analytical and data management procedures are followed and documented
- Assess the precision, accuracy, and completeness of the laboratory data
- Schedule and conduct laboratory quality audits as needed; schedule and oversee or conduct data verification, issue laboratory audit reports, retain laboratory audit records, and follow up on corrective actions as needed

Site Health and Safety Officer (SHSO)

The SHSO, Bjorn Selvig, is responsible for:

- Ensuring that all health and safety procedures are adhered to by all personnel associated with the project
- Documenting health and safety incidents (i.e., near misses, accidents)
- Notifying and correcting lapses observed in health and safety procedures
- Promoting safe work practices among the work crew

Data Users

Data users include the Environmental Information Systems (EIS) manager and the Geographic Information Systems (GIS) manager.

The EIS manager will be responsible for implementing and maintaining the project EQUIS database. The EIS manager will work closely with the CQAM to make sure that all analytical data are loaded into the database.

The GIS manager will be responsible for implementing and maintaining the spatial data. These data will include GIS coverages and CAD files.

1.1.4 Laboratory Contractor QA/QC Team

Roles, activities, and responsibilities of analytical laboratory subcontractor participants are detailed below.

Laboratory Director (LD)

The LD will be responsible for assuring compliance with the quality procedures and managing resources of the laboratory to meet the project needs.

Laboratory Project Manager (LPM)

The LPM will communicate directly with the CPM and the CQAM and will report to the LD. The LPM will:

- Coordinate laboratory analyses
- Supervise chain-of-custody procedures in house
- Schedule sample analyses within required holding times
- Oversee data review and preparation of analytical reports and electronic data deliverables (EDDs)
- Approve final analytical reports and EDDs prior to submission to the CQAM

Laboratory Quality Assurance Manager (LQAM)

The LQAM has overall responsibility for laboratory data and administration of this QAPP. The LQAM or a designee will communicate data issues through the LPM and will:

- Review and approve laboratory QA/QC procedures
- Review QA documentation
- Conduct detailed data review
- Conduct a 100 percent compliance review of EDDs to hardcopy data results
- Develop and implement laboratory corrective actions
- Define appropriate laboratory QA/QC procedures
- Evaluate the effectiveness of the project-specific quality program

- Review and approve laboratory Standard Operating Procedures (SOPs)

Laboratory Sample Custodian (LSC)

The LSC will report to the LD and will:

- Receive, inspect, and record information concerning the condition of incoming sample containers
- Verify and sign sample chain-of-custody forms
- Notify the LPM of sample receipt and inspection
- Assign samples a unique identification number and customer number, and enter each sample into the sample receiving log
- Initiate transfer of the samples to appropriate lab division
- Control and monitor access/storage of samples

1.2 Investigation Objectives and Background

This QAPP supports the NBAWP. The objective of the investigation is to locate and characterize potential upgradient sources of contamination to Ship Creek. The data collected will include groundwater and soil collected from springs located along the North Bluff. Sampling will be based on knowledge of historical processes, historical sample results, areas of known releases/spills, previously documented springs, and through visual surveys of additional springs. Results derived from this effort may be used to define additional investigation during the remedial investigation feasibility process.

This QAPP has been submitted to the regulatory agency, ARRC project managers, RETEC field and management personnel, and the analytical laboratories as part of an integral document that supports the NBAWP.

1.3 Project/Task Description and Schedule

The objectives of the project are described in the NBAWP (RETEC, 2004). Field work for this investigation will be completed in September/October 2004.

1.3.1 Technical and Reporting Standards and Criteria

Field documentation required for this project includes:

- Field Notebooks
- Sample Collection Forms

- Chain-of-custody Forms
- QC Sample Records
- Field Instrument Calibration Records
- Field QC Audit Reports

Analytical work for each field investigation will include fully documented Update III SW-846 (U.S. EPA, 1997) sample collection, preservation, and handling procedures; Update III SW-846, American Society for Testing and Materials (ASTM), or state approved analytical methods; and RETEC Level 3 data packages, as applicable to the analytical method. Components of the RETEC Level 3 data package are identified in Table 1-1. Full QA/QC summary data validation will comply with Update III SW 846 method criteria and will follow the U.S. EPA Contract Laboratory Program (CLP) National Functional Guidelines (U.S. EPA, 1999 and 2001), as they apply to the analytical methods employed.

Independent data validation and laboratory QC Audit Reports will also be prepared and retained with project documents.

Once the activities described in the NBAWP have been completed, a report will be prepared and submitted to U.S. EPA. This report will contain the following information:

- Physical setting (including rainfall, temperature, wind speed, evaporation data, and descriptions of local topography)
- Contamination characterization (presenting data collected to evaluate upgradient sources of contamination along the Northern Boundary)
- Comparison of data to relevant screening levels to define constituents of interest
- Assessment of data gaps and recommendations for further investigation, if necessary

1.3.2 Project Review/Audit Tools

Audits will be conducted as a principal means of determining compliance with the QAPP. The various types of audits to be conducted during the project are detailed in Section 3 and outlined below:

- **Performance Audit.** Verify that measurement systems are operating properly.
- **Data Quality Audit.** Assess whether data quality is adequately documented.

- **Technical Systems Audit.** Confirm the adequacy of data collection systems.

Based on the results of the technical systems audit, the CPM may require a program technical review and/or a management systems audit. This process would include a review of and possible recommendation for modification of appropriate technical procedures and/or an evaluation of management effectiveness to meet QA guidelines.

For complex or highly specialized tasks, senior technical specialists will be assigned portions of an audit, as deemed necessary. In addition, auditors will not be directly involved with the audited work task, so that bias is not introduced into the auditing process.

1.4 Data Quality Objectives

In accordance with guidance provided by the U.S. EPA in the Advanced Notice of Proposed Rulemaking (U.S. EPA, 1996), data gathering strategies should be tailored to reflect the DQOs. DQOs reflect the overall degree of data quality or uncertainty that the decision maker is willing to accept during decision making. DQOs are used to specify the quality of the data, usually in terms of precision, bias, representativeness, comparability, and completeness. DQOs apply to the entire measurement system (e.g., sampling locations, methods of collection and handling, field analysis, and laboratory analysis). DQOs are used to ensure that environmental data are scientifically valid, defensible, and of an appropriate level of quality given the intended use for the data (U.S. EPA, 1996).

The U.S. EPA's goal in using DQOs is to "...minimize expenditures related to data collection by eliminating unnecessary duplicative, or overly precise data. At the same time, the data collected should have sufficient quality and quantity to support defensible decision making" (U.S. EPA, 1994a). DQOs are intended to (U.S. EPA, 1994a and 1994b):

- Clarify the study objectives
- Define the most appropriate type of data to collect
- Determine the most appropriate conditions from which to collect data
- Specify tolerable limits on decision errors to establish quantity and quality of data

To develop DQOs appropriate for this program, ARRC followed the guidance presented in U.S. EPA's *Guidance for the Data Quality Objective Process* (U.S. EPA, 2000). This process led to the development of general DQOs, as presented in NBAWP (RETEC, 2004).

The site-specific DQOs are presented by media in Table 5-1 of the NBAWP (RETEC, 2004). As stated above, the data quality required for this project is a function of the accepted limits of uncertainty. Of the five data quality levels defined in U.S. EPA guidance, Level 3 is appropriate for the NBAWP program.

Level 3 provides the highest level of data quality and is used for site characterization and risk assessment. It includes analytical laboratory data with full QA/QC support and documentation. Analytical laboratory data deliverables associated with Level 3 DQOs allow for thorough data validation procedures to be followed.

Groundwater laboratory analysis will generate Level 3 data reports, as described in Table 1-1 that will be submitted to the CQAM and retained by the laboratory with full analytical documentation. These data may be used for site characterization, evaluation of migration pathways, risk assessment, and determination of remedial alternatives. Field QC samples will be prepared and analyzed to identify possible sources of error during sampling and sample handling.

1.4.1 Measurement Performance Criteria

QA objectives for the data include the qualitative guidelines listed above, as well as quantitative determinations of the data quality indicators or precision, accuracy (bias), representativeness, comparability, and completeness (PARCC) parameters. The objectives for PARCC parameters will vary with the anticipated use of the data. A discussion of how each of these five parameters will be integrated into this project is provided below.

1.4.1.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Precision is measured by the relative percent difference (RPD), a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a mixture of sampling and analytical factors. Precision is evaluated through field and laboratory duplicate samples.

Sampling precision for this program will be evaluated by analysis of field duplicate samples from a given location. When determining field precision, the acceptable level of variability in these results will be no greater than 30 percent RPD for water samples and no greater than 50 percent RPD for soil samples. Field duplicate samples will be collected for analysis at a rate of one sample in 20 (5 percent).

Laboratory precision will be evaluated through analysis of laboratory duplicates, laboratory control sample duplicates (LCSDs), and matrix spike

duplicates (MSDs). Laboratory control limits for these analyses will reference published SW-846 method (U.S. EPA, 1997) or CLP limits (U.S. EPA, 1994a and 1994b), as available. If control limits are not published, laboratory control-charted limits will be referenced. Control limits will vary with analysis and sample type (i.e., duplicate, LCSD, MSD). Laboratory precision will be determined by matrix for one sample in 20 (5 percent).

1.4.1.2 Accuracy

Accuracy measures the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random and systematic error components that result from sampling and analytical operations. Sources of error include the sampling process, field contamination, sample preservation, sample handling, sample matrix, laboratory preparation, and analysis techniques.

Sampling accuracy will be assessed by evaluating the results of field-generated blanks and trip blanks. Field-generated blanks will be collected at a frequency ratio of 1:20. One trip blank per cooler containing samples for volatile organic compound (VOC) analysis will be submitted for analysis.

Laboratory accuracy for analytical methods will be assessed by spiking samples with known standards and measuring the percent recovery of the spiked analyte. Known standards include matrix spikes (MSs), surrogate spikes, and laboratory control samples (LCSs). Surrogate spikes are required for all environmental and QC samples analyzed for organics. MSs and/or LCSs will be submitted for no less than one sample in 20 (5 percent).

Recovery of surrogate, matrix, and laboratory control spikes will be evaluated after each analytical run by the laboratory analyst to verify that the values are within published SW-846, CLP (U.S. EPA, 1997), or laboratory control-charted limits. If recovery values are outside control limits, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions are accurate. If no system, documentation, solution preparation or spiking errors are identified, the data will be reviewed to determine whether the unacceptable spike results are due to matrix interference. If matrix interferences are affecting surrogate and/or matrix spike recovery and re-extraction is not deemed useful, the data will be annotated to document the situation. However, if a surrogate recovery is less than 10 percent, the sample will be re-extracted and reanalyzed once, unless there is objective evidence of matrix interference.

1.4.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a

sampling point, or an environmental condition. Representativeness is a qualitative parameter used to ensure proper design of the sampling program. Representativeness criteria are best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected.

1.4.1.4 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. Completeness is defined by the equation below:

$$C\% = \frac{S}{R}(100\%) \quad [1]$$

Where:

- C = completeness
- S = number of valid analyses
- R = number of requested analyses

The completeness goal is essentially the same for all data uses: that a sufficient amount of valid data be generated. It is important that critical samples are identified and plans made to achieve valid data from critical samples. The completeness goal established for this project is 90 percent.

1.4.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect and analyze representative samples and the consistent reporting of analytical results in appropriate units. Comparability is limited by the other PARCC parameters because the data sets can only be compared with confidence when precision and accuracy are known. For comparability, reporting limits for soil and aqueous sample analyses must achieve the practical quantitation limit (PQL) for those samples not subject to dilution or affected by sample matrix. The PQL is also adjusted for dry weight in soil matrices.

1.4.2 Special Training Requirements/Certification

Specific training requirements for performing fieldwork at the site are as follows:

- All field personnel assigned to the Site must have successfully completed 40 hours of training for hazardous site work in accordance with Occupational Safety and Health Administration (OSHA) 29

Code of Federal Regulations (CFR) 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Documentation of OSHA training is required prior to personnel being permitted to work on site.

- Personnel managing or supervising work on site will also have successfully completed 8 hours of Manager/Supervisor Training meeting the requirements of OSHA 29 CFR 1910.120(e)(4).
- Personnel assigned to the Site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months and be medically cleared to work on a hazardous waste site and capable of wearing appropriate personal protective equipment and respiratory protection as may be required.

It is the responsibility of the employing organization to provide their employees with the required training, medical monitoring, and fit testing prior to assigning them to work at this Site. Each employing organization will be responsible for providing documentation of training, monitoring, and fit testing (with make/model of respirator) to the CPM and the CFTL prior to sending their employees to the Site to work.

1.5 Documentation and Records

This section of the QAPP identifies the protocols for reporting and documentation of field records, laboratory analytical data reports, and EDD reports generated in this program.

1.5.1 Field Records

Field records to be maintained in a field notebook will include all sample collection forms, chain-of-custody forms, QC sample records, field instrument calibration records, daily field activity logs, and field QC audit reports. Direct read data and/or measurements during fieldwork will be written on customized and numbered field forms, immediately after measurements have been taken. All notations will be written in indelible ink and all entries will be signed and dated. If entries must be changed, the reason for the change should be noted and the change should not obscure the original entry (e.g., a single line drawn through text or an “X” through figures, tables, or maps). The change will be initialed and dated by the responsible person. If space is available, revisions will be added to the same page. Otherwise, the page where the revision is entered will be noted. Any lost, damaged, or voided field forms or notebooks will be reported to the CFTL immediately.

1.5.2 Laboratory Data Report Format

Analytical data reports for groundwater samples will be submitted electronically and will include items listed in Table 1-1. Completed data reports from the laboratory will include a narrative outlining any problems, corrections, anomalies, and conclusions, as well as chain-of-custody documentation. Additionally, the laboratory will provide one copy of the associated EDD as appropriate for the requested analyses.

The laboratory report and the EDD must be received within 14 days of the laboratory's receipt of the sample. The EDD must be in text file format (*.txt) and include all sample and analytical data as required for EQUIS 4-file formats.

1.5.3 Independent Analytical Data Validation and Quality Control Audit Reports

To provide an independent validation of the data reports generated during this program, RETEC will review and validate the data presented in the final reports submitted by the analytical laboratories. Data validation will be performed using the National Functional Guidelines (U.S. EPA, 1999 and 2002) as they apply to the Update III SW-846 (U.S. EPA, 1997). Detailed validation checklists and summary tables will be provided, including discussions of any data outliers and validation action taken. Table 1-2 is an example of the RETEC Analytical Data Validation Checklist.

Data validation reports and checklists will include assessments of data precision, accuracy, completeness, and method compliance. Sample results, case narratives, and analytical QC summary forms will be reviewed at a frequency of 100 percent. All sample and QC results will be compared to the EDDs at a 100 percent frequency. Full analytical data documentation, including sample and QC results, analyst's logs, worksheets, instrument printouts, chromatograms, and quantitation reports will be submitted to the CQAM with the laboratory reports and will also be retained by the laboratory as detailed below.

Organic QC summary forms will be comparable to CLP forms I through VIII (U.S. EPA, 1994b) and will include sample results, detection limits, extraction/preparation and analytical dates, surrogate recoveries and control limits, method blank results, LCS results and control limits, MS results and control limits, system performance checks (tunes), initial and continuing calibration results, internal standards, extraction benchesheets, and run chronologies, as applicable to the methods.

Inorganic QC summary forms will be comparable to CLP forms I through XIV (U.S. EPA, 1994a) and will include sample results, detection limits, preparation and analytical dates, method blank results, standard and

interference check recoveries, serial dilutions, duplicate results and control limits, LCS and MS results and control limits, initial and continuing calibration results, preparation logs, and run chronologies, as applicable to the methods.

1.5.4 Archiving and Retrieval

During all active stages of the project, one copy of field documents, laboratory summary reports, work plans, and other reports will be filed in a central location at the RETEC office in Fort Collins, Colorado to allow easy and frequent access. Raw laboratory data and calculations will be maintained by the analytical laboratory for 7 years prior to disposal without notification.

All contract laboratories will archive environmental samples for a period of at least 90 days after submittal of the report in which the data are included. If no requests for reanalysis are received, data will be considered as accepted and samples can be disposed of, unless ARRC provides other written instructions.

2 Data Generation and Acquisition

Project analytical methods were selected on the basis of PQLs and the level of analytical quality control needed to meet project DQOs and data user needs. Standard U.S. EPA methods were selected when available.

2.1 Sampling Process Design

To generate high quality data, general field operations and practices and specific sample collection and inventory must be well planned and carefully implemented. The selection of sampling locations, the development of the sampling program, and specific sampling procedures resulted from the review of existing data and data gaps. The justification for sampling locations may be found in Table 5-2 of the NBAWP (RETEC, 2004).

2.2 Sample Methods Requirements

Field sampling protocols and the supporting SOPs are presented in Appendix A of the NBAWP (RETEC, 2004).

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. Each technical staff member is responsible for verifying that all QC procedures are followed. The technical staff member assesses the correctness of the field methods and the ability to meet QA objectives. If a problem occurs that might jeopardize the integrity of the project or cause some QA objective not to be met, the technical staff member will notify the CFTL, who will then notify the CTL and CPM. Corrective action measures will then be selected and implemented. The technical staff member will document the problem, the selected corrective action, and the corrective action results as a permanent record.

If corrective action requires a departure from procedures in the NBAWP (RETEC, 2004), these changes will be documented in the field notebook. In circumstances where unanticipated conditions are encountered, appropriate sampling actions consistent with project objectives will be conducted after the CFTL confers with the CTL and CPM. This change will be noted in the field notebook.

2.3 Sample Handling and Chain-Of-Custody Requirements

Sample handling and sample identification requirements for field personnel are detailed in Section 6 of the NBAWP (RETEC, 2004).

Sample custody will be maintained and documented in the field from collection through delivery to the laboratory. Sample custody is documented through the use of a field notebook and consultant or laboratory provided

chain-of-custody forms documenting the name of the sampler, the time of sample collection, and the relinquishment of samples (under custody seal) to the analytical laboratory. Figure 2-1 is an example of a chain-of-custody form.

The sampler is responsible for the care and custody of samples from the time they are collected until they are properly transferred. Samples will be transferred to the selected analytical laboratory on an as-needed basis via a recognized, reliable courier service.

- Within the laboratory, chain-of-custody procedures will be followed to document the integrity and security of the samples, as well as the sample paths and locations within the laboratory. Upon receipt of the samples, the LSC will follow these procedures:
 - Check for custody seals and ensure that they were placed at two locations on the outside of the shipping container.
 - Date and sign chain-of-custody forms and any other documents using full signature.
 - Open each cooler, place a thermometer inside the temperature blank until the temperature stabilizes, and record the cooler's temperature on the sample analysis form.
 - Remove all sample containers from coolers and check for breakage.
 - Compare sample identifications and number of bottles to the chain-of-custody form. All discrepancies in chain-of-custody procedures (e.g., analysis requested, number of bottles, etc.) will be recorded. If required, the CQAM will be notified to resolve problematic sample receipt issues.
 - Complete a cooler receipt form and submit along with the final data report. The laboratory shall also provide the completed, original chain-of-custody to ARRC for inclusion in their evidence files.
 - Log samples into the laboratory database system. Record date and time of sample collection, date received, turnaround time, name of person logging the job, client code, client project number and name, laboratory job number, number of jars, sample matrix, requested analyses, method of sample delivery, and the airbill number (if applicable). The integrity of samples received

(including cooler temperature) will be logged on a cooler receipt checklist or a similar form, which will be kept in the project folder.

- Log samples into the appropriate lab refrigerators. Custody has been relinquished as soon as samples are logged into appropriate lab refrigerators for storage.

For the laboratory to satisfy custody provisions, the following minimum procedures will be followed. When not in use, samples will be stored within the secured laboratory facility or in a locking storage facility where access is limited to the LSC and other key laboratory personnel. Transfer of the samples in and out of storage areas will be documented with an internal custody log-in/log-out form or laboratory tracking sheets. Analysts will maintain possession of samples and return samples to secured storage before the end of each working day, recording custody on the appropriate forms.

Internal chain-of-custody records will be retained by the laboratory and are the responsibility of the LPM. The original field-to-laboratory chain-of-custody record will be included in the final data report deliverable to ARRC.

Once all analytical work has been completed and the data report submitted by the lab, samples and extracts will be transferred from cold storage to a sample archiving area where they will be stored until after submittal of the monthly progress report in which the data are included, unless ARRC provides other written instructions. Custody will be maintained in the long-term storage area and upon ultimate disposition, samples will be logged out and the disposition recorded. Disposal will be in accordance with local, state, and federal landfill and wastewater regulations.

2.4 Analytical Method Requirements

The contracted laboratory, and any subcontractors, will implement project-required SOPs for sample preparation, cleanup, and analysis. These SOPs will be based on SW-846, Update III (U.S. EPA, 1997). These SOPs will be kept on file at the contracted laboratory. SW-846 Update III methods are kept on file at RETEC's office in Fort Collins, Colorado, and at the respective laboratories.

Documentation of appropriate method performance for the project target compounds will be available from the selected laboratory and will include the criteria for acceptance, rejection, or qualification of data. The laboratory is also required to periodically update method performance data such as control limits and method detection limits. Minor changes such as these will be communicated to ARRC but will not be subject to approval provided that method criteria continue to be met.

The use of non-standard methods is not anticipated for this program. However, if methods other than those specified in the QAPP are to be used, the following procedure must be completed before using the non-standard method. A copy of the proposed method, including a table detailing the differences in the method, the expected precision and accuracy, and an explanation for the change must be reviewed and approved by the signatories on this document. The CPM or designee will be responsible for obtaining these approvals.

Corrective action in the analytical laboratory may be required due to equipment malfunction, failure of internal QA/QC checks, method blank contamination, noncompliance with QA requirements, or failure of performance or system audits. When measurement equipment or analytical methods fail QA/QC checks, the problem will be immediately brought to the attention of the appropriate persons in the laboratory, in accordance with the laboratory's SOPs. If failure is due to equipment malfunction, the equipment will be repaired, precision and accuracy will be reassessed, and the analysis will be re-run. Attempts will be made to reanalyze all affected parts of the analysis so that, in the end, results are not affected by failure of QA requirements.

All incidents of QA failure and associated corrective action will be documented and reports will be placed in the appropriate project file (Section 3). Also, corrective action will be taken promptly for deficiencies noted during spot-checks of raw data. As soon as sufficient time has elapsed for corrective action to be implemented, evidence of correction of deficiencies will be presented.

The laboratory will screen all samples for VOC analysis by gas chromatography/mass spectrometry (GC/MS) to avoid excessive sample dilution and to minimize the effects of sample matrix. Screening results will help to determine whether samples will be analyzed as low- or medium-level concentration samples. The screening procedure will also indicate an appropriate sample dilution level, if necessary. Sample cleanup procedures may be authorized for semi-volatile organic compound analysis by GC/MS to avoid excessive sample dilution and to minimize the effects of sample matrix. The laboratory should make every attempt to report analytical results for all methods as close to standard reporting limits as possible. Samples reported at diluted levels must report positive results for at least one target analyte within the analytical method, or be reanalyzed at a more appropriate level of dilution at no cost to the client. The laboratory will need to take extra care to avoid holding time conflicts for samples requiring reanalysis due to excessive sample dilution.

Samples to be analyzed for total metals usually require some sort of sample preparation to remove interferences and to convert the sample to a form that is

amenable to analysis on the instrument. The U.S. EPA digestion procedures for total metals do not usually provide for complete digestion of samples. Metals that are tightly bound in the matrix of soil and sediment particles will not be measured.

2.5 Quality Control Requirements

This section details the measurement checks required to meet the DQOs for this project.

2.5.1 Field QC Requirements

Laboratory analysis of field duplicates and field blanks will assess the precision and accuracy of field sampling techniques. The ratio of duplicate samples to field samples is one duplicate sample to every 20 field samples collected of each matrix (i.e., 1:20), or a minimum of one per sample matrix. Field/equipment blanks will be collected at a minimum frequency of one per 20 samples of each matrix. Trip blanks will accompany all shipments containing samples for analysis of VOCs. QC samples will be collected in accordance with the applicable sampling procedures presented in Section 6.3 of the NBAWP (RETEC, 2004).

The QC procedures for measuring pH, oxidation-reduction potential (ORP), conductance, and temperature in groundwater samples will include calibrating the instruments.

2.5.2 Laboratory QC Requirements

This section describes the general QC procedures inherent to the laboratory QA program.

All analytical procedures will be documented in writing as SOPs, with each SOP including a QA section that addresses the minimum QC requirements for the procedure. Certain QC requirements are matrix- or method-specific, but in general, the QA program must include the following:

- Instrument calibration
- Preparation and analysis of reagent/preparation blanks
- Analysis of instrument and/or method blanks
- Preparation and analysis of MSs and MSDs
- Preparation and analysis of surrogate spikes
- Analysis of laboratory duplicates for inorganics

- Preparation and analysis of laboratory control samples and standards
- Identification of internal standard areas and control limits for GC/MS analysis
- System performance checks for both organic and total metals analyses

An analytical batch is defined as 20 samples or less of the same type of matrix, prepared and analyzed as a group. The following analytical QC samples will be associated with each batch if the control procedure is applicable to the analysis.

2.5.2.1 Method Blank

A reagent or media blank will be analyzed as a check on laboratory contamination (glassware, reagents, analytical hardware, etc.) that might affect analytical results. A sample consisting of laboratory reagent-grade water (distilled and deionized water) or a solid matrix will be analyzed to monitor the analytical instrument for contamination. The method blank is processed through the entire analytical procedure, including sample preparation. The results are used in conjunction with other control data to validate overall system performance and identify bias that may impact data quality. Method blanks must be analyzed per SW-846 for applicable analyses, at least once with each analytical batch, with a one in 20 sample minimum.

2.5.2.2 Laboratory Control Samples

Independently prepared check samples will be processed through the entire analytical procedure. The purpose of these samples is to monitor and assure the accuracy of the procedure in the absence of matrix interference. Results of the LCS are charted and must meet acceptance criteria. Laboratory control samples must be analyzed per SW-846 for applicable analyses, at least once with each analytical batch, with a one in 20-sample minimum.

2.5.2.3 LCS Duplicates

Independently prepared check sample duplicates will be processed through the entire analytical procedure. The purpose of the LCS is to assure the precision of the procedure in the absence of matrix interference. Precision results in RPD are tabulated and charted. The RPD equation is given in Section 2.5.2.5. Laboratory control sample duplicates must be analyzed per SW-846 for applicable analyses, at least once with each analytical batch, with a one in 20-sample minimum.

2.5.2.4 Matrix Spikes

An aliquot of a sample will be spiked with a known amount of selected analyte(s). Percent recoveries of the selected spiked analytes are tabulated by subtracting the non-spiked concentration from the spiked sample results. Results are used to assess accuracy in specific matrices. Matrix spikes must be analyzed per SW-846 for applicable analyses, at least once with each matrix-specific analytical batch, with a one in 20 sample minimum.

Percent recovery is calculated as follows:

$$\%R = \frac{(C_1 - C_0)}{C_2} \times 100 \quad [2]$$

Where:

- %R = Percent recovery
- C₁ = Measured concentration in spiked sample aliquot
- C₀ = Measured concentration in unspiked sample aliquot
- C₂ = Actual concentration of spike added

2.5.2.5 Duplicate Samples or Matrix Spike Duplicates

MSDs will be analyzed to monitor the method precision. Results in RPD are tabulated and charted. The RPD calculation (for two samples, C1 and C2) is shown below. For analytical methods in which spiking is not applicable, sample duplicates are used to assess precision. Duplicates or matrix spike duplicates must be analyzed per SW-846 for applicable analyses, at least once with each matrix-specific analytical batch, with a one in 20-sample minimum.

$$RPD = \frac{C_1 - C_2}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \quad [3]$$

Where:

- RPD = Relative percent difference
- C1 = Larger of the two observed values
- C2 = Smaller of the two observed values

$$RSD = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100 \quad [4]$$

2.5.2.6 Performance Evaluation Samples

Known concentration samples may be analyzed quarterly in a commercially administered or internal double blind audit initiated by the LQAM.

Descriptions of the specific QC requirements of this project and the required frequency of audit are presented in the laboratory's SOPs, which are kept on file at the contracted laboratory.

The laboratory's QA program will be reviewed by the CQAM with specific emphasis on the acceptance criteria for QC samples, and on related corrective action should the QC criteria not be met. Acceptance criteria and corrective action consistent with SW-846 Update III method criteria will be deemed acceptable for this investigation. Alternatively, a laboratory QA program incorporating acceptance criteria and corrective action comparable to that presented in Tables 2-1 and 2-2 will be implemented to identify laboratory procedures that are not in control, and ensure that appropriate measures are taken.

All data obtained will be properly recorded. The required laboratory report and EDD format is detailed in Section 1.5.2 and/or Table 1-1. The laboratory will reanalyze samples not handled or analyzed in conformance with the QC criteria, if sufficient sample volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for re-analysis when necessary. The data package submitted by the laboratory will include a full deliverable package capable of allowing the recipient to reconstruct the analytical sequence and compare it to the QC criteria, if requested.

2.5.3 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The primary objective of an instrument/equipment testing, inspection, and maintenance (TIM) program is to help ensure the timely and effective completion of a measurement effort by minimizing the downtime of crucial sampling and/or analytical equipment due to expected or unexpected component failure.

TIM will be carried out on all field and laboratory equipment in accordance with manufacturers' recommendations and professional judgement. Analytical laboratory equipment preventative TIM will be addressed in the laboratory's QA Manual, which will be kept on file at the contracted laboratory.

Preventative TIM will be implemented on a scheduled basis to minimize downtime and to ensure accurate measurements from both field and laboratory equipment. This program is designed to achieve results commensurate with the specified capabilities of equipment operation, thus generating data of known quality without concern for misapplication. In addition, backup equipment and critical spare parts will be maintained to quickly correct equipment malfunction.

All equipment and instruments used to generate data will be calibrated, adjusted, and maintained to operate within manufacturers' specifications and SOPs. Maintaining the necessary accuracy, precision, sensitivity, and traceability of the equipment ensures that reliable measurements and representative samples will be obtained. Methods and intervals of calibration and maintenance will be based on the type of equipment and stability characteristics: required accuracy, intended use, and environmental factors (e.g., temperature and humidity). Such an effort will be conducted by trained technicians using service manuals or through service agreements with a qualified maintenance contractor. In addition, procedures will ensure that trained personnel use the equipment properly.

As appropriate, schedules and records of calibration and maintenance will be maintained for the equipment in the field notebook. To minimize equipment damage, theft, and tampering, both equipment and equipment records will be located in a controlled access facility when not in use. Each instrument will be assigned a unique identification number to document and track usage, maintenance, and calibration. Equipment that is out of calibration or is malfunctioning will be removed from operation until it is recalibrated or repaired.

2.5.4 Instrument Calibration and Frequency

Measuring and test equipment (M&TE) used during environmental data collection activities will be subject to calibration requirements. These requirements are summarized below:

- **Identification.** Either the manufacturer's serial number or the calibration system identification number will be used to uniquely identify M&TE. This identification, along with a label indicating when the next calibration is due, will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference.
- **Standards.** M&TE will be calibrated, whenever possible, against reference standards having known valid relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of natural physical constraints. If national standards do not exist, the basis for calibration will be described and documented.
- **Frequency.** M&TE will be calibrated at prescribed intervals and/or prior to use. Frequency will be based on the type of equipment, inherent stability, manufacturers' recommendations, values given in national standards, intended use, and experience. All sensitive

equipment to be used at the project site or in the laboratory will be calibrated or checked prior to use.

- **Records.** Calibration records (certifications, logs, etc.) will be maintained for all M&TE used on the project.

If M&TE are found to be out of calibration, an evaluation will be made and documented to determine the validity of previous measurements and/or corrective action will be implemented. All laboratory calibration requirements must be met before sample analysis can begin. If calibration nonconformances are noted, samples will be reanalyzed under compliant calibration conditions within method specified holding times.

2.5.4.1 Field Instrument Calibration

Field instruments will be calibrated as described in the NBAWP (RETEC, 2004). Instruments that may be used during the fieldwork include a pH meter, potentiometer for ORP measurement, conductivity meter, and a dissolved oxygen (DO) meter. For specific instructions on the calibration frequency, the acceptance criteria and the conditions that will require more frequent recalibration, refer to the manufacturer's instructions and Section 6.2.3 of the NBAWP (RETEC, 2004).

All the calibration procedures performed will be documented on specified field forms and/or in the field notebook, and will include the date/time of calibration, name of person performing the calibration, reference standard used, temperature at which readings were taken, and the readings. Multiple readings on one sample or standard, as well as readings on replicate samples, will likewise be documented.

2.5.4.2 Laboratory Instrument Calibration

Calibration procedures for a specific laboratory instrument are detailed in laboratory SOPs and will consist of initial calibration verification (ICV) and continuing calibration verification.

Calibration factors are calculated as:

$$CF = \frac{A}{M} \quad [5]$$

Where:

- CF = calibration factor
- A = area of the analyte peak
- M = mass of target analyte injected

If necessary, a correlation coefficient is calculated as:

$$r = \frac{n\Sigma(xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n(\Sigma x^2) - (\Sigma x)^2][n(\Sigma y^2) - (\Sigma y)^2]}} \quad [6]$$

Where:

- x = calibration concentration
- y = instrument response (peak area)
- n = number of calibration points (x, y data pairs)

A description of the calibration procedures for a specific laboratory instrument will be referenced in the appropriate SW-846 Update III (U.S. EPA, 1997) or ASTM method, and the applicable laboratory SOP.

The SOP for each analysis performed in the laboratory will describe the calibration procedures, frequency, acceptance criteria, and the conditions that will require recalibration. In all cases, the ICV will be verified using an independently prepared calibration verification solution.

The laboratory will maintain a sample logbook for each instrument which will contain the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions run, and the samples associated with these calibrations.

2.5.5 Inspection/Acceptance Requirements for Supplies and Consumables

This section describes the requirements for the procurement of supplies and consumables. The procurement program is intended to assure that the supplies purchased for this project meet the required quality criteria of this plan.

Field supplies include the following items:

- Gloves
- Deionized or Distilled Water
- Solvents/Detergent
- Decontamination Reagents and Supplies
- Field Equipment Calibration Standards

The procurement of these items will be documented by a purchase order process. The purchase order will specify the manufacturer and the suitable

grade of material. The CFTL will be responsible for material procurement and control. The CFTL will verify upon receipt that materials meet the required specifications and that, as applicable, material or standard certification documents are provided and maintained. The CFTL will also verify that material storage is properly maintained and contamination of materials is not allowed.

Laboratories contracted for this project must have procedures that are documented and followed that cover the following:

- Checking purity standards, reagent grade water, and other chemicals, as appropriate, versus intended use
- Preparation and storage of chemicals
- Requirements for disposable glassware (grade and handling)

For this project, the LPM or designee will be responsible for procuring and shipping the appropriate sample containers and preservatives to the sampling site. The containers will be precleaned and certified by lot. Reagents provided will be of the appropriate grade for the analysis. Records of these certifications and grades of material will be maintained on file at the laboratory.

2.6 Data Management

All hardcopy and electronic data generated through field activities or by the laboratory operation will be reduced and verified prior to release to the CQAM. The CQAM or his/her designee will then perform a thorough, independent data validation according to the *Contract Laboratory Program* (U.S. EPA, 1999 and 2001) prior to using or distributing the data.

2.6.1 Data Reduction

This section summarizes the procedures for ensuring the accuracy of the data reduction process. Both field and laboratory data reduction procedures are summarized. Responsibilities for the data reduction process are delegated as follows:

- Technical personnel will document and review their own work and are responsible for the accuracy of the work.
- Calculations will receive a method and calculation check by a secondary reviewer prior to reporting (peer review).
- The LQAM will be responsible for ensuring that data reduction is performed according to protocols discussed in this QAPP.

2.6.2 Hand Calculations

Hand calculations will be recorded on calculation sheets, written legibly and in a logical progression. Calculations will be reviewed by an engineer or scientist of a professional level equal to or higher than that of the originator. The secondary reviewer will sign and date the calculation sheet immediately below the originator. Both the originator and secondary reviewer are responsible for the correctness of the calculations. The calculation sheet will document the following (at a minimum):

- Promoting safe work practices among the work crew
- Project title and number or laboratory sample identification number
- Initials and date of originator
- Initials and date of secondary reviewer
- Basis for calculation
- Assumptions made or assumptions inherent in the calculation
- Complete reference for each source of input data
- Methods used for calculation
- Results of calculation

Some laboratory instruments are configured to operate without computers. For these, the signal is recorded as a strip chart trace, numerical output on a printer strip, or direct reading from a digital or analog dial. In such cases, additional work is required by the analyst to reduce the data to a reportable format. The original signal must be multiplied by a calibration factor or compared with a standard curve. The aliquot result must be divided by the mass or volume of sample to produce a concentration-based final result. Most calculations are carried out on hand-held scientific calculators; simple programs are used for some. All of these data are recorded in a dedicated lab notebook or bench sheet for the particular determination in question. Results for single or multiple component tests are hand entered by the analyst in the assigned book.

2.6.3 Computer Calculations

Data reduction calculations used for this project are typically included on the standard reporting forms developed by the laboratories and associated with each individual method or groups of methods. Calculations not present on standard reporting forms include computer-based data reduction programs. The laboratory is responsible for maintaining a list of these data reduction

programs and for being able to demonstrate their validity. The complete calculation procedures used in computer-based data reduction programs (e.g., GC/MS analyses) are based on the calculation procedures specified in each method and will not be covered here.

Spreadsheet calculations will be printed out in both equation form and calculation form. All equations will be reviewed by an engineer or scientist of a professional level equal to or higher than that of the originator. The secondary reviewer will sign and date the calculation sheet immediately below the originator. Both the originator and secondary reviewer are responsible for the correctness of the calculations. The calculation sheet will document the following (at a minimum):

- Project title and number or laboratory sample identification number
- Initials and date of originator
- Initials and date of secondary reviewer
- Basis for calculation
- Assumptions made or assumptions inherent in the calculation
- Complete reference for each source of input data
- Methods used for calculation
- Results of calculation

2.6.4 Field Data Reduction

Field data records will, wherever possible, be organized into standard formats. Data from the project field notebook and field forms will be retained in permanent files and/or input to summary tables and databases to reduce data. The CFTL will review and proof all forms to determine whether errors were made during field documentation.

Tables and databases will be stored on an internal fixed disk, with daily backups at the consultants' offices. Field data will be reported through preparation and transmission of report sheets containing tabulated results of measurements made in the field, and documentation of all field activities. Pertinent results will be summarized in tables included within monthly progress reports.

2.6.5 Laboratory Data Reduction

The laboratories will follow the data reduction and calculation procedures set forth in U.S. EPA-approved methods and 40 CFR Part 136. Hardcopy data reports, electronic data reports, and EDDs generated by the laboratory will undergo internal data verification by the LQAM or designee before being released to the CQAM. The laboratory will perform three levels of data verification:

- Analytical level
- Second level technical review
- Final LPM review

Automated data calculation and reduction, using instrument data system software or electronic spreadsheet software will be used by the laboratory to the greatest extent practical. Analyses will be programmed to allow for raw data entry and editing at the keyboard, with integrated software performing calculations and permanent database generation. Data-entry errors will be checked by comparing the raw data printouts against the chemist's original work, minimizing the common sources of error in data reduction. After QC summary and hardcopy data verification is complete, 100 percent of the electronic data will be checked against the final hardcopy data report. Data verification of 100 percent EDD data to hardcopy data is required for the first three data reports issued by the laboratory that consistently show 0 percent error. After this is achieved, 10 percent EDD data to hardcopy data verification will be required for all subsequent data reports issued, as long as direct download of sample results from instrument to EDD is done.

These data reviews must be completed by the LQAM or designee and approved by the LPM before data is finalized. The final hardcopy or electronic data report and the EDD are then released to the CQAM. Raw and final data will be stored on internal fixed disk, with either magnetic tape or flexible disk as backup at the laboratory. One of the following procedures may also be used to calculate test results:

- Data from simple analytical procedures, such as titration procedures, are converted into final form by means of a spreadsheet program.
- All GCs must be equipped with programmable data systems that generate results in units ready for review by a laboratory supervisor.

Instrument logbooks will be maintained for each instrument. Computer record file identification will readily allow retrieval by the client name. Work sheets and spreadsheets will be prepared using an electronic spreadsheet or

related software package.

Raw data from the chemists' notebooks or bench sheets will include all analytical variables compiled for samples, replicates, blanks, standards, and matrix spikes. The LQAM or designee will review all final results and EDDs. The LPM will approve submittal of the final data report and EDD after internal review.

2.6.6 Laboratory Data Verification

Technical verification requires comparison of QC and instrument performance standard results to required control limits. Technical verification is conducted throughout the analytical process, first by analysts, and finally by the LQAM or designee and LPM. No data will be released to the CQAM prior to the completion of these data verification procedures. The following QC elements will be reviewed (as appropriate) for a full verification effort:

- EDD comparison of both hand entered and direct instrument download of data to final data reports
- Analytical holding times
- Blank contamination
- Initial instrument calibration
- Continuing instrument calibration
- Internal standards
- System performance standards (tunes)
- Interference checks
- Serial dilutions
- Chain-of-custody review
- Analytical accuracy (MS/MSD recoveries, LCS/LCSD recoveries, and surrogate recoveries)
- Analytical precision (comparison of duplicate, LCSD, and MSD results, expressed as RPD)
- Compound identification

- Compound quantitation and reported detection limits
- Target analyte list

Transcription and calculation checks will be performed at a frequency of 10 percent. When an error is noted, 100 percent of the calculations and transcriptions for that data set will be verified.

2.6.7 Independent Data Validation

To submit final data reports, they must be complete and have sufficient quality to undergo the appropriate level of data review by an independent validator. Incomplete data reports will not be accepted and will be returned to the laboratory for correction. EDDs are compared 100 percent to the sample data and QC summaries submitted by the laboratory. The CQAM compares EDDs to the data submitted and corrects any minor errors directly in laboratory data reports or EDD files after verifying with the laboratory which entry is correct. If major errors are found, the CQAM will reject the reports or EDDs, and the laboratory will be obligated to correct and resubmit them. If errors are found, the laboratory will provide a corrected data report. Corrections to the data report or EDD, which are requested by the CQAM, shall be provided by the laboratory within 3 business days of the request. The combined data records will be sufficiently detailed to provide complete and accurate history of data gathering and results for future legal or administrative actions, if necessary.

The independent data validation process assures technical data quality and method compliance; provides precision, accuracy, and completeness assessments; verifies that adequate analytical documentation was performed and reported; determines whether the analytical data are usable; and helps the data user to determine whether project DQOs were met. Laboratory data will be evaluated for compliance with DQOs by the CPM, CQAM, or their designee using the checklist provided as Table 1-2, or a similar form. Independent data validation will be conducted by the CQAM or his/her designee. Procedural requirements and data validation requirements, as described in this QAPP, will conform to the guidelines presented in the CLP (U.S. EPA, 1999 and 2001).

2.6.8 Data Management System

A relational database management system (EQuIS) will be used for this project to store field and laboratory data. The two major types of data to be managed are chemical testing results and field monitoring data. Procedures for managing these data sets are described below.

The results of the laboratory chemical analyses will be stored in an EQUIS database specifically created for this project. The information compiled for the chemical analysis results will include:

- Sampling date and time
- Station identification, sample identification
- Field QA/QC sample identification and duplicate sample cross-reference identification
- Sample matrix
- Analytical laboratory/analytical method date of analysis
- Constituents, results, units, data validation qualifiers, and detection limits

EDDs of the laboratory chemistry data will be supplied by the laboratory, according to the required EQUIS 4-file format, and included in the project database.

The field monitoring information may include:

- Location identification
- Monitoring well reference point elevations
- Depth to water
- pH, conductivity, temperature, ORP, and DO
- Date and time of measurement
- Computed groundwater elevation
- Other field data, as necessary

2.6.9 Database Maintenance

Database maintenance involves a set of specific procedures by which each item of data is processed from the time it is logged in the field or laboratory to when it is issued as a report.

Database Entry and Validation. Field monitoring information from each sampling event or monitoring round will be entered into the database within two weeks following completion of field activities. Chemical data from each sampling event will be entered into the database after independent data validation by the CQAM within 30 days of receipt of all data from the laboratory.

Field data, results received from the laboratory, and data validation qualifiers will be entered into the database. Prior to database entry of chemical data,

100 percent of the laboratory EDD will be checked against the laboratory data report by the CQAM or his/her designee.

Retrieval and Transfer of information. Data tables of laboratory analytical results will be produced using the capabilities of EQUIS. Raw data or summaries will be produced. Data can be provided on computer disk and/or as printed reports. All data tables will be checked 100 percent for accuracy against final laboratory reports.

Security. The project database will be protected to prevent unauthorized access and use. Database modifications will only be made by authority of the database manager. Additionally, the database will be password protected so only authorized personnel can access the data. The database will be maintained on the RETEC server, which is backed up daily.

3 Project Quality Assessment/ Oversight Program

A series of reports will be prepared throughout the course of the project to describe the status and results of the QA process. These include reports on:

- Measurement system performance and data quality audit findings and corrective action measures
- Technical and, if necessary, management system audit findings and corrective action measures
- Laboratory progress
- Final laboratory QA
- Quarterly project progress

The Project Quality Assessment/Oversight Program will be managed by the CTL. All audit findings will be transmitted to the ARRC Project Manager and CPM. A summary of data quality and the results of checking the control sample data against DQOs will be presented in the final report presenting and summarizing the data gathered.

3.1 Assessment and Response Actions

To verify compliance with QAPP requirements, the CPM, CQAM and/or CFTL will perform or designate performance of planned and documented QA audits. Audits will consist of an evaluation of SOPs and the effectiveness of their implementation, an evaluation of work areas and activities, and a review of project documentation. This approach will be used to review actual project performance during its course and across all operations and levels of management. Specifically, audits will be conducted for both field and laboratory operations to assess the accuracy of the measurement systems and to determine the effectiveness of QC procedures.

Audits will be scheduled in a manner to provide coverage and coordination with all ongoing project activities. Scheduling and frequency of audits will include consideration of the following:

- Complexity of the work assignment
- Project or task scope and duration
- Degree of QC specified
- Criteria to achieve DQOs
- Deliverable requirements
- Subcontractor participation

- Importance of the expected data for management decisions
- Potential for or frequency of nonconformance
- Previous audits findings
- Nonconformance and corrective action reports
- Additional applicable information

Auditors will be independent of any direct responsibility for performance of the activities that will be audited. Audits will be performed in accordance with written procedures or checklists as early in the life of the task or work activity as practical. Activities that have been selected for auditing will be objectively evaluated against the specific requirements for the activity, including methodologies, procedures, instructions, and record keeping. Documents and records will be examined to the extent necessary to determine whether the QA program is effective and properly implemented.

The CPM will have primary responsibility for coordinating audits and the authority to delegate certain audit functions to technical specialists, as necessary. For complex or highly specialized tasks, senior technical specialists will be assigned portions of an audit, as necessary. The CPM, CQAM, CFTL, or their selected technical specialists will all be familiar with the technical and procedural requirements of both the field and laboratory operations, and the associated QA plans. In addition, auditors will not be directly involved with the audited work tasks, so that bias is not introduced into the auditing process.

Audit reports will include the following information (as appropriate):

- Description of the audit scope
- Name of the auditor(s)
- Audit notification
- Identification of persons contacted during audit activities
- Summary of audit results, including the effectiveness of the QA program elements that were audited
- Descriptions of each reported audit finding in sufficient detail to enable corrective action to be taken by the audited organization
- Audit completion notification

A copy of each audit report will be given to the ARRC Project Manager and CPM. The management of the audited organization or activity will investigate audit findings, determine the cause of the condition identified in the finding, schedule corrective action (including measures to prevent recurrence),

evaluate the impact of the finding on completed work, and notify the CPM or CQAM in a written report of action taken or planned. The CQAM will evaluate the adequacy of audit responses. Follow up action will be taken, as necessary, to verify whether corrective action is accomplished as scheduled.

Nonconforming items and activities are those that do not meet project requirements, contract criteria, or approved procedures. Nonconformances may be detected and identified by:

- **Project Staff.** During field investigation and testing, supervision of contractors, or preparation and verification of numerical analyses
- **Laboratory Staff.** During the preparation for and performance of laboratory testing, calibration of equipment, or QC activities
- **QA Staff.** During audit, inspection and/or surveillance activities

Formal documentation of nonconforming items will be forwarded to the CPM. Individuals or groups responsible for the audited activities will be notified, nonconformances evaluated, and appropriate corrective action taken. After a nonconforming item or activity has been identified, documented, and dispositioned, corrective action will be determined, performed, and verified. The laboratory department or field crew responsible for the activity being performed will initiate and complete the corrective action. The CPM, CQAM, or CFTL will be responsible for verifying and documenting completion of the corrective action.

3.1.1 Performance Audit

A performance audit will be used to determine the status and effectiveness of both field and laboratory measurement systems. An independent check will be made to obtain a quantitative measure of the quality of data generated. For laboratories, this involves the use of reference material or performance evaluation samples. These samples have known concentrations of constituents; results are evaluated in relation to the DQOs presented earlier in Section 1. Performance audits will be conducted following laboratory analysis of the control samples. Field performance will be evaluated using field blanks and equipment decontamination rinsates at a rate of 5 percent of the total number of samples collected.

3.1.2 Data Quality Audit

A data quality audit will be conducted to document and assess the effectiveness of the data collection (field) and generation (laboratory) processes. In particular, the data assessment parameters will be calculated from the results of the laboratory analysis to determine whether the DQOs of

this QAPP were met. The data quality audit will be conducted following laboratory analysis of the appropriate control samples.

3.1.3 Technical Systems Audits

A technical system audit will be used to confirm the adequacy of the data collection (field) and generation (laboratory) systems. This audit will be conducted on site to determine whether the QA plans and SOPs are properly implemented during the project. The technical systems audit will be conducted once for the laboratory operation and once during each phase of field work. These audits will be performed by the CPM and CQAM or their designees with notification given to the ARRC project manager.

A surveillance-type of technical system audit will be used to document compliance during a given time for one specific area of review, rather than the entire project. Surveillance activities will be conducted at the direction of the CPM, CQAM, or CFTL. The surveillance will be performed by an individual designated by the CPM, CQAM, or CFTL and trained in this QAPP who is not directly involved in the procedures being checked at the time of the surveillance. Surveillance audits will use checklists containing key items specified in this QAPP related to sampling methods (including collection, containers, and preservation); chain-of-custody; sample tracking shipment documentation; sample labeling QC methodology; pre-field activities; equipment decontamination, maintenance, and calibration; post-field activities; sampling documentation and other field activity logs; field team briefing; and equipment check-in and recalibration, regulatory requirements, and general contract requirements, and will be performed at a minimum of one time per field or laboratory task. Observations and nonconformance issues will be documented on the checklist accompanied by reports, as appropriate.

Laboratory audits will be conducted internally by the LQAM. External audits by the CQAM may be performed depending upon the selected laboratories certification status and project specific performance. Internal laboratory audits will conform to procedures set forth in the laboratory Quality Assurance Manual. External laboratory audits will conform to the Resource Conservation and Recovery Act (RCRA) Laboratory Audit Inspection Guidance Document (U.S. EPA, 1988). After sufficient time has elapsed for implementing the laboratory QA program, it may be appropriate to determine whether the laboratory is adequately performing the functions as defined in their QA program. Follow-up audits may occur to verify implementation of required corrective actions.

Activities selected for audit will be evaluated against specified requirements and will include an objective evaluation of the methodology. Typical items reviewed during a laboratory audit include:

- Documentation of the QA Program
- Results of proficiency testing
- Consistency of test procedures with current methods
- Documentation of approval for all test procedure modification
- Proper storage and labeling of reference standards
- Glassware cleaning procedures
- Documentation of laboratory water purity
- Proper sample storage and chain-of-custody
- Records of instrument maintenance
- Traceability and supervisor review of data and calculations
- Record retention systems
- Provisions for confidentiality of data

Corrective action will be undertaken when QC data fail to meet the prescribed limits or when the overall quality of the project is suspect. Corrective actions will be determined based on the nature and severity of the problem. Generally, repeat measurements and/or sample preparation will be required.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory technical personnel or group leader, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department by means of a Nonconformance Memo or similar form. Once resolved, this form is kept in a project folder and filed in the QA department. Corrective action documentation is routinely reviewed by the LQAM.

Corrective action is dictated by the type and extent of the nonconformance. Corrective action may be initiated and carried out by non-supervisory staff, but final approval and data review by management is necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection.

3.2 Reports to Management

Data validation and any required data quality assessment reports will be prepared by the CQAM or designee and will be provided to all data users when the data sets are approved for entry into the project database.

4 Data Validation and Usability

All sample results, QC summaries, raw data, and EDDs will be reviewed for precision, accuracy, and QAPP and method compliance by the laboratory prior to release of the data to the CQAM. The CQAM (or his/her appointee) will also check these data for precision, accuracy, completeness, method compliance, and QAPP compliance as an independent validator. These reviews, along with a review of data representativeness and comparability, performed by an active and knowledgeable project participant, will be used to make a determination regarding the usability of the data collected during this project. Independent professionals with experience in validating data will validate all physical, chemical, and location data.

4.1 Data Review, Verification, and Validation Requirements

Laboratory analysts are responsible for reviewing calibration integrity, sample holding times, method compliance, and completeness of tests, forms, and logbooks. A laboratory supervisor or the LQAM will verify completeness and method compliance, as well as raw data entry and calculations by analysts. The LQAM or designee will be responsible for checking each group or test data package for precision, accuracy, method compliance, compliance to special client requirements, such as target analyte lists, PQLs, methodology, and completeness. The LQAM or designee will also be responsible for checking 10-100 percent of the EDD against the final hardcopy data report, as described in Section 2.6.6. The LD and LPM will be the final checks in the data process for both final data reports and EDDs.

After laboratory release of the verified data report and EDD, data validation will be performed on laboratory analytical data by the CQAM or his/her designee. Precision, accuracy, completeness, and method compliance validation will be conducted by a person skilled in laboratory data validation but with limited site knowledge so as not to be influenced by site characteristics. Data validation results will be reported to the CPM in the format shown on Table 1-2, or in a similar format. A person with site knowledge will complete the representativeness and comparability validation.

4.2 Data Validation Methods for Precision, Accuracy, Completeness, and Method Compliance

The independent laboratory data validation for precision, accuracy, completeness, and method compliance will be conducted by the CQAM or his/her designee in accordance with the CLP (U.S. EPA, 1999 and 2001) as they apply to selected methods. Data validation will include 100 percent QC

summary review, 100 percent EDD review, assessments of data precision, accuracy, completeness, compliance to special client requirements, and method compliance.

Data validation will include 100 percent review of the following QC measurements as they apply to the analytical methods followed:

- Detection limits and dilution factors
- Holding times
- Surrogates
- Instrument, preparation, and method blanks
- MS samples
- Duplicates
- Laboratory control samples
- Instrument calibration and tuning
- Internal standards
- Interference checks
- Reference standards
- Serial dilutions
- Preparation/Extraction logs
- Run chronologies

Other validation and assessment techniques include:

- Chain-of-Custody review
- 100 percent review of EDD to final data reports
- Check of significant figures reported

Data validation qualifiers, as defined in the CLP National Functional Guidelines for Organic and Inorganic Data Review (U.S. EPA, 1999 and 2002) will be assigned and entered into the laboratory EDD by the CQAM prior to the EDD being incorporated into the project database.

Evaluation of field data will be assigned by the CPM and will include reviewing project field notebook and tables or databases for transcription errors, and reviewing table and database reduction.

4.3 Data Validation for Representativeness and Comparability

The CPM will assign a person to perform independent data validation for representativeness and comparability, which will have several components:

4.3.1 Basic Checklist

A standard check for simple errors in data handling will inspect data for:

- Typographical (data entry) errors
- Misplaced decimal points
- Incorrect units of measurement
- Detection limits parallel to dilution ratios
- Confusion of zero values, no detectable contaminant, and “no sample taken” notations
- Transposed “total,” “dissolved,” or “extractable” concentrations
- Verification that all data are traceable to a location, date, and analytical technique

4.3.2 Supportive Information

Supportive information, such as the following, must be complete to properly interpret the data:

- Documentation of sampling techniques
- Placement/distribution of samples
- Well construction, including location of screened interval and sealing to prevent cross-contamination

4.3.3 Professional Judgment

Professional judgment should be used to review data that appear inconsistent with existing regional data for possible errors. While this may appear to be a qualitative approach, it is, in reality, based upon the application of recognized data characteristics. Examples of the application of this approach will include:

- Comparison of the common ion, total dissolved solids, and conductivity values (values should show parallel changes)
- Comparison of data from samples to data from blanks
- Comparison of pH and dissolved metals values
- Comparison with previous data from same unit/area
- Review relative to sample media and location

- Check of dissolved parameters for those that seem high relative to normal solubility characteristics (similar to metals and pH comparisons)
- Scanning values for unusually high or low values and verifying those values against raw data

4.3.4 Basic Statistical and Graphical Analysis

Simple procedures will be implemented to analyze deviations from trends, anomalous data, or special problems, such as:

- Plotting values versus time
- Plotting values (as total dissolved solids and conductivity) versus each other
- Calculation of standard deviation

4.3.5 Data Handling Concepts

The data will be checked for the implementation of “standard procedures” that are frequently omitted or misused, such as:

- Handling outliers (Do they represent real values or errors?)
- Interpretation of blanks (Do “hits” on specific parameters in field, trip, or lab blanks represent problems with the raw data or other influences on data interpretation?)
- Level of detection (For samples having “less than detectable” values, has the detection level, ½ the detection level, or zero been used in statistical analyses or has the sample been dropped from the analysis?)

4.3.6 The PARCC Parameters

The data will be checked against the following PARCC parameters described in Section 1.4.1 to fulfill the requirements of the PARCC:

- Precision
- Accuracy
- Representativeness
- Completeness
- Comparability

Flags will be used to highlight data that, as a result of the data quality review, appear to be useful for only limited purposes or should be qualified in some

way. Flags for specific conditions will be created, incorporated, and defined in the computerized database.

4.4 Reconciliation with Data Quality Objectives

Upon completion and/or approval of the independent data validation report by the CQAM, the CQAM will present a copy of this report to the CPM. An example of the report format is given in Table 1-2. In addition, the CPM designee assigned the task of reviewing the representativeness and comparability of the laboratory data, as well as the general quality of the field documentation associated with the same laboratory report, will present a copy of his/her completed validation report to the CPM. The CPM or designee will review this report and prepare a brief summary report detailing the extent to which the data package meets the project specific DQOs. The CPM will circulate this memo to all personnel active in the project and considered data users.

5 References

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- U.S. EPA, 1994b. *Guidance for the Data Quality Objectives Process*. Washington D.C., United States Environmental Protection Agency, Office of Research and Development. September 194. EPA/600R-96/055.
- U.S. EPA, 1988. RCRA Laboratory Audit Inspection Guidance Document. Washington, D.C: United States Environmental Protection Agency. September 1988. OSWER 9950.4.
- U.S. EPA, 1996. Advanced Notice of Proposed Rulemaking: Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities. Washington, D.C.: United States Environmental Protection Agency. EPA/OSW-FR-96.
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- U.S. EPA, 2001. EPA Requirements for Quality Assurance Projects Plans for Environmental Data Operations. Washington, D.C.: United States Environmental Protection Agency. March 2001. EPA QA/R-5.
- U.S. EPA, 2002. *Guidance for Quality Assurance Project Plans*. Washington, D.C.: United States Environmental Protection Agency. December 2002. EPA QA/G-5.

Tables

Table 1-1 RETEC Level 3 Data Package Deliverables List

Analytical Group Method	Deliverable Requirement	Equivalent U.S. EPA Form	Level 3 Data Package
Moisture Analysis (soils)	Copies of lab notebook pages		✓
Volatile Organics	Case Narrative		✓
(SW8260B) and Semivolatile	Blank Summary: Cross-reference of field sample ID number, laboratory sample number, and analytical batch	IV	✓
Organics (SW8270C)	Chain-of-Custody form		✓
	Results summary for each sample and blank	I	✓
	Blank Spike Results: Identity of spiked compounds, amount spiked, amount recovered, % recovery, acceptance criteria		✓
	Surrogates recovery	II	✓
	Matrix spike/ matrix spike duplicate recoveries	III	✓
	Instrument performance check (tuning)	V	✓
	Initial calibration data	VI	✓
	Continuing calibration data	VII	✓
	Internal standards areas and retention times	VIII	✓
	Reconstructed ion chromatograms for each sample, blank, and standard		✓
	Quantitation list		✓
	Raw and background-subtracted mass spectra for each reported target analyte (except MS/MSD)		✓
	Copies of sample preparation work sheets		✓
Organochlorine	Case narrative		✓
Pesticides and PCBs SW8081A/8082	Blank Summary: Cross-reference of the field sample number, laboratory sample number, and the analytical batch	IV	✓
	Chain-of-Custody form		✓
	Results summary for each sample and blank	I	✓
	Blank spike results: Identity of spiked compounds, amount spiked, amount recovered, % recovery, acceptance criteria		✓
	Surrogates recovery	II	✓
	Matrix spike/ matrix spike duplicate recoveries	III	✓
	Initial calibration for single component analytes, retention time windows, on each column	VI, Pest-1	✓
	Initial calibration for single-component analytes, response factors, on each column	VI, Pest-2	✓
	Initial calibration for multicomponent analytes, one standard at reporting limit, on each column	VI, Pest-3	✓
	Initial calibration for multicomponent analytes, three-point, for detected analytes, on each column	VI, Pest-3	✓
	Analyte resolution, on each column	VI, Pest-4	✓
	PEM calibration verification, on each column, including end-of-run verification	VII, Pest-1	✓

Table 1-1 RETEC Level 3 Data Package Deliverables List

Analytical Group Method	Deliverable Requirement	Equivalent U.S. EPA Form	Level 3 Data Package
	Mixes A & B calibration verification, on each column, including end-of-run verification	VII, Pest-2	✓
Organochlorine Pesticides and PCBs SW8081A/8082 (continued)	Florisol cartridge check	IX, Pest-1	✓
	GPC check	IX, Pest-2	✓
	Chromatograms for each sample, blank, and standard, on each column		✓
	Quantitation report, for each column		✓
	Copies of sample preparation worksheets		✓
	Copies of run logs	VIII	✓
Metals(s) by ICP	Case narrative		✓
SW6010B/6020/C V	Cross-reference of the field sample ID number, laboratory sample number, and analytical batch		✓
	Chain-of-Custody forms		✓
	Sample results	I-IN	✓
	Blank results: Initial, continuing, and preparation	III-IN	✓
	Initial and continuing calibration data	II (Part 1)-IN	✓
	CRDL standard for ICP	II (Part 2)-IN	✓
	Blank Spike Results: Amount spiked, amount recovered, % recovery, acceptance criteria	VII-IN	✓
	Matrix spike results	V (Part 1)-IN	✓
	Postdigestion spike recovery for ICP	V (Part 1)-IN	✓
	Interference check for ICP	IV-IN	✓
	Duplicate sample results	VI-IN	✓
	ICP serial dilutions	IX-IN	✓
	ICP interelement correction factors	XI-IN	✓
	ICP linear range	XII-IN	✓
	Preparation log	XIII-IN	✓
	Analysis run log	XIV-IN	✓
	Raw data and instrument printouts		
Other Organic Methods	Case Narrative		✓
(Herbicides 8151A, Dioxin/Furan 8280A)	Cross-reference of field sample ID, laboratory sample no., and analytical batch		✓
	Chain-of-Custody forms		✓
	Sample results		✓
	Blank results		✓
	Initial and continuing calibration data		✓
	Spiked blank results: material spiked, quantity spiked, quantity recovered, % recovery		✓
	Matrix spike/ matrix spike duplicate results		✓
	Copies of sample preparation worksheets		✓

Table 1-1 RETEC Level 3 Data Package Deliverables List

Analytical Group Method	Deliverable Requirement	Equivalent U.S. EPA Form	Level 3 Data Package
	Chromatograms for each sample, blank, and standard, on each column		✓
	Quantitation reports		✓

Analytical Group Method	Deliverable Requirement	Equivalent EPA Form	Level 3 Data Package
General Chemistry	Case narrative		✓
(as applicable)	Cross-reference of field sample ID, laboratory sample no., and analytical batch		✓
	Chain-of-Custody forms		✓
	Sample results		✓
	Blank results		✓
	Initial and continuing calibration data		✓
	Blank spiked results: material spiked, quantity spiked, quantity recovered, % recovery		✓
	Matrix spike results		✓
	Duplicate sample results		✓
	Sample preparation log		✓
	Printouts and raw data		✓

Note:

U.S. EPA form numbers are shown for informational purposes only.

MS = Matrix spike

MSD = Matrix spike duplicate

PCB = Polychlorinated biphenyl

PEM = Performance evaluation mixture

GPC = Gel permeation chromatography

ICP = Inductively coupled plasma

CRDL = Contract required detection limit

Table 1-2 RETEC Analytical Data Validation Checklist

Project Name:		Laboratory:					
Project Reference:		Sample Matrix:					
RETEC Project No.:		Sample Start Date:					
Validated By/Date Validated:		Sample End Date:					
Reviewed By:		Review Date:					
COC #/Samples Analyzed:							
Parameters Validated:							
Laboratory Project IDs:							
PRECISION, ACCURACY, METHOD COMPLIANCE, AND COMPLETENESS ASSESSMENT							
Precision:		Acceptable		Unacceptable		Initials	
Comments:							
Accuracy:		Acceptable		Unacceptable		Initials	
Comments:							
Method Compliance:		Acceptable		Unacceptable		Initials	
Comments:							
Completeness:		Acceptable		Unacceptable		Initials	
Comments:							
VALIDATION CRITERIA CHECK							
Data validation flags used in this review:							
1. Was the laboratory narrative free of non-conformances related to the analytical results?		Yes		No		Initials	
Explanation by laboratory:							
2. Were sample Chain-of-Custody forms complete?		Yes		No		Initials	
Comments:							
3. Were all the analyses requested for the samples on the COCs completed by the laboratory?		Yes		No		Initials	
Comments:							
4. Were samples received in good condition and at the appropriate temperature?		Yes		No		Initials	
Comments:							
5. Were the requested analytical methods in compliance with QAPP, permit, or COC?		Yes		No		Initials	
Comments:							
6. Were detection limits in accordance with QAPP, permit, or method?		Yes		No		Initials	
Comments:							

Table 1-2 RETEC Analytical Data Validation Checklist

7. Do the laboratory reports include only those constituents requested to be reported for a specific analytical method?		Yes		No		Initials
Comments:						
8. Were sample holding times met?		Yes		No		Initials
Comments:						
9. Were correct concentration units reported?		Yes		No		Initials
Comments:						
10. Were the reporting requirements for flagged data met?		Yes		No		Initials
Comments:						
11. Were laboratory blank samples free of target analyte contamination?		Yes		No		Initials
Comments:						
12. Were trip blank, field blank, and/or equipment rinse blank samples free of target analyte contamination?		Yes		No		Initials
Comments:						
13. Were instrument calibrations within method control limits?		Yes		No		Initials
Comments:						
14. Were surrogate recoveries within control limits?		Yes		No		Initials
Comments:						
15. Were laboratory control sample recoveries within control limits?		Yes		No		Initials
Comments:						
16. Were matrix spike recoveries within control limits?		Yes		No		Initials
Comments:						
17. Were RPDs within control limits?		Yes		No		Initials
Comments:						
18. Were organic system performance criteria met?		Yes		No		Initials
Comments:						
19. Were internal standards within method criteria for GC/MS sample analyses?		Yes		No		Initials
Comments:						
20. Were inorganic system performance criteria met?		Yes		No		Initials

Table 1-2 RETEC Analytical Data Validation Checklist

Comments:						
21. Were blind field duplicates collected? If so, discuss the precision (RPD) of the results.		Yes		No		Initials
Duplicate Sample No.		Primary Sample No.				
Comments:						
22. Were 100% of the EDD concentrations and reporting limits compared to the hardcopy data reports?		Yes		No		Initials
Comments:						
Additional Comments:						
<p>General Comments: Data were evaluated based on validation criteria set forth in the USEPA Contract Laboratory Program National Functional Guidelines for Organic/Inorganic Data Review, document numbers EPA540/R-99/008 and EPA 540-R-01-008 of October 1999 (Organic) and July 2002 (Inorganic), as they applied to EPA SW-846 methodology. Field Duplicate evaluation was based on validation criteria set forth by EPA Region I.</p> <p>Refer to the table of "Qualified Analytical Results" for a listing of the samples, analytes, and concentrations qualified.</p>						

Table 2-1 Quality Control Criteria for Volatile GC/MS Analysis 8260B

Control Item	Frequency	Acceptance Criteria	Corrective Action
System Performance - BFB Tunes	Beginning of each 12-hour clock	Must meet ion abundance criteria	Stop analysis, investigate, and reanalyze
Initial Calibration	When continuing calibration is out of control: Minimum 5 standards with one out of low PQL	%RSDs $\leq 15\%$ or linear regression correlation coefficient ≥ 0.990 %RSD for CCCs $\leq 30\%$. RF for SPCC's ≥ 0.300 (≥ 0.1 for Bromoform) (≥ 0.1 for 1,1-Dichloroethane) (≥ 0.1 for Chloromethane)	Stop analysis, investigate, and reanalyze
Continuing Calibration	Every 12 hours	RF for SPCCs same as initial CCCs must be less than or = 20% difference.	Stop analysis, investigate, and reanalyze. Run new initial calibration curve.
Method Blank	Every 12 hours, 1 per sample set	All target analytes $< \text{PQL}$	Stop analysis, investigate, and reanalyze if required
Laboratory Control Sample (LCS)	Every 12 hours, 1 per sample set or 5%	Selected spike analytes must fall within acceptable recovery range of 70-130%	Stop analysis, reanalyze if required
Matrix Spike (MS) / Matrix Spike Duplicate (MSD)	Water - 5% Soil - 5%	% Recovery and % RPD must be within acceptable % recovery range of 59-142% depending on the analyte and matrix	Investigate and reanalyze (only if problems other than matrix interference are evident)
Surrogates	All standards and samples run	% Recovery must be within acceptable range of 59-138% depending on the analyte and matrix	Reanalyze only if problems other than matrix interference are evident
Internal Standards	Each sample and QC sample	Must meet area and RT criteria unless confirmed matrix effect shown	Reanalyze

Notes:

- CCC = Calibration Check Compound
- SPCC = System Performance Check Compound
- RF = Response Factor
- RSD = Relative Standard Deviation
- RT = Retention Time
- PQL = Practical Quantitation Limit (Reporting Limit)
- BFB = Bromofluorobenzene

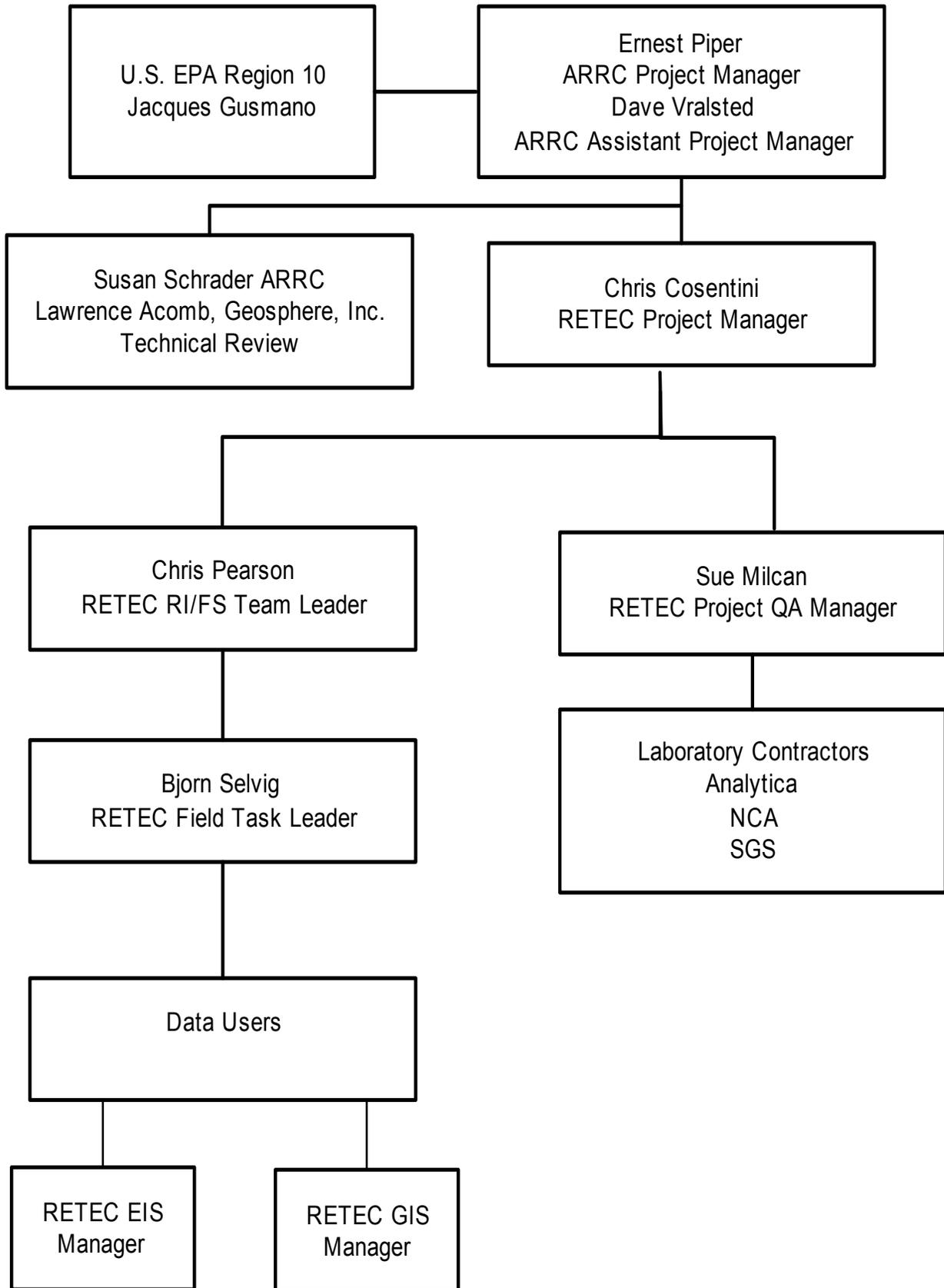
Table 2-2 Quality Control Criteria for Semi-volatile GC/MS Analysis 8270C

Control Item	Frequency	Acceptance Criteria	Corrective Action
System Performance - DFTPP Tunes	Beginning of each 12 hour clock	Must meet ion abundance criteria	Stop analysis, investigate, and reanalyze
Initial Calibration	When continuing calibration is out of control or when system conditions have been altered. Minimum 5 standards with one out of low PQL	% RSD \leq 15% or linear regression correlation coefficient \leq 0.990 RF for SPCCs \geq 0.05. All others less than 15% RSD.	Stop analysis, investigate, and reanalyze
Continuing Calibration	Every 12 hours	RF for SPCCs same as initial. CCCs must be less than 20% difference.	Stop analysis, investigate, and reanalyze. Run new initial calibration curve.
Method Blank	Per extraction batch	All target analytes < PQL	Investigate, reanalyze, reextract if necessary.
Laboratory Control Sample (LCS)	Per extraction batch or 5%	Selected spike analytes must fall within acceptable recovery range of 70-130%	Stop analysis, investigate, reanalyze, reextract, if necessary
Matrix Spike (MS) / Matrix Spike Duplicate (MSD)	Water - 5% Soil - 5%	% Recovery and % RPD must be within acceptable % recovery range of 9-165 depending on analyte and matrix	Same as above unless obvious matrix problems are evident.
Surrogate Compound	All standards and samples run	% Recovery must be within QC limits of 10-141, depending on analyte/matrix, for 2 of 3 base/neutral surrogates and >10% for all surrogates unless matrix effect is confirmed.	Investigate, reanalyze. Reextract if more than one compound is out per fraction.
Internal Standards	Each sample and QC sample	Must meet area and RT criteria unless confirmed matrix effect shown	Re-extract and/or reanalyze

Notes:

- CCC = Calibration Check Compound
- SPCC = System Performance Check Compound
- RF = Response Factor
- RSD = Relative Standard Deviation
- RT = Retention Time
- PQL = Practical Quantitation Limit (Reporting Limit)
- DFTPP = Decafluorotriphenylphosphine

Figures



Northern Boundary Assessment Work Plan
ARRC, Anchorage Terminal Reserve, Anchorage, AK

Project Organization Chart



