Final Work Plan

Work Plan for Site Inspection, Remedial Investigation, and Site Characterization Former Galena Forward Operating Location, Alaska

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Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

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Executive Summary

This Work Plan presents the methodology and data quality objectives (DQOs) for conducting site inspection (SI), site characterization (SC), and remedial investigation (RI) activities at the U.S. Air Force (USAF) Former Galena Forward Operating Location (FOL) in Galena, Alaska. A regional location map of the Former Galena FOL and its surrounding area is provided as Figure ES-1 (figures and tables are located at the end of the Executive Summary). Historical operations at the Former Galena FOL, where former military uses may have caused releases of hazardous substances or petroleum products to the environment, date back to the 1940s. The types of soil and groundwater contamination detected in previous investigations are primarily petroleum, oils, and lubricants (POLs) used for heat, power production, and operating and maintaining vehicles, aircraft, and equipment while the FOL was active. Chlorinated solvents such as trichloroethene (TCE) were also used at various locations for maintaining aircraft, vehicles, and electronics, and have been detected in soil and groundwater at the FOL. Previous investigations have not indicated significant soil or groundwater contamination from pesticides, polychlorinated biphenyls (PCBs), or metals.

Former USAF activities and facilities were evaluated as part of a Preliminary Assessment (PA) (CH2M HILL, April 2010) to identify sites where chemicals or fuel were stored or handled and where there was the potential for a release to the environment. The PA recommended further field investigation for sites where there is uncertainty about whether contamination exists or where additional sampling is required to complete regulatory guidelines for SC, risk assessment, or cleanup complete determinations. This Work Plan identifies the field sampling and data evaluation requirements for completing investigations at the sites the PA recommended for further investigation, and at other USAF Environmental Restoration Program (ERP) sites with known contamination that were not included in the PA. The sites covered by this Work Plan are listed in Table ES-1A and shown in Figure ES-2A. Sites may be added to this Work Plan in the future by providing site-specific field-sampling requirements and updated site tables and figures (for example, Tables ES-1B, ES-1C.)

The objectives of the SI, SC, and RI field investigations described in this Work Plan are as follows:

- **Site Inspection:** The SI is a limited field investigation for which the objective is to ***confirm the presence or absence of contamination***. Sites with positively confirmed contamination that exceed regulatory cleanup levels or risk-based concentrations (discussed in this Work Plan as screening levels [SLs]) will be recommended for further investigation under the SC or RI pathways. Sites with no detected contamination above SLs will be recommended for no further action or redesignation as a non-qualifying site[1].

[1]A site may be considered non-qualifying under the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program if contamination was wrongly suspected or the site is already regulated under another ADEC program.

- **Site Characterization:** The SC is a comprehensive field investigation for which the overall objectives are to ***delineate the extent of POL contamination*** in soil, surface water, and groundwater relative to SLs, ***and evaluate the potential threat*** to human health and the environment from site contamination.

- **Remedial Investigation:** The RI is also a comprehensive field investigation, but it will be ***used for sites with contamination from non-POL sources*** (or a mixture of POL and non-POL contamination), such as chlorinated solvents (which are regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [CERCLA]). The overall objectives of the RI are to ***delineate the nature and extent of site contamination*** in soil, surface water, and groundwater relative to SLs, ***and to evaluate the potential threats*** to human health and the environment.

Sites where historical activities included fuel or chemical storage or handling (for example, fuel storage tanks, maintenance shops, waste accumulation areas), but had limited or no previous environmental media sampling to confirm if contamination exists, were selected for SI sampling. If the SI sampling confirms that site contamination levels do not exceed SLs, then the site will be recommended for no further action and a cleanup complete determination, or redesignation as a non-qualifying site, as appropriate. If contamination is encountered at concentrations greater than the SLs, the site will move forward to the SC/RI phase, and step-out sampling may be required to delineate the nature and extent of contamination. The location, number, and depth of these additional samples (and the target analytical methods) will be determined based on the results of the initial SI phase sampling. Additional media sampling (for example, groundwater and soil vapor sampling) may also be required.

To help streamline the investigation processes, and in recognition of the uncertainties currently associated with the sources, nature, and extent of contamination at various sites, the Triad approach is being used to design and implement the field activities. The primary objectives of the Triad approach are as follows:

- Manage technical and administrative decision uncertainties by involving the project stakeholders at the work-planning stage

- Develop a flexible site investigation approach to ensure that the optimum amount of relevant data will be collected using the most efficient and cost-effective methods available

This Work Plan was prepared in accordance with the guidance provided by the U.S. Environmental Protection Agency (EPA) Uniform Federal Policy for Quality Assurance Project Plans Workbook (UFP QAPP) (EPA, March 2005). The UFP QAPP consists of 37 prescriptive worksheets used to document various aspects of the environmental investigation process to guide the field work. The worksheets are intended to provide program-level information that is applicable to all proposed field activities. Appendix D provides a site-specific field sampling plan (FSP) for each investigation site.

The following appendices are included in the Work Plan:

- **Appendix A** contains the project-specific Health and Safety Plan (HSP).
- **Appendix B** contains the Waste Management Plan (WMP).
- **Appendix C** summarizes the selection and references for SLs.
- **Appendix D** provides the site-specific FSPs for the investigation areas. These include the following information:
  - Site location, characteristics, description and history
  - Summary of previous investigations and remedial actions, including the October 2009 site visit
  - Findings of previous investigations and chemicals of interest
  - Secondary data use information
  - Conceptual site model for exposure
  - DQOs
  - Investigation activities
- **Appendix E** contains the measurement performance criteria tables for Worksheet #12 (*Measurement Performance Criteria*).
- **Appendix F** contains the analytical data processing procedures.
- **Appendix G** contains the human health and ecological risk assessment methodology.
- **Appendix H** includes the field standard operating procedures (SOPs).
- **Appendix I** includes the analytical SOPs.
- **Appendix J** contains the SOPs for data management.
- **Appendix K** contains the analytical instrument calibration tables.
- **Appendix L** contains the approval letter and permits.
- **Appendix M** provides a summary of the agreements reached during the Triad Project Planning meeting.

Project Approach

Historical data gathered during the PA were reviewed to develop DQOs, preliminary CSMs, and field sampling strategies. Program-level DQOs for completing SI, SC, and RI activities were developed using the recommended EPA seven-step process (EPA, February 2006). These DQOs specify the type, quality, quantity, and uses of data needed to adequately

support future decisions for the different types of sites. The program-level DQOs are presented in Worksheet #10 *(Problem Definition)* for the following activities:

- SI Stage:
  - Investigate possible releases and determine need for further sampling
- SC/RI Stage:
  - Determine the nature and extent of contamination in soil
  - Characterize possible free product/smear zone contamination
  - Characterize possible site-related groundwater contamination (sites in vicinity of larger FOL plumes)
  - Delineate the nature and extent of groundwater contamination (isolated plumes)
  - Characterize hydrogeological conditions (FOL-wide)
- Risk Assessment Stage:
  - Human health risk assessment
  - Ecological risk assessment

Many of the FOL sites share the same CSM because the source and release type, released chemicals, and media that could become contaminated are similar and such sites have common problem statements and data needs. Using available information about source type and potentially released chemicals, each site was assigned to one of the following Investigation Approach Groups. The following Investigation Approach Groups have common CSM elements, and thus have similar data needs and sample design requirements to be addressed during the required investigation(s):

- **Surface POL Releases –** Sites with known or potential surface releases of POL from aboveground storage tanks (ASTs), drums, fill-stands, aboveground fueling pipelines, or loading/unloading facilities, or other surface fuel spills.
- **Subsurface POL Releases –** Sites with known or potential subsurface releases of POL from buried fueling piping, valve pits, or sumps.
- **Subsurface POL Releases (UST-related) –** Sites with known or potential subsurface releases of POL from leaking USTs. This category is separated from the Subsurface POL Releases category because there are specific sampling requirements for UST site closure.
- **Surface Multi-chemical Releases –** Sites with known or potential surface releases of non-POL chemicals (i.e., solvents, metals, pesticides; or a mixture of POL and non-POL chemicals) from ASTs, drums (waste management areas), or other surface spills.
- **Subsurface Multi-chemical Releases –** Sites with known or potential subsurface releases of non-POL chemicals (or a mixture of POL and non-POL chemicals) from oil-water separators (OWS), sumps, or fire training area pits.

- **Transformer Sites –** Sites where transformers may have been present and releases of PCBs and other chemicals may have occurred.
- **Unknown Source –** Sites where visual reconnaissance, historical records, and/or remote sensing results suggest management or disposal of waste or hazardous chemicals, but the location and composition of potential releases are unknown.

Program-level DQOs for each Investigation Approach Group, which are presented in Worksheet #17 *(Sampling Design and Rationale)*, were used to guide the development of FSPs for each site. The specific DQOs, CSM, and proposed FSP for each investigation site are presented as attachments to Appendix D of this Work Plan.

Decisions regarding whether a site is considered contaminated and what defines the nature and extent of contamination are made by comparing sampling data to the SLs. The SLs are based on regulatory cleanup levels developed by ADEC and EPA, risk-based concentrations, and local soil background concentrations. The SLs were developed to facilitate the data review process and to flag locations where soil or groundwater contamination may be present. The SLs are intended for screening purposes only; exceedance of an SL is not an indication of unacceptable risk.

The decision process used to determine site investigation pathways and anticipated closure processes is shown in Figure ES-3. The investigation approach for the SI, SC, and RI activities is summarized as follows:

- **SI sites:** SI sampling will focus on areas where contamination is most likely to be present based on evaluations of site operational history, reviews of historical maps and aerial photographs, and/or the result of site-reconnaissance activities. Statistically random sampling approaches, such as multi-incremental samples (MIS), will be employed at sites where there is no information to support a biased sampling approach. The results for SI samples will be compared with the site inspection SLs, with one of the following three possible outcomes:

    1. If concentrations of all target analytes are below SLs, then no further action or redesignation as a non-qualifying site will be recommended for the site.
    2. If concentrations of POL-related chemicals are above SLs, then further investigation to delineate the extent of contamination and evaluate potential risks in accordance with ADEC SC guidance will be recommended for the site.
    3. If concentrations of non-POL chemicals, or a mixture of POL and non-POL chemicals, are above SLs, then further investigation to delineate the nature and extent of contamination and evaluate potential risks in accordance with CERCLA RI/Feasibility Study (FS) guidance will be recommended for the site.

- **SC sites:** SC activities will be performed at sites where PA or SI phase results show that POL-related contamination exists at concentrations above soil or groundwater extent SLs, but where adequate data are not available to delineate the extent of contamination or assess the potential exposure risks. The SC activities are intended to accomplish the

following tasks in accordance with Title 18, Chapter 75, of the *Alaska Administrative Code* (18 AAC 75):

- Determine whether a discharge or release of a hazardous substance has occurred
- Identify each (potential) hazardous substance at the site, including the concentration and extent of contamination; this information must be sufficient to determine cleanup options
- Identify site characteristics or conditions that could result in ongoing site contamination, including the potential for leaching of in situ contamination and the presence of leaking barrels, drums, tanks, pipelines, other containers, or other sources
- Evaluate the potential threat to human health, safety, and welfare, and to the environment from site contamination
- Identify any interim removal action necessary under 18 AAC 75.330
- Locate sources of known site contamination, including a description of potential releases into soil, sediment, groundwater, or surface water
- Evaluate the size of the contaminated area, including the concentrations and extent of any soil, sediment, groundwater, or surface water contamination
- Identify the vertical depth to groundwater and the horizontal distance to nearby wells, surface water, and water supply intakes
- Evaluate the potential for surface water runoff from the site and the potential for surface water or sediment
- Identify the soil type and determine whether the soil is a continuing source of groundwater contamination
- For UST sites, also follow the site characterization and closure requirements in 18 AAC 78.090 of the UST regulations (ADEC, amended October 2006)

Findings from the SC activities will be used to update the preliminary CSM that was developed in the PA phase, estimate potential risks to human health and the environment, and evaluate options for interim or final cleanup actions.

- **RI sites**: RI activities for sites with non-POL contamination (or a mixture of POL and non-POL contamination) are the same as those described previously for SC activities, but reporting will follow the CERCLA process for preparing the RI and FS reports, Proposed Plan, and Record of Decision, and associated public reviews. Site data will also be used to prepare a baseline risk assessment to identify existing or potential risks to human health and the environment, and to develop a range of remedial alternatives that will be evaluated in the FS report.

For sites where an RI or SC have been completed, a baseline risk assessment may be conducted to support risk management decisions. The overall objective of the baseline risk assessment will be to identify whether the risks posed by the site are of sufficient magnitude

to support (along with other factors) one of two decisions: (1) proceed with developing remedial actions (that is, cleanup, long-term monitoring, and/or institutional controls) or (2) proceed with a no further action determination.

During the course of the project, the Triad process will be used to make environmental decisions for each site. Proposed changes will be discussed among the project team members and documented in meeting memoranda, which will be sent to team members. Upon completion of each work phase, consensus will be sought from team members to establish that required data have been collected for that phase. Consensus will be reached using teleconferences and other face-to-face meetings, as necessary. Team decisions will be recorded and documented in summary meeting minutes.

During the course of the field investigation and data evaluation, interim data summaries and figure updates will be provided to the stakeholders as part of the Triad process. After SI and SC activities are completed, a report will be prepared, in accordance with the requirements of 18 AAC 75.335(c), to present the findings of the implemented Work Plan and provide a complete description of the nature and extent of contamination detected during the field sampling and analysis. The report will also propose any additional sample collection required to identify the limits of contamination in soil and groundwater, interim cleanup actions, or, if the SC is considered complete, how the contamination will be cleaned up. Site figures, supporting tables, the preliminary CSM, and other information from the Work Plan will be updated. For sites where RI activities are performed, an RI/FS report will be prepared in accordance with CERCLA guidance (EPA, October 1988). Risk evaluations will be included with both SC and RI reports to identify current and potential future risks to human health and the environment from site contamination.

Project Schedule

Because of the dynamic nature of this Work Plan, the project schedule will likely be revised in response to the field conditions and initial sampling results. Once identified, potential revisions to the project schedule will be communicated to the project team so the changes can be evaluated and, where appropriate, efficiently accommodated within the overall schedule to minimize impacts on milestone dates. The current key milestone events of the project are shown in Figure ES-4.

References

Alaska Department of Environmental Conservation (ADEC). Amended October 2006. *Underground Storage Tanks.* Title 18 *Alaska Administrative Code* Chapter 78.

CH2M HILL. April 2010. *Preliminary Assessment Report for the Former Galena Forward Operating Location, Galena, Alaska*. Prepared for the Air Force Center for Engineering and the Environment (AFCEE).

U.S. Environmental Protection Agency. February 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process.* EPA QA/G-4. Government Printing Office. Washington, D.C.

U.S. Environmental Protection Agency. March 2005. *Uniform Federal Policy for Quality Assurance Project Plans Workbook*.

U.S. Environmental Protection Agency. October 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final.* EPA 540/G/89/004, OSWER 9355.3-01.

TABLE ES-1A
Field Investigation Sites
Former Galena Forward Operating Location, Alaska

Parent ERP Site (if applicable)	Site ID	Site Name	Anticipated Investigation Pathway
ERP Sites			
FT001	FT001	Fire Protection Training Area	RI
ST009	UST1572	1572 Liquid Fuel Pump Station, 3000 gallon UST	SC
ST009	UST15722	UST 1572-2, 2000 gallon UST	SC
ST009	ST009	JP-4 Fill-stands	SC
ST010	ST010	Southeast Runway Fuel Spill	SC
OT099	OT099	Building Demolition/Drum Removal	SC
SS005	SS005	Wilderness Hall, Building 1872	SC
Other Sites			
	TAR	Possible Tar Pit Construction Area	SI

Notes:

ERP = Environmental Restoration Program
ID = identification
SC = site characterization
SI = site inspection
UST = underground storage tank

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VICINITY MAP

LEGEND

Approximate Boundary of FOL

Notes:
1. Orthorectified Ikonos Imagery.
   July 5, 2005. Pixel size 1 meter.

N

0 875 1,750
Feet

FIGURE ES-1
Galena Vicinity
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

CH2MHILL

SS005

ST009

FT001

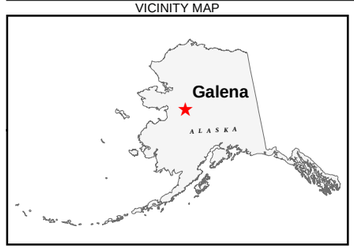
TAR

ST010

OT099

YUKON RIVER

VICINITY MAP



LEGEND

- Investigation Area
- Building or Shed
- Building
- Airfield Surface, Road, or Driveway Area
- Surface Water

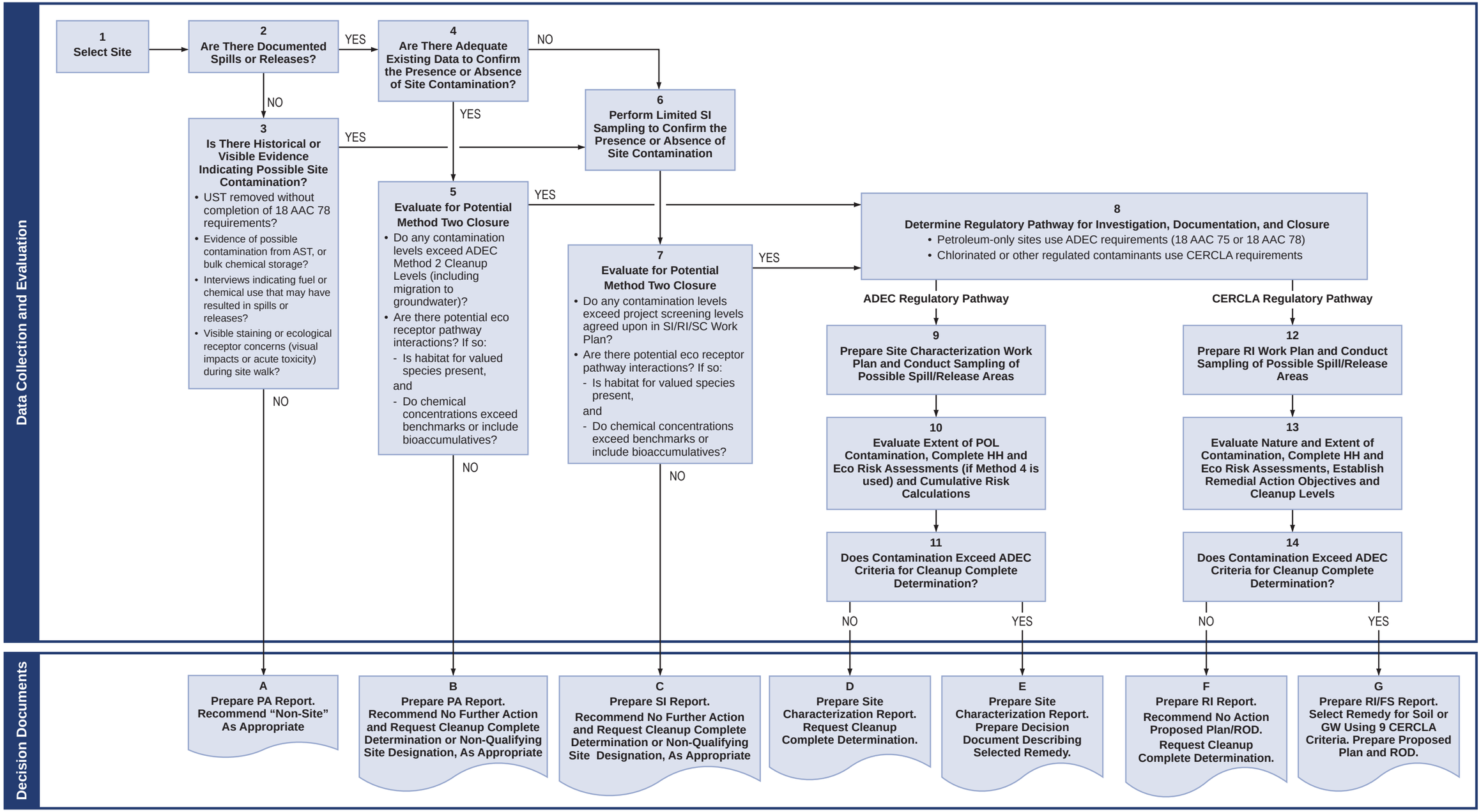
N

0 375 750
Feet

FIGURE ES-2A
Investigation Areas
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

CH2MHILL

\\BALDUR\PROJ\GALENATO184_394439\MAPFILES\QAPP\FIGURE_ES2A_INVESTIGATION_AREAS_QAPP.MXD SEARLY 6/7/2010 13:18:43



Note that contamination migrating from an adjacent site will be addressed as part of the adjacent (or source) site for the purpose of environmental cleanup.

FIGURE ES-3
Flowchart for Site Screening Process
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

ID	Task Name	Duration	Planned Start	Planned Finish
1	**TO 184 Task Order Award**	1 day?	Mon 9/28/09	Mon 9/28/09
2	**Project Administration**	730 days	Thu 10/1/09	Wed 7/18/12
3	Quarterly RAB Meetings (Galena)	720 days	Thu 10/15/09	Wed 7/18/12
16	Quarterly BCT Meetings (Fairbanks)	720 days	Thu 10/1/09	Wed 7/4/12
29	**Preliminary Assessment (PA)**	222 days	Thu 10/1/09	Fri 8/6/10
30	Site Visit and Records Search	27 days	Thu 10/1/09	Fri 11/6/09
31	Draft PA Report	110 days	Mon 11/9/09	Fri 4/9/10
32	Review	30 days	Mon 4/12/10	Fri 5/21/10
33	Final PA Report	45 days	Mon 6/7/10	Fri 8/6/10
34	**Work Plan (QAPP)**	**150 days**	**Mon 1/11/10**	**Fri 8/6/10**
35	Draft Work Plan	61 days	Mon 1/11/10	Mon 4/5/10
36	Review	25 days	Tue 4/6/10	Mon 5/10/10
37	Final Work Plan (includes first 6 sites)	30 days	Tue 5/11/10	Mon 6/21/10
38	Appendix D FSPs for 12 ERP Sites	55 days	Mon 5/17/10	Fri 7/30/10
39	Appendix D FSPs for PA Sites Requiring Investigation	55 days	Mon 5/24/10	Fri 8/6/10
40	**2010 Investigation**	**398 days**	**Tue 6/1/10**	**Thu 12/8/11**
41	Surveying and Utility Locates	24 days	Tue 6/1/10	Fri 7/2/10
42	Mobilization	4 days	Mon 7/5/10	Thu 7/8/10
43	2010 Field Sampling	60 days	Fri 7/9/10	Thu 9/30/10
44	Demobilization	10 days	Fri 10/1/10	Thu 10/14/10
45	Interim Data Evaluation	70 days	Fri 10/15/10	Thu 1/20/11
46	Draft Report, Reviews on Completed 2010 Site Investigations	65 days	Fri 1/21/11	Thu 4/21/11
47	Final Report on Completed 2010 Site Investigations	45 days	Fri 4/22/11	Thu 6/23/11
48	Decision Documents, FS, PP, and ROD	120 days	Fri 6/24/11	Thu 12/8/11
49	**2011 Investigation**	**448 days**	**Mon 1/3/11**	**Wed 9/19/12**
50	Work Plan Amendments, Reviews	80 days	Mon 1/3/11	Fri 4/22/11
51	2011 Field Sampling	60 days	Wed 6/1/11	Tue 8/23/11
52	Data Evaluation	45 days	Thu 9/1/11	Wed 11/2/11
53	Draft Report, Reviews on Completed 2011 Site Investigations	65 days	Thu 11/3/11	Wed 2/1/12
54	Final Report on Completed 2011 Site Investigations	45 days	Thu 2/2/12	Wed 4/4/12
55	Decision Documents, FS, PP, ROD	120 days	Thu 4/5/12	Wed 9/19/12

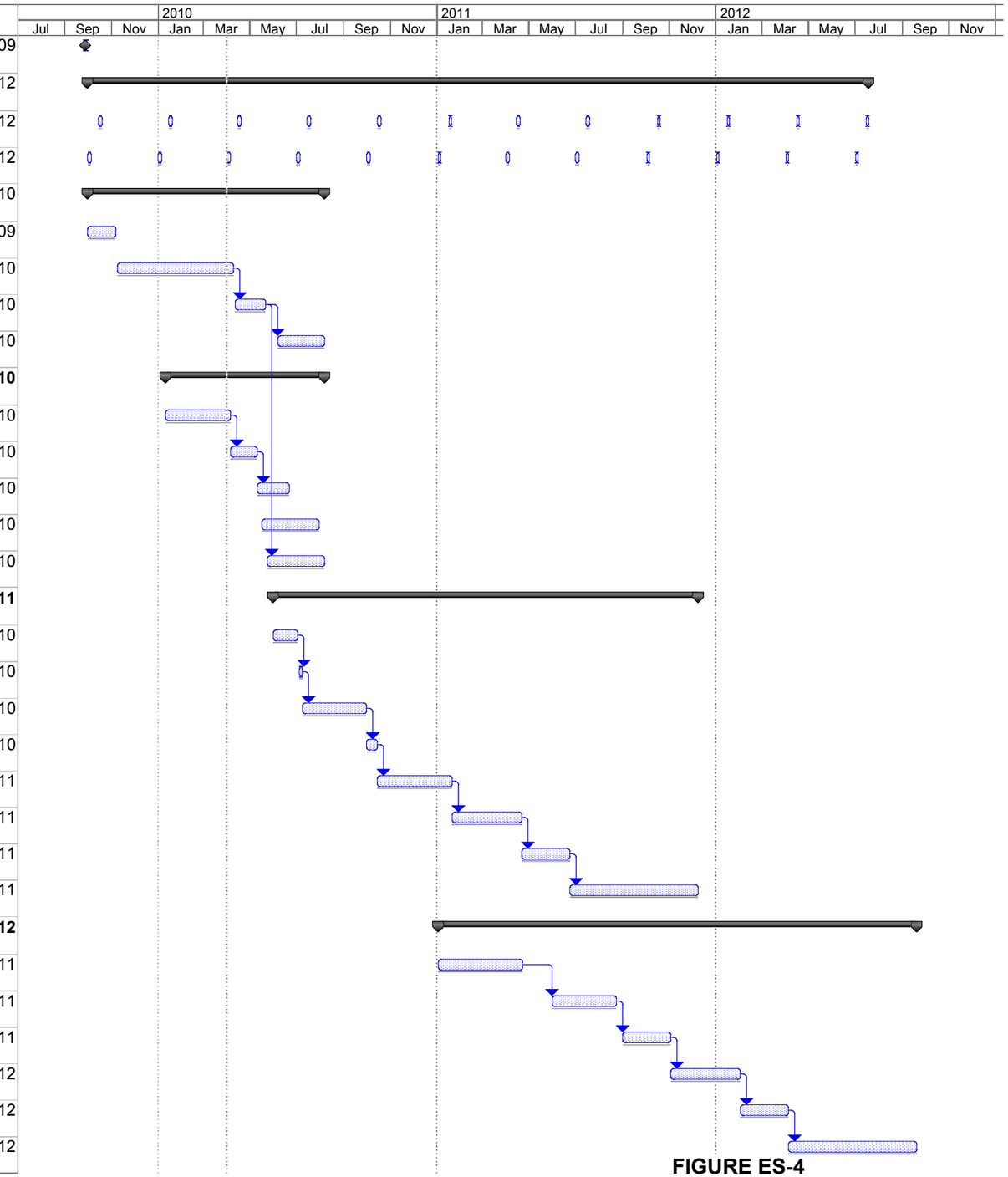


FIGURE ES-4
Schedule
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

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#10	Problem Definition	10-1	Work Planning Process
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#13	Secondary Data Criteria and Limitations	13-1	Work Planning Process
#14	Summary of Project Tasks	14-1	Project Overview and Schedule
#15	Reference Limits and Evaluation	15-1	Sampling Analytical Plan
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#19	Analytical SOP Requirements	19-1	Sampling Analytical Plan
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#23	Analytical SOP References	23-1	Sampling Analytical Plan
#24	Analytical Instrument Calibration	24-1	Sampling Analytical Plan

Worksheet #	Title	Page No.	Type of Information
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#27	Sample Custody Requirements	27-1	Field Sampling Plan
#28	Laboratory QC Sample Summary	28-1	Sampling Analytical Plan
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G Human Health and Ecological Risk Assessment Methodology
H Field Standard Operating Procedures
I Analytical Standard Operating Procedures
J Standard Operating Procedures for Data Management
K Analytical Instrument Calibration Tables
L Approval Letter and Permits

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Acronyms and Abbreviations

%C	percent completeness
µg/dL	microgram per deciliter
µg/L	microgram per liter
%R	percent recovery
% RSD	percent relative standard deviation (QC and calibration statistic)
A2LA	American Association of Laboratory Accreditation
AAC	*Alaska Administrative Code*
ADEC	Alaska Department of Environmental Conservation
ADOT&PF	Alaska Department of Transportation & Public Facilities
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AOC	Area of Concern
ASCII	American Standard Code Information Interchange
ASL	Applied Sciences Laboratory
AST	aboveground storage tank
ASTM	American Society of Testing and Materials
atm-m^3	atmosphere-cubic meters per mole
BAH	Booz Allen Hamilton, Inc.
BFB	4-bromofluorobenzene
bgs	below ground surface
BLM	Bureau of Land Management
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
BOS	Base Operation and Support
CAA	Civil Aeronautics Authority
CAD	computer-aided design
CCV	continuing calibration verification
CD	compact disk
CDRL	Contract Data Requirements List
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
cm	centimeter(s)
cm^2	square centimeters
cm^3	cubic centimeters
CO	Contracting Officer
COC	chemical of concern
COPC	chemical of potential concern

COPEC	chemical of potential ecological concern
COR	*Contracting Officer's Representative*
CPSMR	*Contractor's Progress, Status, and Management Report*
CSM	conceptual site model
D	difference when using RFs or drift when using least square, regression, or nonlinear calibration
DBMS	Database Management System
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DLNR	Department of Land and Natural Resources
DM	Database Manager
DML	Database Management Lead
DMP	Data Management Plan
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DQI	data quality indicator
DQO	data quality objective
DRO	diesel-range organics
DSNW	Northwest Disposal Area
DV Lead	Program Validation Lead
DW	Data Warehouse
EA	Environmental Assessment
EBS	Environmental Baseline Studies
eData	electronic data
E_d	dermal exposure
EDB	ethylene dibromide
EDC	1,2-dichloroethane
EDD	electronic data deliverable
EDS	Environmental Data Services
E_i	inhalation exposure
EICP	extracted ion current profile
ELCR	excess lifetime cancer risk
EMS	Enterprise Management Solutions
E_o	oral exposure
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ERBSC	ecological risk-based screening concentration
ERP	Environmental Restoration Program
ERPIMS	Environmental Resources Program Information Management System
ESL	ecological screening level

E_t	total chemical exposure experienced by wildlife
EVS	Environmental Visualization System
FAA	Federal Aviation Administration
FD	field duplicate
FID	flame ionization detector
FM	field manager
FOL	Forward Operating Location
FS	Feasibility Study
FSC	Field Sample Coordinator
FSP	Field Sample Plan
FTL	Field Team Leader
GA	GIS Analyst
Galena	Former Galena Forward Operating Location
GAVTC	Galena Aviation Vocational Technical Center
GC	gas chromatography
GC/MS	gas chromatograph/mass spectrometer
GEITA	Global Engineering, Integration, and Technical Assistance
GIS	geographic information system
GPS	global positioning system
GRO	gasoline-range organics
HCl	hydrochloric acid
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HPLC	high-performance liquid chromatography
HQ	hazard quotient
HSP	Health and Safety Plan
IC	ion chromatography
ICAL	initial calibration
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma – mass spectrometry
ICS	interference check sample
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
IRIS	Integrated Risk Information System
IS	internal standard
J-flag	Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.
JP-4	jet-propulsion fuel, grade 4

JP-8	jet-propulsion fuel, grade 8
kg	kilogram(s)
Kp	chemical-specific dermal permeability coefficients
L	liter
LCL	lower confidence limit
LCS	laboratory control sample
LNAPL	light, nonaqueous phase liquid
LOAEL	lowest observed adverse effects level
LOEC	lowest observed effect concentration
LOD	limits of detection
LOQ	limits of quantitation
LOX	liquid oxygen
LSOP	laboratory standard operating procedure
m^3	cubic meters
MAJCOM	Major Command
MDL	method detection limit
ME	marginal exceedance
MEC	measured environmental concentration
mg	milligram
mg/kg	milligram per kilogram
mg/L	milligrams per liter
MI	multi-increment
ml	milliliter
mm	millimeter
MMRP	Military Munitions Response Program
MNA	monitored natural attenuation
MPC	measurement performance criteria
MS	matrix spike
MSD	matrix spike duplicate
N/A or NA	not applicable
ND	not detected
N/FD	normal/field duplicate
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NPL	National Priorities List
ODBC	open database connectivity
ODPCP	Oil Discharge Prevention and Contingency Plan
ORNL	Oak Ridge National Laboratory
ORP	oxidation-reduction potential

OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
OWS	oil-water separator
oz	ounce
PA	Preliminary Assessment
PACAF	Pacific Air Force
PAH	polynuclear aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PC	Project Chemist
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PCL	Program Chemistry Lead
PD	Project Delivery
PDF	Portable Document Format
PEL	probable effects level
PGDB	personal geodatabase
PGM	Program GIS Manager
PID	photoionization detector
PM	Project Manager
POC	point of contact
POL	petroleum, oil, and lubricant
PPRTV	Provisional Peer Reviewed Toxicity Value
PQO	project quality objective
QA	quality assurance
QC	quality control
QAPP	Quality Assurance Project Plan
QSM	Quality Systems Manual
RAGS	*Risk Assessment Guidance for Superfund* (EPA, December 1989)
RAPCON	Radar Approach Control
RASCI	responsible, approve, support, consult, and inform
RF	response factors
RfD	reference dose
RI	Remedial Investigation
RL	reporting limit
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
RRO	residual-range organics
RRT	relative retention time
RSD	relative standard deviation
RSL	regional screening level

RT	retention time
SC	Site Characterization
SDG	sample delivery group
SF	slope factor
SI	Site Inspection
SIMS	Site Information Management System
Site FT001	Fire Protection Training Area (Parcel I)
SL	screening level
SOP	standard operating procedure
SOW	Statement of Work
SPCC	Spill Prevention, Control, and Countermeasures Plan
SQG	Sediment Quality Guideline
SQuiRT	Screening Quick Reference Table
SRM	standard reference material
STP	Sample Tracking Program
SVOC	semivolatile organic compound
TBD	to be determined
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TEL	threshold effects level
TM	Task Manager
TO	Task Order
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-d	TPH-diesel range organics
TPH-g	TPH-gasoline range organics
TPH-o	TPH-oil range organics
TRV	toxicity reference value
UCL	upper confidence limit
UJ-flag	The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.
USAFE	U.S. Air Forces in Europe
UFP	Uniform Federal Policy
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
UTL	upper tolerance limit
UTM	Universal Transverse Mercator
VDMS	Validation Data Management System
VF	volatilization factor
VOA	volatile organic analysis

VOC	volatile organic compound
VSI	visual site inspection
WGS	World Geodetic System
WMP	Waste Management Plan
WP	Work Plan
yr	year

Worksheet #1 – Title and Approval Page

Project Name and Site Location:	Former Galena Forward Operating Location, Galena, Alaska
Document Title:	Work Plan for Site Inspection, Remedial Investigation, and Site Characterization Former Galena Forward Operating Location, Galena, Alaska Air Force Center for Engineering and the Environment (AFCEE) Contract FA8903-08-D-8769, Task Order (TO) 0184 Alaska Department of Environmental Conservation (ADEC) File No. 860.38
Lead Organization:	AFCEE
Preparer's Contact Information:	CH2M HILL 949 East 36th Avenue Anchorage, AK 99508 Telephone: (907) 762-1591 Email: Win.Westervelt@ch2m.com
Preparation Date:	August 2010

Regulatory agency concurrence will be documented in a letter from ADEC.

Worksheet #2 – Work Plan Identifying Information

Project Name:	Former Galena Forward Operating Location
Site Location:	Galena, Alaska
Operable Unit:	Not applicable
Contractor Name:	CH2M HILL, Inc.
Contract Title:	Remedial Investigation (RI)/Feasibility Study (FS), Proposed Plan, and Record of Decision at Galena Air Station, Alaska
Contract Number:	FA8903-08-D-8769, TO 0184

1.	**Identify Regulatory Program:**	ADEC Contaminated Site Program and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
2.	**Identify Regulatory Concurrence Entity:**	ADEC
3.	**The Work Plan is (select one):**	☐ Generic ☒ Project-Specific
4.	**List dates of scoping sessions that were held:**	• April 14–15, 2010, Systematic Planning Session
5.	**List dates and titles of Work Plan documents written for previous site work, if applicable:**	*Final Work Plan for Remedial Investigation/Feasibility Study at Galena Airport and Campion Air Station, Alaska* (Earth Tech, May 2004)
6.	**List organizational partners (stakeholders) and connection with lead organization:**	• U.S. Air Force (USAF) – Lead Agency • ADEC – Regulatory Stakeholders
7.	**List data users**	• USAF • ADEC • Alaska Department of Transportation and Public Facilities (ADOT&PF) • City of Galena • Galena School District

8. **If any required Work Plan elements and required information are not applicable to the project, then circle the omitted Work Plan elements and required information on the attached table. Provide an explanation for their exclusions below**

The table below provides the following information:

- Information on the requirements of a Quality Assurance Project Plan (QAPP) as defined by the U.S. Environmental Protection Agency (EPA) (EPA, February 2006)
- A crosswalk to the ADEC-recommended elements for a complete work plan (ADEC, September 23, 2009)
- The worksheet number from the EPA Uniform Federal Policy (UFP) QAPP (EPA, March 2005) format where applicable/similar information is located

EPA-Required QAPP Element(s) and Corresponding QAPP Section(s)	Crosswalk to ADEC Elements of a Complete Work Plan	Crosswalk to Applicable EPA UFP Format Worksheet Number
Project Management and Objectives		
2.1 Title and Approval Page	Cover Page • Name and signature of qualified person who prepared the work plan • Site name • ADEC file number	Worksheet #1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	Table of Contents Acronyms and Abbreviations	Before Worksheet #1 and Worksheet #2
2.3 Distribution List and Project Personnel Sign-off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-off Sheet		Worksheet #3 Worksheet #4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	List of qualified persons working onsite	Worksheet #5 Worksheet #6 Worksheet #7 Worksheet #8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	Site Description and Background • Current site location map with legend, orientation (north arrow), and scale • Current vicinity map with legend, orientation, and scale • Legal description/plat number • Latitude and longitude datum • Street address • Dated aerial photographs • Interviews with previous landowners, Responsible Parties, or others	Site-wide Information • Worksheet #9 • Worksheet #10 Site-specific Information • Appendix D

EPA-Required QAPP Element(s) and Corresponding QAPP Section(s)	Crosswalk to ADEC Elements of a Complete Work Plan	Crosswalk to Applicable EPA UFP Format Worksheet Number
	• Description of prior land use • Current institutional controls in place, if any • Locations of site structures/utilities/potable water sources • Locations of property lines, buildings, and nearby roads • Presence of vent/fill pipes from underground storage tanks, aboveground storage tanks, drums, waste piles, septic systems, or other potential sources of contamination • Evidence of leaks or stained soils • Known contaminant sources Preliminary Conceptual Site Model • Description of potential receptors • Potential migration pathways • Potential points of exposure	
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	Project Objectives Chemicals of Potential Concern (COPC) • Tabular list of COPCs • Cleanup levels • Screening levels • Analysis to be performed Analytical Methods • Request for Analysis – Method detection limits (MDL) – Potential constituents and laboratory methods	Site-wide Information • Worksheet #11 • Worksheet #12 • Worksheet #15 Site-specific Information • Appendix D
2.7 Secondary Data Criteria and Limitations		Site-wide Information • Worksheet #13 Site-specific Information • Appendix D
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	Project timetable	Worksheet #14 Worksheet #16
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/ Sample Containers, Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment	Sampling Plan • Description of problem to be studied • Actions and decision that may result • Data use objectives • Decision unit identification • Narrative of sample locations and rationale • Scaled site diagram with proposed sampling locations (include legend and orientation arrow) • How modifications/deviations to the approved plan will be handled Field Screening • Discussion of method for interval/location of field screening sample	Site-wide Information • Worksheet #17 • Worksheet #18 • Worksheet #19 • Worksheet #20 • Worksheet #21 • Worksheet #22 • Appendix E • Appendix H • Appendix I Site-specific Information • Appendix D

EPA-Required QAPP Element(s) and Corresponding QAPP Section(s)	Crosswalk to ADEC Elements of a Complete Work Plan	Crosswalk to Applicable EPA UFP Format Worksheet Number
Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	– Test kits – Specification of test kit use, sensitivity, interferences – Hand-held devices – Headspace methodology Sample Collection Methods *(describe in detail how any of the methods will be used)* • Soil samples – Test pits – Borings – Direct push • Groundwater samples – Method of well installation and development – Purging techniques – Low-flow methods – Well measurements and instrumentation used – Groundwater elevation/ benchmarks or measuring points (methodology) – Groundwater flow direction – Use of bailers, pumps, or passive diffusion systems – Specified parameters of measurement • Soil gas – Leak detection methods • Indoor Air – Summa canisters • Surface water • Sediment Field Quality Control (QC) Measures • Proposed quality control samples • Sample preservation methods • Unique ID number • Use of cooler and “ice” Analytical Methods • Request for Analysis – Types of containers to be used – Type of preservation to be used – Sample volumes to be collected	
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures		Worksheet #23 Worksheet #24 Worksheet #25 Appendix I Appendix K

EPA-Required QAPP Element(s) and Corresponding QAPP Section(s)	Crosswalk to ADEC Elements of a Complete Work Plan	Crosswalk to Applicable EPA UFP Format Worksheet Number
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody		Worksheet #26 Worksheet #27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples		Worksheet #28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	Field Documentation • Log books and recorded field observations – Date – Weather and other salient observations – Sampling team members – Documentation of instrument calibration – Location of activity and site conditions – Field observations and comments – Changes to sampling protocol – Site photographs – Site sketches – Survey and location of sampling points – Global positioning system (GPS) coordinates Analytical Methods • Name of laboratory completing analysis • Request for Analysis – Turnaround times	Worksheet #29 Worksheet #30 Appendix H
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses		Worksheet #31 Worksheet #32
4.2 QA Management Reports		Worksheet #33
4.3 Final Project Report		
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment		Worksheet #34 Worksheet #35 Worksheet #36 Worksheet #37

EPA-Required QAPP Element(s) and Corresponding QAPP Section(s)	Crosswalk to ADEC Elements of a Complete Work Plan	Crosswalk to Applicable EPA UFP Format Worksheet Number
5.2.3.2 Activities		
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		Worksheet #35

Worksheet #3 – Distribution List

REPORT TITLE:	Work Plan for Site Inspection, Remedial Investigation, and Site Characterization at the Former Galena Forward Operating Location, Galena, Alaska			
Recipient	**Organization**	**CD**	**Hardcopies**	**Notes**
Al Weilbacher	HQ AFCEE/EXC	5	5	
Walter Ruiz	AFCEE/ACR	0	Letter transmittal	
Sonia Gallegos	Administrative Record	1	1	
Fred Vreeman	ADEC	4	4	
Sam Myers	ADOT&PF	1	1	
Win Westervelt	CH2M HILL Project Manager	1	1	
CH2M HILL Project Staff	CH2M HILL	10	10	

Worksheet #4 – Project Personnel Sign-off Sheet

Project Personnel	Title and Organization	Telephone Number	Signature	Date Work Plan Read
Win Westervelt	Project Manager, CH2M HILL	(907) 762-1591		
Rick Sturm	Quality Manager, CH2M HILL	(916) 286-0353		
Doug Downey	Senior Reviewer, CH2M HILL	(303) 674-6547		
Marilyn Gauthier	RI Task Manager, CH2M HILL	(425) 233-3225		
Berney Kidd	Chemist, CH2M HILL	(530) 229-3203		
Dennis Shelton	Toxicologist, CH2M HILL	(541) 768-3524		
Harry Ohlendorf	Ecological Risk Assessor, CH2M HILL	(916) 286-0277		
Peter Lawson	Project Hydrogeologist, CH2M HILL	(530) 229-3383		
Ronny Fields	Field Manager, CH2M HILL	(423) 505-5800		
Jeremiah Knuth	Field Manager, CH2M HILL	(907) 762-1388		
Note: Reading the entire Work Plan may not be necessary for all project personnel. However, all key project personnel should read the sections applicable to their roles and functions.				

Worksheet #5 – Project Organizational Chart

Project Organizational Chart is on Figure 5-1.

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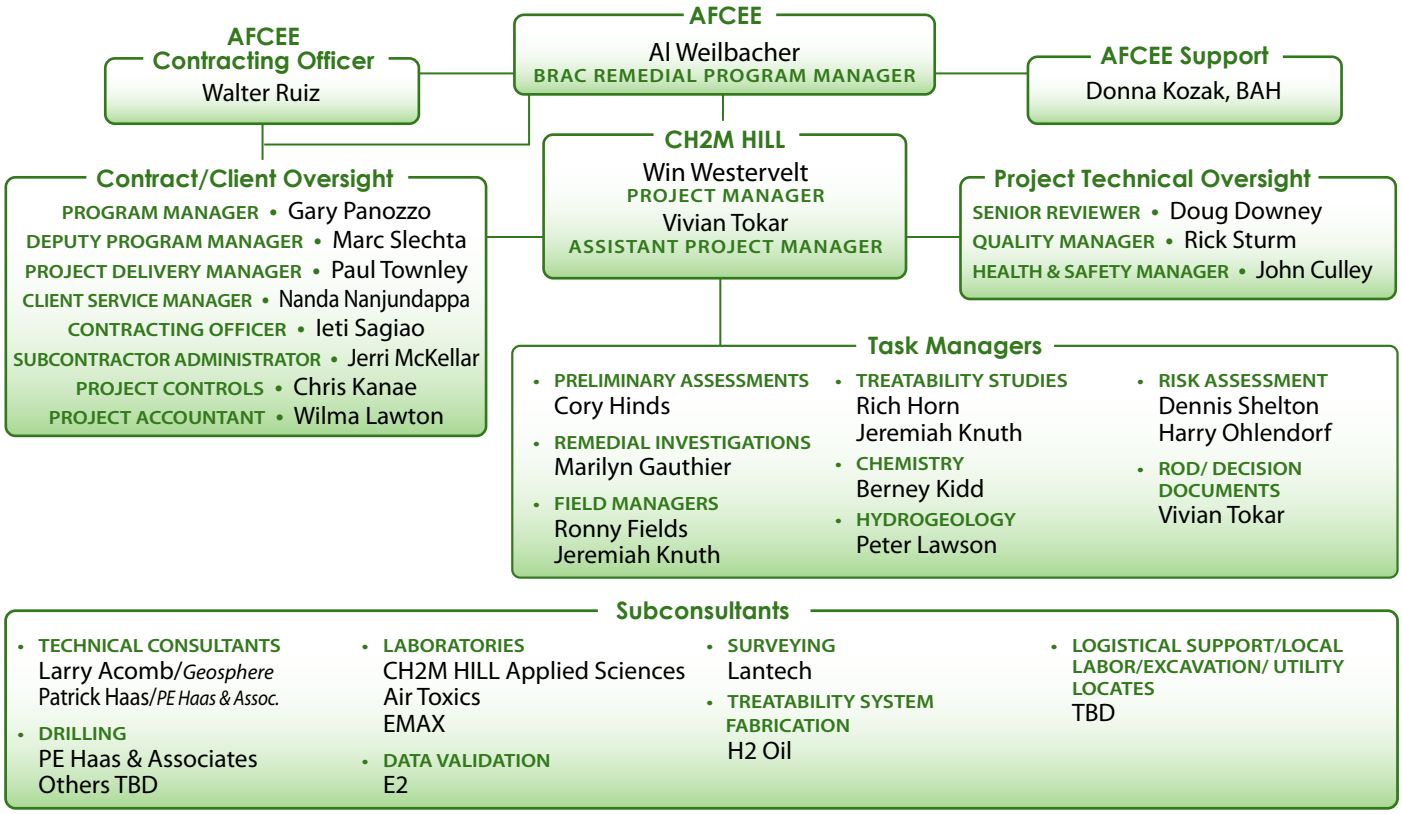

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FIGURE 5-1
Project Organization Chart
Work Plan for Site Inspection,
Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Communication with CH2M HILL Contracts Manager	Contracting Officer (CO)/AFCEE	Walter Ruiz	(210) 536-3288	Provides administrative direction to CH2M HILL Contracts Manager and project team; authorizes real-time changes to Work Plan and can stop work if needed.
Communication with CH2M HILL Project Manager (PM)	Remedial Project Manager (RPM), Contracting Officer's Representative (COR)/AFCEE	Al Weilbacher	(210) 536-4541	Primary point of contact (POC) for AFCEE; provides technical direction to CH2M HILL PM.
Communication with ADEC RPM	RPM/ADEC	Fred Vreeman	(907) 451-2181	Primary POC for ADEC; communicates with AFCEE project team; can delegate communication to other internal or external POCs; reviews and provides regulatory approval of technical deliverables.
Communication with AFCEE CO/COR	Contract Manager/CH2M HILL	Jack Robertson	(714)435-6160	Receives contractual direction from AFCEE CO/COR; notifies AFCEE CO/COR of contractual deviations (changes in scope of work, budget, or schedule) via e-mail or letter.
Communication with AFCEE COR	PM/CH2M HILL	Win Westervelt	(907) 762-1591	Primary POC for CH2M HILL; can delegate communication to other internal or external points of contact; notifies AFCEE COR of project-related problems and issues via e-mail or phone; provides direction to CH2M HILL's project team; authorizes real-time changes to plan and can stop work if needed.
Field and Analytical Corrective Actions	Quality Manager/CH2M HILL	Rick Sturm	(916) 286-0353	Determines the need for corrective action for submittals.
Communication with AFCEE COR	Client Service Manager/CH2M HILL	Nanda Nanjundappa	(210) 377-3085 x270	Secondary POC for CH2M HILL; provides information to CH2M HILL's project team.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Progress of Field Program	Field Managers/ CH2M HILL	Ronny Fields Jeremiah Knuth	(423) 505-5800 (907) 762-1388	Documents and conveys progress of field activities, including deviations from the Work Plan; communicates with CH2M HILL PM, Project Chemist, and others as directed by them; directs CH2M HILL field support staff; provides daily safety briefings and directs onsite safety activities; can stop work in the field. Any corrective actions for field issues will be determined by a Field Manager and reported to the PM within 4 hours.
Health and Safety Issues	Health and Safety Manager/ CH2M HILL	John Culley	(509) 464-7228	Responsible for supporting the CH2M HILL project team and subcontractors by developing health and safety requirements; approves Health and Safety Plan; conducts field audits.
Communication with Laboratory and Release of Analytical Data	Project Chemist/CH2M HILL	Berney Kidd	(530) 229-3203	Ensures that the laboratory meets Work Plan requirements; provides direction on corrective action requirements for analytical issues. No analytical data can be released until data validation is completed and has been approved by the Project Chemist.
Technical Approach and Data Evaluation Review	Senior Reviewer/CH2M HILL	Doug Downey	(303) 674-6547	Communicates with CH2M HILL PM and project team on strategy and technical approach; responds to technical or field questions; reviews data and technical deliverables as necessary; provides verbal or written comments to CH2M HILL PM on technical deliverables.
Risk Assessment Issues	Toxicologist/CH2M HILL Ecological Risk Assessor/CH2M HILL	Dennis Shelton Harry Ohlendorf	(541) 768-3524 (916) 286-0277	Responsible for conducting project-specific risk assessment in accordance with applicable procedures; communicates with CH2M HILL PM and project team on data quality objectives; develops site-specific, risk-based cleanup levels if needed.
Subconsultants	All subconsultants identified in Worksheet #5 (*Project Organizational Chart*)	See Worksheet #5 (*Project Organizational Chart*)	Varies	Communicates with CH2M HILL PM, Field Managers, and Project Chemist about scope of work, cost, and schedule issues.

Worksheet #7 – Personnel Responsibilities and Qualifications

Name	Title	Organizational Affiliation	Responsibilities	Qualifications
Walter Ruiz	CO	AFCEE	Provides administrative direction to CH2M HILL Contract Manager and project team; authorizes real-time changes to Work Plan and can stop work if needed.	Will be provided upon request
Al Weilbacher	RPM, COR	AFCEE	Provides technical direction to CH2M HILL PM.	Will be provided upon request
Fred Vreeman	RPM	ADEC	Reviews and provides regulatory approval of technical deliverables.	Will be provided upon request
Jack Robertson	Contract Manager	CH2M HILL	Receives contractual direction from AFCEE COR/CO; notifies AFCEE CO/COR of contractual deviations (changes in scope of work, budget, or schedule).	Will be provided upon request
Win Westervelt	PM	CH2M HILL	Receives support from AFCEE COR; provides direction to CH2M HILL's project team; tracks project budget and schedule.	23 years of experience; registered Professional Engineer since 1991
Vivian Tokar	Assistant PM	CH2M HILL	Provides support to PM and CH2M HILL project team. Alternate POC for AFCEE COR.	8 years of experience
Rick Sturm	Quality Manager	CH2M HILL	Responsible for overall project quality assurance; determines the need for corrective action for field or analytical issues.	19 years of experience
Doug Downey	Senior Reviewer	CH2M HILL	Provides technical support and reviews technical deliverables.	29 years of experience
Marilyn Gauthier	RI Task Manager	CH2M HILL	Leads the project team for developing strategy and processes for site characterization and data evaluation tasks.	22 years of experience

Name	Title	Organizational Affiliation	Responsibilities	Qualifications
Nanda Nanjundappa	Client Service Manager	CH2M HILL	Provides technical and administrative guidance to CH2M HILL PM.	15 years of experience
Dennis Shelton	Toxicologist	CH2M HILL	Conducts human health risk assessment for the RI. Develops site-specific, risk-based cleanup goals for sites requiring remedial action.	23 years of experience
Harry Ohlendorf	Ecological Risk Assessor	CH2M HILL	Conducts ecological risk assessment for the RI. Develops site-specific, risk-based cleanup goals for sites requiring remedial action.	39 years experience
Berney Kidd	Project Chemist	CH2M HILL	Responsible for ensuring that the laboratory meets Work Plan requirements; provides direction with regard to corrective action requirements for analytical issues; performs data validation; evaluates and releases validated analytical results to the Data Management Lead.	18 years of experience
John Culley	Health and Safety Manager	CH2M HILL	Maintains health and safety records for all site employees. Responsible for maintaining health and safety monitoring equipment, as well as personal protective equipment, and for supervising other health and safety officers. Can stop work in the event of unsafe conditions or worker injury.	20 years of experience
Ronny Fields Jeremiah Knuth	Field Managers	CH2M HILL	Documents and conveys progress of field activities, including deviations from the Work Plan; communicates with CH2M HILL PM and Project Chemist, and others as directed by them; directs CH2M HILL field support staff; provides daily safety briefings and directs onsite safety activities.	18 years of experience 6 years of experience
Peter Lawson	Project Hydrogeologist	CH2M HILL	Provides technical support for field investigation and technical report preparation.	22 years of experience

Note:

Resumes are maintained by each individual's organization and are available upon request; other staff members with similar qualifications may be added, or substituted as necessary.

Worksheet #8 – Special Personnel Training Requirements

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Activities	Hazwoper 40-hour Training; 8-Hour Refresher	Registered Training Organization	Annually	All Field Staff	Field Managers and all field staff	CH2M HILL human resources department
Field Activities	CPR and First Aid	Registered Training Organization	Every 3 Years	All Field Staff	Field Managers and all field staff	CH2M HILL human resources department
Field Activities	Site Safety Coordinator	CH2M HILL	Every 3 Years	Site Safety Coordinator	Field Team Leaders/Site Safety Coordinators	CH2M HILL human resources department

Note:

Project team members with the necessary experience and technical skills are chosen to perform required project-specific tasks. Subcontractors chosen to complete tasks such as drilling, laboratory analysis, and data validation will meet project-specific requirements and specifications set forth by CH2M HILL and EPA.

Worksheet #9 – Project Scoping Session Participants Sheet

To help streamline and focus the investigation process, the EPA Triad approach is being used to design and implement the field investigation at the Former Galena Forward Operating Location (FOL), as applicable. The primary objective of the Triad approach is to manage technical and administrative decision uncertainties by involving the project stakeholders at the work-planning stage, and to develop a flexible site investigation approach to ensure that the optimum amount of relevant data will be collected using the most efficient and cost-effective methods available. Consistent with the Triad philosophy of involving project stakeholders at the beginning of the project, a systematic planning session was held on April 14–15, 2010 (see participants sheet, below). The meeting was attended by the AFCEE project team, representatives from ADEC, and the CH2M HILL project team. The team reviewed the site descriptions, history, available information from previous investigations, and potential exposure scenarios to develop a preliminary conceptual site model (CSM) for the sites. As part of the CSM development, the team identified current data gaps and uncertainties, as well as technical options for collecting the needed data and resolving the project uncertainties.

April 14-15, 2010 Systematic Planning Session Participants Sheet

Name	Title/Role	Affiliation	Phone #	E-mail Address
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Worksheet #10 – Problem Definition

This worksheet and related appendices describe the site-specific environmental problem for each site at the Former Galena FOL in Galena, Alaska. The Former Galena FOL vicinity is shown in Figure 10-1 (figures are located at the end of this worksheet), and the locations of sites addressed in the Work Plan are shown in Figure 10-2A (6 ERP sites) and Figure 10-2B (26 sites).

Based on the review of available site information, three types of field investigations—Site Inspection (SI), Site Characterization (SC), or RI—are recommended for the Former Galena FOL sites. The objectives of these investigations are as follows:

- **SI:** The SI is a limited field investigation with the objective of *confirming the presence or absence of contamination*. Sites that have positively confirmed contamination (that is, chemical concentrations above SI screening levels) will be recommended for further investigation under the SC or RI pathways. Sites with no detected contamination will be recommended for closure.
- **SC:** The SC is a comprehensive field investigation with the overall objectives of *delineating the extent of POL contamination* in soil relative to extent screening levels, assessing potential impacts to groundwater, and *evaluating the potential threat* to human health and the environment from site contamination.
- **RI:** The RI is also a comprehensive field investigation, but it will be used for *sites with contamination from non-POL sources*, such as chlorinated solvents, which are regulated under CERCLA. The overall objectives of the RI are to *delineate the nature and extent of site contamination* in soil relative to extent screening levels, to assess potential impacts to groundwater, and to *evaluate the potential threats* to human health and the environment from site contamination.

Table 10-1 (tables are located at the end of this worksheet) and Figures 10-3A (6 ERP sites) and Figure 10-3B (26 remaining sites) indicate the recommended investigation pathway for each FOL site. The screening process for identifying the investigation pathways is described further in Section 14.5 of Worksheet #14 *[Summary of Project Tasks]*.

10.1 Conceptual Site Models

The CSMs integrate existing information and working assumptions about the physical site conditions; the nature, occurrence, and distribution of chemicals; fate and transport processes; and the possibility of subsequent human and ecological exposure to the chemicals at, or potentially released from, the sites. The CSMs are based on the current understanding of site history and conditions, and they will be updated as necessary based on ongoing input from field investigations.

Many of the FOL sites share the same CSM—in that the source and release type, released chemicals, and media that could become contaminated are similar—and such sites have common problem statements and data needs. Program-level CSMs depicting the types of releases and affected media that are anticipated for the FOL sites are shown pictorially in Figures 10-4 through 10-10, and are described below.

The majority of contaminant releases at the Former Galena FOL were petroleum hydrocarbons. To a lesser extent, some releases of chlorinated hydrocarbon also occurred. As a pure product, petroleum hydrocarbons are less dense than water and are referred to as light non-aqueous phase liquid (LNAPL). Chlorinated hydrocarbons are generally more dense than water and are referred to as dense non-aqueous phase liquid (DNAPL). In sufficient quantities, LNAPL product will accumulate at the groundwater table surface whereas DNAPL product will migrate deeper into the aquifer. When the petroleum and chlorinated products dissolve in groundwater, the specific gravity of the aqueous plumes are nearly the same as uncontaminated groundwater and the plumes will move with the groundwater flow.

When a hydrocarbon release occurs on the surface of unfrozen soils, the fugitive hydrocarbon tends to spread laterally across the ground surface and then to infiltrate into the soils (Figure 10-4). The extent of lateral spreading across the ground surface is a function of quantity and rate of hydrocarbon release and the permeability of the surface.

Similarly, when a hydrocarbon release occurs from a belowgrade tank or pipeline, the product initially will tend to spread in response to a pressure gradient around the leak location and then infiltrate (Figure 10-5). The infiltrating product from the surface spill and subsurface release tends to flow primarily vertically under the influence of gravity through larger air-filled soil pores, although capillary forces may cause some lateral spreading. If a relatively small volume of product is spilled, the product likely will be immobilized in the soil above the water table (as shown in Figures 10-4 and 10-5). If a sufficient quantity of product is spilled, the infiltrating product reaches the saturated capillary fringe and displaces some water from the saturated soil pores. Petroleum hydrocarbons tend to migrate laterally as a mound of LNAPL free product develops near the water table (Figure 10-6). As the water table rises and falls, the mobile free product in the vicinity of the water table encounters uncontaminated soil and tends to be smeared or trapped as immobile residual product (Figure 10-7). Chlorinated hydrocarbons would initially spread out over the capillary fringe until the greater-than-water product density and head pressure from the accumulated DNAPL product built up to push the chlorinated hydrocarbons into the water-filled pore spaces and deeper into the aquifer.

Because some years have higher and/or lower water tables than other years, and because many contaminated sites are several years to a few decades old, it is likely that product will be trapped or smeared both above and below the zone of water table fluctuation observed in only a few years of study (Figure 10-8). At some sites, the releases from several tanks or piping leaks may coalesce into a complex contiguous source area (Figure 10-9). Gravity drainage and flow of the hydrocarbon NAPL to a point of immobility probably occurs relatively quickly (in a period of weeks or months) at sites caused by a discrete spill event, but may occur over a period of years at sites with long-term product leaks. However, after

the long-term leak has been stopped, any mobile hydrocarbon NAPL likely will be immobilized in a period of weeks or months.

At all NAPL spill sites, a portion of the NAPL mass in the subsurface volatilizes into the air-filled soil pores, dissolves into the soil moisture and groundwater, and is adsorbed by the soil solids (primarily the organic carbon) following the phase partitioning relationships. Hence, the NAPL at hydrocarbon spill sites tends to act as a long-term source of dissolved- and vapor-phase hydrocarbons. The dissolved- and vapor-phase contaminants will tend to migrate away from the NAPL-contaminated soil source area, but the contaminant center-of-mass will not move appreciably when NAPL is present. Infiltrating precipitation that encounters vadose-zone hydrocarbon will tend to carry dissolved hydrocarbon toward the water table. There the precipitation containing the dissolved hydrocarbon mixes with the groundwater and is advected downgradient (Figure 10-10). Similarly, NAPL in the saturated zone will tend to partition directly into the groundwater and be advected downgradient. Vapor-phase hydrocarbon tends to diffuse toward the ground surface and into the atmosphere and/or into nearby buildings. At some point downgradient of the spill location, the groundwater will discharge to and mix with surface waters. Biodegradation of hydrocarbons likely will occur throughout the contaminated zone (in the vadose zone and in the saturated zone) and limit the extent of migration (Geosphere and CH2M HILL, 2006).

Site-specific CSM information for each FOL site is presented in Appendix D *[Site-specific Attachments]*. The Appendix D attachments are organized as follows:

- Site location, characteristics, description, and history
- Summary of previous investigations and remedial actions, including the October 2009 site visit
- Findings of previous investigations and chemicals of interest
- Secondary data use information
- Conceptual site model for exposure
- Data quality objectives
- Investigation activities

Sites may be added to this Work Plan in the future through the preparation of additional site-specific attachments for Appendix D.

10.2 Data Quality Objectives

This worksheet also presents the program-level DQOs for completing SI, SC, and RI activities at the FOL sites. DQOs are pre-established goals that help monitor and assess project progress. They provide benchmarks against which the quality of fieldwork and the quality of the resultant analytical data are evaluated. They specify the type, quality, quantity, and uses of the data needed to adequately support future SI, SC, and RI decisions. The program-level DQOs are common to all sites requiring further investigation and may be filled using

existing data or data to be gathered during future sampling activities. The program-level DQOs were developed using the recommended EPA seven-step process (EPA, 2006) and are presented in Table 10-2.

Worksheet #17 *[Sampling Design and Rationale]* presents the decisions and general sampling designs that were developed from these DQOs for each general site-type (approach group), as well as approaches for conducting program-level activities at the different types of sites. These sampling designs and approaches are used to develop the field sampling plans specific to each site, which are presented in Appendix D.

10.3 Triad Guidance

It is intended that a Triad process will be used during the planning and implementation of the fieldwork to involve stakeholders in the decision-making process, disseminate new information promptly, and adjust the investigation approaches based on new information.

Triad is a combination of three elements that are designed to streamline and reduce the cost and schedule for site investigations. These elements are as follows:

- **Systematic Planning** is a planning process that lays a scientifically defensible foundation for proposed project activities. Systematic planning usually includes identification of key decisions to be made, the development of a CSM to support decision making, and an evaluation of decision uncertainty along with approaches for managing that uncertainty in the context of the CSM.
- **Dynamic Work Strategies** are work strategies for contaminated SC that incorporate the flexibility to change or adapt to information generated by real-time measurement technologies. As information is gathered, it is used to make decisions about what subsequent activities will best resolve remaining data and decision uncertainties.
- **Real-time Measurement Technologies** are all data-generation mechanisms that support real-time decision making (that is, dynamic work strategies), including rapid-turnaround sample analysis from a field or offsite laboratory, or field-based measurement technologies. Real-time measurement technologies return results quickly enough to influence the progress of data collection and field activities.

The overall Triad concept is the development and implementation of work plans that allow modifications or adjustments to the site investigation as the work progresses. This approach should reduce the time required and cost compared with a phased approach to investigation.

The decision logic that is used for this Work Plan to determine the investigation process and endpoints for different sites is presented in Worksheet #14, Figure 14-1 *[Flowchart for Site Screening Process]*. The investigation work strategies and management of uncertainty are guided by the DQOs presented in Worksheets #10 and #17. Real-time measurement technologies for this project will include a field laboratory capable of providing rapid-turnaround analyses to guide decisions for additional step-out sampling and delineating the extents of site contamination.

The data collection and review process to support Triad meetings is illustrated in Figure 10-11. Media samples will be submitted for laboratory analysis at both onsite and offsite laboratories. The onsite laboratory will focus on soil sample analysis and provide definitive data for petroleum hydrocarbons (gasoline, diesel, and residual-range organics by Alaska Methods AK 101, AK 102, and AK 103, and benzene, toluene, ethylbenzene, and xylenes by EPA Method SW8021B) and screening data for trichloroethene (TCE) and tetrachloroethene (PCE) by EPA Method SW8021B modified. The detection limits for onsite TCE and PCE screening analyses will be similar to what would be reported by definitive methods. Other soil analytes and all groundwater samples will be analyzed offsite by a fixed base laboratory with a combination of both standard and rapid turnaround times, as necessary to facilitate the Triad decision process. All laboratory data will be validated and uploaded to the electronic data warehouse along with surveyed coordinates for sample locations. Geographic information system (GIS) maps showing both historical and new data and data summary tables will be generated. The figures and tables will be reviewed for accuracy and completeness by the project and field managers, the GIS team will address comments, then post the figures and tables on a secure project Sharepoint site. The Triad stakeholder team will be notified that new data are available so they can download and review this prior to a bi-weekly Triad meeting. For samples analyzed onsite with a 48-hour turnaround time, data will typically be available to the Triad team within 2 weeks of sample collection. Samples analyzed at the offsite laboratories will require time for shipping and may have longer turnaround times for analysis, which will add additional time to the schedule for reporting results to the Triad team.

The bi-weekly Triad meeting will be a teleconference between the Triad team (Air Force, ADEC, ADOT&PF, and CH2M HILL) and use Microsoft Outlook LiveMeeting to share the latest data figures and tables. A specific meeting agenda will be distributed to the Triad team prior to the meeting (3 days prior, when possible) and will generally include the following items:

- Status update for field work activities
- Review of actions items and conclusions from previous Triad meeting. Approval of prior meeting minutes
- Discussion of new data for sites and evaluation of progress towards meeting Work Plan objectives
- Identifying additional work needed and/or concurrence that Work Plan objectives have been met
- Open discussion for other items
- Schedule update for upcoming activities

During the meeting, figures will be updated to show locations that the Triad team agrees require further investigation. A memorandum summarizing discussion topics and key decisions will be prepared within 7 days after each meeting for approval by the team members, then posted on the project SharePoint site as a record of these decisions.

TABLE 10-1
Field Investigation Sites

Parent ERP Site (if applicable)	Site ID	Site Name	Anticipated Investigation Pathway
ERP Sites			
FT001	FT001	Fire Protection Training Area	RI
ST009	UST1572	1572 Liquid Fuel Pump Station, 3,000-gallon UST	SC
ST009	UST1572-2	UST 1572-2, 2,000-gallon UST	SC
ST009	ST009	JP-4 Fill-stands	SC
ST010	ST010	Southeast Runway Fuel Spill	SC
OT099	OT099	Building Demolition/Drum Removal	SC
SS005	SS005	Wilderness Hall, Building 1872	SC
Other Sites			
	TAR	Possible Tar Pit Construction Area	SI

Notes:

ERP = Environmental Restoration Program
ID = identification
JP = jet propulsion fuel
RI = Remedial Investigation
SC = Site Characterization
SI = Site Inspection
UST = underground storage tank

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
Site Inspection (SI) Stage **DQO 1 – Investigate Possible Releases and Determine Need for Further Sampling**						
For some sites, there is an indication that environmental contamination may exist (for example, historical records, site use, visual evidence), but data are insufficient to confirm the presence or absence of contamination.	Decide whether a release has occurred or environmental contamination is present.	1. Existing historical records on site use, releases 2. Site reconnaissance records 3. Site improvements or development history since releases 4. Existing analytical data (verify that sample collection and analytical quality conforms to current practices) 5. Sample locations and depths for site media 6. Field observations and measurements from current and historical sampling activities 7. SI screening levels as described in Worksheet #15 8. Utility location or remote sensing information, if applicable 9. Depth to groundwater, groundwater elevation measurements, and NAPL thickness measurements 10. Site geologic and hydrogeologic information	**Temporal Boundaries:** Use samples collected after release is suspected to have occurred, taking into account any significant changes to the area (for example, soil removal, grading, construction). **Spatial Boundaries:** Site-specific. Use samples from immediate vicinity of likely source or release location; depth appropriate for anticipated source or release mechanism (for example, surface soil for aboveground tanks; subsurface soil beneath tank footprint for belowgrade tanks). **Chemical Boundaries:** Use target analyte list appropriate for suspected source and release history. Use detection limits appropriate for SI screening levels.	**1A. Sample Adequacy** – If samples have been collected in vicinity of likely sources or release locations, and target analyte/detection limits for samples collected in vicinity of likely sources are appropriate, then proceed to screening of available data (Decision 1B) (Result 1A1). Otherwise, perform limited SI sampling to obtain needed data to determine presence or absence of contamination (Result 1A2).	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 1A1 – Proceed to Decision 1B. Result 1A2 – Conduct limited SI sampling to determine presence or absence of contamination. Use remote sensing if needed to identify subsurface features associated with potential sources. Collect soil and potentially co-located groundwater samples in immediate vicinity of suspected source or release locations. • Maximum depth for soil and groundwater sampling is the historical low-level groundwater elevation (bottom of variably saturated zone, or "smear zone") • Target analyte list based on site use and history Then proceed to Decision 1B.
				1B. Screening of Available Data – If concentrations of all target analytes in all samples are below SI screening levels and detection limits are appropriate, then conduct cumulative risk evaluation: – If cumulative risks for carcinogens is less than 1 X 10^{-5} and the HI for non-carcinogens is less than 1, no further evaluation needed (Result 1B1). – If cumulative risks are greater than 1 X 10^{-5} and/or 1, further evaluation and/or additional sampling are required to complete SC or RI (Result 1B2). Proceed to SC/RI stage. If concentrations of target analytes in all samples are above SI screening levels, then further evaluation and/or additional sampling are required to complete SC or RI (Result 1B2). Proceed to SC/RI stage.	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 1B1 – No further evaluation. Result 1B2 – Proceed to SC/RI stage (SC for POL sites and RI for non-POL chemical sites).

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
Site Characterization/Remedial Investigation Stage[a] **DQO 2 – Nature and Extent of Contamination in Soil**						
For some sites, there is sufficient indication that a release or environmental contamination exists (for example, historical records, site use, visual evidence). However, the nature and extent of contamination is not adequately defined to characterize potential risks and/or to support a remedial decision.	Decide whether further sampling is needed to define nature and extent of contamination, so that site risks can be characterized to support a remedial decision.	1. Existing historical records on site use, releases 2. Site reconnaissance records 3. Site improvements or development history since releases or sampling 4. Historical and new analytical data (verify that sample collection and analytical quality conforms to current practices) 5. Sample locations and depths 6. Field observations and measurements from current and historical sampling activities 7. Extent screening levels as described in Worksheet #15 8. Utility location or remote sensing information, if applicable 9. Depth to groundwater measurements (to define the variably saturated zone) 10. Site geologic information	**Temporal Boundaries:** Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Use newer data if newer and older data are inconsistent. **Spatial Boundaries**: Site-specific. Use samples from immediate vicinity of likely source or release location; sample depths appropriate for anticipated source or release mechanism; samples collected at lateral and vertical limits of contamination. **Chemical Boundaries:** Use target analyte list appropriate for suspected source and release history. Use detection limits appropriate to extent screening levels.	**2A. Definition of Lateral Extent in Soil** – If there is a ring of soil samples surrounding the potential source or release location and concentrations of all target analytes in the soil samples are below the extent screening levels and detection limits are appropriate, then the lateral extent of contamination has been determined (Result 2A1). Otherwise, additional samples (or evaluation of nearby soil samples from adjacent AOC) are required to define lateral extent (Result 2A2).	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 2A1 – Complete evaluation with available information and prepare decision documents. Result 2A2 – Perform SC/RI sampling at appropriate locations and depths to determine lateral extent of soil contamination.
				2B. Definition of Vertical Extent in Soil – If there are soil samples collected at depth beneath the release location, and concentrations of all target analytes in the samples are below the extent screening levels and detection limits are appropriate, then the vertical extent of contamination has been determined (Result 2B1). Otherwise, additional soil samples are required to define vertical extent (Result 2B2).	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 2B1 – Complete evaluation with available information and prepare decision documents. Result 2B2 – Perform SC/RI sampling at appropriate locations and depths to determine vertical extent of soil contamination (maximum depth for soil sampling is the historical low-level groundwater elevation (bottom of variably saturated zone, or "smear zone").
Site Characterization/Remedial Investigation Stage **DQO 3 – Free Product/Smear Zone Characterization**						
For some sites, there is sufficient indication that a release of NAPL occurred and the soil column at the water table has been affected by accumu-lation and/or migration of the NAPL layer. However, the nature and extent of the NAPL is not adequately defined to characterize future impacts from the	Decide whether further investigation is needed to define the nature and extent of NAPL at sites, so that potential future impacts to other media (that is, soil vapor and groundwater) can be characterized to support a remedial decision.	1. Existing historical records on site use, releases. 2. Previous groundwater elevation and NAPL thickness measurements to establish past trends in contaminant concentrations and estimate past directions and rates of contaminant migration 3. Previous temporal groundwater quality data (for BTEX, DRO, and GRO for LNAPL or chlorinated VOCs for DNAPL) to determine whether NAPL is	**Temporal Boundaries**: Consider seasonality on groundwater table fluctuations. Use more recently collected data preferentially over older data. **Spatial Boundaries:** Site-specific. Use data from multiple depth intervals and locations to delineate NAPL in three dimensions. Evaluate the spatial relationships among the apparent NAPL extent, the locations of available data points, and the location of the suspected source area(s).	**3A. Determine Need to Investigate NAPL Nature and Extent** – If historical data are sufficient to determine the nature and extent of NAPL and whether the NAPL is stable, then there is no need for additional sampling (Result 3A1). Otherwise, additional sampling is required to define NAPL nature and extent (Result 3A2).	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 3A1 – Complete evaluation with available information and prepare decision documents. Result 3A2 – Perform SC/RI sampling for NAPL and/or evaluate existing NAPL data. Such additional data collection may consist of collecting soil and/or NAPL samples in NAPL source areas, measurement of groundwater levels and NAPL thicknesses at existing monitoring wells, or installation of new monitoring wells and sampling points if existing monitoring networks are inadequate.

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
NAPL to other media and/or to support a remedial decision.		stable or changing in size or concentration 4. Site geologic and hydrogeologic information	**Chemical Boundaries:** Consider effects of free product (LNAPL or DNAPL), contaminant specific gravity, and adsorption potential on NAPL delineation.			
Site Characterization/Remedial Investigation Stage **DQO 4 – Characterize Possible Site-Related Groundwater Contamination (Sites in Vicinity of Larger FOL plumes)**						
For some sites, there is sufficient indication that a release occurred. However data are insufficient to characterize site-related groundwater contamination and evaluate possible contributions from the site to FOL groundwater contamination.	Decide whether further sampling is needed to characterize site-related groundwater contamination, so that potential contributions from the site to existing plumes can be evaluated.	1. Historical and new analytical data (verify that sample collection and analytical quality conforms to current practices) 2. Sample locations and well screen depths 3. Groundwater screening levels as described in Worksheet #15 4. Identification of overlapping sources or commingled plumes 5. Groundwater use information 6. Groundwater gradient and flow direction 7. Potential points of compliance 8. Transport properties of contaminants of interest 9. Geochemistry of the aquifer systems	**Temporal Boundaries:** Consider seasonality on groundwater table fluctuations and surface water – groundwater interactions (potential flow reversals). Use more recently collected data preferentially over older data. **Spatial Boundaries:** Site-specific. Use data from upgradient location and beneath likely contaminant source area. **Chemical Boundaries:** Use target analyte list appropriate for suspected source and release history. Use detection limits appropriate to groundwater screening levels.	**4A. Determination of Possible Groundwater Impacts** – If concentrations of target analytes in upgradient and beneath-site groundwater samples are similar, or decline between the upgradient and site source locations, or are below groundwater screening levels, then the site is not a contributor to FOL groundwater contamination (Result 4A1). Otherwise releases at the site might be contributing to groundwater contamination at the FOL and additional evaluation is required as part of the FOL-wide groundwater program (Result 4A2).	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 4A1 – Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Result 4A2 – Incorporate groundwater results into overall understanding of groundwater contamination at FOL and account for site as source of groundwater contamination in CSM and remedial decisions for the larger groundwater plume.
Site Characterization/Remedial Investigation Stage **DQO 5 – Delineate Nature and Extent of Groundwater Contamination (Isolated Plumes)**						
For some sites, there is sufficient indication of a release that has affected groundwater and is not commingled with other FOL plumes. However, data are insufficient to delineate the nature and extent of site-related groundwater contamination.	Decide whether further sampling is needed to delineate plumes in three dimensions for a specific site, so that site risks can be characterized to support a remedial decision.	1. Historical and new analytical data (verify that sample collection and analytical quality conforms to current practices) 2. Sample locations and depths 3. Monitoring well construction information 4. Groundwater Screening Levels as described in Worksheet #15 5. Groundwater use information 6. Groundwater gradient and flow direction 7. Potential points of compliance 8. Transport properties of contaminants of interest	**Temporal Boundaries:** Consider seasonality on groundwater table fluctuations and surface water – groundwater interactions (potential flow reversals). Use more recently collected data preferentially over older data. **Spatial Boundaries:** Site-specific. Use data from multiple depth intervals and locations to delineate plumes in three dimensions. Evaluate the spatial relationships among the apparent contaminant plume extent, the locations of available data points, and the location of the suspected source area(s). **Chemical Boundaries:** Use target analyte list appropriate for	**5A. Definition of Lateral Extent in Groundwater** – If there is a ring of groundwater samples of appropriate spatial density around and downgradient of the apparent site-specific source, and concentrations of all target analytes in the samples are below groundwater screening levels and detection limits are appropriate, then the lateral extent of contamination has been determined (Result 5A1). Otherwise, additional samples (or evaluation of nearby non-site-related groundwater samples) are required to define lateral extent (Result 5A2).	Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 5A1 – Complete evaluation with available information and prepare decision documents. Result 5A2 – Perform SC/RI sampling at appropriate locations to determine lateral extent of groundwater contamination.

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
		9. Geochemistry of the aquifer systems	suspected source and release history. Use detection limits appropriate to groundwater screening levels.			
				5B. Definition of Vertical Extent in Groundwater – If there are groundwater samples collected at depth beneath and downgradient of the apparent site-specific source that extend beneath the apparent plume extent, and concentrations of all target analytes in the samples are below groundwater screening levels and detection limits are appropriate, then the vertical extent of contamination has been determined (Result 5B1). Otherwise, additional samples are required to define vertical extent (Result 5B2).	Analytical data will meet quality expectations for PARCC as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 5B1 – Complete evaluation with available information and prepare decision documents. Result 5B2 – Perform SC/RI sampling at appropriate locations and depths to determine vertical extent of groundwater contamination.
Site Characterization/Remedial Investigation Stage **DQO 6 – Hydrogeological Characterization (FOL-wide)**						
Based on current understanding of groundwater contamination, there is a potential for future migration to downgradient receptors at levels that could pose risk. However, for some sites, adequate data are not available to formulate a hydrogeologic CSM for evaluating transport and fate of groundwater plumes. This information is needed to characterize potential future risks and/or to support a decision on remedial approach and appropriate institutional controls.	Decide whether further sampling, hydraulic testing, or modeling is needed to define the CSM to the degree necessary to understand and predict plume dynamics.	1. Horizontal and vertical extent of the plumes at the site 2. The three-dimensional distribution of subsurface lithology, including bedrock units; this may be depicted using geological cross-sections and fence diagrams 3. Identification and quantification of the major recharge and discharge components of the groundwater system, both spatially and temporally 4. Definition and quantification of the major components of the water budget within the plume/aquifer system 5. Extent of surface water/ groundwater interactions and how they vary spatially and temporally 6. Horizontal and vertical hydraulic conductivity estimates for all of the major water bearing units at the site	**Temporal Boundaries:** Consider seasonality on groundwater table fluctuations and surface water – groundwater interactions (potential flow reversals). Consider temporal variability in the major components of the water budget within the plume area. **Spatial Boundaries:** FOL-wide. Use data from multiple depth intervals and locations throughout the FOL to delineate the primary characteristics of the hydrogeologic CSM in three dimensions. **Chemical Boundaries:** Use target analyte list appropriate for suspected sources and release histories. Use detection limits appropriate to screening levels.	**6A. Definition of Conceptual Site Model** – If sufficient site data have been collected (to depict the three-dimensional distribution of aquifer and aquitard units, define the primary components of the site water budget both spatially and temporally, quantify the transport properties (K,T,S) of the primary aquifer and aquitard units, define the geochemical conditions of the plume /aquifer system, quantify the mass flux from the source area(s) to the plume and within the plume itself, and define the spatial and temporal magnitude of surface water – groundwater interaction, then the CSM is adequately defined for the purposes of forecasting future plume migration and remedial action effectiveness (Result 6A1). Otherwise, additional site data collection is required (Result 6A2).	Define the CSM to the accuracy necessary to forecast future risks from site plumes to potential receptors, select and screen potential remedial actions, and support remedial design and implementation.	Result 6A1 – Complete evaluation with available information and prepare reporting documents. Use information to perform remedial alternatives screening, evaluation, and remedy selection. Result 6A2 – Perform sampling, hydraulic testing, and/or modeling as needed to define the CSM to the degree necessary to understand and predict plume dynamics.

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
		7. Groundwater elevation data for wells screened at various aquifer depths 8. Climate data such as precipitation, Evapotranspiration rates, and water demand for vegetation in the area 9. Geotechnical properties of the aquifer materials at the site (aquifers and aquitards) such as bulk density, porosity, fraction organic carbon.				
Risk Assessment Stage **DQO 7 – Human Health Risk Assessment**						
For some portions of the FOL, contaminants may be present in soil, soil vapor, and/or groundwater at levels that pose unacceptable risks to current or future users.	Decide whether current or future site users may be exposed to contaminants in site media at concentrations that pose potential unacceptable risks.	1. Conceptual site model 2. Results of the Method 2, 3, or 4 risk assessment 3. Background data for soil and groundwater 4. Parcel/site boundaries 5. Land use information 6. Historical and new analytical data 7. Sample locations and depths	**Temporal Boundaries** – Use samples collected after release is suspected to have occurred, and before any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Use newer data if newer and older data are inconsistent. **Spatial Boundaries:** Use samples within top 15 feet collected at site. **Chemical Boundaries:** Use target analyte list appropriate for suspected source and release history. Use detection limits appropriate to screening levels. For vapor intrusion pathway, focus on volatile contaminants.	**7A. Decide User Risks** – If current or hypothetical future residents, occupational workers, or construction/excavation workers may be exposed to constituent concentrations that pose potentially unacceptable risks, then identify risk assessment refinements (Result 7A1). Otherwise, evaluate remedial options as part of an FS (Result 7A2).	Sampling design will provide sufficient representative data for the baseline risk assessment. Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 7A1 – Risk assessments will incorporate data from all relevant environmental media collected during investigation of nature and extent of contamination at each site. Result 7A2 – Additional data may be collected as part of an FS.
Risk Assessment Stage **DQO 8 – Ecological Risk Assessment**						
For some portions of the FOL, contaminants may be present in soil and/or groundwater at concentrations that may pose unacceptable risks to ecological receptors.	Decide whether plants or animals may be exposed to contaminants in site media at concentrations that pose potential unacceptable risks.	1. Conceptual site model 2. Results of the ecological risk assessment, based on both high- and low-end toxicity values 3. Background data for soil and groundwater 4. Parcel/site boundaries	**Temporal Boundaries** – Use samples collected after release is suspected to have occurred, and before any significant changes to the area (that is, representing current conditions). Use newer data if newer and older data are inconsistent. **Spatial Boundaries:** Use samples collected throughout parcel/site, focusing on top 2 feet of soil and on	**8A. Decide Receptor Risks** – If current or potential future ecological receptors (based on habitat and land use determinations) may be exposed to contaminant concentrations that pose potentially unacceptable risks, then identify risk assessment refinements (Result 8A1). Otherwise, evaluate remedial	Sampling design will provide sufficient representative data for the baseline risk assessment. Analytical data will meet quality expectations for PARCCS as defined by this SI/RI/SC Work Plan, and in accordance with the DoD QSM.	Result 8A1 – Risk assessments will incorporate data from all relevant environmental media collected during investigation of nature and extent of contamination at each site. Result 8A2 – Additional data may be collected as part of an FS.

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
		5. Habitat information, including ecoscoping results 6. Historical and new analytical data 7. Sample locations and depths 8. Ecological significance evaluation	groundwater that may discharge to nearby surface water. **Chemical Boundaries**: Use target analyte list appropriate for suspected source and release history. Use detection limits appropriate to screening levels.	options as part of an FS (Result 8A2).		
DQO A – Identify Target Analytes for Samples Collected During Future Sampling Events						
For some sites, there is an indication that environmental contamination may exist (for example, historical records, site use, visual evidence), but chemicals associated with site use or other conditions have not been established.	Decide which chemicals should be included in the target analyte list for future sampling events	1. Existing historical records on site use, releases 2. Regulatory guidance (for example, ADEC petroleum guidance) 3. Site reconnaissance records 4. Existing analytical data for site 5. SI and Extent Screening Levels 6. Professional judgment and consultation with regulatory agencies during Triad meetings and conference calls 7. Existing analytical data for nearby sites 8. Background concentrations (when available)	**Temporal Boundaries:** Consider historical and current uses of site. Take degradation products of chemicals used at site into account. Use samples collected after release is suspected to have occurred. **Spatial Boundaries:** Use data from samples collected in immediate vicinity of likely source or release location and at depths appropriate for anticipated source or release mechanism. **Chemical Boundaries:** see Decision Rules	**1 – Identify Generic Analyte List Based on Site Use** • If site was used exclusively for transformer storage or use, then target analyte list includes only PCBs (**Transformer Site List**). • If site was exclusively used to store, manage, or convey POL, then generic analyte list includes analytes listed for the POL type on Table 2A of ADEC petroleum guidance (**POL Site List**). • If site was used for POL management, as well as other chemical use, storage or disposal and fire training or incineration, then generic analyte list includes the appropriate POL Site List, plus additional VOCs, SVOCs, and metals not included on the appropriate POL Site List, as well as PCBs, pesticides, and dioxins/furans (**POL and Multi-chemical Site List, Plus D/Fs**). • If site was used for POL management, as well as other chemical use, storage or disposal and <u>not fire training or incineration</u>, then generic analyte list includes the appropriate POL Site List, plus additional VOCs, SVOCs, and metals not	Not applicable	Not applicable – decisions based on review of existing information

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design
				included on the appropriate POL Site List, as well as PCBs and pesticides (**POL and Multi-chemical Site List**). • If site was used for management or disposal of multiple chemicals other than POL, then generic analyte list includes VOCs, SVOCS, metals, PCBs, and pesticides (**Multi-Chemical Site List**). • If site was used for fire training or incineration, then generic analyte list includes the Multi-Chemical Site List, plus dioxins/furans. (**Multi-Chemical Site List, Plus D/Fs)**. **2 –Refine Generic Analyte List for Site** Review available analytical for site: Identify detected chemicals and compare results to screening levels: Use results to add to (SL exceedances) or eliminate (no SL exceedances) analytes on generic analyte list. Refine list based on site knowledge. **3. – Consider Analytes Associated with Other Sites** Review available analytical data and potential sources of contamination for nearby sites (w/in 500 ft). Identify detected chemicals and compare results to screening levels: Use results to identify additional analytes, taking location of the site and type(s) of contamination into account. **4. – Finalize Site Specific Target Analyte List** Discuss refined target analyte list with Triad Team and adjust as necessary.		

TABLE 10-2
Program-level Data Quality Objectives for SI, SC, and RI Sites

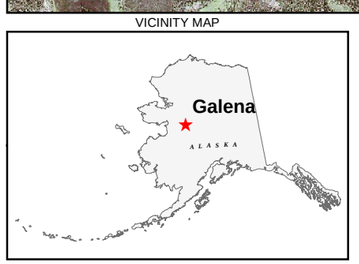
Problem Statement	Decision to Be Made	Input to the Decision	Study Area Boundaries [temporal, spatial, or chemical boundaries]	Decision Rule	Acceptable Limits on Decision Error	Optimize the Design

[a]The same decisions apply whether the ADEC SC or the CERCLA RI path is taken.

Notes:

ADEC = Alaska Department of Conservation
AOC = Area of Concern
BTEX = benzene, toluene, ethylbenzene, and xylenes
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM = conceptual site model
DNAPL = dense nonaqueous-phase liquid
DoD = U.S. Department of Defense
DQO = data quality objective
DRO = diesel-range organics
FOL = Forward Operating Location
FS = Feasibility Study
GRO = gasoline-range organics
LNAPL = light, nonaqueous-phase liquid
NAPL = nonaqueous-phase liquid
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation
SC = Site Characterization
SI = Site Inspection
VOC = volatile organic compound

VICINITY MAP



LEGEND

Approximate Boundary of FOL

Note:
1. Orthorectified Ikonos Imagery.
July 5, 2005. Pixel size 1 meter.

N

0 875 1,750
Feet

FIGURE 10-1
Galena Vicinity
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

CH2MHILL

\\BALDUR\PROJ\GALENATO184_394439\MAPFILES\QAPP\FIGURE_10-1_VICINITY_QAPP.MXD TMCBROOM 4/6/2010 09:16:24

SS005

ST009

FT001

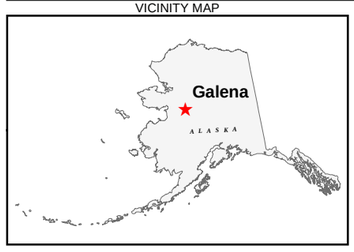
TAR

ST010

OT099

YUKON RIVER

VICINITY MAP



LEGEND

- Investigation Area
- Building or Shed
- Building
- Airfield Surface, Road, or Driveway Area
- Surface Water

N

0 375 750
Feet

FIGURE 10-2A
Investigation Areas
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

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SS005

ST009

FT001

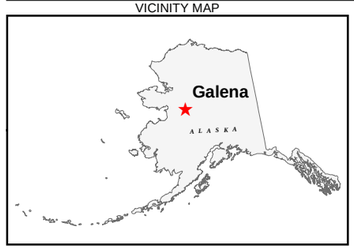
TAR

ST010

OT099

YUKON RIVER

VICINITY MAP



LEGEND

Anticipated Path for Further Action

- SI: Site Inspection
- SC: ADEC Site Characterization
- RI: CERCLA Remedial Investigation

- Building or Shed
- Building
- Airfield Surface, Road, or Driveway Area
- Surface Water

N

0 375 750
Feet

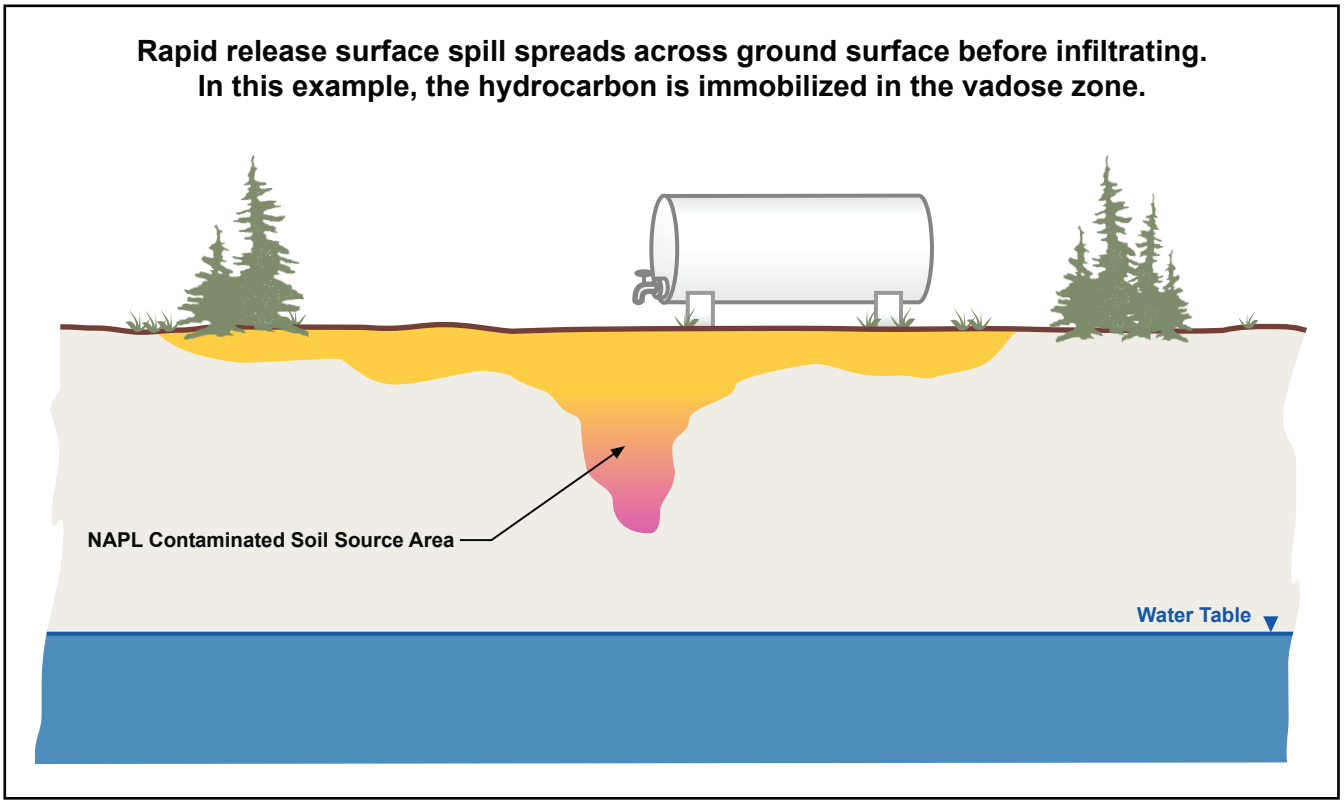
FIGURE 10-3A
Anticipated Pathways for Investigation

Work Plan for Site Inspection, Remedial Investigation, and Site Characterization

Former Galena Forward Operating Location, Alaska

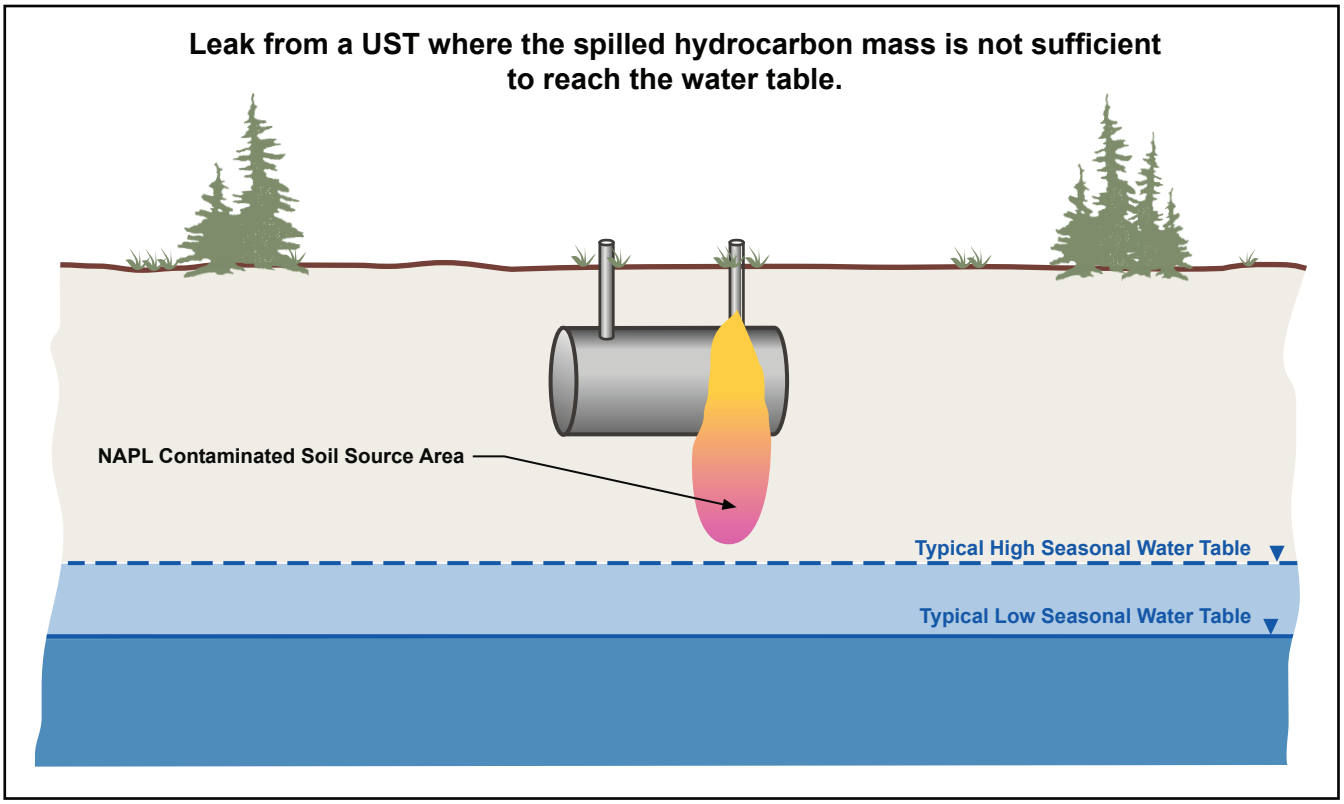
CH2MHILL

\\BALDUR\PROJ\GALENATO184_394439\MAPFILES\QAPP\FIGURE_10-3A_ANTICIPATED_PATH_QAPP.MXD SEARLY 6/7/2010 13:18:18



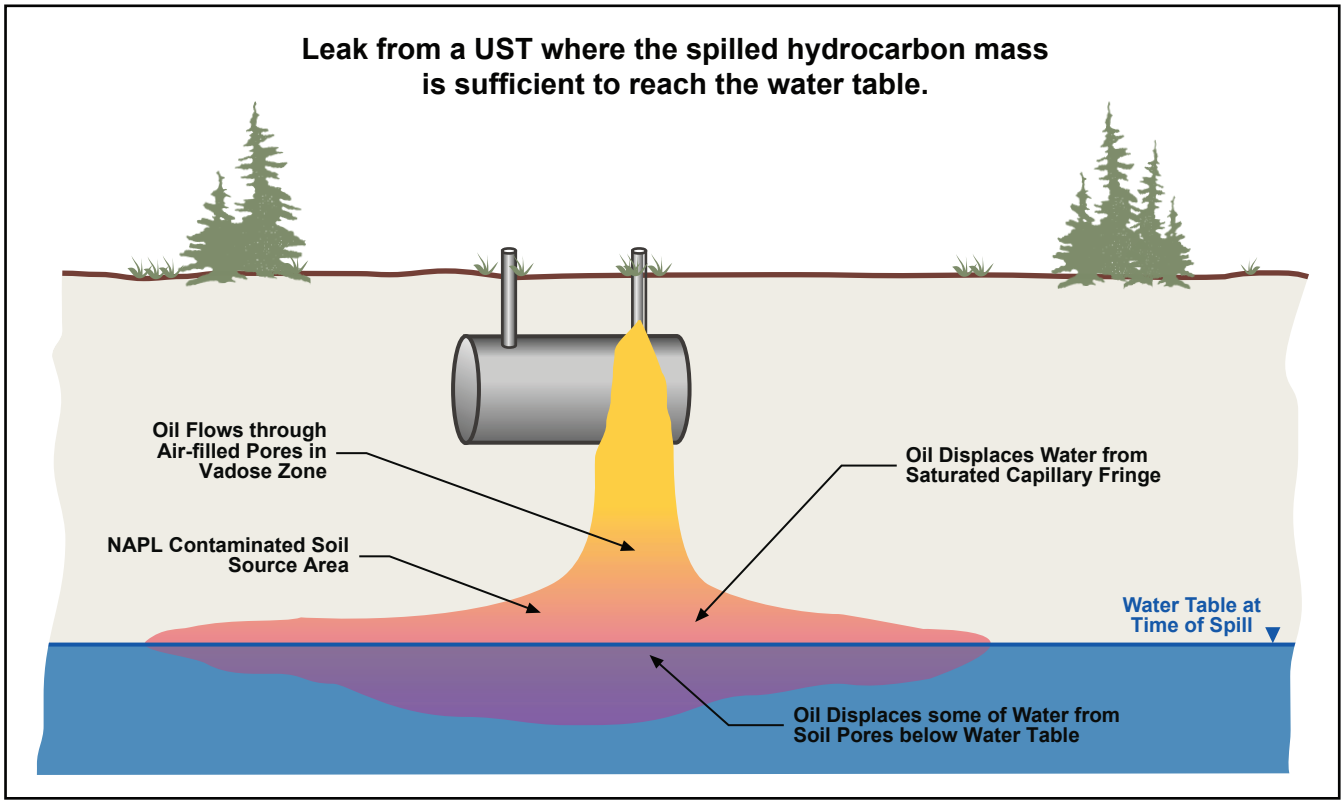
ES102709093509ANC GAL184_VadoseZone_01 cts

FIGURE 10-4
Vadose Zone NAPL Source Area from Surface Spill
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska



ES102709093509ANC GAL184_VadoseZone2_01 cts

FIGURE 10-5
Vadose Zone NAPL Source Area from Subsurface Release
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

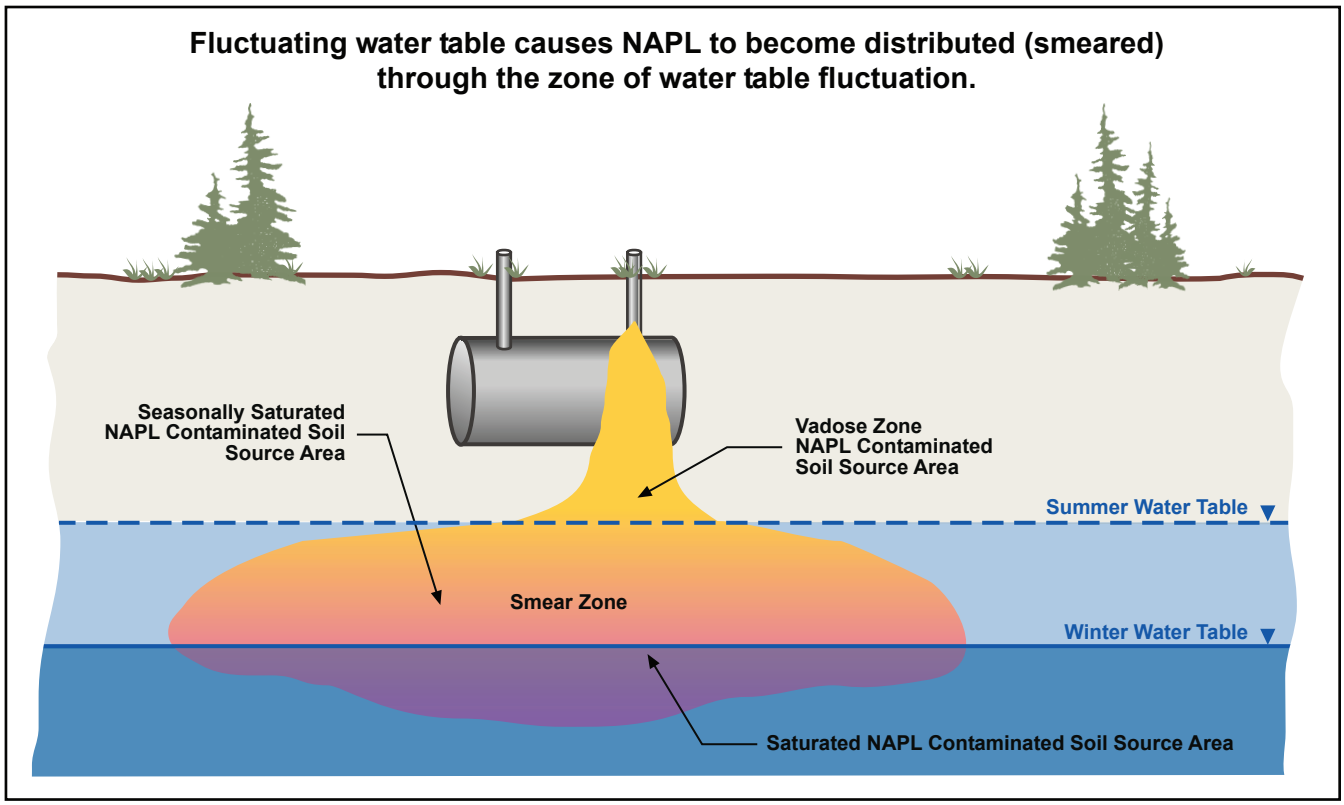


ES102709093509ANC GAL184_VadoseZone3_01 cts

FIGURE 10-6

Saturated Zone NAPL Source Area from Subsurface Release

Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

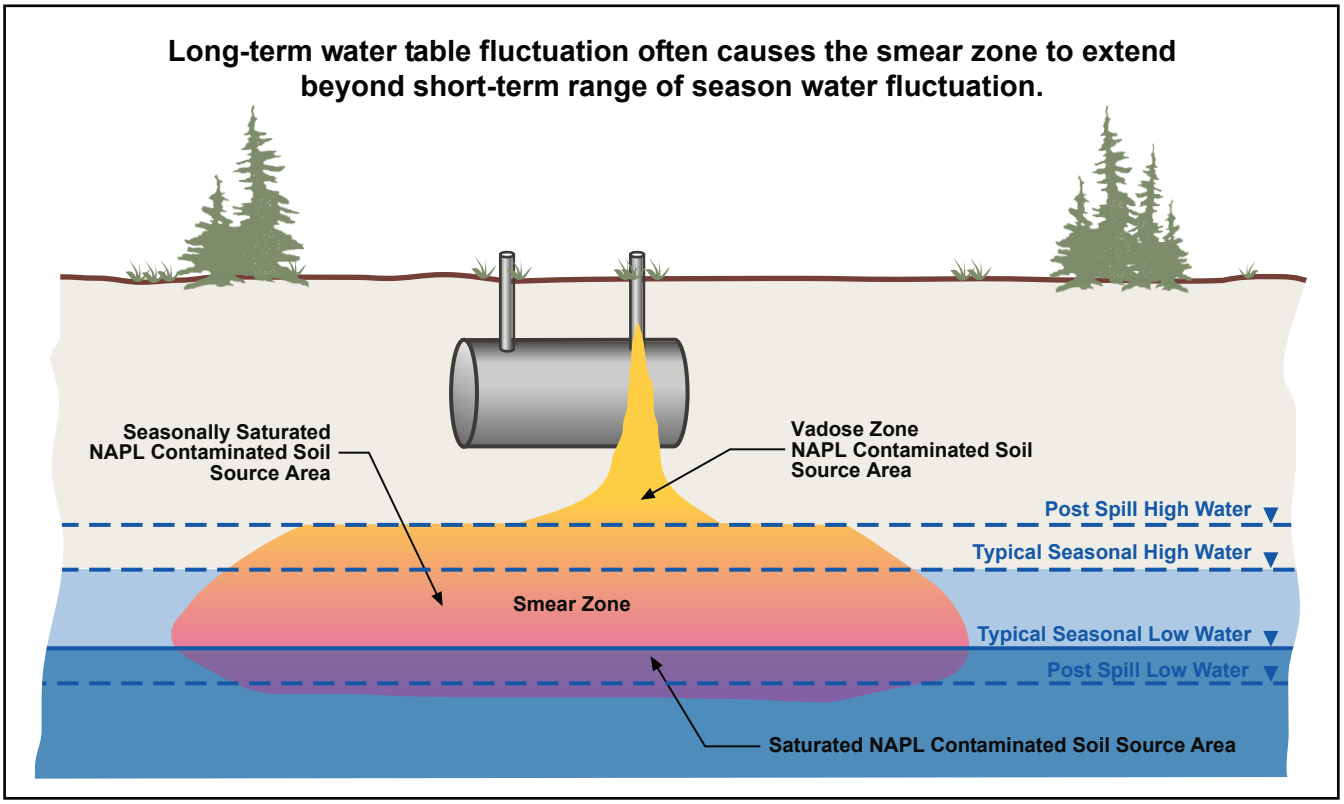


ES102709093509ANC GAL184_VadoseZone4_01 cts

FIGURE 10-7

Saturated Zone NAPL Source Area Subject to Seasonal Groundwater Fluctuation

Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

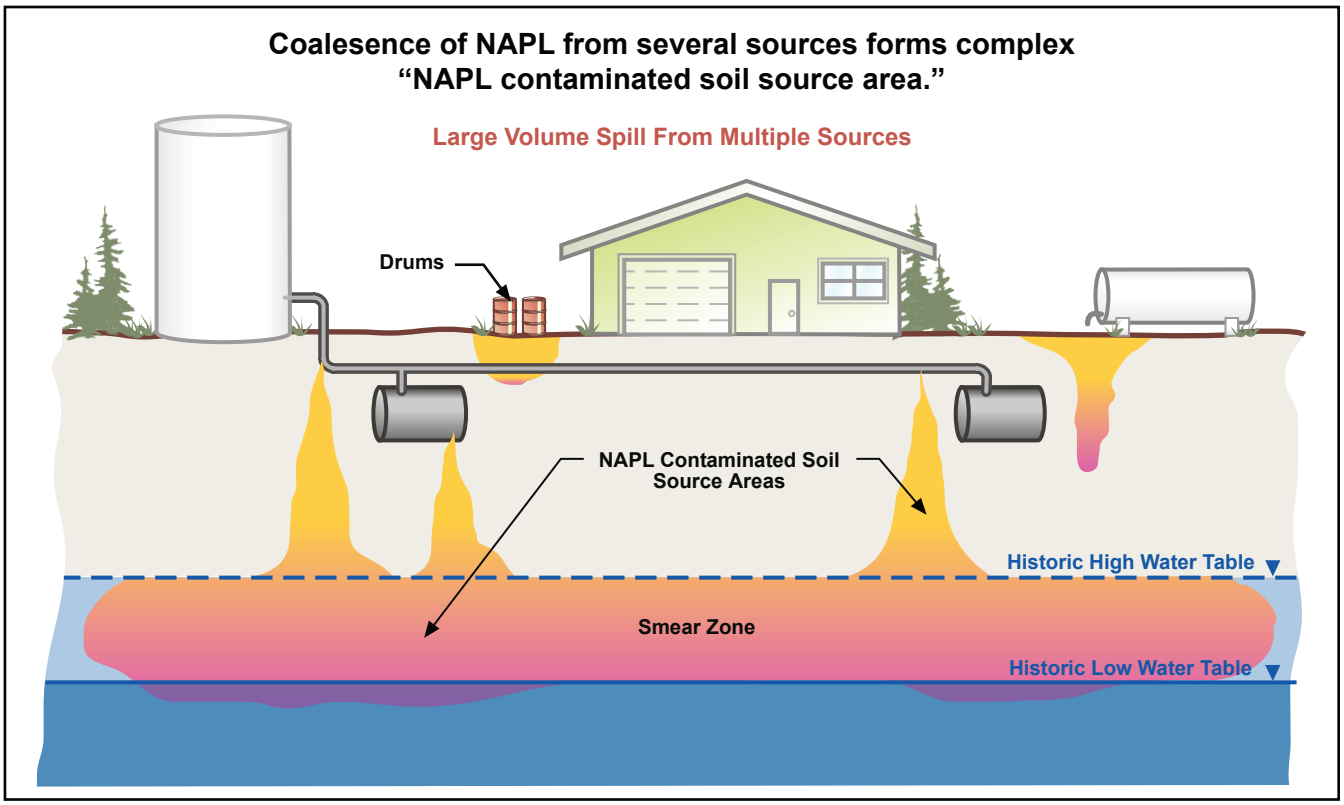


ES102709093509ANC GAL184_VadoseZone5_01 cts

FIGURE 10-8

Saturated Zone NAPL Source Area Subject to Long-Term Groundwater Fluctuation

Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

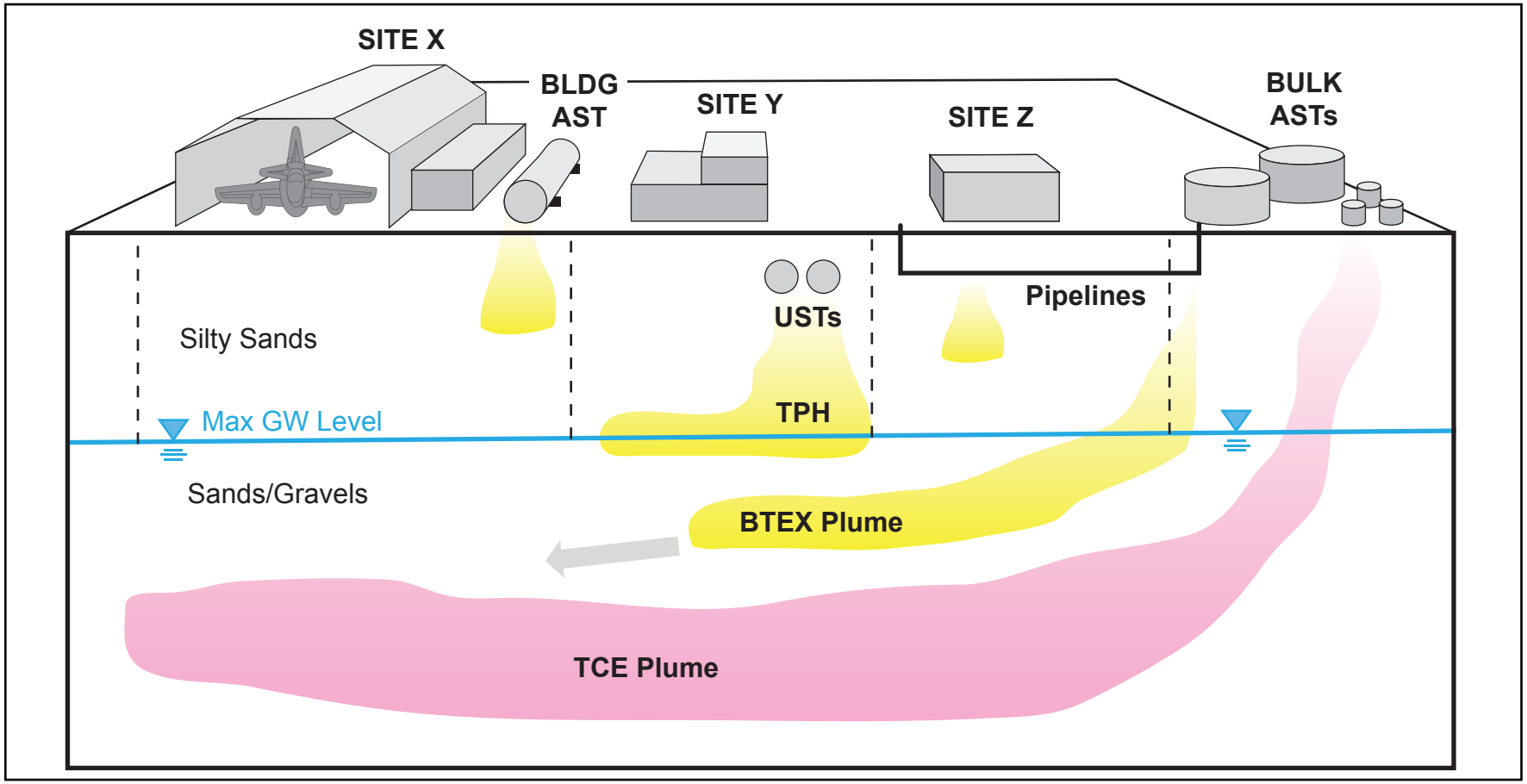


ES102709093509ANC GAL184_VadoseZone6_01 cts

FIGURE 10-9

Complex NAPL Source Area Resulting from Multiple Releases

Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska



ES030810213738RDD_10-10

FIGURE 10-10
Dissolved-phase Groundwater Plumes Resulting from Multiple Releases
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

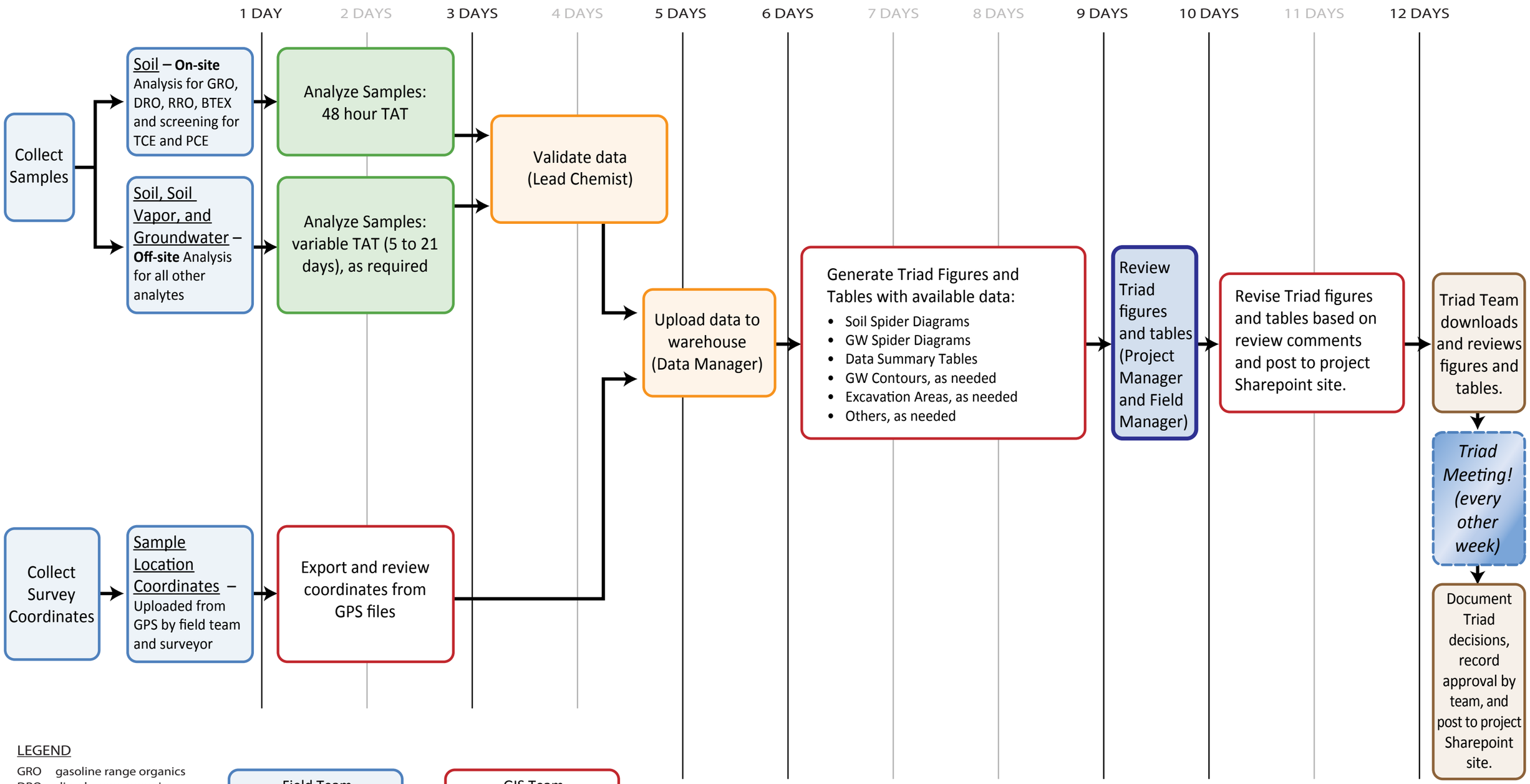


FIGURE 10-11
Data Collection and Review Process for Triad Meetings
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operations, Location, Alaska

ES102709093509ANC GAL_TriadDataFlowProcess_01.ai 06/07/2010 cts

CH2MHILL

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

Project quality objectives (PQOs) define the type, quantity, and quality of data that are needed to answer specific environmental questions and support proper environmental decisions.

11.1 Who Will Use the Data?

USAF, ADEC, and project stakeholders will use the data to support the environmental decisions to be made for each site, as outlined in Worksheet #10 (*Problem Definition*) and specified in Appendix D.

11.2 What Are the Project Screening Levels?

Concentrations of chemicals in soil, groundwater, and soil vapor will be compared with the project screening levels, which are conservative risk-based values appropriate to the potential human and ecological exposure pathways that may be present at each site. The derivation of screening levels is described in Worksheet #15 (*Reference Limits and Evaluation*). Use of the screening levels to make decisions about the presence and/or nature and extent of contamination is described in Worksheet #10 (*Problem Definition*). Additional details about SI, RI, and SC processes are provided in Worksheet #14 (*Summary of Project Tasks*).

11.3 For What Purposes Will the Data Be Used?

As indicated in Worksheet #10 (*Problem Definitions*), the following three types of investigations will be conducted at the Former Galena FOL, with somewhat different—but related—data uses:

- **SI –** SI sampling and comparisons with screening levels will be used to identify possible contaminant sources or releases and to recommend one of three outcomes for the site:
  - No environmental contamination was detected above the screening levels, and the site is recommended for no further action or redesignation as a non-qualifying site.
  - Contamination above screening levels was confirmed and consists of petroleum, oils, and lubricants (POL)-related constituents. Further investigation to delineate the extent of contamination and evaluate potential exposure risks is recommended, in accordance with ADEC guidelines for SC.
  - Contamination above screening levels was confirmed and consists of non-POL constituents or a mixture of POL and non-POL constituents. Further investigation to delineate the nature and extent of contamination and evaluate potential exposure

risks is recommended, in accordance with CERCLA guidelines for Remedial Investigation.

- **SC –** SC activities will be performed at sites where it was determined (during the Preliminary Assessment [PA] or SI phase) that POL-related contamination exists at concentrations above screening levels, but where adequate data are not available to delineate the extent of contamination or assess the potential exposure risks. The SC results will be used to characterize site conditions according to the requirements of Title 18, Chapter 75, Section 335 of the *Alaska Administrative Code* (18 AAC 75.335), which requires that before proceeding with site cleanup under the site cleanup rules, a responsible person shall characterize the extent of hazardous substance contamination at the site. This sampling and data evaluation activities will be used for the following purposes:

  – Determine if a discharge or release of a hazardous substance has occurred

  – Identify each (potential) hazardous substance at the site, including the concentration and extent of contamination; this information must be sufficient to determine cleanup options

  – Identify site characteristics or conditions that could result in ongoing site contamination, including the potential for leaching of in situ contamination and the presence of leaking barrels, drums, tanks, pipelines, other containers, or other sources

  – Evaluate the potential threat to human health, safety, and welfare, and to the environment from site contamination

  – Identify any interim removal action necessary under 18 AAC 75.330

  – Locate sources of known site contamination, including a description of potential releases into soil, sediment, groundwater, or surface water

  – Evaluate the size of the contaminated area, including the concentrations and extent of any soil, sediment, groundwater, or surface water contamination

  – Identify the vertical depth to groundwater and the horizontal distance to nearby wells, surface water, and water supply intakes

  – Evaluate the potential for surface water runoff from the site and the potential for surface water or sediment

  – Identify the soil type and determine whether the soil is a continuing source of groundwater contamination

  For UST sites, the SC assessment will also follow requirements in 18 AAC 78.090 of the *Underground Storage Tanks* regulations (ADEC, 2006). Findings from the SC activities will be used to update the preliminary CSM, estimate potential exposure risks to human health and the environment, and evaluate options for interim or final cleanup actions.

- **RI –** RI activities will be performed at sites where it was determined (during the PA or SI phase) that non-POL (for example, solvents, metals, PCBs) contamination exists at

concentrations above screening levels, but where adequate data are not available to delineate the extent of contamination or assess the potential exposure risks. The objectives of RI sampling and data evaluation activities are the same as those for SC sites, but reporting will follow the CERCLA process for preparing the RI and FS reports, Proposed Plan, and Record of Decision, and for the associated public reviews. Site data will also be used to prepare a baseline risk assessment to identify existing or potential risks to human health and the environment, as well as develop a range of remedial alternatives that will be evaluated in the FS Report.

Each of the FOL sites was assigned to one of these three investigation groups (see Table 10-1 [tables are located at the end of this worksheet]). The sites were further grouped into Investigation Approach Groups based on review of available information about source type and potentially released chemicals. The Investigation Approach Groups listed below have common CSM elements, and thus have similar data needs and sample design requirements to be addressed during the required investigation(s):

- **Surface POL Releases –** Sites with known or potential surface releases of POL from ASTs, drums, fill-stands, aboveground fueling pipelines, or loading/unloading facilities, or other surface fuel spills.
- **Subsurface POL Releases –** Sites with known or potential subsurface releases of POL from buried fueling piping, valve pits, or sumps.
- **Subsurface POL Releases (UST-related) –** Sites with known or potential subsurface releases of POL from leaking USTs. This category is separate from the Subsurface POL Releases category because there are special sampling requirements for UST site closure.
- **Surface Multi-chemical Releases –** Sites with known or potential surface releases of non-POL chemicals (that is, solvents, metals, pesticides; or a mixture of POL and non-POL chemicals) from ASTs, drums (waste management areas), or other surface spills.
- **Subsurface Multi-chemical Releases –** Sites with known or potential subsurface releases of non-POL chemicals (or a mixture of POL and non-POL chemicals) from oil-water separators (OWS), sumps, or fire training area pits.
- **Transformer Sites –** Sites where transformers may have been present and releases of polychlorinated biphenyls (PCB) and other chemicals may have occurred.
- **Unknown Source –** Sites where visual reconnaissance, historical records, and/or remote sensing results suggest management or disposal of waste or hazardous chemicals, but where the location and composition of potential releases are unknown.

Table 11-1 lists the Investigation Approach Group assigned to each FOL site. Worksheet #17 provides the data quality objectives (DQOs) for completing the required investigations. The actual SI, SC, or RI tasks and sampling programs to be implemented at each FOL site are detailed in Appendix D.

11.4 What Types of Data Are Needed?

Surface soil, subsurface soil, NAPL, groundwater, and/or soil vapor samples may be required in order to identify and delineate contamination. The samples may be analyzed by an onsite laboratory or be shipped for analysis to an offsite laboratory. Depending on site history, known or suspected release information, and previously collected sample results, the required analytical suites may include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PAHs, diesel-range organics (DRO)/residual-range organics (RRO)/gasoline-range organics (GRO), metals, PCBs, and pesticides. A complete listing of the analytes associated with these suites is provided in Worksheet #15 (*Reference Limits and Evaluation*). Additionally, groundwater samples from selected wells will be analyzed for monitored natural attenuation (MNA) parameters to support future remedial alternative evaluations. Samples of investigation-derived waste (IDW) and waste materials encountered during the investigations may also be analyzed for toxicity characteristic leaching procedure (TCLP) analysis and other waste characterization analyses in order to identify appropriate waste disposal options.

In addition to analytical data, information about site geology and hydrogeology is required for making decisions about sampling locations and depths. This information will be obtained through evaluation of previously collected data (including boring logs, depth-to-groundwater measurements, potentiometric surface maps, and other documents) or through observation and measurements obtained during the planned investigations.

More information about the types of data required to complete SI, SC, and RI activities is presented in Worksheet #17 (*Sampling Design and Rationale*). The actual SI, SC, or RI tasks and sampling programs to be conducted at each FOL site are detailed in Appendix D.

11.5 How "Good" Do the Data Need to Be in Order to Support the Environmental Decision?

Definitive-quality data will be screened against the appropriate screening levels and used to support the decisions listed in the Worksheet #17 DQO tables. The data from the planned investigations will be generated by using rigorous analytical methods (such as approved EPA SW-846 reference methods). The use of these data is not restricted unless there is a quality problem associated with them. The detection limits of the analytical methods shall meet the appropriate project screening levels unless otherwise justified (see Worksheet #15 [*Reference Limits and Evaluation*]).

11.6 How Many Data Are Needed? Where, When, and How Should They Be Collected and Generated?

Tables provided in Worksheet #17 (*Sampling Design and Rationale*) describe the types of samples and other data that are required in order to determine whether contamination is present (and, if so, to define the nature and extent of that contamination). The number and locations of samples needed at each site, and the site-specific rationale for placement, are presented in Appendix D. Soil sampling will typically follow the sampling intervals

presented in Figure 11-1. Samples will be collected for analysis at 0-2 feet, 5-7 feet, 10-12 feet, the middle of the variable saturated groundwater zone, the bottom of the variable saturated groundwater zone, and 10 feet below the variably saturated groundwater zone. At select locations, grab groundwater samples will be co-located with soil samples at the middle of the variably saturated groundwater zone and 10 feet below the bottom of the variably saturated groundwater zone to evaluate if a site is contributing to groundwater contamination. When NAPL is present, the variably saturated groundwater zone may also be referred to as the smear zone. The high and low groundwater elevations for each site will be inferred from historical records of continuous water level monitoring in the wells nearest to the site. The main objective for the site-specific field sampling plans in Appendix D is to characterize the nature and extent of soil contamination in the vadose and variably saturated groundwater water (smear) zones for each site. These sampling plans will include grab groundwater samples as necessary to determine whether the site is contributing contamination to groundwater. The dissolved-phase groundwater plumes and installation and sampling of permanent monitoring wells will be evaluated as part of the Groundwater Investigation Field Sampling Plan (refer to Section 14.2.5 – *Groundwater Approach*).

Pending the initial sampling results, additional samples may be required in order to delineate the lateral or vertical extent of soil contamination. An iterative process of "step out" sampling will be used at most sites to delineate the full nature and extent of contamination. Using the Triad process, interim results will be communicated to the project team (USAF, ADEC, and stakeholders) so that decisions can be made on what additional sampling is required and when the sampling is complete.

The standard operating procedures (SOP) that are expected to be employed during the planned investigations are in Worksheet #21 (*Project Sampling SOP References*). Fieldwork-related SOPs are provided in Appendix H. Laboratory analytical SOPs are provided in Appendix I.

The fieldwork associated with this Work Plan is scheduled to start in 2010.

11.7 Who Will Collect and Generate the Data?

CH2M HILL will collect the data on behalf of USAF. Data will be generated by ADEC-approved laboratories – CH2M HILL Applied Sciences Laboratory, EMAX, and Air Toxics.

11.8 How Will the Data Be Reported and Archived?

During the field investigation, teleconferences and electronic meetings (Microsoft Outlook LiveMeeting, or equivalent) will be scheduled with USAF, ADEC, and stakeholders as part of the Triad process to report sampling results. Validated data will be summarized in tables and posted on GIS figures and provided to the team through a project SharePoint site. Decisions made during the teleconference regarding additional sample locations and analyses will be documented on the figures and summarized in a memorandum and distributed to the team after the call for their project files.

The data will be reported in accordance with procedures outlined in Worksheet #36 (*Validation [Steps IIa and IIb] Summary*). Hardcopy and electronic (such as database management system and project GIS) data will be stored by CH2M HILL for 5 years after project completion. Project reports will be archived on CD-ROM or DVD+R media and stored in the project file.

TABLE 11-1
Investigation Approach Group Assignments

Parent ERP Site (if applicable)	Site ID	Site Name	Anticipated Investigation Pathway	Source/Release Type	Investigation Approach Group
ERP Sites					
FT001	FT001	Fire Protection Training Area (Parcel I)	RI	Fire Training; large-scale surface release (and subsurface releases from pit) from fire training operations (POL [primarily] and multi-chemical)	Surface Release Site – Multi-chemical; Subsurface Release Site - Multi-chemical
ST009	UST1572	1572 Liquid Fuel Pump Station, 3,000-gallon UST	SC	Localized subsurface release from UST (POL)	Subsurface Release Site – POL
ST009	UST1572-2	UST 1572-2, 2,000-gallon UST	SC	Localized subsurface release from UST (POL)	Subsurface Release Site – POL
ST009	ST009	JP-4 Fill-stands	SC	Localized surface and subsurface releases from fueling system and associated piping (POL)	Surface Release Site – POL; Subsurface Release Site – POL
ST010	ST010	Southeast Runway Fuel Spill	SC	Large-scale surface fuel spill (POL)	Surface Release Site – POL
OT099	OT099	Building Demolition/Drum Removal	SC	Localized surface release from AST and shallow sump, and subsurface migration from upgradient tank farm source area (POL)	Surface Release Site – POL
SS005	SS005	Wilderness Hall, Building 1872	SC	Localized surface releases from tank or drum storage (POL)	Surface Release Site – POL
Other Sites					
	TAR	Possible Tar Pit Construction Area	SI	Potential impacts from tar pits	Unknown Source

Notes:

AST = aboveground storage tank
ERP = Environmental Restoration Program
ID = identification
JP = jet propulsion fuel
POL = petroleum, oils, and lubricants
RI = Remedial Investigation
SC = Site Characterization
SI = Site Inspection
UST = underground storage tank

Worksheet #12 – Measurement Performance Criteria

Tables summarizing the measurement performance criteria (MPC) that are established for each matrix and analytical parameter of this project are provided in Appendix E. In general, the MPCs follow those defined in the AFCEE QAPP, Final Version 4.0.02 (AFCEE, May 2006).

The quality of the data to be collected for this project will be verified through appropriate MPCs established for both sampling procedures and analytical methods. The criteria should relate to data quality indicators (DQIs), consisting of precision, accuracy, representativeness, comparability, completeness, and sensitivity, commonly referred to as precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters. The DQIs are defined as follows:

- *Precision* refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms.
- *Accuracy* refers to the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.
- *Representativeness* describes the extent to which a sampling design adequately reflects the environmental conditions of a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.
- *Comparability* addresses the degree to which different methods or data agree or can be represented as similar. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.
- *Completeness* is a measure of the amount of valid data collected using a measurement system. Completeness is expressed as a percentage of the number of measurements that are specified in this Work Plan.
- *Sensitivity* is the ability of a method or instrument to detect the target analytes at the level of interest. Sensitivity can be measured by calculating the percent recovery of the analytes at the quantitation limit, which is the minimum concentration of an analyte that can be routinely identified and quantified above the method detection limit by a laboratory.

The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet #37 (*Usability Assessment*). The results will be summarized in an overall Data Quality Report, which will be included as an appendix to the RI/SC Report for the Former Galena FOL.

Worksheet #13 – Secondary Data Criteria and Limitations

"Secondary data" refers to historical data collected previously for the sites. The source(s) of the data, date of collection, planned uses, and limitations of the secondary data that may affect use for the current project objectives, if any, must be described in the site-specific sampling plans (provided in Appendix D). Table 13-1 (tables are located at the end of this worksheet) presents the categories of secondary data that are potentially available for project use.

The following are general guidelines to define how site-specific historical data can be evaluated to determine applicability for project use. A number of reference materials are suggested for guidance on the evaluation of historical data, such as the following:

- Section 3 of EPA's Guidance for Quality Assurance Project Plans (EPA QA/G-5) December 2002, http://www.epa.gov/QUALITY/qs-docs/g5-final.pdf
- Chapter 5 of EPA's Guidance for Data Useability in Risk Assessment, April 1992, http://www.epa.gov/oswer/riskassessment/datause/parta.htm
- CH2M HILL SOP Number 503, Data Management, Managing Historical/Legacy Data (March 2010) (provided as an attachment to Appendix J *[Standard Operating Procedures for Data Management]*)

Existing historical data can come from many sources. However, these data may not have been generated with the same quality criteria established for the current project (that is, the current project team did not choose the process of collection, analysis, evaluation, validation, or end use objective of the historical data). Therefore, all historical data require evaluation to determine what use, if any, and what possible limitations the data may have to meet the current project goals.

The references listed above provide added detail about the overall process of evaluation. In general, the process will follow these steps:

1. **Determine current data needs**. This is part of the current project DQO thought process. Questions to answer may include the following: Will screening-level data meet the need? Must the data all be definitive data quality, or will some combination of screening and definitive data best meet the end goals, as well as consider overall cost and schedule for the project? Once current data needs have been determined, the historical data will be evaluated to see if there is a fit. Will historical data aid in selecting current sample collection locations? Will historical data be so useful in meeting overall objectives that only data gaps need to be considered?
2. **Identify existing sources of data that may be available**. Available data may be hardcopy only, electronic data tables, databases, Environmental Resources Program

Information Management System (ERPIMS) data, GPS detail, field logs, figures, modeling results, etc. Consider each source. All sources will have different quality considerations and applicability to a project objective. Use of any source of data needs to be sufficient to meet current project goals.

3. **Evaluate existing data relative to the current project data quality requirements**. Evaluation may include a chemistry review of data quality from existing data validation records, revalidation of data, determination of GIS reliability for location data, review of original DQOs for determination of screening versus definitive data, review of detection levels of analytical results (do they meet the screening levels?), evaluation of temporal concerns with the data (are they in conflict with current objectives?). These are just some examples of the data review required or the questions that may be asked. All aspects of the existing data should be considered to determine potential limitations and usefulness.

4. **Document the quality issues with historical data.** Once the evaluation is completed, document an overview of the findings in the site-specific sampling plans (provided in Appendix D). Provide enough detail to allow a reader to understand the evaluation results and determine whether the historical data will fulfill the data needs for the intended purpose.

TABLE 13-1
Secondary Data Types

Secondary Data Type	Source of the Secondary Data	Date of Collection	How Data Will Be Used	Limitations on Data Use
Soil, soil vapor, groundwater, surface water, and sediment data that were collected under an approved Work Plan and QAPP, by approved ADEC analytical laboratory methods, with appropriate detection limits to meet project goals	Previous site reports, client-provided electronic databases	Prior to 2007	Data will be used for applicable DQO purposes, including nature and extent determinations and risk assessment evaluations.	None.
Soil, soil vapor, groundwater, surface water, and sediment data that were not collected under an approved Work Plan and QAPP and were analyzed by unapproved analytical laboratory methods (for example, SW8015), and/or without appropriate detection limits to meet project goals	Previous site reports, client-provided electronic databases	Prior to 2007	Data will be used as screening-level data to assist with conceptual site model development and guide placement of samples to fill potential data gaps.	The data cannot be used to determine the final nature and extent of contamination or for risk assessment purposes because the sample data will not meet minimum standards for the current project DQOs.
Soil, soil vapor, groundwater, surface water, and sediment data that were not collected under an approved Work Plan and QAPP, but were analyzed using approved ADEC analytical laboratory methods, with appropriate detection limits to meet project goals	Electronic database data provided by AECOM	Between 2007 and 2009	If proper data collection, analysis, and validation can be verified by the procedures outlined in this worksheet, data will be used for all applicable DQO purposes—including nature and extent determinations and risk assessment evaluations. Otherwise, data will be used as screening-level data to assist with conceptual site model development and guide placement of samples to fill potential data gaps.	Proper field collection methods, laboratory analytical methods, and proper data validation must first be verified prior to data use. If these are verified, there are no limitations on data use. However, if proper data collection, analysis, and validation cannot be verified, the data should be considered of screening-level quality and cannot be used to determine the final nature and extent of contamination or for risk assessment purposes.

TABLE 13-1
Secondary Data Types

Secondary Data Type	Source of the Secondary Data	Date of Collection	How Data Will Be Used	Limitations on Data Use
Soil, soil vapor, groundwater, surface water, and sediment data that were not collected under an approved Work Plan and QAPP and were analyzed by unapproved analytical laboratory methods (for example, SW8015), and/or without appropriate detection limits to meet project goals	Electronic database data provided by AECOM	Between 2007 and 2009	Data will be used as screening-level data to assist with conceptual site model development and guide placement of additional samples to fill potential data gaps.	The data cannot be used to determine the final nature and extent of contamination or for risk assessment purposes because the sample data will not meet minimum standards for the current project DQOs.
Screening-level field data (including field meter readings or field kit analyses)	Previous site reports, client-provided electronic databases	Any year	Data will be used as screening-level data to assist with conceptual site model development and guide placement of samples to fill potential data gaps.	The data cannot be used to determine the final nature and extent of contamination or for risk assessment purposes because the sample data were based on a screening-level field collection and analysis approach that will not meet minimum standards for the current project DQOs.
Boring log information	Previous site reports	Any year	Data will be used to generate geologic cross- sections and to support the development of the hydrogeologic conceptual site model.	An evaluation of the impact of heaving sands should be performed prior to use of lithologic information for project purposes.
Well construction and water level elevation information	Previous site reports	Any year	Data will be used to support the development of the hydrogeologic conceptual site model, hydrographs, and for future groundwater sample planning.	An evaluation of the impact of front heaving on top of casing elevations should be performed prior to use of well construction information for project purposes.
GIS mapping layers and coordinates	Previous site reports, electronic files, and geodatabases	Any year	Data will be used to determine well, boring, sample, and site feature locations to support conceptual site models and nature and extent evaluations.	Review of data and professional judgment will be required to determine applicability and usability of data.

TABLE 13-1
Secondary Data Types

Secondary Data Type	Source of the Secondary Data	Date of Collection	How Data Will Be Used	Limitations on Data Use

Notes:

ADEC = Alaska Department of Environmental Conservation

DQO = data quality objective

GIS = geographic information system

QAPP = Quality Assurance Project Plan

Worksheet #14 – Summary of Project Tasks

This worksheet provides a summary of project tasks as the outcome of the project scoping activities. The following project tasks are discussed:

- Pre-investigation activities
- Field investigation
- Laboratory analysis
- Data management, data review, and evaluation
- Preliminary assessment
- Baseline risk assessment
- Reporting

14.1 Pre-investigation Activities

Several activities will take place before the field activities begin. These activities will include conducting site reconnaissance, coordinating site access, obtaining clearances and required permits, and acquiring subcontractors and materials.

Work will be coordinated with HQ AFCEE/EXC. Notification of field activities, site access, and security will be coordinated with the entities listed below.

Notification of Field Activities	Permits for Airfield Access	Security
ADEC Fred Vreeman, Remedial Project Manager (907) 451-2181 **ADOT&PF** Bill O'Halloran, Airport Director (907) 656-1236 Sam Myers, Environmental (907) 451-5291 **City of Galena** Russ Sweetsir, Mayor (907) 656-1223 Tom Corrigan, City Manager (907) 656-1301 **Galena School District** Jim Smith, Superintendent (907) 656-1883 **Louden Tribal Council** March Runner, Chief Executive Officer (907) 656-1711 **KIYU Radio for Public Notice** Shadow (shadow@kiyu.com) (907) 656-1488	**ADOT&PF Leasing Officer** Collette Foster (907) 451-5201	**City of Galena Police Department** (907) 656-2177 (non-emergency) **Alaska State Troopers** (907) 656-1233

Vehicle access routes to sampling locations will be determined before any field activity takes place. No traffic disruptions (or control measures) are anticipated.

Clearances and permits will be obtained for the field activities. The appropriate utility and/or private company will be contacted to help locate buried utility lines at each site before any subsurface drilling or sampling occurs.

Refer to SOP-02 and SOP-03 in Appendix H for further details on the pre-investigation approach.

14.2 Field Investigation

Field investigation activities will be conducted for SI, SC, and RI purposes. The general objectives of these studies are presented in Worksheet #10 (*Problem Definition*). Information in the following guidance documents will be used to design and conduct the field investigations:

- Guidance for Performing Site Inspections Under CERCLA; Interim Final (EPA, September 1992)
- Draft *Field Sampling Guidance* (ADEC, January 2010)
- *Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites* (ADEC, September 23, 2009)
- *Underground Storage Tanks Procedures Manual, Guidance for Treatment of Petroleum-Contaminated Soil and Water and Standard Sampling Procedures* (UST Procedures Manual) (ADEC, November 7, 2002)
- *Policy Guidance on Developing Conceptual Site Models* (ADEC, November 30, 2005)
- *18 AAC 75 Oil and Other Hazardous Substances Pollution Control* (ADEC, amended October 9, 2008)
- *18 AAC 78 Underground Storage Tanks Regulations* (ADEC, amended October 2006)
- *Ecoscoping Guidance* (ADEC, March 2009)
- *Monitoring Well Guidance* (ADEC, February 2009)
- *Draft Guidance on Multi-Increment Soil Sampling* (ADEC, March 2009)
- *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC, July 2009)
- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988)

This section describes the program-level elements of the SI, SC, and RI activities. Worksheet #17 (*Sampling Design and Rationale*) presents the general approaches for conducting these program-level activities at the different types of sites, and Appendix D details the rationale for investigation and work to be conducted at each site.

14.2.1 Site Inspection

A limited SI will be performed at sites where it was determined—during the PA phase—that there is a potential or likelihood of environmental contamination, but where insufficient information was found to confirm the presence or absence of contamination. The SI sampling will test hypotheses developed during the PA with regard to potential sources of contamination or affected media. The scope of the SI will depend on the number of PA hypotheses requiring investigation, the questions remaining after the PA, and the number of migration and exposure pathways that significantly influence the further action recommendation. The SI is not intended to be a comprehensive SC or risk assessment, nor will the results be used to rank the site for possible inclusion on the National Priorities List (NPL). The results of the SI sampling and comparisons with SI screening levels (SLs)[1] will be used to recommend one of three outcomes for the site:

1. No environmental contamination was detected above SI SLs, and the site is recommended for no further action.
2. Contamination above SI SLs was confirmed and consists of POL-related constituents. Further investigation to delineate the extent of contamination and evaluate potential exposure risks is recommended, in accordance with ADEC guidelines for SIs.
3. Contamination above SI SLs was confirmed and consists of non-POL constituents or a mixture of POL and non-POL constituents. Further investigation to delineate the nature and extent of contamination and evaluate potential exposure risks is recommended, in accordance with CERCLA guidelines for RIs.

14.2.2 Site Characterization

Site Characterization activities will be performed at sites where it was determined during the PA or SI phase that POL-related contamination exists at concentrations above extent SLs, but where adequate data are not available to delineate the extent of contamination or assess the potential exposure risks. 18 AAC 75.335 requires that, before proceeding with site cleanup under the site cleanup rules, a responsible person shall characterize the extent of hazardous substance contamination at the site. The SC activities are intended to accomplish the following tasks (ADEC, September 23, 2009):

- Determine whether a discharge or release of a hazardous substance has occurred
- Identify each (potential) hazardous substance at the site, including the concentration and extent of contamination; this information must be sufficient to determine cleanup options
- Identify site characteristics or conditions that could result in ongoing site contamination, including the potential for leaching of in situ contamination and the presence of leaking barrels, drums, tanks, pipelines, other containers, or other sources
- Evaluate the potential threat to human health, safety, and welfare, and to the environment from site contamination

[1] SI and extent screening level selection and use are described in Worksheet #15 (*Reference Limits and Evaluation*).

- Identify any interim removal action necessary under 18 AAC 75.330
- Locate sources of known site contamination, including a description of potential releases into soil, sediment, groundwater, or surface water
- Evaluate the size of the contaminated area, including the concentrations and extent of any soil, sediment, groundwater, or surface water contamination
- Identify the vertical depth to groundwater and the horizontal distance to nearby wells, surface water, and water supply intakes
- Evaluate the potential for surface water runoff from the site and the potential for surface water or sediment
- Identify the soil type and determine whether the soil is a continuing source of groundwater contamination

For UST sites, the SC and assessment will also follow requirements in 18 AAC 78.090 of the UST regulations (ADEC, amended October 2006). Findings from the SC activities will be used to update the preliminary CSM that was developed in the PA phase, estimate potential exposure risks to human health and the environment, and evaluate options for interim or final cleanup actions.

14.2.3 Remedial Investigation

Remedial Investigation activities for sites with non-POL contamination (or a mixture of POL and non-POL contamination) are the same as those described in the previous section for SC activities, but reporting will follow the CERCLA process for preparing the RI and FS reports, Proposed Plan, and Record of Decision, and associated public reviews. Site data will also be used to prepare a baseline risk assessment to identify existing or potential risks to human health and the environment, and develop a range of remedial alternatives that will be evaluated in the FS Report.

14.2.4 Types of Field Investigation Tasks

The SI, SC, and RI activities will use the same sample collection and analysis methods to generate data of appropriate quality for decision making. General procedures for the tasks are described in Worksheet #17 (*Sampling Design and Rationale*), and the site-specific applications of the tasks are discussed in Appendix D for the following sampling activities:

- Surface soil sampling, including discrete and multi-increment samples
- Subsurface soil sampling
- Groundwater sampling
- Active soil gas sampling

The field sampling will be conducted in accordance with the SOPs provided in Appendix H of this Work Plan. Equipment decontamination during field sampling will follow those procedures outlined in SOP-13. At the completion of the investigations, the sampling locations will be surveyed in accordance with the procedures described in SOP-23.

14.2.5 Groundwater Approach

Initial groundwater investigations at the Galena FOL have indicated that more than a dozen large and small plumes are commingled in the central operations area known as the "triangle." These plumes consist primarily of fuel-related contaminants with lesser areas of chlorinated VOCs contamination. The further delineation of these groundwater plumes must be performed at a larger scale than individual site investigations. The approach proposed for these plumes is to develop one or more groundwater operable units (OUs) that encompass both the dissolved-phase contamination present in the aquifer system and the contamination present in the "smear zone," or zone of annual groundwater fluctuation. The contamination present in the aquifer is now migrating and attenuating as a part of the overall groundwater flow system, independent of individual source areas. Therefore, the strategy used to delineate and track the fate and transport of these plumes must be developed on the same scale as the overall groundwater system. Site-specific investigations will continue to search for sources of groundwater contamination, and to recommend source remediation where this is appropriate and feasible.

Hydrogeologic Study

The focus of the hydrogeologic study will be to collect sufficient information to define the primary components of the groundwater flow system at the site. The groundwater investigation effort will be focused on the following areas:

- Hydraulic properties of the aquifer system at the site
- Groundwater conditions within the primary aquifer systems at the site
- The degree of surface water/groundwater interaction between the Yukon River and the site groundwater system

The proposed approach to collecting additional information in these three areas is described below.

Aquifer Properties. The hydraulic properties of the aquifer system at the site, including the magnitude of horizontal to vertical anisotropy, will be quantified by conducting a series of aquifer tests. The overall approach will be to select discrete locations for hydraulic testing, spaced throughout the former Galena FOL, using existing monitoring wells as much as possible. Individual locations will require a central pumping well surrounded by monitoring wells at varying distances, as well as monitoring points screened within different depths of the aquifer than the screened interval of the pumping well. This array of monitoring points will allow estimation of both the transmissivity and storage properties of the pumped interval, and will also allow estimation of the magnitude of horizontal to vertical anisotropy of the aquifer system at the site. Accurate estimates of the horizontal to vertical anisotropy of the aquifer are critical to understanding the potential for vertical migration of the site contaminant plumes. A second option that will be evaluated for gathering aquifer characterization data is to place pressure transducers in monitoring wells located in close proximity to the existing base water supply wells. These wells periodically cycle as demand fluctuates over time, and the response of the aquifer system to these changing hydraulic stresses can be monitored in nearby wells much as is done in a

traditional aquifer test. If enough monitoring points exist in the vicinity of the production wells, these data can also be used to estimate aquifer properties and the magnitude of horizontal to vertical anisotropy. If not enough wells are available for monitoring in this area, additional wells may be installed to augment the monitoring network.

Groundwater Conditions. The groundwater conditions within the aquifer system at the former Galena FOL that will be investigated further are the horizontal and vertical hydraulic gradients, the groundwater flow directions at various locations across the site, and the associated groundwater flow velocities. The groundwater system at the Galena site is very dynamic and changes significantly over time, primarily in response to changing conditions in the nearby Yukon River. During most of the year, the Yukon River is a gaining stream, and groundwater flows toward and eventually discharges into the river. However, during breakup in late May or June (depending on the climatic conditions during a given year), the stage of the Yukon River increases significantly and groundwater levels rise rapidly by as much as 20 feet. During this high-stage condition, the Yukon becomes a losing stream, and surface water flow recharges the underlying aquifer system. Groundwater flow directions during this period shift, and groundwater flows away from the river. The duration of this flow reversal depends on the surface and groundwater flow characteristics of that particular year and on the distance from the river. Vertical flow components also change during this period, with upward hydraulic gradients predominating near the river during most of the year, shifting to downward hydraulic gradients during the high-flow periods.

The Galena area also experiences high-intensity rainfall events during the late summer/ early fall period. These events can produce significant flow increases in the Yukon River, which also result in changing groundwater flow directions and gradients. To improve the understanding of this dynamic flow regime, pressure transducers with automated data-recording devices will be placed in monitoring wells across the site to collect groundwater elevation data during these periods. Monitoring well clusters, with wells screened at multiple depths at a single location, will be constructed and pressure transducers will be installed. The collection of this type of data is necessary to understand the nature of the variability in vertical hydraulic gradients within the aquifer over time. These clusters will be constructed at varying distances from the river to evaluate the changing aquifer response with distance from the river.

Groundwater–Surface Water Interaction. As discussed above, the nature of flows in the Yukon River has a significant influence on groundwater conditions—and, therefore, on plume migration—at the site. To better understand the connection between the river system and the aquifer system in the Galena area, monitoring wells located near the river will have pressure transducers installed with automated data collection devices. Existing wells will be used where possible; however, it is anticipated that several new wells or well clusters may need to be installed to support this effort. As the stage in a stream rises, a pressure wave is propagated through the underlying aquifer and can be detected in groundwater-level data collected from surrounding wells. The timing and magnitude of the pressure wave as it passes through the well (that is, the time-series of groundwater levels measured in the well) are indicative of the distribution and magnitude of aquifer transmissivity, aquifer storage coefficient, hydraulic conductivity of the streambed, and vertical hydraulic conductivity of

the aquifer. These data can be analyzed using numerical analysis tools to obtain an estimate of the degree of hydraulic connection between the river and the underlying aquifer. These data are critical to understanding the movement of plumes in the vicinity of the river, as well as the potential for contaminant mass transport to occur from the aquifer system to the surface water system. If a site contaminant plume were to reach the river, these data will also allow quantification of the mass flux to the river, supporting evaluations of potential ecological risk to aquatic receptors.

All of the data collection described above, along with the analysis of these data, is necessary to understand the potential for contaminant movement at the site. Many of the plumes currently under investigation will be remediated using a monitored natural attenuation (MNA) approach. To successfully implement MNA remedies at a site of this type, sufficient information needs to be obtained so that forecasts of future plume behavior can be made. These data will provide a basis for determining whether the current plumes will continue to migrate toward downgradient receptors, or whether they will stabilize and be addressed effectively by an MNA remedy. These data will also provide the basis for development of an effective groundwater monitoring network that will allow for effective long-term monitoring at the site.

Plume Delineation and Monitoring Strategy

The individual source areas at the former Galena FOL are being delineated further using a site-specific approach whereby data gaps are identified and addressed at each particular site. This approach is appropriate for individual potential source areas; however, a different approach is proposed to evaluate the groundwater contaminant plumes present at the former Galena FOL. The groundwater contaminant plumes present at the site are the result of contaminant releases from numerous individual source areas that have coalesced into larger regions of contaminated groundwater. As such, the further delineation of these groundwater plumes must be performed at a larger scale than the individual site investigations of the potential source areas.

The approach proposed for these plumes is to develop one or more groundwater OUs that encompass both the dissolved-phase contamination present in the aquifer system and the contamination present in the smear zone. The contamination present in these components of the aquifer system moves independently of individual source areas, and it migrates in response to the overall groundwater flow system described above. Therefore, the strategy used to delineate and track the migration of these plumes must be developed on the same scale as the overall groundwater system.

The further delineation of the groundwater contaminant plumes at the Galena FOL site will rely primarily on the installation of groundwater monitoring wells. Historically, much of the delineation of contaminant plumes has been performed using individual grab groundwater samples. This approach provides information on the levels of contamination within a very limited thickness of the aquifer, often less than 1 foot thick. Because these types of samples are not repeatable, they provide no information on the temporal trends in contaminant concentrations at the site.

Information collected from monitoring wells, on the other hand, provides contaminant concentration data on a scale similar to that of a domestic water supply well, which is more relevant when assessing the threat of contaminant plumes on nearby drinking water supplies. Further, a critical component of evaluating the risk posed by a particular groundwater contaminant plume is to forecast future plume behavior. This can be done only by collecting time-series data of contaminant concentrations so that an assessment of whether a plume is stable, expanding, or contracting can be made. The installation of additional monitoring wells will allow collection of this type of information.

The approach for selecting new well locations and well screen intervals will be to compile all of the available groundwater concentration data, both from monitoring wells and individual grab groundwater samples, and plot them on a site base map for several selected time intervals. Contaminant data will be classified according to sampling depth, and three-dimensional trends will be evaluated. Time-series concentration trends within individual wells will also be evaluated, so that the temporal behavior of the plume can be considered in the selection of new monitoring well locations. Well locations will be selected primarily to fill existing data gaps and improve delineation of the existing plumes, but several additional monitoring well locations will be identified to provide indications of ongoing plume expansion into currently uncontaminated areas. Initially, all new monitoring wells will be sampled at least semiannually (during high and low groundwater elevation periods) for at least a year, to obtain data for assessing the seasonal fluctuations in contaminant concentrations at the site. The need for additional monitoring wells will be assessed periodically, as data from these new and existing wells are collected and analyzed.

Fate and Transport Data Collection

In addition to the hydrogeologic and contaminant concentration data collection described above, it is also important to collect site data to support the evaluation of the fate and transport of contaminants in the vadose zone and the groundwater system. These data are critical in predicting the long-term persistence and migration of contaminants through the subsurface environment. The types of information that will be included in this sampling program relate to the characteristics of the aquifer solids, as well as to the geochemical conditions within the aquifer system. The specific data elements that will be collected are as follows:

- Soil bulk density
- Soil porosity
- Soil fraction organic carbon
- Oxidation-reduction potential of the groundwater
- Dissolved oxygen in groundwater
- Natural attenuation parameters such as nitrate, sulfate, dissolved iron and manganese, and methane

These data will be used, in conjunction with the hydrogeologic and plume concentration data, to assess whether MNA is a viable remedial action for the current plumes at the site. If

it appears that the mass flux of contaminants moving through the aquifer system is too great to be attenuated by natural processes, an evaluation of the source area delineation data will be performed to identify sites that represent major contributors of contaminant mass to the plume. Once a sufficient number of these sites undergo vadose zone and/or smear zone remediation, it is likely that the remaining contaminant plume can be controlled using an MNA remedial approach.

14.3 Laboratory Analysis

Laboratory analyses are described in detail in Worksheet #17 (*Sampling Design and Rationale*) and are summarized below. The laboratory analyses will be performed in accordance with the analytical SOPs provided in Appendix I of this Work Plan.

14.3.1 POL Sites

Several types of petroleum fuels, oils, and lubricants were used at the Former Galena FOL for operating and maintaining vehicles, aircraft, and equipment. Historical information about the POL types used and the planned analyses for each investigation area are summarized in Appendix D.

Soil and Groundwater

In general, soil and groundwater analyses for POL-contaminated investigation areas will follow ADEC requirements (ADEC, January 2010). The soil and groundwater analysis requirements for each POL type are summarized in Table 14-1 (tables are located at the end of this worksheet).

Soil Gas

Soil gas analysis for field screening of POL-contaminated investigation areas will include volatile organic constituents of fuel, such as benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds. Field instruments may be used to measure indicators of fuel biodegradation, such as methane, oxygen, and carbon dioxide.

14.3.2 Non-POL Sites

Sample analysis for non-POL sites will be focused on the potential hazardous constituents identified in the preliminary CSM based on known site history, chemical usage or storage, and spill or release records. Sites designated as non-POL sites may also have POL contamination present, so analyses for these sites can also include the POL-type analyses discussed above. The preliminary CSM and analyte list for each non-POL investigation area are presented in Appendix D.

The types of sites that may be designated as non-POL sites include the following:

- Bulk chemical storage sites
- Waste accumulation areas
- Fire training pits
- Maintenance shops

- Incinerators
- Waste oil tanks
- Oil-water separators
- Transformer sites

Soil and Groundwater

Laboratory analysis for soil and groundwater at non-POL sites will include the following analytes, depending on site history and the preliminary CSM:

- Chlorinated solvents (for example, trichloroethene [TCE], which historically was commonly used as a degreaser solvent for equipment and vehicle maintenance activities)
- Organochlorine pesticides (for example, dichlorodiphenyltrichloroethane [DDT] and the closely related compounds dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethene [DDE]), if there are suspected spills of these chemicals from bulk storage or waste accumulation areas
- PCBs, which were manufactured in North America under the trade name Aroclor and were used as insulating fluids in transformers
- Dioxins and furans, also known as polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), which can be formed during the combustion of chlorinated compounds
- Metals (for example, arsenic, lead, and chromium), which may be concentrated in ash from incinerators

Soil Gas

Soil gas analysis for field screening at non-POL sites will focus on volatile organic compounds that include chlorinated compounds found in solvents. Field instruments may be used to measure indicators of solvent biodegradation, such as methane, oxygen, and carbon dioxide.

14.4 Data Management, Data Review, and Evaluation

14.4.1 Data Management

Field activities will be recorded in a project log book, as applicable, and on the applicable standard logs provided in Appendix H of this Work Plan. Site maps will be maintained and sample locations will be updated on the maps as necessary. Field and analytical data will be consolidated and maintained within an electronic database system. The data management SOPs are provided in Appendix J.

14.4.2 Data Review

A three-step data review process (consisting of verification, validation, and usability assessment) will be employed in examining the collected data. This process should ensure

that only scientifically sound data of known and documented quality are used in making environmental decisions. Worksheets #34 through #37 (*Verification [Step I] Process, Validation [Steps IIa and IIb] Process, Validation [Steps IIa and IIb] Summary*, and *Usability Assessment*) describe the process and criteria in detail.

Analytical data obtained during the project will be validated by a qualified CH2M HILL chemist in accordance with specifications provided in Worksheet #36 (*Validation [Steps IIa and IIb] Summary*). Full documentation of the data validation process and the results will be provided in appendices to the investigation reports.

An electronic deliverable report of validated data will be provided to AFCEE in the ERPIMS format.

14.4.3 Data Evaluation

Field data will be compiled from field logs and presented in tables listing the sampling details, field observations, and field parameter measurements. Field data will be used to further refine the understanding of conditions at the sites and to create and update the CSM, as appropriate.

Validated analytical data will be processed to produce a "working" dataset with which to run statistical summaries, evaluate the nature and extent of contamination, conduct the environmental hazard evaluation, and prepare the baseline risk assessment. In particular, data to be used for risk assessment will be processed using the following rules:

- Resolving multiple results for a single chemical reported by different analytical methods (for example, naphthalene reported by both Methods SW8260 and SW8270SIM) to produce a single value for each analyte per sample
- Resolving field-duplicate results to produce a single value for each sampling location

Appendix F describes the data processing procedures in detail. A complete set of the processed results, as well as full documentation of the original results and how the processed results were derived, will be included as appendices in the investigation reports.

Processed analytical data, in conjunction with the existing data of adequate quality, will be used to evaluate the nature and extent of contamination, to perform the environmental hazard evaluation, and to characterize the risks to human and ecological receptors at the sites.

14.5 Preliminary Assessment

Sites proposed for further investigation in this Work Plan were either previously identified by USAF as ERP sites with known environmental contamination, or were evaluated as part of the PA (CH2M HILL, 2010) and identified as sites with potential environmental contamination. This section summarizes the screening process that was used in the PA to identify sites with potential environmental hazards that are addressed in this Work Plan for further site assessment.

The PA screening began with information gathering to identify USAF activities and facilities where chemicals or fuel were stored or handled and where there was a potential for a release to the environment that could have affected soil, groundwater, sediment, or air. The information gathering focused on waste handling practices, waste containment, inspection reports, aerial photographs, permit applications, hazardous waste notification handling forms, waste hauling manifests, analytical sampling results, records of citizen complaints, and previous SC reports. The following resources were reviewed:

- Environmental Baseline Studies (EBS) (USAF, May 2008; AECOM, October 2009 and December 2009)
- Administrative record for the Galena Airport (http://www.adminrec.com)
- ADEC Contaminated Sites records
- 2004 Galena Air Station Oil Discharge Prevention and Contingency Plan (ODPCP) (also referred to as the "Spill Plan") and the Spill Prevention, Control, and Countermeasures (SPCC) Plan
- Characterization reports, ADEC comments, and draft reports provided by AFCEE (in addition to those reports available in the administrative record)
- Real estate and real property accounting records
- Cultural resources management plans and historic building inventories
- Historical accounts of activities at Galena
- Environmental Assessments (EAs) completed for real estate actions
- EBSs completed before 2007
- Investigation reports produced since the 2007 RI that have not yet been finalized or approved by ADEC

In addition, the following items had been incorporated into the EBSs and were reviewed as part of the EBS documents:

- Ms. Karlene Leeper, 611th Civil Engineer Squadron (611 CES) Cultural Resource Manager, and Mr. Joe Orr, 11th Air Force History Office (11 AF HO), confirmed that all known existing USAF aerial photos were collected and reviewed in the EBS process.
- The available environmental management plans of the Base Operation and Support (BOS) contractor, Chugach Support Services, were reviewed in the EBS process; relevant lists of such items as hazmat storage were provided in the EBSs.

CH2M HILL also performed a site visit from October 6 to October 8, 2009, to familiarize the project team with the Former Galena FOL site, identify any visual evidence of site contamination, and complete ADEC ecological risk scoping forms to identify potential habitat at the sites. CH2M HILL team members entered facilities to confirm the presence of OWSs, ASTs, and USTs, where possible. Members of the Galena community were contacted to assist with

visual site inspections and answer questions about current and historical use of facilities. Current and former USAF military members and civilian employees were also contacted and answered questions about historical facility use and operational practices.

The sites identified from the information gathering were then screened for potential environmental hazards using the flowchart process shown in Figure 14-1 (figures are located at the end of this worksheet). The PA evaluation addressed the first five steps of the process:

Step 1 – Select Site. The sites evaluated include facilities and leased areas where former USAF activities may have caused releases of hazardous substances or petroleum products to the environment. Sites that were excluded from the screening include former leased areas and facilities classified as Category 1 in the EBSs (USAF, May 2008; 2010, pending), ERP sites, and Military Munitions Response Program (MMRP) sites.

Step 2 – Are There Documented Spills or Releases? This step in the process relied heavily on ADEC records. A documented spill or release was defined as a location or structure with at least one of the following:

- Spill report sent to ADEC
- UST closure document submitted to ADEC indicating the presence of soil or groundwater contamination
- Analytical data collected from within the site boundary indicating the presence of soil or groundwater contamination

Step 3 – Is There Historical or Visible Evidence Indicating Possible Site Contamination? This step relied on historical documents to identify operations within facilities, waste handling, and storage that had the potential for contaminant releases. Interviews with former installation personnel were conducted, and findings from the October 2009 site visit and records from a 2009 visual site inspection (VSI) performed in support of the EBS were reviewed in this step. ADEC ecological scoping forms were filled out for each site to identify whether potential ecological habitat exists.

Underground storage tank sites without removal documentation, sites with surface staining, and sites with historical evidence of a spill or contamination were recommended for limited SI sampling to confirm the presence or absence of site contamination. If there was no historical or visible evidence indicating possible site contamination, the site was recommended for a "Non-Site" designation.

Step 4 – Are There Adequate Existing Data to Confirm the Presence or Absence of Site Contamination? In this step, existing field screening and analytical data were reviewed for those sites with documented spills or releases. At the PA stage, "adequate data" was defined as follows:

- For UST sites: "Yes" indicated that all required sampling data were available to complete the release investigation in accordance with 18 AAC 78.235 and the UST Procedures Manual (ADEC, November 7, 2002). "No" indicated either that no data are available or that existing data are incomplete.

- For other POL sites: "Yes" indicated that all analytical data are available for the chemicals of interest, as identified in Tables 2A and 2B of the UST Procedures Manual (ADEC, November 7, 2002), and that the site contamination is delineated. "No" indicated either that no data were available or that there were no data for a chemical of interest.
- For non-POL areas: "Yes" indicated that the analytical data exist for a CERCLA hazardous substance and that the site contamination is delineated. "No" indicated either that no data were available or that there were no data for a chemical of interest.

Sites without adequate existing data were recommended for limited SI sampling. Sites that did have adequate existing data proceeded to Step 5 for data screening.

Step 5 – Screen for Potential Method Two Closure. For sites with documented spills and adequate existing data, the data were reviewed to determine whether the site could be closed under ADEC Method Two requirements. This review addressed the following questions:

- For human health risks: Do any of the detected contamination levels exceed ADEC Method Two Cleanup Levels (direct contact, inhalation, or migration to groundwater) listed in Tables B1, B2, and C for the "Under 40 inch Zone" in 18 AAC 75?
- For ecological risks: Are there potential ecological receptor pathway interactions? If so, is the habitat for species present and do chemical concentrations exceed ecological benchmarks or include bioaccumulatives?

If the answer to both the human health and ecological risk screening questions was "No," the site was recommended for no further action or for redesignation as a non-qualifying site, as appropriate. If the answer to one or both of the human health and ecological risk screening questions was "Yes," the site was recommended for further investigation following either the ADEC Regulatory Pathway for POL-only sites or the CERCLA Regulatory Pathway for sites with chlorinated compounds or other CERCLA- regulated contaminants.

The remaining Steps 6 through 14 in Figure 14-1 are addressed through the SI, RI, and SC activities described in this Work Plan.

14.6 Baseline Risk Assessment

For sites where an RI or SC has been completed, a baseline risk assessment may be conducted to support risk management decisions. The overall objective of the baseline risk assessment will be to identify whether the risks posed by the site are of sufficient magnitude (defined in Sections 14.6.1 and 14.6.2) to support (along with other factors) one of two decisions: (1) proceed with developing remedial actions (i.e., cleanup, long-term monitoring, and/or institutional controls) or (2) proceed with a No Further Action determination. For some sites, a full baseline risk assessment may not be necessary, but rather a screening-level evaluation approach may be used. The decision to use a screening approach will depend on

the number of chemicals of interest, the site media affected, and the concentrations found in these media.

The decision to proceed to remedial action is reached when risk assessment results exceed selected action levels,[2] whereas proceeding to a No Further Action determination is warranted when risk assessment results do not exceed these action levels. Risk-based action levels are not intended to be categorical, but to provide general direction for risk management decisions when considering all relevant information at a specific site (for example, reasonably anticipated future uses). When the risk assessment results are close to the action levels, or when considerable uncertainty exists in the exposure or risk models, a decision is made either to refine the risk assessment assumptions or to collect additional data to yield more reliable exposure estimates (or both). The baseline risk assessment will use validated processed analytical data collected during the RI or SC, and previous investigation data (of adequate quality) in conjunction with the updated CSM for the site.

This section describes the general approach to conducting baseline risk assessments for ERP sites at the Former Galena FOL. Appendix G provides a more detailed description of the human health and ecological risk quantification methodologies, including equations and input parameters used for estimating chemical intake, sources of toxicity values, and methods for calculating human health and ecological risk.

The baseline risk assessment will comprise two components: a human health risk assessment (HHRA) and an ecological risk assessment (ERA). The HHRA will be conducted for all sites, whereas the ERA will be conducted only at sites where suitable habitat quality exists and/or where groundwater can reasonably affect offsite surface water. The results of the baseline risk assessment will serve, along with other factors, as the basis for risk management decisions. The assessment will identify and characterize the toxicity of chemicals of potential concern (COPCs), potential exposure pathways, potential human and environmental receptors, and the likelihood and extent of impact or threat under the conditions defined for the site. If evaluation of remedial action is required, risk assessments conducted for the remedial action alternatives will identify potential threats to human health or the environment that may arise from the implementation of various remedial actions. Finally, the risk assessment process provides a basis for determining chemical concentrations that can remain in place at a site without posing risks to human health or the environment.

The HHRA and the ERA for the site will include the following three primary components:

- Developing and refining the CSM, including identifying relevant pathways of potential exposure to human and ecological receptors (this component is included in Worksheet #10 [*Problem Definition*]).
- Identifying COPCs in the identified exposure media (soil, soil gas, sediment, surface water, groundwater, and biota) that are most important to the risk assessment. Historical data of sufficient quality, combined with RI or SC data, will be evaluated to

[2] The term "action levels" is generally used here to denote criteria against which decisions are made. Action levels for human health risk include risk thresholds for cancer risk and noncancer hazard. Action levels for ecological receptors are based on comparison with water quality standards and terrestrial wildlife benchmarks.

identify COPCs in order to focus the risk assessment on the most important chemicals at the site. According to EPA guidance (EPA, December 1989), COPCs generally are chemicals that represent 99 percent of the total site risk.

- Quantitatively evaluating concentrations of COPCs in the identified exposure medium to identify whether they may occur at levels that support one of the decisions described above. COPCs contributing to the exceeding of action levels will be designated as chemicals of concern (COCs) and will be identified as chemicals that require further evaluation and remedial action.

14.6.1 HHRA Approach

The HHRA will serve to quantify (using health-conservative assumptions) the potential for unacceptable risks posed by COPCs identified in soil, groundwater, and soil gas. The HHRA will follow procedures described in the *Risk Assessment Procedures Manual* (ADEC, February 18, 2009) and consists of three primary components: exposure assessment, toxicity assessment, and risk characterization.

Exposure Assessment

Exposure assessment estimates the magnitude, frequency, and duration of exposure to a chemical, and the estimation of the exposure routes. This involves identifying the populations that could be exposed to chemicals at a site, as well as identifying potential pathways by which exposure could occur. The rates of exposure to those populations are calculated considering the following: the potential pathways of exposure, the frequency and duration of potential exposures, rates of contact with environmental media, and the concentrations of chemicals in these media.

In accordance with the generalized CSM, it is anticipated that risk will be evaluated for the following potential human exposure scenarios at all sites:

- **Excavation/construction workers:** Potential exposure of excavation/construction workers to chemicals in soil (to 15 bgs[3]) and shallow groundwater by incidental ingestion, dermal contact, and inhalation of ambient dust and vapors.
- **Current and future occupational workers:** Potential exposure of future occupational workers to chemicals in soil (to 2 feet bgs) by incidental ingestion, dermal contact, and inhalation of ambient dust and vapors in ambient air. Inhalation of vapors migrating from subsurface soil and groundwater to indoor air. Potential consumption of groundwater.
- **Hypothetical future residents:** Potential exposure of hypothetical future residents to chemicals in soil (to 15 feet bgs) by incidental ingestion, dermal contact, and inhalation of ambient dust and vapors in ambient air. Inhalation of vapors migrating from subsurface soil and groundwater to indoor air. Although future residential land use of the site is not anticipated at some sites, this scenario will address the possibility for restrictions on land use in the future. Potential domestic use of groundwater.

[3] If groundwater levels are less than 15 feet bgs, risk will be evaluated using soil results down to the groundwater table.

The exposure scenarios selected for evaluation are expected to account for the range of reasonably anticipated exposures under current and future conditions at the Former Galena FOL. The scenarios selected will be sufficiently conservative to adequately address other less common scenarios for soil, soil gas, and groundwater.

Toxicity Assessment

Toxicity assessment determines the relationship between the magnitude of exposure to a chemical and the occurrence of adverse health effects. This assessment provides, where possible, a numerical estimate of the increased likelihood or severity of adverse effects associated with exposure to a chemical. Appendix G provides a more detailed description of the sources of toxicity factors for the HHRA.

Risk Characterization

Risk characterization estimates the magnitude of the potential risk for each evaluated exposure scenario. Estimated intakes of substances will be compared with toxicity values to characterize potential noncancer effects. To characterize potential cancer effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from calculated intakes and chemical-specific dose-response information. Risk characterization also considers the nature and weight of evidence supporting these estimates, as well as the magnitude of uncertainty surrounding such estimates.

For media posing potentially unacceptable risks, the major risk-contributing COPCs (those contributing to the majority of the risk) will be identified as COCs. For the purposes of this evaluation, the potential for unacceptable human health risk is identified when the following occurs:

- The multi-constituent aggregate risk for the direct-contact pathways (soil, groundwater, and indoor air) exceeds an excess lifetime cancer risk (ELCR) of 1×10^{-5} or a noncancer HI of 1. When this occurs, the major risk-contributing chemicals will be evaluated as COCs. Risk estimates within the EPA risk management range of 1×10^{-6} to 1×10^{-4} will be evaluated for action on a case-by-case basis.
- If lead concentrations in environmental media result in a predicted blood-lead level of 10 micrograms per deciliter (µg/dL) in greater than 5 percent of the potentially exposed population, lead will be identified as a COC.

14.6.1 Ecological Risk Screening Evaluation Approach

The ERA approach will primarily follow guidance provided by ADEC in the *Risk Assessment Procedures Manual* (ADEC, February 18, 2009). This guidance provides for a phased approach to the risk assessment that includes a scoping evaluation (Step 1), followed by a preliminary screening evaluation (Step 2), a screening-level ERA (Step 3), and a baseline ERA (Step 4), as warranted (see Figure G3 in Appendix G).

Step 1 of the process (scoping evaluation) has been conducted at the Former Galena FOL. Sites identified at the FOL were evaluated using the *Ecoscoping Guidance* (ADEC, March

2009) to determine whether further ecological evaluation was warranted. The sites are categorized into the following four groups:

- Sites with no complete pathways at the site and no complete groundwater pathways from the site to or near the Yukon River; therefore, these sites will not be evaluated further
- Sites with potentially complete terrestrial and/or aquatic pathways at the site only; these sites will need to be evaluated further
- Sites with no potentially complete pathways at the site; however, these sites will be evaluated further to determine whether an aquatic pathway of groundwater from the site can daylight near or in the Yukon River
- Sites with potentially complete pathways at the site that will be evaluated further; in addition, these sites will be evaluated to determine whether an aquatic pathway of groundwater from the site can daylight near or in the Yukon River

The completed ecoscoping forms for most sites and the results are reported in the PA Report (CH2M HILL, 2010). Ecoscoping forms for the ERP sites are provided in this Work Plan (Appendix G, Attachment G-1). Those sites that require evaluation beyond the PA are summarized in Worksheet #10. On the basis of that assessment, two categories of sites were carried forward for evaluation in the SI and are included in this Work Plan. These are (1) sites lacking ecological exposure pathways that were carried forward for other reasons (e.g., human health screening levels were exceeded); and (2) sites with ecological exposure pathways potentially present (in addition to being carried forward for other reasons). Sites with ecological habitat are depicted in Figure 14-2A (6 ERP sites) and Figure 14-2B (26 remaining ERP sites).

Sites with no ecological pathways will not be evaluated further in an ERA. For sites with potential ecological pathways, existing media contaminant concentration data or limited media data collected during the SI (for sites lacking sufficient data) will be evaluated against ecological screening levels (ESLs). This screening will represent Steps 2 and 3 of the ADEC process, and will be presented in the SI Report and in refinement of this Baseline ERA Work Plan. Sites that do not have exceedances of the ESLs will not be further evaluated beyond the SI Report. Those sites that either have exceedances of ESLs or have bioaccumulative chemicals as indicated in the *Ecoscoping Guidance* (ADEC, March 2009) will be carried forward for evaluation in the Baseline ERA (BERA) (Step 4), as appropriate. The BERA will be included in the RI report for sites following the CERCLA regulatory pathway or in the SC report for sites following the ADEC regulatory pathway. A refinement of this Work Plan, outlining the methods and approaches for the Step 4 BERA, will be developed based on the screening results and identified data gaps (which will be addressed as part of a follow-up sampling event).

For sites with chlorinated contaminants or other hazardous substances, EPA guidance for ERA at Superfund sites (EPA, June 1997), as provided under CERCLA, will be followed (Figure G2 in Appendix G). Conversely, POL-only sites will continue along the ADEC regulatory pathway (ADEC, February 18, 2009). In both cases, components of the BERA will

include problem formulation, analysis, and risk characterization (including uncertainties), as outlined in EPA (1997) and ADEC (February 18, 2009) guidance. It should be noted that ADEC guidance generally follows EPA (April 1998). Descriptions of each of these elements and the approach proposed for the Former Galena FOL are provided below.

Problem Formulation

The Problem Formulation integrates available information (sources, contaminants, effects, and environmental setting) and serves to provide focus to the ERA. According to ADEC (February 18, 2009), this section includes a description of the site history and environmental setting, documentation of site visits, identification of contaminants known or suspected to be at the site, information about receptors likely to be present at the site, contaminant transport and fate, a preliminary ecotoxicity evaluation, and identification of exposure pathways. The end products of the problem formulation are an ecological CSM that describes the contaminant sources and transport mechanisms, evaluates potential exposure pathways, and identifies the representative species that will be used to assess ecological risk, assessment endpoints (the values to be protected), and measures (the means to evaluate potential adverse effects on the assessment endpoints).

Details of the problem formulation are provided in Appendix G. The ecological CSM diagram (developed based on the site history and environmental setting, chemicals of potential ecological concern [COPECs] at the site, and exposure pathways present) is provided in Figure G6(Appendix G). Preliminary assessment endpoints and measures identified for the site are outlined in Table G1 (Appendix G). Final selection of assessment endpoints and representative receptors will be determined through discussion with state and federal agencies during a risk assessment scoping meeting.

Analysis. The analysis phase consists of the technical evaluation of chemical and ecological data to determine potential for ecological exposure and adverse effects. This phase includes the characterization of exposure and the characterization of effects.

Available data for the screening evaluation will consist of existing contaminant concentrations in site media (soil and groundwater) and data gathered via limited sampling during the SI at sites with insufficient existing datasets. Typically, additional soil and water samples will be needed at each site evaluated in the BERA. For the screening evaluation, toxicity data will be derived from the literature as represented by screening benchmarks for soil and water (ADEC, March 2009) and sediment (Buchman, 2008). Avian and mammalian life-history parameters required for calculation of exposure estimates in the BERA (e.g., body weight, food ingestion rates, and dietary components) and toxicity reference values (TRVs) will also be developed from literature.

Exposure Characterization. The exposure characterization provides a description and quantification of the nature and magnitude of the interaction between ecological receptors and COPECs in soil, sediment, surface water, or groundwater. The preliminary exposure models and assumptions for each receptor at the Former Galena FOL are provided in Appendix G.

Effects Assessment. The ecological effects assessment consists of an evaluation of available toxicity or other effects information that can be used to relate the exposures to COPECs and adverse effects in ecological receptors. Data that can be used include literature-derived or site-specific single-chemical toxicity data, site-specific ambient-media toxicity tests, and site-specific field surveys (Suter et al., 2000). For the Former Galena FOL, the screening-level assessment will use single-chemical toxicity data from literature sources. As previously indicated, these will include screening values for soil, water, and sediment. A determination of whether to collect site-specific single-chemical toxicity data or perform site-specific ambient-media toxicity tests or site-specific field surveys for the BERA will be based on sampling and data evaluation in the SI. For the BERA, TRVs will be developed and detailed in the Step 4 refinement of this Work Plan.

Risk Characterization

In the risk characterization, exposure and effects data are integrated to draw conclusions about the presence, nature, and magnitude of effects that may exist at the site. The process by which exposure and effects data will be integrated to estimate risk at the screening level and likely methods for this process at the baseline level include estimation of risk and description of risk. Descriptions of the procedures to develop each of these elements are provided below.

Risk Estimate. In accordance with EPA (June 1997, April 1998) and ADEC (February 18, 2009) guidance, risks at the site will be evaluated based on the ratio of exposure concentrations or doses to TRVs, resulting in hazard quotients (HQs). For the screening evaluation, HQs for all receptors will be based on measured environmental concentrations (MECs) and benchmarks. HQ values less than 1.0 will be considered to indicate that adverse effects associated with exposure to a given analyte are unlikely (EPA, June 1997). These analytes will not be considered to present unacceptable risk and will be excluded from further evaluation. Because the screening benchmarks are derived primarily from effects data, an HQ equal to or greater than 1.0 will be considered to indicate a potential for adverse ecological effects. These analytes will be retained for further evaluation in the BERA. Additionally, bioaccumulative COPECs will be retained following the screening-level ERA for evaluation in the BERA. COPECS for which appropriate toxicity data are unavailable will not be evaluated further, but will be retained as uncertainties.

In contrast to the conservative approach used for the initial screening-level evaluation, the baseline evaluation focuses on the more reasonable potential for exposure of target species to COPECs. The reasonable potential for exposure and adverse effects will be evaluated through assessment of the available chemical (magnitude of HQ, cumulative risk for some chemical classes, and frequency of detection and exceedance) and biological (habitat quality and bioavailability of the COPEC) information. Examples of these evaluations (or lines of evidence) that may be incorporated in the BERA include a background screen, point-by-point analysis, frequency of detection, cumulative risk, habitat quality, exposure parameters, and site-specific data (see Appendix G for details).

Risk Description. The risk description will employ a weight-of-evidence approach in which all lines of evidence are considered to determine the potential for risk. Not all lines of evidence will be given equal weight in this analysis. For example, the background analysis

may be used to exclude risks from inorganics with site concentrations that do not statistically differ from background. However, other lines of evidence (e.g., frequency of detection, habitat quality) must be considered together as supporting or not supporting a conclusion of risk (or, in some cases, low risk).

Uncertainties

Uncertainties are inherent in all aspects of an ERA and include those related to problem formulation, exposure assessment, ecological effects assessment, and risk estimation and risk characterization. They may be associated with exposure parameters, toxicity values, and other literature-based information, as well as with site data or lack thereof. This section will list the important sources of uncertainty and describe whether they result in an underestimate or overestimate of ecological risks.

14.6.2 Media-specific Risk Assessment Strategies

The results of both the HHRA and the ERA will be used to make decisions for each environmental medium. The step-by-step procedures, to be used for evaluation of the analytical data for environmental media sampled during the field investigations conducted at each RI and SC site, are provided in this section.

For each sampled medium at the site, the samples will be evaluated to determine whether they provide sufficient spatial coverage of the site to be pooled for a risk assessment (that is, if the sampled area is small enough to be reasonably evaluated as a single-sample population). Chemicals detected in each medium and identified as COPCs will be carried forward to the HHRA and the ERA (where appropriate) to determine whether they should be designated as COCs.

Based on the results of the CSM discussed in Worksheet #10 [*Problem Definition*], potential risks from chemicals in soil, soil gas, and/or groundwater will be evaluated for feasible pathways of potential exposure. The analytical data for these media will be evaluated using the following steps:

- Identify COPCs using the process described in Appendix G.
- Calculate aggregate constituent excess cancer risk and noncancer HI and ecological HQs using the methods described in Appendix G for the identified COPCs.
- Compare the results of these risk calculations with the human health and ecological risk thresholds defined in Sections 14.6.1 and 14.6.2.
- Identify the major risk-contributing chemicals for risk estimates that exceed respective human and ecological risk thresholds as COCs.
- Determine whether further evaluation of COCs or collection of additional data would be expected to (1) support a No Further Action designation, (2) refine the evaluation assumptions, and/or (3) plan an additional field investigation phase.

- Evaluate remedial actions or institutional controls if further evaluation of COCs or collection of additional data would not be expected to support a No Further Action designation.

14.7 Reporting

After the SI and SC activities are completed, a report will be prepared, in accordance with the requirements of 18 AAC 75.335 (c), to present the findings of the implemented Work Plan and provide a complete description of the nature and extent of contamination detected during the field sampling and analysis. The report will also propose any additional SC required to identify the limits of contamination in soil and groundwater, interim cleanup actions, or, if the SC is considered complete, how the contamination will be cleaned up. Site figures, supporting tables, the preliminary CSM, and other information from the Work Plan will be updated (ADEC, September 23, 2009). For sites where RI activities were performed, an RI/FS report will be prepared in accordance with CERCLA guidance (EPA, October 1988). A baseline risk assessment will be included with both SC and RI reports to identify current and potential future risks to human health and the environment from site contamination.

TABLE 14-1
Soil and Groundwater Analyses for POL-contaminated Investigation Areas

Petroleum Product	GRO	DRO	RRO	BTEX	PAHs[a, c, e]	Other VOCs	EDB 1,2-DCA	MTBE	Metals[b, d]	PCBs
Leaded Gasoline	X			X	X[a]		X		X[b]	
Aviation Gasoline	X			X	X[a]		X		X[b]	
Unleaded Gasoline	X			X	X[c]					
JP-4, Kerosene, Jet B	X	X		X	X[c]					
Diesel #1 or Arctic Diesel	X	X		X	X[c]					
#2 Diesel	X	X		X	X[c]					
JP-5, JP-8, or Jet A	X	X		X	X[c]					
#3 – #6 Fuel Oils or Bunker C		X	X	X	X[c]					
Crude Oil	X	X	X	X	X[c]				X[d]	
Waste Oil, Used Oil, or unknowns	X	X	X	X	X[c]	X	X		X[d]	X

Source: Modified from Appendix F (ADEC, January 2010).

[a]PAH analysis for gasolines may be limited to naphthalene only.

[b]Metal analysis for leaded and aviation gasolines may be limited to lead only.

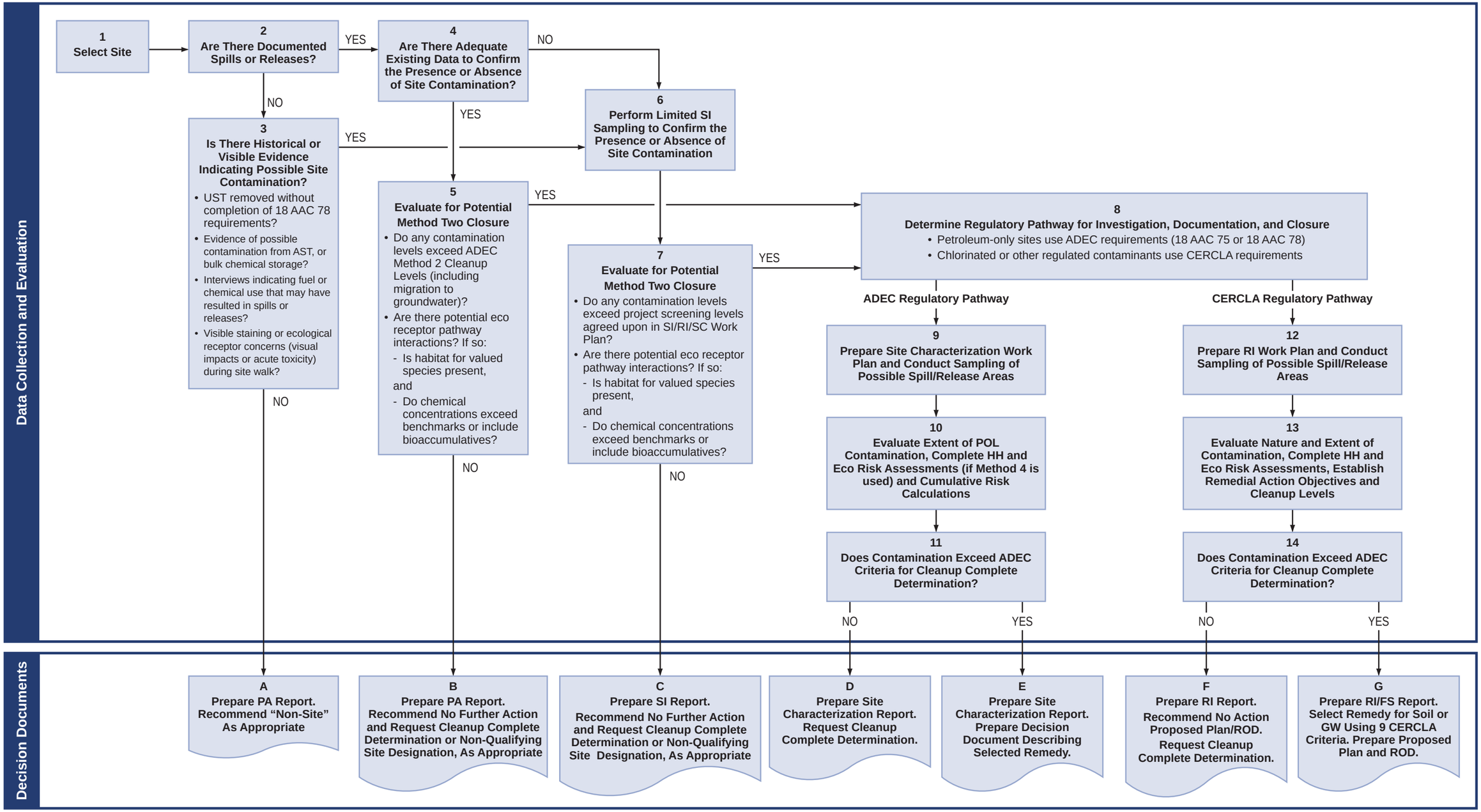
[c]PAH indicator compounds include the following: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(123-cd)pyrene, naphthalene, phenanthrene, and pyrene.

[d]Metal analysis includes the following: arsenic, barium, cadmium, chromium, lead, nickel, and vanadium.

[e]For site inspections and UST closures, PAH analysis will be conducted only on samples collected from the suspected source area and identified zones of contamination, and may be limited to 10 percent of samples obtained in those areas.

Notes:

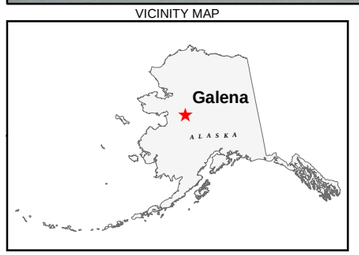
1,2-DCA = 1,2-dichloroethane
BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel-range organics
EDB = ethylene dibromide
GRO = gasoline-range organics
MTBE = methyl tertiary butyl ether
PAH = polynuclear aromatic hydrocarbon
PCBs = polychlorinated biphenyls
POL = petroleum, oils, and lubricants
RRO = residual-range organics
VOCs = volatile organic compounds



Note that contamination migrating from an adjacent site will be addressed as part of the adjacent (or source) site for the purpose of environmental cleanup.

FIGURE 14-1
Flowchart for Site Screening Process
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

VICINITY MAP



LEGEND

- Higher Quality Habitat
- Limited/No Habitat
- Marginal Habitat

Notes:
1. Imagery September 4, 2009. Pixel size 0.25 meters.

N

0 375 750
Feet

FIGURE 14-2A
Ecological Habitat at Investigation Areas
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location

CH2MHILL

Worksheet #15 – Reference Limits and Evaluation

One of the primary goals of this Work Plan is to select the appropriate analytical methods needed to achieve the limits of detection (LODs) to satisfy the overall project DQOs (as defined in Worksheet #10 [*Problem Definition*]).

15.1 Target Analytical Suites

The target analyte list for each site will depend on the types of materials and chemicals handled at or near the site, as well as analytical results for samples collected at and near (i.e., within 500 feet) the site. On the basis of site histories and operational information for the FOL, the target analytes for most sites are expected to be chemicals that make up one or more of the following analytical suites:

- VOCs
- SVOCs
- Metals
- Pesticides
- PCBs
- Total petroleum hydrocarbons as GRO, DRO, and RRO
- Dioxins/furans

Figure 15-1 (figures are located at the end of this worksheet) depicts the decision process for selecting target analytes for each site (figures are located at the end of this worksheet).

15.2 Project Screening Levels

Screening levels are conservative, predominantly risk-based values used to characterize and determine the nature and extent of contamination in soil and groundwater, and to predict possible impacts to indoor air. The SLs are intended for screening purposes only; exceedance of an SL is not an indication of unacceptable risk. Tables listing the values used in the selection process for each medium and evaluation group are provided in Appendix C. The processes used to select SLs for soil, groundwater, surface water, sediment, and soil vapor are presented in Figure 15-2.

15.3 Soil Screening Levels

The investigation type, sample depth, presence or absence of ecological habitat, and sample depth determine which SLs will be applied to soil samples collected at each site. The following three types of soil SLs have been developed for use in the SI/SC/RI:

- **SI Soil SLs –** apply to all soil samples collected at nonhabitat sites and subsurface soil (>2 feet bgs) samples collected at habitat sites during the SI
- **SI Soil SLs – Ecological Habitat –** apply to surface soil (0 to 2 feet bgs) samples collected at habitat sites during the SI
- **Extent Soil SLs –** apply to all surface and subsurface soil samples collected for extent delineation purposes during the SC or RI

15.3.1 SI Soil Screening Levels

The selection process for SI soil SLs is shown in Figure 15-2. This process considers potential exposure of human receptors to contaminants in soil through direct contact and outdoor inhalation, considers protection of groundwater, and also accounts for background concentrations of metals.

The primary sources of the human health risk-based values are the ADEC Method 2 Cleanup Levels for direct contact and outdoor inhalation for sites with less than 40 inches of precipitation and the ADEC Method 2 Cleanup Levels for migration to groundwater (listed in Tables B1 and B2 of 18 AAC 75 [ADEC, revised October 9, 2008]). For analytes without ADEC-listed values, the human health risk-based values are the residential values listed in *Regional Screening Levels for Chemical Contaminants at Superfund Sites* (RSLs) (EPA, 2009).

For most analytes, the SI soil SL is the lowest of the ADEC Method 2 values. For metals, however, this lowest value is compared with background concentrations of metals in FOL soils, , and if the background concentration is higher, it is selected as the screening level.

15.3.2 SI Soil Screening Levels – Ecological Habitat

The selection process for SI soil SLs for surface soil at sites within or near ecological habitat is shown in Figure 15-2. This process considers protection of human and ecological receptors, protection of groundwater, and background concentrations for metals.

The sources and selection process for the human health values are the same as for the nonecological sites. The source of the ecological values used in the SL selection process is the ADEC ecological risk-based screening concentrations (ERBSCs) listed in the ADEC *Ecoscoping Guidance* (ADEC, March 2009).

For most analytes, the SI soil SL is the lowest of the ADEC Method 2 and ecological screening values. For metals, however, if the background concentration is higher, it is selected as the screening level.

15.3.3 Extent Soil Screening Levels

The selection process for extent soil SLs is shown in Figure 15-2. This process considers cumulative exposure of human receptors to contaminants in soil through direct contact and outdoor inhalation, as well as protection of groundwater. It also accounts for background concentrations of metals.

The primary sources of the human health risk-based values are the ADEC Method 2 Cleanup Levels for direct contact and outdoor inhalation for sites with less than 40 inches of precipitation, as adjusted to account for possible cumulative risk associated with multiple chemical exposures[1], and the ADEC Method 2 Cleanup Levels for migration to groundwater. The adjusted ADEC values are compared with each other to choose the lowest ADEC value for each analyte. For analytes without ADEC-listed values, the human health risk-based values are the RSLs, as adjusted to account for possible cumulative risk.[2]

For most analytes, the extent soil SL is the lowest of the adjusted ADEC Method 2 values. For metals, however, this lowest value is compared with background concentrations of metals in FOL soils, , and if the background concentration is higher, it is selected as the screening level. [need to provide reference to new TM and to use of background in SI evaluations]

15.4 Groundwater Screening Levels

Four sets of SLs were developed for groundwater. The investigation type and location of the site relative to surface water determine which SLs will be applied to groundwater samples collected at each site. The following four types of groundwater SLs have been developed for use in the SI/SC/RI:

- **SI Groundwater SLs –** apply to all groundwater samples collected at sites greater than 1,000 feet[3] from the Yukon River during the SI.
- **SI Groundwater to Surface Water SLs –** apply to all groundwater samples collected at sites less than 1,000 feet from the Yukon River during the SI.
- **Extent Groundwater SLs –** apply to all groundwater samples collected at sites greater than 1,000 feet from the Yukon River during the SC or RI.
- **Extent Groundwater to Surface Water SLs –** apply to all groundwater samples collected at sites less than 1,000 feet from the Yukon River during the SC or RI.

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1 The Method 2 soil cleanup levels for carcinogenic chemicals are based on an ELCR of 1×10^{-5}, and the cleanup levels for noncarcinogenic chemicals are based on a hazard index (HI) of 1. To account for possible cumulative risk associated with multiple chemical exposures, the listed Method 2 cleanup levels for direct contact and outdoor inhalation are divided by 10.

2 The RSLs are based on an HI of 1 for noncarcinogens and an ELCR of 1×10^{-6} for carcinogens; consequently, the residential RSLs for noncarcinogenic chemicals are divided by 10 to account for possible cumulative risk, but the RSLs for carcinogenic chemicals do not require adjustment.

3 The distance was selected as reasonably conservative from the river for evaluation of potential groundwater discharge to surface water, and encompasses much of the southern portion of the FOL.

15.4.1 SI Groundwater Screening Levels

The selection process for SI groundwater SLs at sites where surface water discharge is not a consideration is shown in Figure 15-2. This process considers potential exposure of human receptors to contaminants in groundwater through drinking water and accounts for background concentrations of metals.

The primary source of the groundwater values is the ADEC Method 2 Cleanup Levels listed in Table C of 18 AAC 75. For target analytes without ADEC-listed values, the human health risk-based values are based on the tap water values listed in the RSLs.

For most analytes, the groundwater SL is the drinking-water-based value. For metals, however, this value is compared with background concentrations of metals in FOL groundwater, and if the background concentration is higher, it is selected as the screening level.

15.4.2 SI Groundwater to Surface Water Screening Levels

The selection process for SI groundwater SLs at sites where surface water discharge is a consideration is shown in Figure 15-2. This process considers potential exposure of human receptors to contaminants in groundwater through drinking water, potential exposure of ecological receptors to contaminants in surface water, and background concentrations of metals.

The sources and selection process for the human health drinking water values are the same as for the groundwater-only sites. The source of the ecological values used in the SL selection process is the ADEC ERBSCs for surface water, listed in the ADEC *Ecoscoping Guidance* (ADEC, March 2009), 18 AAC 70 Water Quality Standards (September 2009), and Alaska Water Quality Criteria for Aquatic Life (freshwater, chronic) (ADEC, December 2008). For most analytes, the SI groundwater-to-surface-water SL is the lowest of the human health and ecological screening values. For metals, however, this value is compared with the higher of the background concentrations of metals in FOL groundwater and surface water, and if the background concentration is higher, it is selected as the screening level.

15.4.3 Extent Groundwater Screening Levels

The selection process for extent groundwater SLs at sites where surface water discharge is not a consideration is shown in Figure 15-2. This process considers potential exposure of human receptors to contaminants in groundwater through drinking water and accounts for background concentrations of metals.

The primary source of the groundwater values is the ADEC Method 2 Cleanup Levels listed in Table C of 18 AAC 75, as adjusted to account for possible cumulative risk associated with multiple chemical exposures. For analytes without ADEC-listed values, the human health risk-based values will be the RSLs, as adjusted to account for possible cumulative risk.

For most analytes, the extent groundwater SL is the drinking-water-based value. For metals, however, this value is compared to background concentrations of metals in FOL groundwater, and if the background concentration is higher, it is selected as the screening level.

15.4.4 Extent Groundwater to Surface Water Screening Levels

The selection process for extent groundwater SLs at sites where surface water discharge is a consideration is shown in Figure 15-2. This process considers potential exposure of human receptors to contaminants in groundwater through drinking water, potential exposure of ecological receptors to contaminants in surface water, and background concentrations of metals.

The sources and selection process for extent SLs are the same as for the SI groundwater to surface water SLs. However, for the ADEC-only sites, the source of the ecological values used in the SL selection process is the ADEC ERBSCs for surface water, listed in the ADEC *Ecoscoping Guidance* (ADEC, March 2009), 18 AAC 70 Water Quality Standards (September 2009), and Alaska Water Quality Criteria for Aquatic Life (freshwater, chronic) (ADEC, December 2008). For most analytes, the SI groundwater-to-surface-water SL is the lowest of the human health and ecological screening values. For metals, however, this value is compared with background concentrations of metals in FOL groundwater, and if the background concentration is higher, it is selected as the screening level.

15.5 Soil Vapor Screening Levels

The SLs used to evaluate the potential for contaminants in soil vapor to adversely affect indoor air are based on the ADEC Shallow Soil Target Levels, as listed in *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC, July 2009).

15.6 Surface Water and Sediment Screening Levels

Surface water and sediment are not currently the focus of site inspections or nature and extent of contamination evaluations. However, because samples of these media may be collected to assist in characterization of site conditions, screening levels based on ecological criteria have been identified. The surface water screening levels include the same surface water criteria used in the groundwater to surface water SLs and background levels of metals in FOL surface water samples. The sediment screening levels are based on the ADEC sediment ERBSCs.

15.7 Reference Limit Determination

The estimated LODs and Limits of Quantitation (LOQs) for each chemical included in the above-listed analytical suites were compared with the lowest of the potentially applicable SLs for each medium and evaluation group. The results of these comparisons are listed in Tables 15-1 (soil SLs), 15-2 (groundwater SLs), 15-3 (soil vapor SLs), 15-4 (surface water SLs), and 15-5 (sediment SLs) (tables are located at the end of this worksheet).

The tables show that, in most cases, the estimated LODs for each listed target analyte will meet the analytical DQOs. If the LOD is below the screening criterion, the LOD is sufficient for quantitative use. Laboratory-specific LODs and LOQs will be reviewed in detail prior to project startup.

Sample dilution, because of target and/or nontarget analyte concentrations or matrix interference, may prevent the achievement of LODs. Initially, all samples must be analyzed undiluted (when reasonable). If a dilution is necessary, both the original and diluted result must be delivered. Any samples that are not analyzed undiluted must have approval from the CH2M HILL project chemist within the extraction/analysis holding time and be supported by matrix interference documentation (such as sample viscosity, color, odor, or results from other analyses of the same sample) to show that an undiluted sample is not possible. Appropriate cleanup procedures must be followed to minimize the matrix effects on the LODs.

Table 15-1
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Soil
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Extent Soil SL	Source of Extent Soil SL	Estimated LOD Exceeds Extent Soil SL?	Estimated LOQ Exceeds Extent Soil SL?	SI Soil Eco SL	Source of SI Soil Eco SL	Estimated LOD Exceeds SI Soil Eco SL?	Estimated LOQ Exceeds SI Soil Eco SL?	SI Soil non-Eco SL	Source of SI Soil non-Eco SL	Estimated LOD Exceeds SI Soil non-Eco SL?	Estimated LOQ Exceeds SI Soil non-Eco SL?
AK101	Gasoline Range Organics	C6-C10 GRO	mg/kg	0.5	1	140	1/10th 2009 ADEC Table B2 Method 2-Under 40 in-Ingestion	No	No	300	2009 ADEC Table B2 Method 2 - Migration to Groundwater	No	No	300	2009 ADEC Table B2 Method 2 - Migration to Groundwater	No	No
AK102/103	Diesel Range Organics	C10-C25 DRO	mg/kg	5	10	250	2009 ADEC Table B2 Method 2 - Migration to Groundwater	No	No	250	2009 ADEC Table B2 Method 2 - Migration to Groundwater	No	No	250	2009 ADEC Table B2 Method 2 - Migration to Groundwater	No	No
AK102/103	Motor Oil Range Organics	C25-C36 RRO	mg/kg	5	10	1000	1/10th 2009 ADEC Table B2 Method 2-Under 40 in-Ingestion	No	No	1000	1/10th 2009 ADEC Table B2 Method 2-Under 40 in-Outdoor Inhl	No	No	1000	1/10th 2009 ADEC Table B2 Method 2-Under 40 in-Outdoor Inhl	No	No
NWEPH	C10-C12 Aliphatics	C10-C12 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C10-C12 Aromatics	C10-C12 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C12-C16 Aliphatics	C12-C16 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C12-C16 Aromatics	C12-C16 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C16-C21 Aliphatics	C16-C21 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C16-C21 Aromatics	C16-C21 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C21-C34 Aliphatics	C21-C34 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C21-C34 Aromatics	C21-C34 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C8-C10 Aliphatics	C8-C10 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C8-C10 Aromatics	C8-C10 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	Total EPH (TEPH)	TEPH	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C10-C12 Aliphatics	C10-C12 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C10-C12 Aromatics	C10-C12 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C12-C13 Aromatics	C12-C13 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C5-C6 Aliphatics	C5-C6 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C5-C6 Aromatics	C5-C6 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C6-C8 Aliphatics	C6-C8 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C6-C8 Aromatics	C6-C8 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C8-C10 Aliphatics	C8-C10 Aliphatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C8-C10 Aromatics	C8-C10 Aromatics	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	Total VPH (TVPH)	TVPH	mg/kg	2	5	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW6010B/SW6020	Aluminum	7429-90-5	mg/kg	5	20	-	-	-	-	5	2009 ADEC Ecoscoping Soil ERBSC	No	Yes	-	-	-	-
SW6010B/SW6020	Antimony	7440-36-0	mg/kg	0.1	0.5	3.6	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.27	2009 ADEC Ecoscoping Soil ERBSC	No	Yes	3.6	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Arsenic	7440-38-2	mg/kg	0.1	0.5	0.45	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	Yes	0.25	2009 ADEC Ecoscoping Soil ERBSC	No	Yes	3.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Barium	7440-39-3	mg/kg	0.1	0.5	1100	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	5	2009 ADEC Ecoscoping Soil ERBSC	No	No	1100	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Beryllium	7440-41-7	mg/kg	0.1	0.5	20	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	2.42	2009 ADEC Ecoscoping Soil ERBSC	No	No	42	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Cadmium	7440-43-9	mg/kg	0.1	0.5	5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.2	2009 ADEC Ecoscoping Soil ERBSC	No	Yes	5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Calcium	7440-70-2	mg/kg	10	100	-	-	-	-	-	-	-	-	-	-	-	-
SW6010B/SW6020	Chromium	7440-47-3	mg/kg	0.1	0.5	25	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	25	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	25	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Cobalt	7440-48-4	mg/kg	0.1	0.5	-	-	-	-	13	2009 ADEC Ecoscoping Soil ERBSC	No	No	-	-	-	-
SW6010B/SW6020	Copper	7440-50-8	mg/kg	0.1	0.5	410	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	1	2009 ADEC Ecoscoping Soil ERBSC	No	No	460	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Iron	7439-89-6	mg/kg	3	20	-	-	No	No	-	-	-	-	-	-	-	-
SW6010B/SW6020	Lead	7439-92-1	mg/kg	0.1	0.5	40	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	9.36	2009 ADEC Ecoscoping Soil ERBSC	No	No	400	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW6010B/SW6020	Magnesium	7439-95-4	mg/kg	10	100	-	-	-	-	-	-	-	-	-	-	-	-
SW6010B/SW6020	Manganese	7439-96-5	mg/kg	0.1	0.5	-	-	-	-	100	2009 ADEC Ecoscoping Soil ERBSC	No	No	-	-	-	-
SW6010B/SW6020	Molybdenum	7439-98-7	mg/kg	0.5	5	-	-	-	-	-	-	-	-	-	-	-	-
SW6010B/SW6020	Nickel	7440-02-0	mg/kg	0.1	0.5	86	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	25	2009 ADEC Ecoscoping Soil ERBSC	No	No	86	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Potassium	7440-09-7	mg/kg	20	200	-	-	-	-	-	-	-	-	-	-	-	-
SW6010B/SW6020	Selenium	7782-49-2	mg/kg	0.1	0.5	3.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.02	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	3.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Silver	7440-22-4	mg/kg	0.1	0.5	11.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	2	2009 ADEC Ecoscoping Soil ERBSC	No	No	11.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Sodium	7440-23-5	mg/kg	10	100	-	-	-	-	-	-	-	-	-	-	-	-
SW6010B/SW6020	Thallium	7440-28-0	mg/kg	0.1	0.5	0.81	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.01	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	1.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW6010B/SW6020	Vanadium	7440-62-2	mg/kg	0.5	1	71	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	2	2009 ADEC Ecoscoping Soil ERBSC	No	No	710	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW6010B/SW6020	Zinc	7440-66-6	mg/kg	1	2.5	3040	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.9	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	4100	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW7471A	Mercury	7439-97-6	mg/kg	0.033	0.1	1.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8021B	Benzene	71-43-2	mg/kg	0.002	0.005	0.025	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0068	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.025	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8021B	Ethylbenzene	100-41-4	mg/kg	0.002	0.005	6.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Ecoscoping Soil ERBSC	No	No	6.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8021B	m,p-Xylene	136777-61-2	mg/kg	0.002	0.005	6.3	1/10th 2009 ADEC Table B1 Method 2 - Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	63	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8021B	o-Xylene	95-47-6	mg/kg	0.002	0.005	380	1/10th 2010 EPA Residential Soil RSL	No	No	1	2009 ADEC Ecoscoping Soil ERBSC	No	No	3800	2010 EPA Residential Soil RSL	No	No
SW8021B	Toluene	108-88-3	mg/kg	0.002	0.005	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.08	2009 ADEC Ecoscoping Soil ERBSC	No	No	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8021B	Xylenes (total)	1330-20-7	mg/kg	0.002	0.005	6.3	1/10th 2009 ADEC Table B1 Method 2 - Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	63	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	4,4'-DDD	72-54-8	mg/kg	0.0015	0.004	3	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	7.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	7.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	4,4'-DDE	72-55-9	mg/kg	0.0015	0.004	2.1	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	1.3	2009 ADEC Ecoscoping Soil ERBSC	No	No	5.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	4,4'-DDT	50-29-3	mg/kg	0.0015	0.004	2.1	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.7	2009 ADEC Ecoscoping Soil ERBSC	No	No	7.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Aldrin	309-00-2	mg/kg	0.0015	0.004	0.03	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.07	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.07	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	alpha-BHC	319-84-6	mg/kg	0.0015	0.004	0.0064	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0064	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0064	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	alpha-Chlordane	5103-71-9	mg/kg	0.0015	0.004	1.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	2.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	2.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	beta-BHC	319-85-7	mg/kg	0.0015	0.004	0.022	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.022	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.022	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	delta-BHC	319-86-8	mg/kg	0.0015	0.004	0.27	2010 EPA Residential Soil RSL	No	No	0.27	2010 EPA Residential Soil RSL	No	No	0.27	2010 EPA Residential Soil RSL	No	No
SW8081A	Dieldrin	60-57-1	mg/kg	0.0015	0.004	0.0076	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0076	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0076	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Endosulfan I	959-98-8	mg/kg	0.0015	0.004	61	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.55	2009 ADEC Ecoscoping Soil ERBSC	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Endosulfan II	33213-65-9	mg/kg	0.0015	0.004	61	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.55	2009 ADEC Ecoscoping Soil ERBSC	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Endosulfan sulfate	1031-07-8	mg/kg	0.0015	0.004	61	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No

Table 15-1
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Soil
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Extent Soil SL	Source of Extent Soil SL	Estimated LOD Exceeds Extent Soil SL?	Estimated LOQ Exceeds Extent Soil SL?	SI Soil Eco SL	Source of SI Soil Eco SL	Estimated LOD Exceeds SI Soil Eco SL?	Estimated LOQ Exceeds SI Soil Eco SL?	SI Soil non-Eco SL	Source of SI Soil non-Eco SL	Estimated LOD Exceeds SI Soil non-Eco SL?	Estimated LOQ Exceeds SI Soil non-Eco SL?
SW8081A	Endrin	72-20-8	mg/kg	0.0015	0.004	0.2	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.083	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.29	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Endrin aldehyde	7421-93-4	mg/kg	0.0015	0.004	61	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Endrin ketone	53494-70-5	mg/kg	0.0015	0.004	61	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	gamma-BHC (Lindane)	58-89-9	mg/kg	0.0015	0.004	0.0095	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0095	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0095	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	gamma-Chlordane	5103-74-2	mg/kg	0.0015	0.004	1.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	2.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	2.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Heptachlor	76-44-8	mg/kg	0.0015	0.004	0.13	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.28	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.28	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Heptachlor epoxide	1024-57-3	mg/kg	0.0015	0.004	0.014	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.014	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.014	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Methoxychlor	72-43-5	mg/kg	0.004	0.02	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8081A	Toxaphene	8001-35-2	mg/kg	0.004	0.02	0.75	1/10th 2009 ADEC Table B1 Method 2 - Under 40 inch Zone - Direct Contact	No	No	3.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	3.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8082	Aroclor-1016	12674-11-2	mg/kg	0.02	0.05	3.9	2010 EPA Residential Soil RSL	No	No	2510	2009 ADEC Ecoscoping Soil ERBSC	No	No	3.9	2010 EPA Residential Soil RSL	No	No
SW8082	Aroclor-1221	11104-28-2	mg/kg	0.02	0.05	0.14	2010 EPA Residential Soil RSL	No	No	0.14	2010 EPA Residential Soil RSL	No	No	0.14	2010 EPA Residential Soil RSL	No	No
SW8082	Aroclor-1232	11141-16-5	mg/kg	0.02	0.05	0.14	2010 EPA Residential Soil RSL	No	No	0.14	2010 EPA Residential Soil RSL	No	No	0.14	2010 EPA Residential Soil RSL	No	No
SW8082	Aroclor-1242	53469-21-9	mg/kg	0.02	0.05	0.22	2010 EPA Residential Soil RSL	No	No	0.22	2010 EPA Residential Soil RSL	No	No	0.22	2010 EPA Residential Soil RSL	No	No
SW8082	Aroclor-1248	12672-29-6	mg/kg	0.02	0.05	0.22	2010 EPA Residential Soil RSL	No	No	0.22	2010 EPA Residential Soil RSL	No	No	0.22	2010 EPA Residential Soil RSL	No	No
SW8082	Aroclor-1254	11097-69-1	mg/kg	0.02	0.05	0.22	2010 EPA Residential Soil RSL	No	No	2510	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.22	2010 EPA Residential Soil RSL	No	No
SW8082	Aroclor-1260	11096-82-5	mg/kg	0.02	0.05	0.22	2010 EPA Residential Soil RSL	No	No	0.22	2010 EPA Residential Soil RSL	No	No	0.22	2010 EPA Residential Soil RSL	No	No
SW8260B	1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	0.002	0.005	1.9	2010 EPA Residential Soil RSL	No	No	1.9	2010 EPA Residential Soil RSL	No	No	1.9	2010 EPA Residential Soil RSL	No	No
SW8260B	1,1,1-Trichloroethane	71-55-6	mg/kg	0.002	0.005	0.82	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.82	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.82	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	0.002	0.005	0.017	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.017	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.017	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,1,2-Trichloroethane	79-00-5	mg/kg	0.002	0.005	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,1-Dichloroethane	75-34-3	mg/kg	0.002	0.005	25	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Ecoscoping Soil ERBSC	No	No	25	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,1-Dichloroethene	75-35-4	mg/kg	0.002	0.005	0.03	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.03	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.03	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,1-Dichloropropene	563-58-6	mg/kg	0.002	0.005	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,2,3-Trichlorobenzene	87-61-6	mg/kg	0.002	0.005	4.9	1/10th 2010 EPA Residential Soil RSL	No	No	20	2009 ADEC Ecoscoping Soil ERBSC	No	No	49	2010 EPA Residential Soil RSL	No	No
SW8260B	1,2,3-Trichloropropane	96-18-4	mg/kg	0.002	0.005	0.00053	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0005	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.00053	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8260B	1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.002	0.005	0.85	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.85	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.85	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,2,4-Trimethylbenzene	95-63-6	mg/kg	0.002	0.005	4.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	0.005	0.01	0.0054	2010 EPA Residential Soil RSL	No	Yes	0.0054	2010 EPA Residential Soil RSL	No	Yes	0.0054	2010 EPA Residential Soil RSL	No	Yes
SW8260B	1,2-Dibromoethane	106-93-4	mg/kg	0.005	0.01	0.00016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0002	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.00016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8260B	1,2-Dichlorobenzene	95-50-1	mg/kg	0.002	0.005	4.5	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	5.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,2-Dichloroethane	107-06-2	mg/kg	0.002	0.005	0.016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,2-Dichloropropane	78-87-5	mg/kg	0.002	0.005	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,3,5-Trimethylbenzene	108-67-8	mg/kg	0.002	0.005	4.2	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	23	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,3-Dichlorobenzene	541-73-1	mg/kg	0.002	0.005	6.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	28	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	1,3-Dichloropropane	142-28-9	mg/kg	0.002	0.005	160	1/10th 2010 EPA Residential Soil RSL	No	No	1600	2010 EPA Residential Soil RSL	No	No	1600	2010 EPA Residential Soil RSL	No	No
SW8260B	1,4-Dichlorobenzene	106-46-7	mg/kg	0.002	0.005	0.64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	2,2-Dichloropropane	594-20-7	mg/kg	0.002	0.005	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	2-Butanol	79.92-2	mg/kg	0.005	0.01	16000	1/10th 2010 EPA Residential Soil RSL	No	No	160000	2010 EPA Residential Soil RSL	No	No	160000	2010 EPA Residential Soil RSL	No	No
SW8260B	2-Butanone	78-93-3	mg/kg	0.005	0.01	59	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	35	2009 ADEC Ecoscoping Soil ERBSC	No	No	59	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	2-Chlorotoluene	95-49-8	mg/kg	0.002	0.005	160	1/10th 2010 EPA Residential Soil RSL	No	No	1600	2010 EPA Residential Soil RSL	No	No	1600	2010 EPA Residential Soil RSL	No	No
SW8260B	2-Hexanone	591-78-6	mg/kg	0.005	0.01	21	1/10th 2010 EPA Residential Soil RSL	No	No	210	2010 EPA Residential Soil RSL	No	No	210	2010 EPA Residential Soil RSL	No	No
SW8260B	4-Chlorotoluene	106-43-4	mg/kg	0.002	0.005	550	1/10th 2010 EPA Residential Soil RSL	No	No	5500	2010 EPA Residential Soil RSL	No	No	5500	2010 EPA Residential Soil RSL	No	No
SW8260B	4-Methyl-2-pentanone	108-10-1	mg/kg	0.005	0.01	8.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	8.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	8.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Acetone	67-64-1	mg/kg	0.005	0.01	88	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	20	2009 ADEC Ecoscoping Soil ERBSC	No	No	88	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Benzene	71-43-2	mg/kg	0.002	0.005	0.025	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0068	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.025	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Bromobenzene	108-86-1	mg/kg	0.002	0.005	30	1/10th 2010 EPA Residential Soil RSL	No	No	300	2010 EPA Residential Soil RSL	No	No	300	2010 EPA Residential Soil RSL	No	No
SW8260B	Bromochloromethane	74-97-5	mg/kg	0.002	0.005	0.044	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.044	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.044	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Bromodichloromethane	75-27-4	mg/kg	0.002	0.005	0.044	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.044	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.044	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Bromoform	75-25-2	mg/kg	0.002	0.005	0.34	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.34	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.34	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Bromomethane	74-83-9	mg/kg	0.005	0.01	0.16	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.16	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.16	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Carbon Disulfide	75-15-0	mg/kg	0.002	0.005	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Carbon Tetrachloride	56-23-5	mg/kg	0.002	0.005	0.023	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.023	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.023	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Chlorobenzene	108-90-7	mg/kg	0.002	0.005	0.63	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.63	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Chloroethane	75-00-3	mg/kg	0.002	0.005	2.3	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	23	2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	23	2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No
SW8260B	Chloroform	67-66-3	mg/kg	0.002	0.005	0.32	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.46	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.46	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Chloromethane	74-87-3	mg/kg	0.005	0.01	0.21	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.21	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.21	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	cis-1,2-Dichloroethene	156-59-2	mg/kg	0.002	0.005	0.24	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.24	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.24	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	cis-1,3-Dichloropropene	10061-01-5	mg/kg	0.002	0.005	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Dibromochloromethane	124-48-1	mg/kg	0.002	0.005	0.032	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.032	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.032	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Dibromomethane	74-95-3	mg/kg	0.002	0.005	1.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Dichlorodifluoromethane	75-71-8	mg/kg	0.002	0.005	38	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	140	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	140	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Ethylbenzene	100-41-4	mg/kg	0.002	0.005	6.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.018	2009 ADEC Ecoscoping Soil ERBSC	No	No	6.9	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Hexachlorobutadiene	87-68-3	mg/kg	0.002	0.005	0.12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Isopropylbenzene	98-82-8	mg/kg	0.002	0.005	6.2	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	51	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	51	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	m,p-Xylene	136777-61-2	mg/kg	0.005	0.01	6.3	1/10th 2009 ADEC Table B1 Method 2 - Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	63	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Methyl tert butylether	1634-04-4	mg/kg	0.005	0.01	1.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No

Table 15-1
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Soil
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Extent Soil SL	Source of Extent Soil SL	Estimated LOD Exceeds Extent Soil SL?	Estimated LOQ Exceeds Extent Soil SL?	SI Soil Eco SL	Source of SI Soil Eco SL	Estimated LOD Exceeds SI Soil Eco SL?	Estimated LOQ Exceeds SI Soil Eco SL?	SI Soil non-Eco SL	Source of SI Soil non-Eco SL	Estimated LOD Exceeds SI Soil non-Eco SL?	Estimated LOQ Exceeds SI Soil non-Eco SL?
SW8260B	Methylene Chloride	75-09-2	mg/kg	0.005	0.01	0.016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.016	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Naphthalene	91-20-3	mg/kg	0.002	0.005	2.8	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	20	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	n-Butylbenzene	104-51-8	mg/kg	0.005	0.01	4.2	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	n-Propylbenzene	103-65-1	mg/kg	0.005	0.01	4.2	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	o-Xylene	95-47-6	mg/kg	0.002	0.005	380	1/10th 2010 EPA Residential Soil RSL	No	No	1	2009 ADEC Ecoscoping Soil ERBSC	No	No	3800	2010 EPA Residential Soil RSL	No	No
SW8260B	p-Isopropyltoluene	99-87-6	mg/kg	0.002	0.005	6.2	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	51	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	51	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	sec-Butylbenzene	135-98-8	mg/kg	0.002	0.005	4.1	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Styrene	100-42-5	mg/kg	0.002	0.005	0.96	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.96	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	tert-Butylbenzene	98-06-6	mg/kg	0.002	0.005	7	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Tetrachloroethene	127-18-4	mg/kg	0.002	0.005	0.024	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.024	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.024	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Toluene	108-88-3	mg/kg	0.002	0.005	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.08	2009 ADEC Ecoscoping Soil ERBSC	No	No	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	trans-1,2-Dichloroethene	156-60-5	mg/kg	0.002	0.005	0.37	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.37	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.37	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	trans-1,3-Dichloropropene	10061-02-6	mg/kg	0.002	0.005	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.033	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Trichloroethene	79-01-6	mg/kg	0.002	0.005	0.02	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.02	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.02	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Trichlorofluoromethane	75-69-4	mg/kg	0.005	0.01	86	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	86	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	86	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Vinyl Chloride	75-01-4	mg/kg	0.002	0.005	0.0085	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0085	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.0085	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8260B	Xylenes (total)	1330-20-7	mg/kg	0.005	0.01	6.3	1/10th 2009 ADEC Table B1 Method 2 - Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	63	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.2	0.5	0.85	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.85	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.85	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	1,2-Dichlorobenzene	95-50-1	mg/kg	0.2	0.5	4.5	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	5.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	1,2-Diphenylhydrazine	122-66-7	mg/kg	0.2	0.5	0.61	2010 EPA Residential Soil RSL	No	No	0.61	2010 EPA Residential Soil RSL	No	No	0.61	2010 EPA Residential Soil RSL	No	No
SW8270C	1,3-Dichlorobenzene	541-73-1	mg/kg	0.2	0.5	6.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	28	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	1,4-Dichlorobenzene	106-46-7	mg/kg	0.2	0.5	0.64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	0.64	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	1-Methylnaphthalene	90-12-0	mg/kg	0.2	0.5	6.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.2	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2,4,5-Trichlorophenol	95-95-4	mg/kg	0.2	0.5	67	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	4	2009 ADEC Ecoscoping Soil ERBSC	No	No	67	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2,4,6-Trichlorophenol	88-06-2	mg/kg	0.2	0.5	1.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.4	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2,4-Dichlorophenol	120-83-2	mg/kg	0.2	0.5	1.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.3	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2,4-Dimethylphenol	105-67-9	mg/kg	0.2	0.5	8.8	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	8.8	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	8.8	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2,4-Dinitrophenol	51-28-5	mg/kg	0.2	1	0.54	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	Yes	0.54	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	Yes	0.54	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	Yes
SW8270C	2,4-Dinitrotoluene	121-14-2	mg/kg	0.2	0.5	0.0093	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0093	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0093	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	2,6-Dinitrotoluene	606-20-2	mg/kg	0.2	0.5	0.0094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	2-Chloronaphthalene	91-58-7	mg/kg	0.2	0.5	120	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	120	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	120	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2-Chlorophenol	95-57-8	mg/kg	0.2	0.5	1.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2-Methylnaphthalene	91-57-6	mg/kg	0.2	0.5	6.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2-Methylphenol	95-48-7	mg/kg	0.2	0.5	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	2-Nitroaniline	88-74-4	mg/kg	0.2	0.5	61	1/10th 2010 EPA Residential Soil RSL	No	No	610	2010 EPA Residential Soil RSL	No	No	610	2010 EPA Residential Soil RSL	No	No
SW8270C	2-Nitrophenol	88-75-5	mg/kg	0.2	0.5	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	3,3'-Dichlorobenzidine	91-94-1	mg/kg	0.2	0.5	0.19	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.19	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.19	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	Methylphenol	108-39-4/106	mg/kg	0.2	0.5	1.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	1.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	3-Nitroaniline	99-09-2	mg/kg	0.2	0.5	24	2010 EPA Residential Soil RSL	No	No	24	2010 EPA Residential Soil RSL	No	No	24	2010 EPA Residential Soil RSL	No	No
SW8270C	4,6-Dinitro-2-methylphenol	534-52-1	mg/kg	0.2	1	0.49	1/10th 2010 EPA Residential Soil RSL	No	Yes	4.9	2010 EPA Residential Soil RSL	No	No	4.9	2010 EPA Residential Soil RSL	No	No
SW8270C	4-Bromophenyl-phenylether	101-55-3	mg/kg	0.2	0.5	0.78	1/10th 2010 EPA Residential Soil RSL	No	No	7.8	2010 EPA Residential Soil RSL	No	No	7.8	2010 EPA Residential Soil RSL	No	No
SW8270C	4-Chloro-3-methylphenol	59-50-7	mg/kg	0.2	0.5	610	1/10th 2010 EPA Residential Soil RSL	No	No	15	2009 ADEC Ecoscoping Soil ERBSC	No	No	6100	2010 EPA Residential Soil RSL	No	No
SW8270C	4-Chloroaniline	106-47-8	mg/kg	0.2	0.5	0.057	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.057	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.057	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	4-Chlorophenyl-phenylether	7005-72-3	mg/kg	0.2	0.5	0.78	1/10th 2010 EPA Residential Soil RSL	No	No	7.8	2010 EPA Residential Soil RSL	No	No	7.8	2010 EPA Residential Soil RSL	No	No
SW8270C	4-Nitroaniline	100-01-6	mg/kg	0.2	0.5	24	2010 EPA Residential Soil RSL	No	No	40	2009 ADEC Ecoscoping Soil ERBSC	No	No	24	2010 EPA Residential Soil RSL	No	No
SW8270C	4-Nitrophenol	100-02-7	mg/kg	0.2	1	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	Acenaphthene	83-32-9	mg/kg	0.2	0.5	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Acenaphthylene	208-96-8	mg/kg	0.2	0.5	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Anthracene	120-12-7	mg/kg	0.2	0.5	2060	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	1.6	2009 ADEC Ecoscoping Soil ERBSC	No	No	3000	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Benzo(a)anthracene	56-55-3	mg/kg	0.2	0.5	0.49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	Yes	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	3.6	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Benzo(a)pyrene	50-32-8	mg/kg	0.2	0.5	0.049	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	Yes	Yes	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	0.49	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	Yes
SW8270C	Benzo(b)fluoranthene	205-99-2	mg/kg	0.2	0.5	0.49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	Yes	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	4.9	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270C	Benzo(g,h,i)perylene	191-24-2	mg/kg	0.2	0.5	140	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	33	2009 ADEC Ecoscoping Soil ERBSC	No	No	1400	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270C	Benzo(k)fluoranthene	207-08-9	mg/kg	0.2	0.5	4.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	49	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270C	Benzoic acid	65-85-0	mg/kg	0.2	0.5	410	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	410	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	410	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Benzyl Alcohol	100-51-6	mg/kg	0.2	0.5	610	1/10th 2010 EPA Residential Soil RSL	No	No	6100	2010 EPA Residential Soil RSL	No	No	6100	2010 EPA Residential Soil RSL	No	No
SW8270C	Bis(2-chloroethoxy)methane	111-91-1	mg/kg	0.2	0.5	18	1/10th 2010 EPA Residential Soil RSL	No	No	180	2010 EPA Residential Soil RSL	No	No	180	2010 EPA Residential Soil RSL	No	No
SW8270C	Bis(2-chloroethyl)ether	111-44-4	mg/kg	0.2	0.5	0.0022	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0022	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0022	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	Bis(2-chloroisopropyl) ether	108-60-1	mg/kg	0.2	0.5	4.6	2010 EPA Residential Soil RSL	No	No	4.6	2010 EPA Residential Soil RSL	No	No	4.6	2010 EPA Residential Soil RSL	No	No
SW8270C	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	0.2	0.5	13	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.91	2009 ADEC Ecoscoping Soil ERBSC	No	No	13	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Butyl Benzyl Phthlate	85-68-7	mg/kg	0.2	0.5	290	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	48	2009 ADEC Ecoscoping Soil ERBSC	No	No	920	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Carbazole	86-74-8	mg/kg	0.2	0.5	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.5	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Chrysene	218-01-9	mg/kg	0.2	0.5	49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	35	2009 ADEC Ecoscoping Soil ERBSC	No	No	360	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Dibenzo(a,h)anthracene	53-70-3	mg/kg	0.2	0.5	0.049	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	Yes	Yes	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	0.49	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	Yes
SW8270C	Dibenzofuran	132-64-9	mg/kg	0.2	0.5	11	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	11	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	11	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Diethyl Phthalate	84-66-2	mg/kg	0.2	0.5	130	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	53	2009 ADEC Ecoscoping Soil ERBSC	No	No	130	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No

Table 15-1
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Soil
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Extent Soil SL	Source of Extent Soil SL	Estimated LOD Exceeds Extent Soil SL?	Estimated LOQ Exceeds Extent Soil SL?	SI Soil Eco SL	Source of SI Soil Eco SL	Estimated LOD Exceeds SI Soil Eco SL?	Estimated LOQ Exceeds SI Soil Eco SL?	SI Soil non-Eco SL	Source of SI Soil non-Eco SL	Estimated LOD Exceeds SI Soil non-Eco SL?	Estimated LOQ Exceeds SI Soil non-Eco SL?
SW8270C	Dimethyl Phthalate	131-11-3	mg/kg	0.2	0.5	1100	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	84	2009 ADEC Ecoscoping Soil ERBSC	No	No	1100	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Di-n-butyl Phthalate	84-74-2	mg/kg	0.2	0.5	80	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	0.91	2009 ADEC Ecoscoping Soil ERBSC	No	No	80	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Di-n-octyl Phthalate	117-84-0	mg/kg	0.2	0.5	310	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	3100	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	3100	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270C	Fluoranthene	206-44-0	mg/kg	0.2	0.5	190	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	260	2009 ADEC Ecoscoping Soil ERBSC	No	No	1400	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Fluorene	86-73-7	mg/kg	0.2	0.5	220	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	30	2009 ADEC Ecoscoping Soil ERBSC	No	No	220	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Hexachlorobenzene	118-74-1	mg/kg	0.2	0.5	0.047	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.047	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.047	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	Hexachlorobutadiene	87-68-3	mg/kg	0.2	0.5	0.12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.12	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	Hexachloroethane	67-72-1	mg/kg	0.2	0.5	0.21	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	Yes	0.21	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	Yes	0.21	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	Yes
SW8270C	Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	0.2	0.5	0.49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	Yes	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	4.9	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270C	Isophorone	78-59-1	mg/kg	0.2	0.5	3.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	3.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	3.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Naphthalene	91-20-3	mg/kg	0.2	0.5	2.8	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	20	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Nitrobenzene	98-95-3	mg/kg	0.2	0.5	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.094	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	n-Nitrosodimethylamine	62-75-9	mg/kg	0.2	0.5	0.000053	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	5E-05	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	5.3E-05	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	n-Nitroso-di-n-propylamine	621-64-7	mg/kg	0.2	0.5	0.0011	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0011	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.0011	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	n-Nitrosodiphenylamine	86-30-6	mg/kg	0.2	0.5	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	15	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Pentachlorophenol	87-86-5	mg/kg	0.2	1	0.047	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.047	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes	0.047	2009 ADEC Table B1 Method 2 - Migration to Groundwater	Yes	Yes
SW8270C	Phenanthrene	85-01-8	mg/kg	0.2	0.5	2060	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	3000	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Phenol	108-95-2	mg/kg	0.2	0.5	68	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	3.8	2009 ADEC Ecoscoping Soil ERBSC	No	No	68	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270C	Pyrene	129-00-0	mg/kg	0.2	0.5	140	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	Yes	Yes	1000	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	1-Methylnaphthalene	90-12-0	mg/kg	0.2	0.5												
SW8270CSIM	2-Methylnaphthalene	91-57-6	mg/kg	0.01	0.02	6.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	6.1	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Acenaphthene	83-32-9	mg/kg	0.01	0.02	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Acenaphthylene	208-96-8	mg/kg	0.01	0.02	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	180	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Anthracene	120-12-7	mg/kg	0.01	0.02	2060	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	1.6	2009 ADEC Ecoscoping Soil ERBSC	No	No	3000	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Benzo(a)anthracene	56-55-3	mg/kg	0.01	0.02	0.49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	3.6	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Benzo(a)pyrene	50-32-8	mg/kg	0.01	0.02	0.049	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.49	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270CSIM	Benzo(b)fluoranthene	205-99-2	mg/kg	0.01	0.02	0.49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	4.9	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270CSIM	Benzo(g,h,i)perylene	191-24-2	mg/kg	0.01	0.02	140	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	33	2009 ADEC Ecoscoping Soil ERBSC	No	No	1400	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270CSIM	Benzo(k)fluoranthene	207-08-9	mg/kg	0.01	0.02	4.9	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	49	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270CSIM	Chrysene	218-01-9	mg/kg	0.01	0.02	49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	35	2009 ADEC Ecoscoping Soil ERBSC	No	No	360	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Dibenzo(a,h)anthracene	53-70-3	mg/kg	0.01	0.02	0.049	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	0.49	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270CSIM	Fluoranthene	206-44-0	mg/kg	0.01	0.02	190	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	260	2009 ADEC Ecoscoping Soil ERBSC	No	No	1400	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Fluorene	86-73-7	mg/kg	0.01	0.02	220	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No	30	2009 ADEC Ecoscoping Soil ERBSC	No	No	220	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	0.01	0.02	0.49	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	4.9	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8270CSIM	Naphthalene	91-20-3	mg/kg	0.01	0.02	2.8	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Outdoor Inhl	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	20	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Phenanthrene	85-01-8	mg/kg	0.01	0.02	2060	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	3000	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8270CSIM	Pyrene	129-00-0	mg/kg	0.01	0.02	140	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.1	2009 ADEC Ecoscoping Soil ERBSC	No	No	1000	2009 ADEC Table B1 Method 2 - Migration to Groundwater	No	No
SW8290	1,2,3,4,6,7,8-HpCDD	35822-46-9	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,6,7,8-HpCDF	67562-39-4	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,7,8,9-HpCDF	55673-89-7	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDD	39227-28-6	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDF	70648-26-9	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDD	57653-85-7	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDF	57117-44-9	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDD	19408-74-3	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDF	72918-21-9	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8-PeCDD	40321-76-4	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8-PeCDF	57117-41-6	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	2,3,4,6,7,8-HxCDF	60851-34-5	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	2,3,4,7,8-PeCDF	57117-31-4	mg/kg	0.000002	0.000005	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	2,3,7,8-TCDD	1746-01-6	mg/kg	0.0000005	0.000001	4.7E-06	1/10th 2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	5E-05	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No	0.000047	2009 ADEC Table B1 Method 2-Under 40 in-Direct Contact	No	No
SW8290	2,3,7,8-TCDF	51207-31-9	mg/kg	0.0000005	0.000001	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	OCDD	3268-87-9	mg/kg	0.00005	0.0001	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	OCDF	39001-02-0	mg/kg	0.00005	0.0001	NA	-	-	-	NA	-	-	-	NA	-	-	-

Notes:
Estimated LODs and LOQs are not laboratory-specific but are levels that should be achievable by all project laboratories. Laboratory-specific MDLs, LODs, and LOQs will be reviewed in detail prior to project startup.
1,2,3-Trichloropropane, 1,2-Dibromoethane, n-Nitrosodimethylamine, n-Nitroso-di-n-propylamine - not likely to reach SLs even with low-level methods. Best available technology will be used to achieve the lowest possible LOD and LOQ.
2,4-Dinitrotoluene, 2,6-Dinitrotoluene, Bis(2-chloroethyl)ether, 3,3'-Dichlorobenzidine, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 3,3'-Dichlorobenzidine, 4-Chloroaniline, Nitrobenzene, Pentachlorophenol, Hexachlorobenzene, Hexachlorobutadiene are not expected to be compounds of concern at Galena
Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene exceed SLs by Method SW8270C, SLs are reached by Method SW8270CSIM.

TABLE 15-2
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Groundwater
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW NE SL	Source of GW NE Screening Level	Estimated LOD Exceeds GW NE SL?	Estimated LOQ Exceeds GW NE SL?	GW SI SL	Source of GW SI Screening Level	Estimated LOD Exceeds GW SI SL?	Estimated LOQ Exceeds GW SI SL?	GW to SW NE SL	Source of GW to SW NE Screening Level	Estimated LOD Exceeds GW to SW NE SL?	Estimated LOQ Exceeds GW to SW NE SL?	GW to SW SI SL	Source of GW to SW SI Screening Level	Estimated LOD Exceeds GW to SW SI SL?	Estimated LOQ Exceeds GW to SW SI SL?
AK101	Gasoline Range Organics	C6-C10 GRO	µg/L	100	20	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No
AK102/103	Diesel Range Organics	C10-C25 DRO	µg/L	500	100	150	1/10th 2009 ADEC Table C GW	No	Yes	1500	2009 ADEC Table C GW	No	No	150	1/10th 2009 ADEC Table C GW	No	Yes	1500	2009 ADEC Table C GW	No	No
AK102/103	Motor Oil Range Organics	C25-C36 RRO	µg/L	1000	100	110	1/10th 2009 ADEC Table C GW	No	Yes	1100	2009 ADEC Table C GW	No	No	110	1/10th 2009 ADEC Table C GW	No	Yes	1100	2009 ADEC Table C GW	No	No
NWEPH	C10-C12 Aliphatics	C10-C12 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C10-C12 Aromatics	C10-C12 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C12-C16 Aliphatics	C12-C16 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C12-C16 Aromatics	C12-C16 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C16-C21 Aliphatics	C16-C21 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C16-C21 Aromatics	C16-C21 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C21-C34 Aliphatics	C21-C34 Aliphatics	µg/L	Comparison of	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C21-C34 Aromatics	C21-C34 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C8-C10 Aliphatics	C8-C10 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	C8-C10 Aromatics	C8-C10 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWEPH	Total EPH (TEPH)	TEPH	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C10-C12 Aliphatics	C10-C12 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C10-C12 Aromatics	C10-C12 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C12-C13 Aromatics	C12-C13 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C5-C6 Aliphatics	C5-C6 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C5-C6 Aromatics	C5-C6 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C6-C8 Aliphatics	C6-C8 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C6-C8 Aromatics	C6-C8 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C8-C10 Aliphatics	C8-C10 Aliphatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	C8-C10 Aromatics	C8-C10 Aromatics	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
NWVPH	Total VPH (TVPH)	TVPH	µg/L	50	5	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW6010B/SW6020	Aluminum	7429-90-5	µg/L	200	60	-	-	-	-	-	-	-	-	75	2009 ADEC Eco Freshwater ERBSC	No	Yes	75	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Antimony	7440-36-0	µg/L	1	0.5	0.6	1/10th 2009 ADEC Table C GW	No	Yes	6	2009 ADEC Table C GW	No	No	0.6	1/10th 2009 ADEC Table C GW	No	Yes	6	2009 ADEC Table C GW	No	No
SW6010B/SW6020	Arsenic	7440-38-2	µg/L	5	0.5	1	1/10th 2009 ADEC Table C GW	No	Yes	10	2009 ADEC Table C GW	No	No	1	1/10th 2009 ADEC Table C GW	No	Yes	10	2009 ADEC Table C GW	No	No
SW6010B/SW6020	Barium	7440-39-3	µg/L	3	0.5	200	1/10th 2009 ADEC Table C GW	No	No	2000	2009 ADEC Table C GW	No	No	3.9	2009 ADEC Eco Freshwater ERBSC	No	No	3.9	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Beryllium	7440-41-7	µg/L	3	0.5	0.4	1/10th 2009 ADEC Table C GW	Yes	Yes	4	2009 ADEC Table C GW	No	No	0.4	1/10th 2009 ADEC Table C GW	Yes	Yes	0.53	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Cadmium	7440-43-9	µg/L	2	0.5	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.013	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.013	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Calcium	7440-70-2	µg/L	1100	100	-	-	-	-	-	-	-	-	116000	2009 ADEC Eco Freshwater ERBSC	No	No	116000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Chromium	7440-47-3	µg/L	4	0.5	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No
SW6010B/SW6020	Cobalt	7440-48-4	µg/L	8	0.5	-	-	-	-	-	-	-	-	3	2009 ADEC Eco Freshwater ERBSC	No	Yes	3	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Copper	7440-50-8	µg/L	6	0.5	100	1/10th 2009 ADEC Table C GW	No	No	1000	2009 ADEC Table C GW	No	No	0.205	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.205	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Iron	7439-89-6	µg/L	200	40	-	-	-	-	-	-	-	-	16	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	16	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Lead	7439-92-1	µg/L	2	0.5	1.5	1/10th 2009 ADEC Table C GW	No	Yes	15	2009 ADEC Table C GW	No	No	1	2009 ADEC Eco Freshwater ERBSC	No	Yes	1	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Magnesium	7439-95-4	µg/L	1000	100	-	-	-	-	-	-	-	-	82000	2009 ADEC Eco Freshwater ERBSC	No	No	82000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Manganese	7439-96-5	µg/L	2	0.5	-	-	-	-	-	-	-	-	80	2009 ADEC Eco Freshwater ERBSC	No	No	80	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Molybdenum	7439-98-7	µg/L	15	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW6010B/SW6020	Nickel	7440-02-0	µg/L	2	0.5	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No	5	2009 ADEC Eco Freshwater ERBSC	No	No	5	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Potassium	7440-09-7	µg/L	1000	200	-	-	-	-	-	-	-	-	53000	2009 ADEC Eco Freshwater ERBSC	No	No	53000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Selenium	7782-49-2	µg/L	2	0.5	5	1/10th 2009 ADEC Table C GW	No	No	50	2009 ADEC Table C GW	No	No	1	2009 ADEC Eco Freshwater ERBSC	No	Yes	1	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Silver	7440-22-4	µg/L	2	0.5	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Sodium	7440-23-5	µg/L	1000	100	-	-	-	-	-	-	-	-	680000	2009 ADEC Eco Freshwater ERBSC	No	No	680000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Thallium	7440-28-0	µg/L	1	0.5	0.2	1/10th 2009 ADEC Table C GW	Yes	Yes	2	2009 ADEC Table C GW	No	No	0.2	1/10th 2009 ADEC Table C GW	Yes	Yes	0.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Vanadium	7440-62-2	µg/L	10	5	26	1/10th 2009 ADEC Table C GW	No	No	260	2009 ADEC Table C GW	No	No	19	2009 ADEC Eco Freshwater ERBSC	No	No	19	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Zinc	7440-66-6	µg/L	25	5	500	1/10th 2009 ADEC Table C GW	No	No	5000	2009 ADEC Table C GW	No	No	21	2009 ADEC Eco Freshwater ERBSC	No	Yes	21	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW7470A	Mercury	7439-97-6	µg/L	1	0.5	0.2	1/10th 2009 ADEC Table C GW	Yes	Yes	2	2009 ADEC Table C GW	No	No	0.2	1/10th 2009 ADEC Table C GW	Yes	Yes	3.7	2009 ADEC Table C GW	No	No
SW8011	1,2-Dibromo-3-chloropropane	96-12-8	µg/L	0.02	0.005	0.00032	2010 EPA Regional RSL	Yes	Yes	0.00032	2010 EPA Regional RSL	Yes	Yes	0.00032	2010 EPA Regional RSL	Yes	Yes	0.00032	2010 EPA Regional RSL	Yes	Yes
SW8011	1,2-Dibromoethane	106-93-4	µg/L	0.02	0.005	0.005	1/10th 2009 ADEC Table C GW	No	Yes	0.05	2009 ADEC Table C GW	No	No	0.005	1/10th 2009 ADEC Table C GW	No	Yes	0.05	2009 ADEC Table C GW	No	No
SW8081A	4,4'-DDD	72-54-8	µg/L	0.1	0.02	0.35	1/10th 2009 ADEC Table C GW	No	No	3.5	2009 ADEC Table C GW	No	No	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	4,4'-DDE	72-55-9	µg/L	0.1	0.02	0.25	1/10th 2009 ADEC Table C GW	No	No	2.5	2009 ADEC Table C GW	No	No	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	4,4'-DDT	50-29-3	µg/L	0.1	0.02	0.25	1/10th 2009 ADEC Table C GW	No	No	2.5	2009 ADEC Table C GW	No	No	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Aldrin	309-00-2	µg/L	0.1	0.02	0.005	1/10th 2009 ADEC Table C GW	Yes	Yes	0.05	2009 ADEC Table C GW	No	Yes	0.005	1/10th 2009 ADEC Table C GW	Yes	Yes	0.05	2009 ADEC Table C GW	No	Yes
SW8081A	alpha-BHC	319-84-6	µg/L	0.1	0.02	0.014	1/10th 2009 ADEC Table C GW	Yes	Yes	0.14	2009 ADEC Table C GW	No	No	0.014	1/10th 2009 ADEC Table C GW	Yes	Yes	0.14	2009 ADEC Table C GW	No	No
SW8081A	alpha-Chlordane	5103-71-9	µg/L	0.1	0.02	0.2	1/10th 2009 ADEC Table C GW	No	No	2	2009 ADEC Table C GW	No	No	0.0043	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes	0.0043	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes
SW8081A	beta-BHC	319-85-7	µg/L	0.1	0.02	0.047	1/10th 2009 ADEC Table C GW	No	Yes	0.47	2009 ADEC Table C GW	No	No	0.047	1/10th 2009 ADEC Table C GW	No	Yes	0.47	2009 ADEC Table C GW	No	No
SW8081A	delta-BHC	319-86-8	µg/L	0.1	0.02	0.037	1/10th 2010 EPA Regional RSL	No	Yes	0.037	2010 EPA Regional RSL	No	Yes	0.037	2010 EPA Regional RSL	No	Yes	0.037	2010 EPA Regional RSL	No	Yes
SW8081A	Dieldrin	60-57-1	µg/L	0.1	0.02	0.0053	1/10th 2009 ADEC Table C GW	Yes	Yes	0.053	2009 ADEC Table C GW	No	Yes	0.0053	1/10th 2009 ADEC Table C GW	Yes	Yes	0.053	2009 ADEC Table C GW	No	Yes
SW8081A	Endosulfan I	959-98-8	µg/L	0.1	0.02	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No	0.02	2009 ADEC Eco Freshwater ERBSC	No	Yes	0.02	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8081A	Endosulfan II	33213-65-9	µg/L	0.1	0.02	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No	0.02	2009 ADEC Eco Freshwater ERBSC	No	Yes	0.02	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8081A	Endosulfan sulfate	1031-07-8	µg/L	0.1	0.02	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No
SW8081A	Endrin	72-20-8	µg/L	0.1	0.02	0.2	1/10th 2009 ADEC Table C GW	No	No	2	2009 ADEC Table C GW	No	No	0.0023	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.0023	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Endrin aldehyde	7421-93-4	µg/L	0.1	0.02	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No
SW8081A	Endrin ketone	53494-70-5	µg/L	0.1	0.02	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No	22	1/10th 2009 ADEC Table C GW	No	No	220	2009 ADEC Table C GW	No	No
SW8081A	gamma-BHC (Lindane)	58-89-9	µg/L	0.1	0.02	0.02	1/10th 2009 ADEC Table C GW	No	Yes	0.2	2009 ADEC Table C GW	No	No	0.02	1/10th 2009 ADEC Table C GW	No	Yes	0.08	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8081A	gamma-Chlordane	5103-74-2	µg/L	0.1	0.02	0.2	1/10th 2009 ADEC Table C GW	No	No	2	2009 ADEC Table C GW	No	No	0.0043	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes	0.0043	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes
SW8081A	Heptachlor	76-44-8	µg/L	0.1	0.02	0.04	1/10th 2009 ADEC Table C GW	No	Yes	0.4	2009 ADEC Table C GW	No	No	0.0038	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.0038	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Heptachlor epoxide	1024-57-3	µg/L	0.1	0.02	0.02	1/10th 2009 ADEC Table C GW	No	Yes	0.2	2009 ADEC Table C GW	No	No	0.0038	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.0038	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Methoxychlor	72-43-5	µg/L	0.1	0.02	4	1/10th 2009 ADEC Table C GW	No	No	40	2009 ADEC Table C GW	No	No	0.019	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.019	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Toxaphene	8001-35-2	µg/L	0.1	0.02	0.3	1/10th 2009 ADEC Table C GW	No	No	3	2009 ADEC Table C GW	No	No	0.0002	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes	0.0002	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes
SW8082	Aroclor-1016	12674-11-2	µg/L	0.5	0.25	0.96	2010 EPA Regional RSL	No	No	0.96	2010 EPA Regional RSL	No	No	0.19	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.19	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1221	11104-28-2	µg/L	0.5	0.25	0.0068	2010 EPA Regional RSL	Yes	Yes	0.0068	2010 EPA Regional RSL	Yes	Yes	0.28	2009 ADEC Eco Freshwater ERBSC	No	Yes	0.28	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8082	Aroclor-1232	11141-16-5	µg/L	0.5	0.25	0.0068	2010 EPA Regional RSL	Yes	Yes	0.0068	2010 EPA Regional RSL	Yes	Yes	0.58	2009 ADEC Eco Freshwater ERBSC	No	No	0.58	2009 ADEC Eco Freshwater ERBSC	No	No
SW8082	Aroclor-1242	53469-21-9	µg/L	0.5	0.25	0.034	2010 EPA Regional RSL	Yes	Yes	0.034	2010 EPA Regional RSL	Yes	Yes	0.053	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.053	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1248	12672-29-6	µg/L	0.5	0.25	0.034	2010 EPA Regional RSL	Yes	Yes	0.034	2010 EPA Regional RSL	Yes	Yes	0.081	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.081	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1254	11097-69-1	µg/L	0.5	0.25	0.034	2010 EPA Regional RSL	Yes	Yes	0.034	2010 EPA Regional RSL	Yes	Yes	0.033	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.033	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1260	11096-82-5	µg/L	0.5	0.25	0.034	2010 EPA Regional RSL	Yes	Yes	0.034	2010 EPA Regional RSL	Yes	Yes	2.1	2009 ADEC Eco Freshwater ERBSC	No	No	2.1	2009 ADEC Eco Freshwater ERBSC	No	No

TABLE 15-2
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Groundwater
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW NE SL	Source of GW NE Screening Level	Estimated LOD Exceeds GW NE SL?	Estimated LOQ Exceeds GW NE SL?	GW SI SL	Source of GW SI Screening Level	Estimated LOD Exceeds GW SI SL?	Estimated LOQ Exceeds GW SI SL?	GW to SW NE SL	Source of GW to SW NE Screening Level	Estimated LOD Exceeds GW to SW NE SL?	Estimated LOQ Exceeds GW to SW NE SL?	GW to SW SI SL	Source of GW to SW SI Screening Level	Estimated LOD Exceeds GW to SW SI SL?	Estimated LOQ Exceeds GW to SW SI SL?
SW8260B	1,1,1,2-Tetrachloroethane	630-20-6	µg/L	1	0.2	0.52	2010 EPA Regional RSL	No	Yes	0.52	2010 EPA Regional RSL	No	Yes	0.52	2010 EPA Regional RSL	No	Yes	0.52	2010 EPA Regional RSL	No	Yes
SW8260B	1,1,1-Trichloroethane	71-55-6	µg/L	1	0.2	20	1/10th 2009 ADEC Table C GW	No	No	200	2009 ADEC Table C GW	No	No	11	2009 ADEC Eco Freshwater ERBSC	No	No	11	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1,2,2-Tetrachloroethane	79-34-5	µg/L	1	0.2	0.43	1/10th 2009 ADEC Table C GW	No	Yes	4.3	2009 ADEC Table C GW	No	No	0.43	1/10th 2009 ADEC Table C GW	No	Yes	4.3	2009 ADEC Table C GW	No	No
SW8260B	1,1,2-Trichloroethane	79-00-5	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	1,1-Dichloroethane	75-34-3	µg/L	1	0.2	730	1/10th 2009 ADEC Table C GW	No	No	7300	2009 ADEC Table C GW	No	No	47	2009 ADEC Eco Freshwater ERBSC	No	No	47	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1-Dichloroethene	75-35-4	µg/L	1	0.2	0.7	1/10th 2009 ADEC Table C GW	No	Yes	7	2009 ADEC Table C GW	No	No	0.7	1/10th 2009 ADEC Table C GW	No	Yes	7	2009 ADEC Table C GW	No	No
SW8260B	1,1-Dichloropropene	563-58-6	µg/L	1	0.2	0.85	1/10th 2009 ADEC Table C GW	No	Yes	8.5	2009 ADEC Table C GW	No	No	0.85	1/10th 2009 ADEC Table C GW	No	Yes	8.5	2009 ADEC Table C GW	No	No
SW8260B	1,2,3-Trichlorobenzene	87-61-6	µg/L	1	0.2	2.9	1/10th 2010 EPA Regional RSL	No	No	29	2010 EPA Regional RSL	No	No	8	2009 ADEC Eco Freshwater ERBSC	No	No	8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,2,3-Trichloropropane	96-18-4	µg/L	1	0.2	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.12	2009 ADEC Table C GW	Yes	Yes	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.12	2009 ADEC Table C GW	Yes	Yes
SW8260B	1,2,4-Trichlorobenzene	120-82-1	µg/L	10	5	7	1/10th 2009 ADEC Table C GW	No	Yes	70	2009 ADEC Table C GW	No	No	7	1/10th 2009 ADEC Table C GW	No	Yes	24	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,2,4-Trimethylbenzene	95-63-6	µg/L	1	0.2	180	1/10th 2009 ADEC Table C GW	No	No	1800	2009 ADEC Table C GW	No	No	180	1/10th 2009 ADEC Table C GW	No	No	1800	2009 ADEC Table C GW	No	No
SW8260B	1,2-Dibromo-3-chloropropane	96-12-8	µg/L	1	0.2	0.00032	2010 EPA Regional RSL	Yes	Yes	0.00032	2010 EPA Regional RSL	Yes	Yes	0.00032	2010 EPA Regional RSL	Yes	Yes	0.00032	2010 EPA Regional RSL	Yes	Yes
SW8260B	1,2-Dibromoethane	106-93-4	µg/L	1	0.2	0.005	1/10th 2009 ADEC Table C GW	Yes	Yes	0.05	2009 ADEC Table C GW	Yes	Yes	0.005	1/10th 2009 ADEC Table C GW	Yes	Yes	0.05	2009 ADEC Table C GW	Yes	Yes
SW8260B	1,2-Dichlorobenzene	95-50-1	µg/L	10	5	60	1/10th 2009 ADEC Table C GW	No	No	600	2009 ADEC Table C GW	No	No	0.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8260B	1,2-Dichloroethane	107-06-2	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	1,2-Dichloropropane	78-87-5	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	1,3,5-Trimethylbenzene	108-67-8	µg/L	1	0.2	180	1/10th 2009 ADEC Table C GW	No	No	1800	2009 ADEC Table C GW	No	No	180	1/10th 2009 ADEC Table C GW	No	No	1800	2009 ADEC Table C GW	No	No
SW8260B	1,3-Dichlorobenzene	541-73-1	µg/L	10	5	330	1/10th 2009 ADEC Table C GW	No	No	3300	2009 ADEC Table C GW	No	No	50.2	2009 ADEC Eco Freshwater ERBSC	No	No	50.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,3-Dichloropropane	142-28-9	µg/L	1	0.2	73	1/10th 2010 EPA Regional RSL	No	No	730	2010 EPA Regional RSL	No	No	244	2009 ADEC Eco Freshwater ERBSC	No	No	244	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,4-Dichlorobenzene	106-46-7	µg/L	10	5	7.5	1/10th 2009 ADEC Table C GW	No	Yes	75	2009 ADEC Table C GW	No	No	7.5	1/10th 2009 ADEC Table C GW	No	Yes	11.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	2,2-Dichloropropane	594-20-7	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	2-Butanol	78-92-2	µg/L	1	0.2	7300	1/10th 2010 EPA Regional RSL	No	No	73000	2010 EPA Regional RSL	No	No	7300	1/10th 2010 EPA Regional RSL	No	No	73000	2010 EPA Regional RSL	No	No
SW8260B	2-Butanone	78-93-3	µg/L	10	5	2200	1/10th 2009 ADEC Table C GW	No	No	22000	2009 ADEC Table C GW	No	No	2200	1/10th 2009 ADEC Table C GW	No	No	14000	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	2-Chlorotoluene	95-49-8	µg/L	1	0.2	73	1/10th 2010 EPA Regional RSL	No	No	730	2010 EPA Regional RSL	No	No	73	1/10th 2010 EPA Regional RSL	No	No	730	2010 EPA Regional RSL	No	No
SW8260B	2-Hexanone	591-78-6	µg/L	10	5	4.7	1/10th 2010 EPA Regional RSL	Yes	Yes	47	2010 EPA Regional RSL	No	No	4.7	1/10th 2010 EPA Regional RSL	Yes	Yes	47	2010 EPA Regional RSL	No	No
SW8260B	4-Chlorotoluene	106-43-4	µg/L	1	0.2	260	1/10th 2010 EPA Regional RSL	No	No	2600	2010 EPA Regional RSL	No	No	260	1/10th 2010 EPA Regional RSL	No	No	2600	2010 EPA Regional RSL	No	No
SW8260B	4-Methyl-2-pentanone	108-10-1	µg/L	10	5	290	1/10th 2009 ADEC Table C GW	No	No	2900	2009 ADEC Table C GW	No	No	170	2009 ADEC Eco Freshwater ERBSC	No	No	170	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Acetone	67-64-1	µg/L	10	5	3300	1/10th 2009 ADEC Table C GW	No	No	33000	2009 ADEC Table C GW	No	No	1500	2009 ADEC Eco Freshwater ERBSC	No	No	1500	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Benzene	71-43-2	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	Bromobenzene	108-86-1	µg/L	1	0.2	8.8	1/10th 2010 EPA Regional RSL	No	No	88	2010 EPA Regional RSL	No	No	8.8	1/10th 2010 EPA Regional RSL	No	No	88	2010 EPA Regional RSL	No	No
SW8260B	Bromochloromethane	74-97-5	µg/L	1	0.2	1.4	1/10th 2009 ADEC Table C GW	No	No	14	2009 ADEC Table C GW	No	No	1.4	1/10th 2009 ADEC Table C GW	No	No	14	2009 ADEC Table C GW	No	No
SW8260B	Bromodichloromethane	75-27-4	µg/L	1	0.2	1.4	1/10th 2009 ADEC Table C GW	No	No	14	2009 ADEC Table C GW	No	No	1.4	1/10th 2009 ADEC Table C GW	No	No	14	2009 ADEC Table C GW	No	No
SW8260B	Bromoform	75-25-2	µg/L	1	0.3	11	1/10th 2009 ADEC Table C GW	No	No	110	2009 ADEC Table C GW	No	No	11	1/10th 2009 ADEC Table C GW	No	No	110	2009 ADEC Table C GW	No	No
SW8260B	Bromomethane	74-83-9	µg/L	1	0.2	5.1	1/10th 2009 ADEC Table C GW	No	No	51	2009 ADEC Table C GW	No	No	5.1	1/10th 2009 ADEC Table C GW	No	No	51	2009 ADEC Table C GW	No	No
SW8260B	Carbon Disulfide	75-15-0	µg/L	1	0.3	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No	0.92	2009 ADEC Eco Freshwater ERBSC	No	Yes	0.92	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8260B	Carbon Tetrachloride	56-23-5	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	Chlorobenzene	108-90-7	µg/L	1	0.3	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No	1.3	2009 ADEC Eco Freshwater ERBSC	No	No	1.3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Chloroethane	75-00-3	µg/L	1	0.2	29	1/10th 2009 ADEC Table C GW	No	No	290	2009 ADEC Table C GW	No	No	29	1/10th 2009 ADEC Table C GW	No	No	290	2009 ADEC Table C GW	No	No
SW8260B	Chloroform	67-66-3	µg/L	1	0.2	14	1/10th 2009 ADEC Table C GW	No	No	140	2009 ADEC Table C GW	No	No	1.8	2009 ADEC Eco Freshwater ERBSC	No	No	1.8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Chloromethane	74-87-3	µg/L	1	0.2	6.6	1/10th 2009 ADEC Table C GW	No	No	66	2009 ADEC Table C GW	No	No	6.6	1/10th 2009 ADEC Table C GW	No	No	66	2009 ADEC Table C GW	No	No
SW8260B	cis-1,2-Dichloroethene	156-59-2	µg/L	1	0.2	7	1/10th 2009 ADEC Table C GW	No	No	70	2009 ADEC Table C GW	No	No	7	1/10th 2009 ADEC Table C GW	No	No	70	2009 ADEC Table C GW	No	No
SW8260B	cis-1,3-Dichloropropene	10061-01-5	µg/L	1	0.2	0.85	1/10th 2009 ADEC Table C GW	No	Yes	8.5	2009 ADEC Table C GW	No	No	0.85	1/10th 2009 ADEC Table C GW	No	Yes	8.5	2009 ADEC Table C GW	No	No
SW8260B	Dibromochloromethane	124-48-1	µg/L	1	0.2	1	1/10th 2009 ADEC Table C GW	No	No	10	2009 ADEC Table C GW	No	No	1	1/10th 2009 ADEC Table C GW	No	No	10	2009 ADEC Table C GW	No	No
SW8260B	Dibromomethane	74-95-3	µg/L	1	0.2	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No
SW8260B	Dichlorodifluoromethane	75-71-8	µg/L	1	0.2	730	1/10th 2009 ADEC Table C GW	No	No	7300	2009 ADEC Table C GW	No	No	730	1/10th 2009 ADEC Table C GW	No	No	7300	2009 ADEC Table C GW	No	No
SW8260B	Ethylbenzene	100-41-4	µg/L	1	0.2	70	1/10th 2009 ADEC Table C GW	No	No	700	2009 ADEC Table C GW	No	No	7.3	2009 ADEC Eco Freshwater ERBSC	No	No	7.3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Hexachlorobutadiene	87-68-3	µg/L	10	5	0.72	1/10th 2009 ADEC Table C GW	Yes	Yes	7.2	2009 ADEC Table C GW	No	Yes	0.72	1/10th 2009 ADEC Table C GW	Yes	Yes	0.93	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8260B	Isopropylbenzene	98-82-8	µg/L	2	0.5	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No
SW8260B	m,p-Xylene	136777-61-2	µg/L	2	0.5	1000	1/10th 2009 ADEC Table C GW	No	No	10000	2009 ADEC Table C GW	No	No	13	2009 ADEC Eco Freshwater ERBSC	No	No	13	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Methyl tert butylether	1634-04-4	µg/L	1	0.2	47	1/10th 2009 ADEC Table C GW	No	No	470	2009 ADEC Table C GW	No	No	47	1/10th 2009 ADEC Table C GW	No	No	470	2009 ADEC Table C GW	No	No
SW8260B	Methylene Chloride	75-09-2	µg/L	1	0.5	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	Naphthalene	91-20-3	µg/L	10	5	73	1/10th 2009 ADEC Table C GW	No	No	730	2009 ADEC Table C GW	No	No	1.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	1.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8260B	n-Butylbenzene	104-51-8	µg/L	1	0.5	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No
SW8260B	n-Propylbenzene	103-65-1	µg/L	1	0.5	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No
SW8260B	o-Xylene	95-47-6	µg/L	1	0.5	120	1/10th 2010 EPA Regional RSL	No	No	1200	2010 EPA Regional RSL	No	No	120	1/10th 2010 EPA Regional RSL	No	No	1200	2010 EPA Regional RSL	No	No
SW8260B	p-Isopropyltoluene	99-87-6	µg/L	1	0.5	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No
SW8260B	sec-Butylbenzene	135-98-8	µg/L	1	0.5	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No
SW8260B	Styrene	100-42-5	µg/L	1	0.2	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No	10	1/10th 2009 ADEC Table C GW	No	No	72	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	tert-Butylbenzene	98-06-6	µg/L	1	0.5	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No	37	1/10th 2009 ADEC Table C GW	No	No	370	2009 ADEC Table C GW	No	No
SW8260B	Tetrachloroethene	127-18-4	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	Toluene	108-88-3	µg/L	1	0.2	100	1/10th 2009 ADEC Table C GW	No	No	1000	2009 ADEC Table C GW	No	No	2	2009 ADEC Eco Freshwater ERBSC	No	No	2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	trans-1,2-Dichloroethene	156-60-5	µg/L	1	0.2	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No	10	1/10th 2009 ADEC Table C GW	No	No	100	2009 ADEC Table C GW	No	No
SW8260B	trans-1,3-Dichloropropene	10061-02-6	µg/L	1	0.2	0.85	1/10th 2009 ADEC Table C GW	No	Yes	8.5	2009 ADEC Table C GW	No	No	0.85	1/10th 2009 ADEC Table C GW	No	Yes	8.5	2009 ADEC Table C GW	No	No
SW8260B	Trichloroethylene	79-01-6	µg/L	1	0.2	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No	0.5	1/10th 2009 ADEC Table C GW	No	Yes	5	2009 ADEC Table C GW	No	No
SW8260B	Trichlorofluoromethane	75-69-4	µg/L	1	0.2	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No
SW8260B	Vinyl Chloride	75-01-4	µg/L	1	0.2	0.2	1/10th 2009 ADEC Table C GW	No	Yes	2	2009 ADEC Table C GW	No	No	0.2	1/10th 2009 ADEC Table C GW	No	Yes	2	2009 ADEC Table C GW	No	No
SW8260B	Xylenes (total)	1330-20-7	µg/L	2	0.5	1000	1/10th 2009 ADEC Table C GW	No	No	10000	2009 ADEC Table C GW	No	No	13	2009 ADEC Eco Freshwater ERBSC	No	No	13	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1,2,4-Trichlorobenzene	120-82-1	µg/L	10	5	7	1/10th 2009 ADEC Table C GW	No	Yes	70	2009 ADEC Table C GW	No	No	7	1/10th 2009 ADEC Table C GW	No	Yes	24	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1,2-Dichlorobenzene	95-50-1	µg/L	10	5	60	1/10th 2009 ADEC Table C GW	No	No	600	2009 ADEC Table C GW	No	No	0.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	1,2-Diphenylhydrazine	122-66-7	µg/L	10	5	0.084	2010 EPA Regional RSL	Yes	Yes	0.084	2010 EPA Regional RSL	Yes	Yes	2.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	2.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	1,3-Dichlorobenzene	541-73-1	µg/L	10	5	330	1/10th 2009 ADEC Table C GW	No	No	3300	2009 ADEC Table C GW	No	No	50.2	2009 ADEC Eco Freshwater ERBSC	No	No	50.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1,4-Dichlorobenzene	106-46-7	µg/L	10	5	7.5	1/10th 2009 ADEC Table C GW	No	Yes	75	2009 ADEC Table C GW	No	No	7.5	1/10th 2009 ADEC Table C GW	No	Yes	11.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1-Methylnaphthalene	90-12-0	µg/L	10	5	15	1/10th 2009 ADEC Table C GW	No	No	150	2009 ADEC Table C GW	No	No	2.1	1/10th 2009 ADEC Table C GW	Yes	Yes	2.1	1/10th 2009 ADEC Table C GW	Yes	Yes
SW8270C	2,4,5-Trichlorophenol	95-95-4	µg/L	10	5	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No
SW8270C	2,4,6-Trichlorophenol	88-06-2	µg/L	10	5	7.7	1/10th 2009 ADEC Table C GW	No	Yes	77	2009 ADEC Table C GW	No	No	3.2	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	3.2	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	2,4-Dichlorophenol	120-83-2	µg/L	10	5	11	1/10th 2009 ADEC Table C GW	No	No	110	2009 ADEC Table C GW	No	No	0.2	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.2	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	2,4-Dimethylphenol	105-67-9	µg/L	10	5	73	1/10th 2009 ADEC Table C GW	No	No	730	2009 ADEC Table C GW	No	No	21.2	2009 ADEC Eco Freshwater ERBSC	No	No	21.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	2,4-Dinitrophenol	51-28-5	µg/L	20	5	7.3	1/10th 2009 ADEC Table C GW	No	Yes	73	2009 ADEC Table C GW	No	No	6.2	2009 ADEC Eco Freshwater ERBSC	No	Yes	6.2	2009 ADEC Eco Freshwater ERBSC	No	Yes

TABLE 15-2
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Groundwater
Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW NE SL	Source of GW NE Screening Level	Estimated LOD Exceeds GW NE SL?	Estimated LOQ Exceeds GW NE SL?	GW SI SL	Source of GW SI Screening Level	Estimated LOD Exceeds GW SI SL?	Estimated LOQ Exceeds GW SI SL?	GW to SW NE SL	Source of GW to SW NE Screening Level	Estimated LOD Exceeds GW to SW NE SL?	Estimated LOQ Exceeds GW to SW NE SL?	GW to SW SI SL	Source of GW to SW SI Screening Level	Estimated LOD Exceeds GW to SW SI SL?	Estimated LOQ Exceeds GW to SW SI SL?
SW8270C	2,4-Dinitrotoluene	121-14-2	µg/L	10	5	0.13	1/10th 2009 ADEC Table C GW	Yes	Yes	1.3	2009 ADEC Table C GW	Yes	Yes	0.13	1/10th 2009 ADEC Table C GW	Yes	Yes	1.3	2009 ADEC Table C GW	Yes	Yes
SW8270C	2,6-Dinitrotoluene	606-20-2	µg/L	10	5	0.13	1/10th 2009 ADEC Table C GW	Yes	Yes	1.3	2009 ADEC Table C GW	Yes	Yes	0.13	1/10th 2009 ADEC Table C GW	Yes	Yes	1.3	2009 ADEC Table C GW	Yes	Yes
SW8270C	2-Chloronaphthalene	91-58-7	µg/L	10	5	290	1/10th 2009 ADEC Table C GW	No	No	2900	2009 ADEC Table C GW	No	No	290	1/10th 2009 ADEC Table C GW	No	No	2900	2009 ADEC Table C GW	No	No
SW8270C	2-Chlorophenol	95-57-8	µg/L	10	5	18	1/10th 2009 ADEC Table C GW	No	No	180	2009 ADEC Table C GW	No	No	7	2009 ADEC Eco Freshwater ERBSC	No	Yes	7	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	2-Methylnaphthalene	91-57-6	µg/L	10	5	15	1/10th 2009 ADEC Table C GW	No	No	150	2009 ADEC Table C GW	No	No	15	1/10th 2009 ADEC Table C GW	No	No	150	2009 ADEC Table C GW	No	No
SW8270C	2-Methylphenol	95-48-7	µg/L	10	5	180	1/10th 2009 ADEC Table C GW	No	No	1800	2009 ADEC Table C GW	No	No	13	2009 ADEC Eco Freshwater ERBSC	No	No	13	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	2-Nitroaniline	88-74-4	µg/L	10	5	37	1/10th 2010 EPA Regional RSL	No	No	370	2010 EPA Regional RSL	No	No	37	1/10th 2010 EPA Regional RSL	No	No	370	2010 EPA Regional RSL	No	No
SW8270C	2-Nitrophenol	88-75-5	µg/L	10	5	1.8	1/10th 2009 ADEC Table C GW	Yes	Yes	18	2009 ADEC Table C GW	No	No	1.8	1/10th 2009 ADEC Table C GW	Yes	Yes	18	2009 ADEC Table C GW	No	No
SW8270C	3,3'-Dichlorobenzidine	91-94-1	µg/L	10	5	0.19	1/10th 2009 ADEC Table C GW	Yes	Yes	1.9	2009 ADEC Table C GW	Yes	Yes	0.19	1/10th 2009 ADEC Table C GW	Yes	Yes	1.9	2009 ADEC Table C GW	Yes	Yes
SW8270C	3-Methylphenol & 4-Methylphenol	108-39-4/106	µg/L	10	5	18	1/10th 2009 ADEC Table C GW	No	No	180	2009 ADEC Table C GW	No	No	18	1/10th 2009 ADEC Table C GW	No	No	180	2009 ADEC Table C GW	No	No
SW8270C	3-Nitroaniline	99-09-2	µg/L	10	5	3.4	2010 EPA Regional RSL	Yes	Yes	3.4	2010 EPA Regional RSL	Yes	Yes	3.4	2010 EPA Regional RSL	Yes	Yes	3.4	2010 EPA Regional RSL	Yes	Yes
SW8270C	4,6-Dinitro-2-methylphenol	534-52-1	µg/L	20	5	0.37	1/10th 2010 EPA Regional RSL	Yes	Yes	3.7	2010 EPA Regional RSL	Yes	Yes	2.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	2.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	4-Bromophenyl-phenylether	101-55-3	µg/L	10	5	0.37	1/10th 2010 EPA Regional RSL	Yes	Yes	3.7	2010 EPA Regional RSL	Yes	Yes	1.5	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	1.5	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	4-Chloro-3-methylphenol	59-50-7	µg/L	10	5	370	1/10th 2010 EPA Regional RSL	No	No	3700	2010 EPA Regional RSL	No	No	0.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	4-Chloroaniline	106-47-8	µg/L	10	5	1.6	1/10th 2009 ADEC Table C GW	Yes	Yes	16	2009 ADEC Table C GW	No	No	1.6	1/10th 2009 ADEC Table C GW	Yes	Yes	16	2009 ADEC Table C GW	No	No
SW8270C	4-Chlorophenyl-phenylether	7005-72-3	µg/L	10	5	0.37	1/10th 2010 EPA Regional RSL	Yes	Yes	3.7	2010 EPA Regional RSL	Yes	Yes	0.37	1/10th 2010 EPA Regional RSL	Yes	Yes	3.7	2010 EPA Regional RSL	Yes	Yes
SW8270C	4-Nitroaniline	100-01-6	µg/L	10	5	3.4	2010 EPA Regional RSL	Yes	Yes	3.4	2010 EPA Regional RSL	Yes	Yes	3.4	2010 EPA Regional RSL	Yes	Yes	3.4	2010 EPA Regional RSL	Yes	Yes
SW8270C	4-Nitrophenol	100-02-7	µg/L	20	5	1.8	1/10th 2009 ADEC Table C GW	Yes	Yes	18	2009 ADEC Table C GW	No	Yes	1.8	1/10th 2009 ADEC Table C GW	Yes	Yes	18	2009 ADEC Table C GW	No	Yes
SW8270C	Acenaphthene	83-32-9	µg/L	10	5	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No	5.8	2009 ADEC Eco Freshwater ERBSC	No	Yes	5.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	Acenaphthylene	208-96-8	µg/L	10	5	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No
SW8270C	Anthracene	120-12-7	µg/L	10	5	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Benzo(a)anthracene	56-55-3	µg/L	10	5	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	Yes	Yes	0.018	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.018	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Benzo(a)pyrene	50-32-8	µg/L	10	5	0.02	1/10th 2009 ADEC Table C GW	Yes	Yes	0.2	2009 ADEC Table C GW	Yes	Yes	0.014	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.014	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Benzo(b)fluoranthene	205-99-2	µg/L	10	5	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	Yes	Yes	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	Yes	Yes
SW8270C	Benzo(g,h,i)perylene	191-24-2	µg/L	10	5	110	1/10th 2009 ADEC Table C GW	No	No	1100	2009 ADEC Table C GW	No	No	110	1/10th 2009 ADEC Table C GW	No	No	1100	2009 ADEC Table C GW	No	No
SW8270C	Benzo(k)fluoranthene	207-08-9	µg/L	10	5	1.2	1/10th 2009 ADEC Table C GW	Yes	Yes	12	2009 ADEC Table C GW	No	No	1.2	1/10th 2009 ADEC Table C GW	Yes	Yes	12	2009 ADEC Table C GW	No	No
SW8270C	Benzoic acid	65-85-0	µg/L	10	5	15000	1/10th 2009 ADEC Table C GW	No	No	150000	2009 ADEC Table C GW	No	No	42	2009 ADEC Eco Freshwater ERBSC	No	No	42	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Benzyl Alcohol	100-51-6	µg/L	10	5	370	1/10th 2010 EPA Regional RSL	No	No	3700	2010 EPA Regional RSL	No	No	8.6	2009 ADEC Eco Freshwater ERBSC	No	Yes	8.6	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	Bis(2-chloroisopropyl) ether	108-60-1	µg/L	10	5	0.32	2010 EPA Regional RSL	Yes	Yes	0.32	2010 EPA Regional RSL	Yes	Yes	0.32	2010 EPA Regional RSL	Yes	Yes	0.32	2010 EPA Regional RSL	Yes	Yes
SW8270C	Bis(2-chloroethoxy)methane	111-91-1	µg/L	10	5	11	1/10th 2010 EPA Regional RSL	No	No	110	2010 EPA Regional RSL	No	No	11	1/10th 2010 EPA Regional RSL	No	No	110	2010 EPA Regional RSL	No	No
SW8270C	Bis(2-chloroethyl)ether	111-44-4	µg/L	10	5	0.077	1/10th 2009 ADEC Table C GW	Yes	Yes	0.77	2009 ADEC Table C GW	Yes	Yes	0.077	1/10th 2009 ADEC Table C GW	Yes	Yes	0.77	2009 ADEC Table C GW	Yes	Yes
SW8270C	Bis(2-ethylhexyl)phthalate	117-81-7	µg/L	10	5	0.6	1/10th 2009 ADEC Table C GW	Yes	Yes	6	2009 ADEC Table C GW	No	Yes	0.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Butyl Benzyl Phthlate	85-68-7	µg/L	10	5	730	1/10th 2009 ADEC Table C GW	No	No	7300	2009 ADEC Table C GW	No	No	19	2009 ADEC Eco Freshwater ERBSC	No	No	19	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Carbazole	86-74-8	µg/L	10	5	4.3	1/10th 2009 ADEC Table C GW	Yes	Yes	43	2009 ADEC Table C GW	No	No	4.3	1/10th 2009 ADEC Table C GW	Yes	Yes	43	2009 ADEC Table C GW	No	No
SW8270C	Chrysene	218-01-9	µg/L	10	5	12	1/10th 2009 ADEC Table C GW	No	No	120	2009 ADEC Table C GW	No	No	12	1/10th 2009 ADEC Table C GW	No	No	120	2009 ADEC Table C GW	No	No
SW8270C	Dibenz(a,h)anthracene	53-70-3	µg/L	10	5	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.12	2009 ADEC Table C GW	Yes	Yes	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.027	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Dibenzofuran	132-64-9	µg/L	10	5	7.3	1/10th 2009 ADEC Table C GW	No	Yes	73	2009 ADEC Table C GW	No	No	3.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	3.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Diethyl Phthalate	84-66-2	µg/L	10	5	2900	1/10th 2009 ADEC Table C GW	No	No	29000	2009 ADEC Table C GW	No	No	0.18	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.18	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Dimethyl Phthalate	131-11-3	µg/L	10	5	37000	1/10th 2009 ADEC Table C GW	No	No	370000	2009 ADEC Table C GW	No	No	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Di-n-butyl Phthalate	84-74-2	µg/L	10	5	370	1/10th 2009 ADEC Table C GW	No	No	3700	2009 ADEC Table C GW	No	No	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Di-n-octyl Phthalate	117-84-0	µg/L	10	5	150	1/10th 2009 ADEC Table C GW	No	No	1500	2009 ADEC Table C GW	No	No	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Fluoranthene	206-44-0	µg/L	10	5	150	1/10th 2009 ADEC Table C GW	No	No	1500	2009 ADEC Table C GW	No	No	0.04	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.04	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Fluorene	86-73-7	µg/L	10	5	150	1/10th 2009 ADEC Table C GW	No	No	1500	2009 ADEC Table C GW	No	No	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Hexachlorobenzene	118-74-1	µg/L	10	5	0.1	1/10th 2009 ADEC Table C GW	Yes	Yes	1	2009 ADEC Table C GW	Yes	Yes	0.1	1/10th 2009 ADEC Table C GW	Yes	Yes	1	2009 ADEC Table C GW	Yes	Yes
SW8270C	Hexachlorobutadiene	87-68-3	µg/L	10	5	0.72	1/10th 2009 ADEC Table C GW	Yes	Yes	7.2	2009 ADEC Table C GW	No	Yes	0.72	1/10th 2009 ADEC Table C GW	Yes	Yes	0.93	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Hexachloroethane	67-72-1	µg/L	10	5	4	1/10th 2009 ADEC Table C GW	Yes	Yes	40	2009 ADEC Table C GW	No	No	4	1/10th 2009 ADEC Table C GW	Yes	Yes	9.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	10	5	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	Yes	Yes	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	Yes	Yes
SW8270C	Isophorone	78-59-1	µg/L	10	5	90	1/10th 2009 ADEC Table C GW	No	No	900	2009 ADEC Table C GW	No	No	90	1/10th 2009 ADEC Table C GW	No	No	900	2009 ADEC Table C GW	No	No
SW8270C	Naphthalene	91-20-3	µg/L	10	5	73	1/10th 2009 ADEC Table C GW	No	No	730	2009 ADEC Table C GW	No	No	1.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	1.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Nitrobenzene	98-95-3	µg/L	10	5	1.8	1/10th 2009 ADEC Table C GW	Yes	Yes	18	2009 ADEC Table C GW	No	No	1.8	1/10th 2009 ADEC Table C GW	Yes	Yes	18	2009 ADEC Table C GW	No	No
SW8270C	N-Nitrosodimethylamine	62-75-9	µg/L	10	5	0.0017	1/10th 2009 ADEC Table C GW	Yes	Yes	0.017	2009 ADEC Table C GW	Yes	Yes	0.0017	1/10th 2009 ADEC Table C GW	Yes	Yes	0.017	2009 ADEC Table C GW	Yes	Yes
SW8270C	N-Nitroso-di-N-propylamine	621-64-7	µg/L	10	5	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.12	2009 ADEC Table C GW	Yes	Yes	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.12	2009 ADEC Table C GW	Yes	Yes
SW8270C	N-Nitrosodiphenylamine	86-30-6	µg/L	10	5	17	1/10th 2009 ADEC Table C GW	No	No	170	2009 ADEC Table C GW	No	No	17	1/10th 2009 ADEC Table C GW	No	No	170	2009 ADEC Table C GW	No	No
SW8270C	Pentachlorophenol	87-86-5	µg/L	20	5	0.1	1/10th 2009 ADEC Table C GW	Yes	Yes	1	2009 ADEC Table C GW	Yes	Yes	0.1	1/10th 2009 ADEC Table C GW	Yes	Yes	1	2009 ADEC Table C GW	Yes	Yes
SW8270C	Phenanthrene	85-01-8	µg/L	10	5	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No	0.4	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.4	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Phenol	108-95-2	µg/L	10	5	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No	110	2009 ADEC Eco Freshwater ERBSC	No	No	110	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Pyrene	129-00-0	µg/L	10	5	110	1/10th 2009 ADEC Table C GW	No	No	1100	2009 ADEC Table C GW	No	No	0.025	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.025	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	1-Methylnaphthalene	90-12-0	µg/L	10	5	15	1/10th 2009 ADEC Table C GW	No	No	150	2009 ADEC Table C GW	No	No	2.1	1/10th 2009 ADEC Table C GW	Yes	Yes	2.1	1/10th 2009 ADEC Table C GW	Yes	Yes
SW8270CSIM	2-Methylnaphthalene	91-57-6	µg/L	1	0.2	15	1/10th 2009 ADEC Table C GW	No	No	150	2009 ADEC Table C GW	No	No	15	1/10th 2009 ADEC Table C GW	No	No	150	2009 ADEC Table C GW	No	No
SW8270CSIM	Acenaphthene	83-32-9	µg/L	1	0.2	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No	5.8	2009 ADEC Eco Freshwater ERBSC	No	No	5.8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270CSIM	Acenaphthylene	208-96-8	µg/L	1	0.2	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No	220	1/10th 2009 ADEC Table C GW	No	No	2200	2009 ADEC Table C GW	No	No
SW8270CSIM	Anthracene	120-12-7	µg/L	1	0.2	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Benzo(a)anthracene	56-55-3	µg/L	1	0.2	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	No	No	0.018	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.018	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Benzo(a)pyrene	50-32-8	µg/L	1	0.2	0.02	1/10th 2009 ADEC Table C GW	Yes	Yes	0.2	2009 ADEC Table C GW	No	Yes	0.014	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.014	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Benzo(b)fluoranthene	205-99-2	µg/L	1	0.2	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	No	No	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	No	No
SW8270CSIM	Benzo(g,h,i)perylene	191-24-2	µg/L	1	0.2	110	1/10th 2009 ADEC Table C GW	No	No	1100	2009 ADEC Table C GW	No	No	110	1/10th 2009 ADEC Table C GW	No	No	1100	2009 ADEC Table C GW	No	No
SW8270CSIM	Benzo(k)fluoranthene	207-08-9	µg/L	1	0.2	1.2	1/10th 2009 ADEC Table C GW	No	No	12	2009 ADEC Table C GW	No	No	1.2	1/10th 2009 ADEC Table C GW	No	No	12	2009 ADEC Table C GW	No	No
SW8270CSIM	Chrysene	218-01-9	µg/L	1	0.2	12	1/10th 2009 ADEC Table C GW	No	No	120	2009 ADEC Table C GW	No	No	12	1/10th 2009 ADEC Table C GW	No	No	120	2009 ADEC Table C GW	No	No
SW8270CSIM	Dibenz(a,h)anthracene	53-70-3	µg/L	1	0.2	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.12	2009 ADEC Table C GW	Yes	Yes	0.012	1/10th 2009 ADEC Table C GW	Yes	Yes	0.027	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Fluoranthene	206-44-0	µg/L	1	0.2	150	1/10th 2009 ADEC Table C GW	No	No	1500	2009 ADEC Table C GW	No	No	0.04	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.04	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Fluorene	86-73-7	µg/L	1	0.2	150	1/10th 2009 ADEC Table C GW	No	No	1500	2009 ADEC Table C GW	No	No	3	2009 ADEC Eco Freshwater ERBSC	No	No	3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270CSIM	Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	1	0.2	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	No	No	0.12	1/10th 2009 ADEC Table C GW	Yes	Yes	1.2	2009 ADEC Table C GW	No	No
SW8270CSIM	Naphthalene	91-20-3	µg/L	1	0.2	73	1/10th 2009 ADEC Table C GW	No	No	730	2009 ADEC Table C GW	No	No	1.1	2009 ADEC Eco Freshwater ERBSC	No	No	1.1	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270CSIM	Phenanthrene	85-01-8	µg/L	1	0.2	1100	1/10th 2009 ADEC Table C GW	No	No	11000	2009 ADEC Table C GW	No	No	0.4	2009 ADEC Eco Freshwater ERBSC	No	Yes	0.4	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270CSIM	Pyrene	129-00-0	µg/L	1	0.2	110	1/10th 2009 ADEC Table C GW	No	No	1100	2009 ADEC Table C GW	No	No	0.025	2009 ADEC Eco Freshwater ERBSC	Yes	Yes	0.025	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8290	1,2,3,4,6,7,8-HpCDD	35822-46-9	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,6,7,8-HpCDF	67562-39-4	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,7,8,9-HpCDF	55673-89-7	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-

TABLE 15-2

Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Groundwater

Former Galena Forward Operating Location, Alaska

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW NE SL	Source of GW NE Screening Level	Estimated LOD Exceeds GW NE SL?	Estimated LOQ Exceeds GW NE SL?	GW SI SL	Source of GW SI Screening Level	Estimated LOD Exceeds GW SI SL?	Estimated LOQ Exceeds GW SI SL?	GW to SW NE SL	Source of GW to SW NE Screening Level	Estimated LOD Exceeds GW to SW NE SL?	Estimated LOQ Exceeds GW to SW NE SL?	GW to SW SI SL	Source of GW to SW SI Screening Level	Estimated LOD Exceeds GW to SW SI SL?	Estimated LOQ Exceeds GW to SW SI SL?
SW8290	1,2,3,4,7,8-HxCDD	39227-28-6	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDF	70648-26-9	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDD	57653-85-7	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDF	57117-44-9	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDD	19408-74-3	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDF	72918-21-9	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8-PeCDD	40321-76-4	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	1,2,3,7,8-PeCDF	57117-41-6	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	2,3,4,6,7,8-HxCDF	60851-34-5	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	2,3,4,7,8-PeCDF	57117-31-4	µg/L	0.00005	0.00001	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	2,3,7,8-TCDD	1746-01-6	µg/L	0.00001	0.000003	0.000003	1/10th 2009 ADEC Table C GW	No	Yes	0.00003	2009 ADEC Table C GW	No	No	0.000003	1/10th 2009 ADEC Table C GW	No	Yes	0.00003	2009 ADEC Table C GW	No	No
SW8290	2,3,7,8-TCDF	51207-31-9	µg/L	0.00001	0.000003	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	OCDD	3268-87-9	µg/L	0.001	0.0005	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-
SW8290	OCDF	39001-02-0	µg/L	0.001	0.0005	NA	-	-	-	NA	-	-	-	NA	-	-	-	NA	-	-	-

Notes:

Estimated LODs and LOQs are not laboratory-specific but are levels that should be achievable by all project laboratories. Laboratory-specific MDLs, LODs, and LOQs will be reviewed in detail prior to project startup.

Some analyte LODs are not likely to reach SLs even with low-level methods. Best available technology will be used to achieve the lowest possible LOD and LOQ.

TABLE 15-3

Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Soil Gas

Method	Analyte	CAS	Units	Soil Gas SL	Soil Gas SL Source	AirToxics LOQ	Adjusted LOQ 1L Canister	Adjusted LOQ 1L > SL?	Adjusted LOQ 6L Canister	Adjusted LOQ 6L > SL?	AirToxics LOD	Adjusted LOD 1L Canister	Adjusted LOD 1L > SL?	Adjusted LOD 6L Canister	Adjusted LOD 6L > SL?
TO-15	1,1,1-Trichloroethane	71-55-6	$\mu g/m^3$	22900	ADEC Res Shallow SG Target	2.80	7.28	No	4.48	No	0.28	0.728	No	0.448	No
TO-15	1,1,2,2-Tetrachloroethane	79-34-5	$\mu g/m^3$	4.2	ADEC Res Shallow SG Target	3.50	9.1	Yes	5.6	Yes	0.77	2.002	No	1.232	No
TO-15	1,1,2-Trichloroethane	79-00-5	$\mu g/m^3$	15	ADEC Res Shallow SG Target	2.80	7.28	No	4.48	No	0.168	0.4368	No	0.2688	No
TO-15	1,1-Dichloroethane	75-34-3	$\mu g/m^3$	5200	ADEC Res Shallow SG Target	2.00	5.2	No	3.2	No	0.4	1.04	No	0.64	No
TO-15	1,1-Dichloroethene	75-35-4	$\mu g/m^3$	4.9	ADEC Res Shallow SG Target	2.00	5.2	Yes	3.2	No	0.28	0.728	No	0.448	No
TO-15	1,2-Dibromoethane	106-93-4	$\mu g/m^3$	0.41	ADEC Res Shallow SG Target	3.90	10.14	Yes	6.24	Yes	0.39	1.014	Yes	0.624	Yes
TO-15	1,2-Dichloroethane	107-06-2	$\mu g/m^3$	9.4	ADEC Res Shallow SG Target	2.00	5.2	No	3.2	No	0.32	0.832	No	0.512	No
TO-15	1,2-Dichloropropane	78-87-5	$\mu g/m^3$	13	ADEC Res Shallow SG Target	2.30	5.98	No	3.68	No	0.414	1.0764	No	0.6624	No
TO-15	Benzene	71-43-2	$\mu g/m^3$	31	ADEC Res Shallow SG Target	1.60	4.16	No	2.56	No	0.128	0.3328	No	0.2048	No
TO-15	Carbon Tetrachloride	56-23-5	$\mu g/m^3$	16	ADEC Res Shallow SG Target	3.20	8.32	No	5.12	No	0.576	1.4976	No	0.9216	No
TO-15	Chloroethane	75-00-3	$\mu g/m^3$	290	ADEC Res Shallow SG Target	1.30	3.38	No	2.08	No	0.286	0.7436	No	0.4576	No
TO-15	Chloroform	67-66-3	$\mu g/m^3$	11	ADEC Res Shallow SG Target	2.50	6.5	No	4	No	0.2	0.52	No	0.32	No
TO-15	Chloromethane	74-87-3	$\mu g/m^3$	140	ADEC Res Shallow SG Target	4.20	10.92	No	6.72	No	0.672	1.7472	No	1.0752	No
TO-15	cis-1,2-Dichloroethene	156-59-2	$\mu g/m^3$	370	ADEC Res Shallow SG Target	2.00	5.2	No	3.2	No	0.2	0.52	No	0.32	No
TO-15	Ethylbenzene	100-41-4	$\mu g/m^3$	220	ADEC Res Shallow SG Target	2.20	5.72	No	3.52	No	0.308	0.8008	No	0.4928	No
TO-15	Methylene Chloride	75-09-2	$\mu g/m^3$	520	ADEC Res Shallow SG Target	1.80	4.68	No	2.88	No	0.288	0.7488	No	0.4608	No
TO-15	Styrene	100-42-4	$\mu g/m^3$	10400	ADEC Res Shallow SG Target	2.20	5.72	No	3.52	No	0.176	0.4576	No	0.2816	No
TO-15	Tetrachloroethene	127-18-4	$\mu g/m^3$	41	ADEC Res Shallow SG Target	3.40	8.84	No	5.44	No	0.544	1.4144	No	0.8704	No
TO-15	Toluene	108-88-3	$\mu g/m^3$	52100	ADEC Res Shallow SG Target	1.90	4.94	No	3.04	No	0.114	0.2964	No	0.1824	No
TO-15	trans-1,2-Dichloroethene	156-60-5	$\mu g/m^3$	630	ADEC Res Shallow SG Target	2.00	5.2	No	3.2	No	0.24	0.624	No	0.384	No
TO-15	Trichloroethene	79-01-6	$\mu g/m^3$	2.2	ADEC Res Shallow SG Target	2.70	7.02	Yes	4.32	Yes	0.216	0.5616	No	0.3456	No
TO-15	Vinyl Chloride	75-01-4	$\mu g/m^3$	8.1	ADEC Res Shallow SG Target	1.30	3.38	No	2.08	No	0.182	0.4732	No	0.2912	No
TO-15	Xylenes (total)	1330-20-7	$\mu g/m^3$	1000	ADEC Res Shallow SG Target	4.40	11.44	No	7.04	No	0.484	1.2584	No	0.7744	No

Notes:

Canister dilution factors approximately 2.6 for a 1-liter canister and 1.6 for a 6-liter canister. 6-Liter canisters recommended.

TO-15 SIM currently not available for 1,2-Dibromoethane, but can be set up on request.

TABLE 15-4

Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Surface Water

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW SL	Source of SW Screening Level	Estimated LOD Exceeds SW SL?	Estimated LOQ Exceeds SW SL?
AK101	Gasoline Range Organics	C6-C10 GRO	µg/L	100	20	NA		-	-
AK102/103	Diesel Range Organics	C10-C25 DRO	µg/L	500	100	NA	-	-	-
AK102/103	Motor Oil Range Organics	C25-C36 RRO	µg/L	1000	100	NA	-	-	-
NWEPH	C10-C12 Aliphatics	C10-C12 Aliphatics	µg/L	50	5	NA	-	-	-
NWEPH	C10-C12 Aromatics	C10-C12 Aromatics	µg/L	50	5	NA	-	-	-
NWEPH	C12-C16 Aliphatics	C12-C16 Aliphatics	µg/L	50	5	NA	-	-	-
NWEPH	C12-C16 Aromatics	C12-C16 Aromatics	µg/L	50	5	NA	-	-	-
NWEPH	C16-C21 Aliphatics	C16-C21 Aliphatics	µg/L	50	5	NA	-	-	-
NWEPH	C16-C21 Aromatics	C16-C21 Aromatics	µg/L	50	5	NA	-	-	-
NWEPH	C21-C34 Aliphatics	C21-C34 Aliphatics	µg/L	50	5	NA	-	-	-
NWEPH	C21-C34 Aromatics	C21-C34 Aromatics	µg/L	50	5	NA	-	-	-
NWEPH	C8-C10 Aliphatics	C8-C10 Aliphatics	µg/L	50	5	NA	-	-	-
NWEPH	C8-C10 Aromatics	C8-C10 Aromatics	µg/L	50	5	NA	-	-	-
NWEPH	Total EPH (TEPH)	TEPH	µg/L	50	5	NA	-	-	-
NWVPH	C10-C12 Aliphatics	C10-C12 Aliphatics	µg/L	50	5	NA	-	-	-
NWVPH	C10-C12 Aromatics	C10-C12 Aromatics	µg/L	50	5	NA	-	-	-
NWVPH	C12-C13 Aromatics	C12-C13 Aromatics	µg/L	50	5	NA	-	-	-
NWVPH	C5-C6 Aliphatics	C5-C6 Aliphatics	µg/L	50	5	NA	-	-	-
NWVPH	C5-C6 Aromatics	C5-C6 Aromatics	µg/L	50	5	NA	-	-	-
NWVPH	C6-C8 Aliphatics	C6-C8 Aliphatics	µg/L	50	5	NA	-	-	-
NWVPH	C6-C8 Aromatics	C6-C8 Aromatics	µg/L	50	5	NA	-	-	-
NWVPH	C8-C10 Aliphatics	C8-C10 Aliphatics	µg/L	50	5	NA	-	-	-
NWVPH	C8-C10 Aromatics	C8-C10 Aromatics	µg/L	50	5	NA	-	-	-
NWVPH	Total VPH (TVPH)	TVPH	µg/L	50	5	NA	-	-	-
SW6010B/SW6020	Aluminum	7429-90-5	µg/L	200	60	75	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Antimony	7440-36-0	µg/L	1	0.5	30	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Arsenic	7440-38-2	µg/L	5	0.5	55	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Barium	7440-39-3	µg/L	3	0.5	3.9	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Beryllium	7440-41-7	µg/L	3	0.5	0.53	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Cadmium	7440-43-9	µg/L	2	0.5	0.013	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Calcium	7440-70-2	µg/L	1100	100	116000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Chromium	7440-47-3	µg/L	4	0.5	-	-	-	-
SW6010B/SW6020	Cobalt	7440-48-4	µg/L	8	0.5	3	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Copper	7440-50-8	µg/L	6	0.5	0.205	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Iron	7439-89-6	µg/L	200	40	16	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Lead	7439-92-1	µg/L	2	0.5	1	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Magnesium	7439-95-4	µg/L	1000	100	82000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Manganese	7439-96-5	µg/L	2	0.5	80	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Molybdenum	7439-98-7	µg/L	15	5	-	-	-	-
SW6010B/SW6020	Nickel	7440-02-0	µg/L	2	0.5	5	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Potassium	7440-09-7	µg/L	1000	200	53000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Selenium	7782-49-2	µg/L	2	0.5	1	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Silver	7440-22-4	µg/L	2	0.5	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW6010B/SW6020	Sodium	7440-23-5	µg/L	1000	100	680000	2009 ADEC Eco Freshwater ERBSC	No	No
SW6010B/SW6020	Thallium	7440-28-0	µg/L	1	0.5	0.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW6010B/SW6020	Vanadium	7440-62-2	µg/L	10	5	19	2009 ADEC Eco Freshwater ERBSC	No	No

TABLE 15-4
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Surface Water

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW SL	Source of SW Screening Level	Estimated LOD Exceeds SW SL?	Estimated LOQ Exceeds SW SL?
SW6010B/SW6020	Zinc	7440-66-6	µg/L	25	5	21	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW7470A	Mercury	7439-97-6	µg/L	1	0.5	0.77	Alaska 2008 Aquatic Life Freshwater (chronic)	No	Yes
SW8011	1,2-Dibromo-3-chloropropane	96-12-8	µg/L	0.02	0.005	NA	-	-	-
SW8011	1,2-Dibromoethane	106-93-4	µg/L	0.02	0.005	NA	-	-	-
SW8081A	4,4'-DDD	72-54-8	µg/L	0.1	0.02	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	4,4'-DDE	72-55-9	µg/L	0.1	0.02	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	4,4'-DDT	50-29-3	µg/L	0.1	0.02	0.000011	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Aldrin	309-00-2	µg/L	0.1	0.02	0.3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8081A	alpha-BHC	319-84-6	µg/L	0.1	0.02	2.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8081A	alpha-Chlordane	5103-71-9	µg/L	0.1	0.02	NA	-	-	-
SW8081A	beta-BHC	319-85-7	µg/L	0.1	0.02	2.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8081A	delta-BHC	319-86-8	µg/L	0.1	0.02	NA	-	-	-
SW8081A	Dieldrin	60-57-1	µg/L	0.1	0.02	0.056	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8081A	Endosulfan I	959-98-8	µg/L	0.1	0.02	0.02	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8081A	Endosulfan II	33213-65-9	µg/L	0.1	0.02	0.02	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8081A	Endosulfan sulfate	1031-07-8	µg/L	0.1	0.02	NA	-	-	-
SW8081A	Endrin	72-20-8	µg/L	0.1	0.02	0.0023	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Endrin aldehyde	7421-93-4	µg/L	0.1	0.02	NA	-	-	-
SW8081A	Endrin ketone	53494-70-5	µg/L	0.1	0.02	NA	-	-	-
SW8081A	gamma-BHC (Lindane)	58-89-9	µg/L	0.1	0.02	NA	-	-	-
SW8081A	gamma-Chlordane	5103-74-2	µg/L	0.1	0.02	NA	-	-	-
SW8081A	Heptachlor	76-44-8	µg/L	0.1	0.02	0.0038	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Heptachlor epoxide	1024-57-3	µg/L	0.1	0.02	0.0038	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Methoxychlor	72-43-5	µg/L	0.1	0.02	0.019	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8081A	Toxaphene	8001-35-2	µg/L	0.1	0.02	0.0002	Alaska 2008 Aquatic Life Freshwater (chronic)	Yes	Yes
SW8082	Aroclor-1016	12674-11-2	µg/L	0.5	0.25	0.19	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1221	11104-28-2	µg/L	0.5	0.25	0.28	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8082	Aroclor-1232	11141-16-5	µg/L	0.5	0.25	0.58	2009 ADEC Eco Freshwater ERBSC	No	No
SW8082	Aroclor-1242	53469-21-9	µg/L	0.5	0.25	0.053	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1248	12672-29-6	µg/L	0.5	0.25	0.081	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1254	11097-69-1	µg/L	0.5	0.25	0.033	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8082	Aroclor-1260	11096-82-5	µg/L	0.5	0.25	2.1	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1,1,2-Tetrachloroethane	630-20-6	µg/L	1	0.2	NA	-	-	-
SW8260B	1,1,1-Trichloroethane	71-55-6	µg/L	1	0.2	11	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1,2,2-Tetrachloroethane	79-34-5	µg/L	1	0.2	240	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1,2-Trichloroethane	79-00-5	µg/L	1	0.2	940	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1-Dichloroethane	75-34-3	µg/L	1	0.2	47	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1-Dichloroethene	75-35-4	µg/L	1	0.2	25	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,1-Dichloropropene	563-58-6	µg/L	1	0.2	NA	-	-	-
SW8260B	1,2,3-Trichlorobenzene	87-61-6	µg/L	1	0.2	8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,2,3-Trichloropropane	96-18-4	µg/L	1	0.2	NA	-	-	-
SW8260B	1,2,4-Trichlorobenzene	120-82-1	µg/L	10	5	24	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,2,4-Trimethylbenzene	95-63-6	µg/L	1	0.2	NA	-	-	-
SW8260B	1,2-Dibromo-3-chloropropane	96-12-8	µg/L	1	0.2	NA	-	-	-
SW8260B	1,2-Dibromoethane	106-93-4	µg/L	1	0.2	NA	-	-	-
SW8260B	1,2-Dichlorobenzene	95-50-1	µg/L	10	5	0.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes

TABLE 15-4
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Surface Water

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW SL	Source of SW Screening Level	Estimated LOD Exceeds SW SL?	Estimated LOQ Exceeds SW SL?
SW8260B	1,2-Dichloroethane	107-06-2	µg/L	1	0.2	100	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,2-Dichloropropane	78-87-5	µg/L	1	0.2	525	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,3,5-Trimethylbenzene	108-67-8	µg/L	1	0.2	NA	-	-	-
SW8260B	1,3-Dichlorobenzene	541-73-1	µg/L	10	5	50.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,3-Dichloropropane	142-28-9	µg/L	1	0.2	244	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	1,4-Dichlorobenzene	106-46-7	µg/L	10	5	11.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	2,2-Dichloropropane	594-20-7	µg/L	1	0.2	NA	-	-	-
SW8260B	2-Butanol	78-92-2	µg/L	1	0.2	NA	-	-	-
SW8260B	2-Butanone	78-93-3	µg/L	10	5	14000	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	2-Chlorotoluene	95-49-8	µg/L	1	0.2	NA	-	-	-
SW8260B	2-Hexanone	591-78-6	µg/L	10	5	99	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	4-Chlorotoluene	106-43-4	µg/L	1	0.2	NA	-	-	-
SW8260B	4-Methyl-2-pentanone	108-10-1	µg/L	10	5	170	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Acetone	67-64-1	µg/L	10	5	1500	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Benzene	71-43-2	µg/L	1	0.2	21	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Bromobenzene	108-86-1	µg/L	1	0.2	NA	-	-	-
SW8260B	Bromochloromethane	74-97-5	µg/L	1	0.2	NA	-	-	-
SW8260B	Bromodichloromethane	75-27-4	µg/L	1	0.2	NA	-	-	-
SW8260B	Bromoform	75-25-2	µg/L	1	0.3	NA	-	-	-
SW8260B	Bromomethane	74-83-9	µg/L	1	0.2	110	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Carbon Disulfide	75-15-0	µg/L	1	0.3	0.92	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8260B	Carbon Tetrachloride	56-23-5	µg/L	1	0.2	9.8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Chlorobenzene	108-90-7	µg/L	1	0.3	1.3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Chloroethane	75-00-3	µg/L	1	0.2	NA	-	-	-
SW8260B	Chloroform	67-66-3	µg/L	1	0.2	1.8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Chloromethane	74-87-3	µg/L	1	0.2	5500	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	cis-1,2-Dichloroethene	156-59-2	µg/L	1	0.2	590	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	cis-1,3-Dichloropropene	10061-01-5	µg/L	1	0.2	NA	-	-	-
SW8260B	Dibromochloromethane	124-48-1	µg/L	1	0.2	NA	-	-	-
SW8260B	Dibromomethane	74-95-3	µg/L	1	0.2	NA	-	-	-
SW8260B	Dichlorodifluoromethane	75-71-8	µg/L	1	0.2	NA	-	-	-
SW8260B	Ethylbenzene	100-41-4	µg/L	1	0.2	7.3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Hexachlorobutadiene	87-68-3	µg/L	10	5	0.93	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8260B	Isopropylbenzene	98-82-8	µg/L	2	0.5	NA	-	-	-
SW8260B	m,p-Xylene	136777-61-2	µg/L	2	0.5	1.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8260B	Methyl tert butylether	1634-04-4	µg/L	1	0.2	NA	-	-	-
SW8260B	Methylene Chloride	75-09-2	µg/L	1	0.5	410	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Naphthalene	91-20-3	µg/L	10	5	1.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8260B	n-Butylbenzene	104-51-8	µg/L	1	0.5	NA	-	-	-
SW8260B	n-Propylbenzene	103-65-1	µg/L	1	0.5	NA	-	-	-
SW8260B	o-Xylene	95-47-6	µg/L	1	0.5	NA	-	-	-
SW8260B	p-Isopropyltoluene	99-87-6	µg/L	1	0.5	NA	-	-	-
SW8260B	sec-Butylbenzene	135-98-8	µg/L	1	0.5	NA	-	-	-
SW8260B	Styrene	100-42-5	µg/L	1	0.2	72	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	tert-Butylbenzene	98-06-6	µg/L	1	0.5	NA	-	-	-
SW8260B	Tetrachloroethene	127-18-4	µg/L	1	0.2	84	2009 ADEC Eco Freshwater ERBSC	No	No

TABLE 15-4
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Surface Water

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW SL	Source of SW Screening Level	Estimated LOD Exceeds SW SL?	Estimated LOQ Exceeds SW SL?
SW8260B	Toluene	108-88-3	µg/L	1	0.2	2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	trans-1,2-Dichloroethene	156-60-5	µg/L	1	0.2	590	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	trans-1,3-Dichloropropene	10061-02-6	µg/L	1	0.2	NA	-	-	-
SW8260B	Trichloroethylene	79-01-6	µg/L	1	0.2	47	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Trichlorofluoromethane	75-69-4	µg/L	1	0.2	NA	-	-	-
SW8260B	Vinyl Chloride	75-01-4	µg/L	1	0.2	1300	2009 ADEC Eco Freshwater ERBSC	No	No
SW8260B	Xylenes (total)	1330-20-7	µg/L	2	0.5	13	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1,2,4-Trichlorobenzene	120-82-1	µg/L	10	5	24	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1,2-Dichlorobenzene	95-50-1	µg/L	10	5	0.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	1,2-Diphenylhydrazine	122-66-7	µg/L	10	5	2.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	1,3-Dichlorobenzene	541-73-1	µg/L	10	5	50.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1,4-Dichlorobenzene	106-46-7	µg/L	10	5	11.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	1-Methylnaphthalene	90-12-0	µg/L	10	5	2.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	2,4,5-Trichlorophenol	95-95-4	µg/L	10	5	NA	-	-	-
SW8270C	2,4,6-Trichlorophenol	88-06-2	µg/L	10	5	3.2	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	2,4-Dichlorophenol	120-83-2	µg/L	10	5	0.2	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	2,4-Dimethylphenol	105-67-9	µg/L	10	5	21.2	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	2,4-Dinitrophenol	51-28-5	µg/L	20	5	6.2	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	2,4-Dinitrotoluene	121-14-2	µg/L	10	5	23	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	2,6-Dinitrotoluene	606-20-2	µg/L	10	5	60	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	2-Chloronaphthalene	91-58-7	µg/L	10	5	NA	-	-	-
SW8270C	2-Chlorophenol	95-57-8	µg/L	10	5	7	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	2-Methylnaphthalene	91-57-6	µg/L	10	5	NA	-	-	-
SW8270C	2-Methylphenol	95-48-7	µg/L	10	5	13	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	2-Nitroaniline	88-74-4	µg/L	10	5	NA	-	-	-
SW8270C	2-Nitrophenol	88-75-5	µg/L	10	5	3500	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	3,3'-Dichlorobenzidine	91-94-1	µg/L	10	5	NA	-	-	-
SW8270C	3-Methylphenol & 4-Methylphenol	108-39-4/106	µg/L	10	5	NA	-	-	-
SW8270C	3-Nitroaniline	99-09-2	µg/L	10	5	NA	-	-	-
SW8270C	4,6-Dinitro-2-methylphenol	534-52-1	µg/L	20	5	2.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	4-Bromophenyl-phenylether	101-55-3	µg/L	10	5	1.5	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	4-Chloro-3-methylphenol	59-50-7	µg/L	10	5	0.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	4-Chloroaniline	106-47-8	µg/L	10	5	NA	-	-	-
SW8270C	4-Chlorophenyl-phenylether	7005-72-3	µg/L	10	5	NA	-	-	-
SW8270C	4-Nitroaniline	100-01-6	µg/L	10	5	NA	-	-	-
SW8270C	4-Nitrophenol	100-02-7	µg/L	20	5	82.8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Acenaphthene	83-32-9	µg/L	10	5	5.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	Acenaphthylene	208-96-8	µg/L	10	5	NA	-	-	-
SW8270C	Anthracene	120-12-7	µg/L	10	5	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Benzo(a)anthracene	56-55-3	µg/L	10	5	0.018	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Benzo(a)pyrene	50-32-8	µg/L	10	5	0.014	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Benzo(b)fluoranthene	205-99-2	µg/L	10	5	NA	-	-	-
SW8270C	Benzo(g,h,i)perylene	191-24-2	µg/L	10	5	NA	-	-	-
SW8270C	Benzo(k)fluoranthene	207-08-9	µg/L	10	5	NA	-	-	-
SW8270C	Benzoic acid	65-85-0	µg/L	10	5	42	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Benzyl Alcohol	100-51-6	µg/L	10	5	8.6	2009 ADEC Eco Freshwater ERBSC	No	Yes

TABLE 15-4
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Surface Water

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW SL	Source of SW Screening Level	Estimated LOD Exceeds SW SL?	Estimated LOQ Exceeds SW SL?
SW8270C	Bis(2-chloroethoxy)methane	111-91-1	µg/L	10	5	NA	-	-	-
SW8270C	Bis(2-chloroethyl)ether	111-44-4	µg/L	10	5	2380	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Bis(2-chloroisopropyl) ether	108-60-1	µg/L	10	5	NA	-	-	-
SW8270C	Bis(2-ethylhexyl)phthalate	117-81-7	µg/L	10	5	0.3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Butyl Benzyl Phthlate	85-68-7	µg/L	10	5	19	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Carbazole	86-74-8	µg/L	10	5	NA	-	-	-
SW8270C	Chrysene	218-01-9	µg/L	10	5	NA	-	-	-
SW8270C	Dibenz(a,h)anthracene	53-70-3	µg/L	10	5	0.027	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Dibenzofuran	132-64-9	µg/L	10	5	3.7	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Diethyl Phthalate	84-66-2	µg/L	10	5	0.18	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Dimethyl Phthalate	131-11-3	µg/L	10	5	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Di-n-butyl Phthalate	84-74-2	µg/L	10	5	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Di-n-octyl Phthalate	117-84-0	µg/L	10	5	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Fluoranthene	206-44-0	µg/L	10	5	0.04	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Fluorene	86-73-7	µg/L	10	5	3	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Hexachlorobenzene	118-74-1	µg/L	10	5	3.68	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Hexachlorobutadiene	87-68-3	µg/L	10	5	0.93	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Hexachloroethane	67-72-1	µg/L	10	5	9.8	2009 ADEC Eco Freshwater ERBSC	No	Yes
SW8270C	Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	10	5	NA	-	-	-
SW8270C	Isophorone	78-59-1	µg/L	10	5	1170	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Naphthalene	91-20-3	µg/L	10	5	1.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Nitrobenzene	98-95-3	µg/L	10	5	270	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	N-Nitrosodimethylamine	62-75-9	µg/L	10	5	NA	-	-	-
SW8270C	N-Nitroso-di-N-propylamine	621-64-7	µg/L	10	5	NA	-	-	-
SW8270C	N-Nitrosodiphenylamine	86-30-6	µg/L	10	5	NA	-	-	-
SW8270C	Pentachlorophenol	87-86-5	µg/L	20	5	1.61	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Phenanthrene	85-01-8	µg/L	10	5	0.4	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270C	Phenol	108-95-2	µg/L	10	5	110	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270C	Pyrene	129-00-0	µg/L	10	5	0.025	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	1-Methylnaphthalene	90-12-0	µg/L	10	5	2.1	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	2-Methylnaphthalene	91-57-6	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Acenaphthene	83-32-9	µg/L	1	0.2	5.8	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270CSIM	Acenaphthylene	208-96-8	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Anthracene	120-12-7	µg/L	1	0.2	0.012	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Benzo(a)anthracene	56-55-3	µg/L	1	0.2	0.018	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Benzo(a)pyrene	50-32-8	µg/L	1	0.2	0.014	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Benzo(b)fluoranthene	205-99-2	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Benzo(g,h,i)perylene	191-24-2	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Benzo(k)fluoranthene	207-08-9	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Chrysene	218-01-9	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Dibenz(a,h)anthracene	53-70-3	µg/L	1	0.2	0.027	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Fluoranthene	206-44-0	µg/L	1	0.2	0.04	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8270CSIM	Fluorene	86-73-7	µg/L	1	0.2	3	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270CSIM	Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	1	0.2	NA	-	-	-
SW8270CSIM	Naphthalene	91-20-3	µg/L	1	0.2	1.1	2009 ADEC Eco Freshwater ERBSC	No	No
SW8270CSIM	Phenanthrene	85-01-8	µg/L	1	0.2	0.4	2009 ADEC Eco Freshwater ERBSC	No	Yes

TABLE 15-4

Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Surface Water

Method	Analyte	CAS	Units	Estimated LOQ	Estimated LOD	GW SL	Source of SW Screening Level	Estimated LOD Exceeds SW SL?	Estimated LOQ Exceeds SW SL?
SW8270CSIM	Pyrene	129-00-0	µg/L	1	0.2	0.025	2009 ADEC Eco Freshwater ERBSC	Yes	Yes
SW8290	1,2,3,4,6,7,8-HpCDD	35822-46-9	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,4,6,7,8-HpCDF	67562-39-4	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,4,7,8,9-HpCDF	55673-89-7	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDD	39227-28-6	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDF	70648-26-9	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDD	57653-85-7	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDF	57117-44-9	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDD	19408-74-3	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDF	72918-21-9	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,7,8-PeCDD	40321-76-4	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	1,2,3,7,8-PeCDF	57117-41-6	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	2,3,4,6,7,8-HxCDF	60851-34-5	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	2,3,4,7,8-PeCDF	57117-31-4	µg/L	0.00005	0.00001	NA	-	-	-
SW8290	2,3,7,8-TCDD	1746-01-6	µg/L	0.00001	0.000003	NA	-	-	-
SW8290	2,3,7,8-TCDF	51207-31-9	µg/L	0.00001	0.000003	NA	-	-	-
SW8290	OCDD	3268-87-9	µg/L	0.001	0.0005	NA	-	-	-
SW8290	OCDF	39001-02-0	µg/L	0.001	0.0005	NA	-	-	-

Notes:

Estimated LODs and LOQs are not laboratory-specific but are levels that should be achievable by all project laboratories. Laboratory-specific MDLs, LODs, and LOQs will be reviewed in detail prior to project startup.

Some analyte LODs are not likely to reach SLs even with low-level methods. Best available technology will be used to achieve the lowest possible LOD and LOQ.

TABLE 15-5
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Sediment

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Screening Level	Source of Sediment SL	Estimated LOD Exceeds Sediment SL?	Estimated LOQ Exceeds Sediment SL?
AK101	Gasoline Range Organics	C6-C10 GRO	mg/kg	0.5	1	NA	-	-	-
AK102/103	Diesel Range Organics	C10-C25 DRO	mg/kg	5	10	NA	-	-	-
AK102/103	Motor Oil Range Organics	C25-C36 RRO	mg/kg	5	10	NA	-	-	-
NWEPH	C10-C12 Aliphatics	C10-C12 Aliphatics	mg/kg	2	5	NA	-	-	-
NWEPH	C10-C12 Aromatics	C10-C12 Aromatics	mg/kg	2	5	NA	-	-	-
NWEPH	C12-C16 Aliphatics	C12-C16 Aliphatics	mg/kg	2	5	NA	-	-	-
NWEPH	C12-C16 Aromatics	C12-C16 Aromatics	mg/kg	2	5	NA	-	-	-
NWEPH	C16-C21 Aliphatics	C16-C21 Aliphatics	mg/kg	2	5	NA	-	-	-
NWEPH	C16-C21 Aromatics	C16-C21 Aromatics	mg/kg	2	5	NA	-	-	-
NWEPH	C21-C34 Aliphatics	C21-C34 Aliphatics	mg/kg	2	5	NA	-	-	-
NWEPH	C21-C34 Aromatics	C21-C34 Aromatics	mg/kg	2	5	NA	-	-	-
NWEPH	C8-C10 Aliphatics	C8-C10 Aliphatics	mg/kg	2	5	NA	-	-	-
NWEPH	C8-C10 Aromatics	C8-C10 Aromatics	mg/kg	2	5	NA	-	-	-
NWEPH	Total EPH (TEPH)	TEPH	mg/kg	2	5	NA	-	-	-
NWVPH	C10-C12 Aliphatics	C10-C12 Aliphatics	mg/kg	2	5	NA	-	-	-
NWVPH	C10-C12 Aromatics	C10-C12 Aromatics	mg/kg	2	5	NA	-	-	-
NWVPH	C12-C13 Aromatics	C12-C13 Aromatics	mg/kg	2	5	NA	-	-	-
NWVPH	C5-C6 Aliphatics	C5-C6 Aliphatics	mg/kg	2	5	NA	-	-	-
NWVPH	C5-C6 Aromatics	C5-C6 Aromatics	mg/kg	2	5	NA	-	-	-
NWVPH	C6-C8 Aliphatics	C6-C8 Aliphatics	mg/kg	2	5	NA	-	-	-
NWVPH	C6-C8 Aromatics	C6-C8 Aromatics	mg/kg	2	5	NA	-	-	-
NWVPH	C8-C10 Aliphatics	C8-C10 Aliphatics	mg/kg	2	5	NA	-	-	-
NWVPH	C8-C10 Aromatics	C8-C10 Aromatics	mg/kg	2	5	NA	-	-	-
NWVPH	Total VPH (TVPH)	TVPH	mg/kg	2	5	NA	-	-	-
SW6010B/SW6020	Aluminum	7429-90-5	mg/kg	5	20	NA	-	-	-
SW6010B/SW6020	Antimony	7440-36-0	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Arsenic	7440-38-2	mg/kg	0.1	0.5	5.9	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW6010B/SW6020	Barium	7440-39-3	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Beryllium	7440-41-7	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Cadmium	7440-43-9	mg/kg	0.1	0.5	0.596	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW6010B/SW6020	Calcium	7440-70-2	mg/kg	10	100	NA	-	-	-
SW6010B/SW6020	Chromium	7440-47-3	mg/kg	0.1	0.5	37.3	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW6010B/SW6020	Cobalt	7440-48-4	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Copper	7440-50-8	mg/kg	0.1	0.5	35.7	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW6010B/SW6020	Iron	7439-89-6	mg/kg	3	20	NA	-	-	-
SW6010B/SW6020	Lead	7439-92-1	mg/kg	0.1	0.5	35	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW6010B/SW6020	Magnesium	7439-95-4	mg/kg	10	100	NA	-	-	-
SW6010B/SW6020	Manganese	7439-96-5	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Molybdenum	7439-98-7	mg/kg	0.5	5	NA	-	-	-
SW6010B/SW6020	Nickel	7440-02-0	mg/kg	0.1	0.5	18	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW6010B/SW6020	Potassium	7440-09-7	mg/kg	20	200	NA	-	-	-
SW6010B/SW6020	Selenium	7782-49-2	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Silver	7440-22-4	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Sodium	7440-23-5	mg/kg	10	100	NA	-	-	-
SW6010B/SW6020	Thallium	7440-28-0	mg/kg	0.1	0.5	NA	-	-	-
SW6010B/SW6020	Vanadium	7440-62-2	mg/kg	0.5	1	NA	-	-	-
SW6010B/SW6020	Zinc	7440-66-6	mg/kg	1	2.5	123	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No

TABLE 15-5
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Sediment

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Screening Level	Source of Sediment SL	Estimated LOD Exceeds Sediment SL?	Estimated LOQ Exceeds Sediment SL?
SW7471A	Mercury	7439-97-6	mg/kg	0.033	0.1	0.174	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8021B	Benzene	71-43-2	mg/kg	0.002	0.005	NA	-	-	-
SW8021B	Ethylbenzene	100-41-4	mg/kg	0.002	0.005	NA	-	-	-
SW8021B	m,p-Xylene	136777-61-2	mg/kg	0.002	0.005	NA	-	-	-
SW8021B	o-Xylene	95-47-6	mg/kg	0.002	0.005	NA	-	-	-
SW8021B	Toluene	108-88-3	mg/kg	0.002	0.005	NA	-	-	-
SW8021B	Xylenes (total)	1330-20-7	mg/kg	0.002	0.005	NA	-	-	-
SW8081A	4,4'-DDD	72-54-8	mg/kg	0.0015	0.004	0.00354	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	Yes
SW8081A	4,4'-DDE	72-55-9	mg/kg	0.0015	0.004	0.00142	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8081A	4,4'-DDT	50-29-3	mg/kg	0.0015	0.004	0.00119	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8081A	Aldrin	309-00-2	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	alpha-BHC	319-84-6	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	alpha-Chlordane	5103-71-9	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	beta-BHC	319-85-7	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	delta-BHC	319-86-8	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Dieldrin	60-57-1	mg/kg	0.0015	0.004	0.00285	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	Yes
SW8081A	Endosulfan I	959-98-8	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Endosulfan II	33213-65-9	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Endosulfan sulfate	1031-07-8	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Endrin	72-20-8	mg/kg	0.0015	0.004	0.00267	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	Yes
SW8081A	Endrin aldehyde	7421-93-4	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Endrin ketone	53494-70-5	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	gamma-BHC (Lindane)	58-89-9	mg/kg	0.0015	0.004	0.00094	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8081A	gamma-Chlordane	5103-74-2	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Heptachlor	76-44-8	mg/kg	0.0015	0.004	NA	-	-	-
SW8081A	Heptachlor epoxide	1024-57-3	mg/kg	0.0015	0.004	0.0006	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8081A	Methoxychlor	72-43-5	mg/kg	0.004	0.02	NA	-	-	-
SW8081A	Toxaphene	8001-35-2	mg/kg	0.004	0.02	0.0001	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8082	Aroclor-1016	12674-11-2	mg/kg	0.02	0.05	NA	-	-	-
SW8082	Aroclor-1221	11104-28-2	mg/kg	0.02	0.05	NA	-	-	-
SW8082	Aroclor-1232	11141-16-5	mg/kg	0.02	0.05	NA	-	-	-
SW8082	Aroclor-1242	53469-21-9	mg/kg	0.02	0.05	NA	-	-	-
SW8082	Aroclor-1248	12672-29-6	mg/kg	0.02	0.05	NA	-	-	-
SW8082	Aroclor-1254	11097-69-1	mg/kg	0.02	0.05	0.06	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8082	Aroclor-1260	11096-82-5	mg/kg	0.02	0.05	NA	-	-	-
SW8260B	1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,1,1-Trichloroethane	71-55-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,1,2-Trichloroethane	79-00-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,1-Dichloroethane	75-34-3	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,1-Dichloroethene	75-35-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,1-Dichloropropene	563-58-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2,3-Trichlorobenzene	87-61-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2,3-Trichloropropane	96-18-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2,4-Trimethylbenzene	95-63-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	0.005	0.01	NA	-	-	-

TABLE 15-5
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Sediment

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Screening Level	Source of Sediment SL	Estimated LOD Exceeds Sediment SL?	Estimated LOQ Exceeds Sediment SL?
SW8260B	1,2-Dibromoethane	106-93-4	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	1,2-Dichlorobenzene	95-50-1	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2-Dichloroethane	107-06-2	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,2-Dichloropropane	78-87-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,3,5-Trimethylbenzene	108-67-8	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,3-Dichlorobenzene	541-73-1	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,3-Dichloropropane	142-28-9	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	1,4-Dichlorobenzene	106-46-7	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	2,2-Dichloropropane	594-20-7	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	2-Butanol	79.92-2	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	2-Butanone	78-93-3	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	2-Chlorotoluene	95-49-8	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	2-Hexanone	591-78-6	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	4-Chlorotoluene	106-43-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	4-Methyl-2-pentanone	108-10-1	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Acetone	67-64-1	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Benzene	71-43-2	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Bromobenzene	108-86-1	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Bromochloromethane	74-97-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Bromodichloromethane	75-27-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Bromoform	75-25-2	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Bromomethane	74-83-9	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Carbon Disulfide	75-15-0	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Carbon Tetrachloride	56-23-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Chlorobenzene	108-90-7	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Chloroethane	75-00-3	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Chloroform	67-66-3	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Chloromethane	74-87-3	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	cis-1,2-Dichloroethene	156-59-2	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	cis-1,3-Dichloropropene	10061-01-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Dibromochloromethane	124-48-1	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Dibromomethane	74-95-3	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Dichlorodifluoromethane	75-71-8	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Ethylbenzene	100-41-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Hexachlorobutadiene	87-68-3	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Isopropylbenzene	98-82-8	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	m,p-Xylene	136777-61-2	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Methyl tert butylether	1634-04-4	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Methylene Chloride	75-09-2	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Naphthalene	91-20-3	mg/kg	0.002	0.005	0.0346	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8260B	n-Butylbenzene	104-51-8	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	n-Propylbenzene	103-65-1	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	o-Xylene	95-47-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	p-Isopropyltoluene	99-87-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	sec-Butylbenzene	135-98-8	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Styrene	100-42-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	tert-Butylbenzene	98-06-6	mg/kg	0.002	0.005	NA	-	-	-

TABLE 15-5
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Sediment

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Screening Level	Source of Sediment SL	Estimated LOD Exceeds Sediment SL?	Estimated LOQ Exceeds Sediment SL?
SW8260B	Tetrachloroethene	127-18-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Toluene	108-88-3	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	trans-1,2-Dichloroethene	156-60-5	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	trans-1,3-Dichloropropene	10061-02-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Trichloroethene	79-01-6	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Trichlorofluoromethane	75-69-4	mg/kg	0.005	0.01	NA	-	-	-
SW8260B	Vinyl Chloride	75-01-4	mg/kg	0.002	0.005	NA	-	-	-
SW8260B	Xylenes (total)	1330-20-7	mg/kg	0.005	0.01	NA	-	-	-
SW8270C	1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	1,2-Dichlorobenzene	95-50-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	1,2-Diphenylhydrazine	122-66-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	1,3-Dichlorobenzene	541-73-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	1,4-Dichlorobenzene	106-46-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	1-Methylnaphthalene	90-12-0	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2,4,5-Trichlorophenol	95-95-4	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2,4,6-Trichlorophenol	88-06-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2,4-Dichlorophenol	120-83-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2,4-Dimethylphenol	105-67-9	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2,4-Dinitrophenol	51-28-5	mg/kg	0.2	1	NA	-	-	-
SW8270C	2,4-Dinitrotoluene	121-14-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2,6-Dinitrotoluene	606-20-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2-Chloronaphthalene	91-58-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2-Chlorophenol	95-57-8	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2-Methylnaphthalene	91-57-6	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2-Methylphenol	95-48-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2-Nitroaniline	88-74-4	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	2-Nitrophenol	88-75-5	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	3,3'-Dichlorobenzidine	91-94-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	3-Methylphenol & 4-Methylphenol	108-39-4/106	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	3-Nitroaniline	99-09-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	4,6-Dinitro-2-methylphenol	534-52-1	mg/kg	0.2	1	NA	-	-	-
SW8270C	4-Bromophenyl-phenylether	101-55-3	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	4-Chloro-3-methylphenol	59-50-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	4-Chloroaniline	106-47-8	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	4-Chlorophenyl-phenylether	7005-72-3	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	4-Nitroaniline	100-01-6	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	4-Nitrophenol	100-02-7	mg/kg	0.2	1	NA	-	-	-
SW8270C	Acenaphthene	83-32-9	mg/kg	0.2	0.5	0.00671	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Acenaphthylene	208-96-8	mg/kg	0.2	0.5	0.00587	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Anthracene	120-12-7	mg/kg	0.2	0.5	0.0469	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Benzo(a)anthracene	56-55-3	mg/kg	0.2	0.5	0.0317	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Benzo(a)pyrene	50-32-8	mg/kg	0.2	0.5	0.0319	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Benzo(b)fluoranthene	205-99-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Benzo(g,h,i)perylene	191-24-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Benzo(k)fluoranthene	207-08-9	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Benzoic acid	65-85-0	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Benzyl Alcohol	100-51-6	mg/kg	0.2	0.5	NA	-	-	-

TABLE 15-5
Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Sediment

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Screening Level	Source of Sediment SL	Estimated LOD Exceeds Sediment SL?	Estimated LOQ Exceeds Sediment SL?
SW8270C	Bis(2-chloroethoxy)methane	111-91-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Bis(2-chloroethyl)ether	111-44-4	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Bis(2-chloroisopropyl) ether	108-60-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Butyl Benzyl Phthlate	85-68-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Carbazole	86-74-8	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Chrysene	218-01-9	mg/kg	0.2	0.5	0.0571	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Dibenzo(a,h)anthracene	53-70-3	mg/kg	0.2	0.5	0.00622	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Dibenzofuran	132-64-9	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Diethyl Phthalate	84-66-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Dimethyl Phthalate	131-11-3	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Di-n-butyl Phthalate	84-74-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Di-n-octyl Phthalate	117-84-0	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Fluoranthene	206-44-0	mg/kg	0.2	0.5	0.111	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Fluorene	86-73-7	mg/kg	0.2	0.5	0.0212	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Hexachlorobenzene	118-74-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Hexachlorobutadiene	87-68-3	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Hexachloroethane	67-72-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Isophorone	78-59-1	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Naphthalene	91-20-3	mg/kg	0.2	0.5	0.0346	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Nitrobenzene	98-95-3	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	n-Nitrosodimethylamine	62-75-9	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	n-Nitroso-di-n-propylamine	621-64-7	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	n-Nitrosodiphenylamine	86-30-6	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Pentachlorophenol	87-86-5	mg/kg	0.2	1	NA	-	-	-
SW8270C	Phenanthrene	85-01-8	mg/kg	0.2	0.5	0.0419	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270C	Phenol	108-95-2	mg/kg	0.2	0.5	NA	-	-	-
SW8270C	Pyrene	129-00-0	mg/kg	0.2	0.5	0.053	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270CSIM	1-Methylnaphthalene	90-12-0	mg/kg	0.2	0.5	NA	-	-	-
SW8270CSIM	2-Methylnaphthalene	91-57-6	mg/kg	0.01	0.02	NA	-	-	-
SW8270CSIM	Acenaphthene	83-32-9	mg/kg	0.01	0.02	0.00671	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270CSIM	Acenaphthylene	208-96-8	mg/kg	0.01	0.02	0.00587	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270CSIM	Anthracene	120-12-7	mg/kg	0.01	0.02	0.0469	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Benzo(a)anthracene	56-55-3	mg/kg	0.01	0.02	0.0317	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Benzo(a)pyrene	50-32-8	mg/kg	0.01	0.02	0.0319	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Benzo(b)fluoranthene	205-99-2	mg/kg	0.01	0.02	NA	-	-	-
SW8270CSIM	Benzo(g,h,i)perylene	191-24-2	mg/kg	0.01	0.02	NA	-	-	-
SW8270CSIM	Benzo(k)fluoranthene	207-08-9	mg/kg	0.01	0.02	NA	-	-	-
SW8270CSIM	Chrysene	218-01-9	mg/kg	0.01	0.02	0.0571	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Dibenzo(a,h)anthracene	53-70-3	mg/kg	0.01	0.02	0.00622	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	Yes	Yes
SW8270CSIM	Fluoranthene	206-44-0	mg/kg	0.01	0.02	0.111	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Fluorene	86-73-7	mg/kg	0.01	0.02	0.0212	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	0.01	0.02	NA	-	-	-
SW8270CSIM	Naphthalene	91-20-3	mg/kg	0.01	0.02	0.0346	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Phenanthrene	85-01-8	mg/kg	0.01	0.02	0.0419	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No
SW8270CSIM	Pyrene	129-00-0	mg/kg	0.01	0.02	0.053	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	No

TABLE 15-5

Comparison of Estimated Laboratory LODs and LOQs with Screening Levels for Sediment

Method	Analyte	CAS	Units	Estimated LOD	Estimated LOQ	Screening Level	Source of Sediment SL	Estimated LOD Exceeds Sediment SL?	Estimated LOQ Exceeds Sediment SL?
SW8290	1,2,3,4,6,7,8-HpCDD	35822-46-9	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,4,6,7,8-HpCDF	67562-39-4	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,4,7,8,9-HpCDF	55673-89-7	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDD	39227-28-6	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,4,7,8-HxCDF	70648-26-9	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDD	57653-85-7	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,6,7,8-HxCDF	57117-44-9	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDD	19408-74-3	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,7,8,9-HxCDF	72918-21-9	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,7,8-PeCDD	40321-76-4	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	1,2,3,7,8-PeCDF	57117-41-6	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	2,3,4,6,7,8-HxCDF	60851-34-5	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	2,3,4,7,8-PeCDF	57117-31-4	mg/kg	0.000002	0.000005	NA	-	-	-
SW8290	2,3,7,8-TCDD	1746-01-6	mg/kg	0.0000005	0.000001	0.00000085	NOAA SQuiRts Sediment Quality Guidelines Freshwater Sediment TEL	No	Yes
SW8290	2,3,7,8-TCDF	51207-31-9	mg/kg	0.0000005	0.000001	NA	-	-	-
SW8290	OCDD	3268-87-9	mg/kg	0.00005	0.0001	NA	-	-	-
SW8290	OCDF	39001-02-0	mg/kg	0.00005	0.0001	NA	-	-	-

Notes:

Estimated LODs and LOQs are not laboratory-specific but are levels that should be achievable by all project laboratories. Laboratory-specific MDLs, LODs, and LOQs will be reviewed in detail prior to project startup.

Soil Screening Levels

Screening Level Type	Site Type	Media	2009 ADEC Table B1/B2 Method 2 Cleanup Levels[a]					2009 ADEC Ecoscoping Soil ERBSC	Maximum Background Concentration[b]	Process
			Under 40-inch Zone - Direct Contact	Under 40-inch Zone - Outdoor Inhalation	Migration to Groundwater	1/10th Under 40 inch Zone - Direct Contact	1/10th Under 40 inch Zone - Outdoor Inhalation			
Site Inspection Screening Level	Ecological Habitat Sites	Surface Soil (0 to 2 ft)	X	X	X			X	X	1. Choose lowest Table B1/B2 Value 2. Compare Table B1/B2 Value to ERBSC, if ERBSC is lower than Table B1/B2 Value, consider ERBC in background comparison, else consider Table B1/B2 Value 3. Compare risk-based value to Backgound, if Background is greater, use Background as Screening Level, else use risk-based value as Screening Level
	Non-Ecological Habitat Sites	Surface Soil (0 to 2 ft)	X	X	X				X	1. Choose lowest Table B1/B2 Value 2. Compare risk-based value to Backgound, if Background is greater, use Background as Screening Level, else use risk-based value as Screening Level
	All Sites	Subsurface Soil (>2 ft)	X	X	X				X	1. Choose lowest Table B1/B2 Value 2. Compare risk-based value to Backgound, if Background is greater, use Background as Screening Level, else use risk-based value as Screening Level
Extent Screening Level	All Sites	Surface Soil (0 to 2 ft)			X	X	X		X	1. Choose lowest Table B1/B2 Value 2. Compare risk-based value to Backgound, if Background is greater, use Background as Screening Level, else use risk-based value as Screening Level
	All Sites	Subsurface Soil (>2 ft)			X	X	X		X	1. Choose lowest Table B1/B2 Value 2. Compare risk-based value to Backgound, if Background is greater, use Background as Screening Level, else use risk-based value as Screening Level

[a] If no ADEC Table B1/B2 value is available, the EPA RSLs will be used
[b] Maximum of 0 to 2 ft and > 2 ft background concentration, as presented in USAF 1996

Groundwater Screening Levels

Screening Level Type	Site Type	Media	2009 ADEC Table C Groundwater Cleanup Levels[a]	2009 ADEC Ecoscoping Freshwater ERBSC	Maximum Background Concentration	Process
Groundwater Characterization Screening Level	Sites > 1000 feet from River	Groundwater	X		X	1. Compare Table C value to Backgound, if Background is greater, use Background as Screening Level, else use Table C value as Screening Level
	Sites < 1000 feet from River	Groundwater	X	X	X	1. Compare Table C Value to ERBSC, if ERBSC is lower than Table C Value, consider ERBC in background comparison, else consider Table C Value 2. Compare risk-based value to Backgound, if Background is greater, use Background as Screening Level, else use risk-based value as Screening Level

[a] If no ADEC C value is available, the EPA RSLs will be used
[b] Maximum of groundwater and surface water background concentration, as presented in USAF 1996

Soil Vapor Screening Levels

Screening Level Type	Site Type	Media	ADEC Residential Shallow Soil Gas Cleanup Level
Soil Vapor Screening Level	All Sites	Soil Vapor	X

FIGURE 15-1
SCREENING LEVEL COMPARISON
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

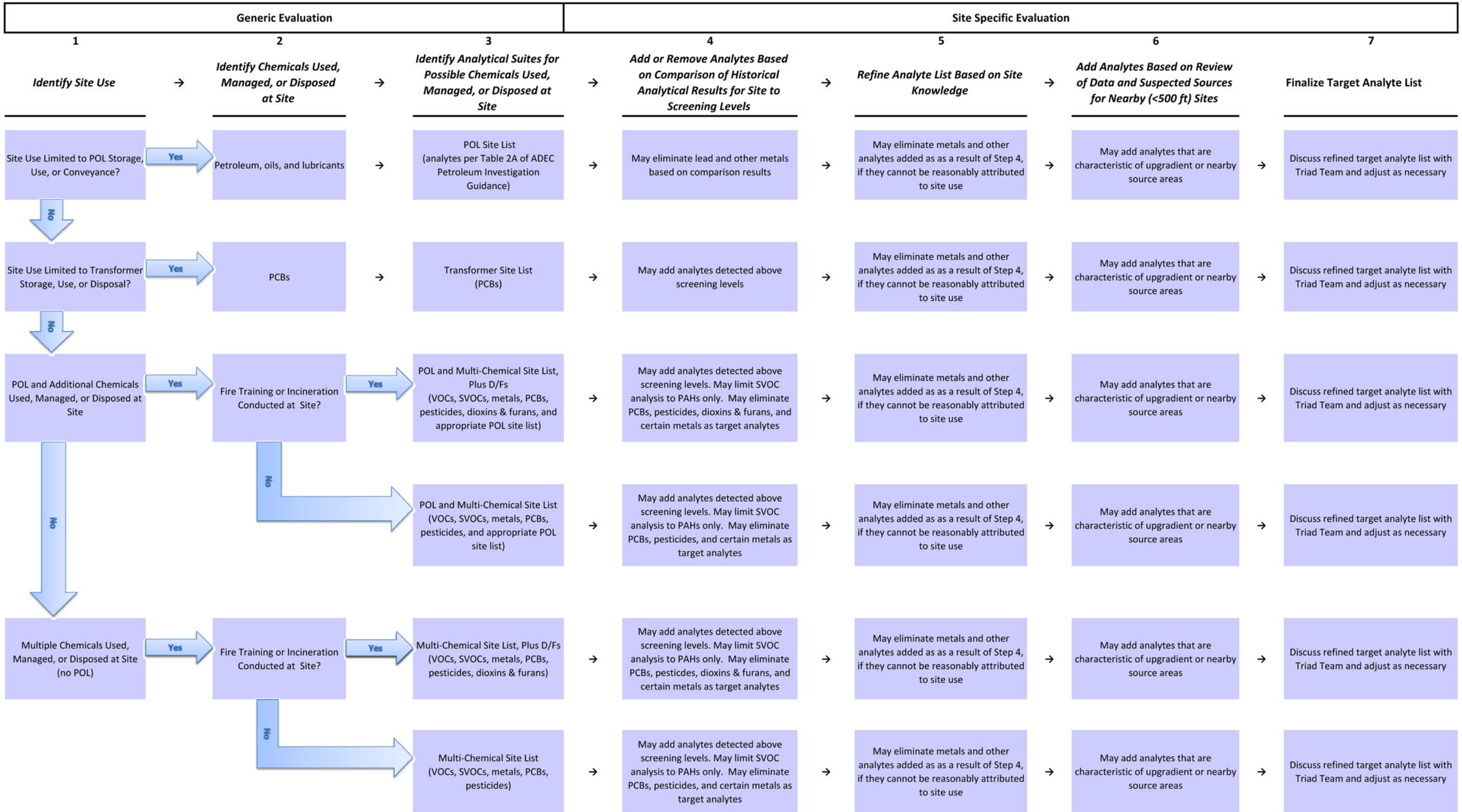

FIGURE 15-2
SELECTION OF TARGET ANALYTICAL SUITES FOR SI, SC, AND RI SAMPLING PLANS
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

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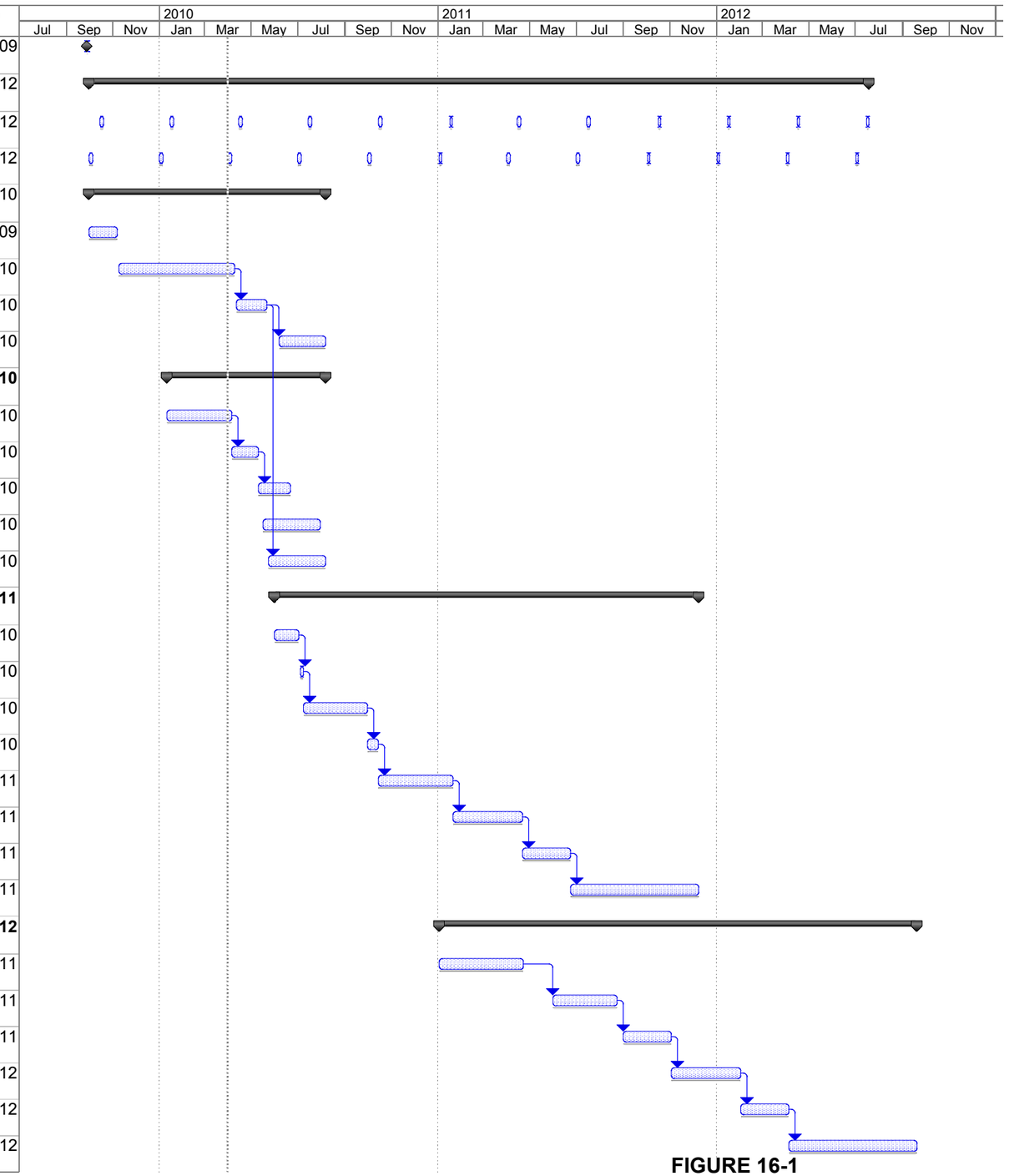
Worksheet #16 – Project Schedule

This worksheet presents the anticipated schedule for this project, which shows the timeframes for the major activities and deliverables, as well as the individual tasks and their interrelationships.

Because of the dynamic nature of this Work Plan, the project schedule will inevitably be revised in response to unpredictable project events. Once recognized, potential revisions to the project schedule will be communicated to the project team so that the changes can be evaluated and, where appropriate, efficiently accommodated within the overall schedule to minimize impacts on the milestone dates. Several meetings or conference calls are also anticipated to coincide with project milestones such as Work Plan approval, receipt of sampling results, and preparation of draft reports. The schedule has been structured to achieve efficiency during project execution. In some cases, significant changes in the schedule structure may be required if the planning assumptions are inconsistent with actual project requirements.

ID	Task Name	Duration	Planned Start	Planned Finish
1	**TO 184 Task Order Award**	1 day?	Mon 9/28/09	Mon 9/28/09
2	**Project Administration**	730 days	Thu 10/1/09	Wed 7/18/12
3	Quarterly RAB Meetings (Galena)	720 days	Thu 10/15/09	Wed 7/18/12
16	Quarterly BCT Meetings (Fairbanks)	720 days	Thu 10/1/09	Wed 7/4/12
29	**Preliminary Assessment (PA)**	222 days	Thu 10/1/09	Fri 8/6/10
30	Site Visit and Records Search	27 days	Thu 10/1/09	Fri 11/6/09
31	Draft PA Report	110 days	Mon 11/9/09	Fri 4/9/10
32	Review	30 days	Mon 4/12/10	Fri 5/21/10
33	Final PA Report	45 days	Mon 6/7/10	Fri 8/6/10
34	**Work Plan (QAPP)**	**150 days**	**Mon 1/11/10**	**Fri 8/6/10**
35	Draft Work Plan	61 days	Mon 1/11/10	Mon 4/5/10
36	Review	25 days	Tue 4/6/10	Mon 5/10/10
37	Final Work Plan (includes first 6 sites)	30 days	Tue 5/11/10	Mon 6/21/10
38	Appendix D FSPs for 12 ERP Sites	55 days	Mon 5/17/10	Fri 7/30/10
39	Appendix D FSPs for PA Sites Requiring Investigation	55 days	Mon 5/24/10	Fri 8/6/10
40	**2010 Investigation**	**398 days**	**Tue 6/1/10**	**Thu 12/8/11**
41	Surveying and Utility Locates	24 days	Tue 6/1/10	Fri 7/2/10
42	Mobilization	4 days	Mon 7/5/10	Thu 7/8/10
43	2010 Field Sampling	60 days	Fri 7/9/10	Thu 9/30/10
44	Demobilization	10 days	Fri 10/1/10	Thu 10/14/10
45	Interim Data Evaluation	70 days	Fri 10/15/10	Thu 1/20/11
46	Draft Report, Reviews on Completed 2010 Site Investigations	65 days	Fri 1/21/11	Thu 4/21/11
47	Final Report on Completed 2010 Site Investigations	45 days	Fri 4/22/11	Thu 6/23/11
48	Decision Documents, FS, PP, and ROD	120 days	Fri 6/24/11	Thu 12/8/11
49	**2011 Investigation**	**448 days**	**Mon 1/3/11**	**Wed 9/19/12**
50	Work Plan Amendments, Reviews	80 days	Mon 1/3/11	Fri 4/22/11
51	2011 Field Sampling	60 days	Wed 6/1/11	Tue 8/23/11
52	Data Evaluation	45 days	Thu 9/1/11	Wed 11/2/11
53	Draft Report, Reviews on Completed 2011 Site Investigations	65 days	Thu 11/3/11	Wed 2/1/12
54	Final Report on Completed 2011 Site Investigations	45 days	Thu 2/2/12	Wed 4/4/12
55	Decision Documents, FS, PP, ROD	120 days	Thu 4/5/12	Wed 9/19/12



Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

FIGURE 16-1
Schedule
Work Plan for Site Inspection, Remedial Investigation, and Site Characterization
Former Galena Forward Operating Location, Alaska

Worksheet #17 – Sampling Design and Rationale

This worksheet presents the investigation approaches and sampling designs that were developed for each of the Investigation Approach Groups described in Worksheet #11. The following Investigation Approach Groups have common CSM elements and, thus, have similar data needs and sample design requirements to be addressed during the required investigation(s):

- **Surface POL Releases –** Sites with known or potential surface releases of POL from ASTs, drums, fill-stands, aboveground fueling pipelines, or loading/unloading facilities, or other surface fuel spills.
- **Subsurface POL Releases –** Sites with known or potential subsurface releases of POL from buried fueling piping, valve pits, or sumps.
- **Subsurface POL Releases (UST-related) –** Sites with known or potential subsurface releases of POL from leaking USTs. This category is separate from the Subsurface POL Releases category because there are special sampling requirements for UST site closure.
- **Surface Multi-chemical Releases –** Sites with known or potential surface releases of non-POL chemicals (that is, solvents, metals, pesticides; or a mixture of POL and non-POL chemicals) from ASTs, drums (waste management areas), or other surface spills.
- **Subsurface Multi-chemical Releases –** Sites with known or potential subsurface releases of non-POL chemicals (or a mixture of POL and non-POL chemicals) from OWSs, sumps, or fire training area pits.
- **Transformer Sites –** Sites where transformers may have been present and releases of PCBs and other chemicals may have occurred.
- **Unknown Source –** Sites where visual reconnaissance, historical records, and/or remote sensing results suggest management or disposal of waste or hazardous chemicals, but where the location and composition of potential releases are unknown.

Tables 17-1 through 17-12 (tables are located at the end of this worksheet) identify the investigation approaches and sampling design elements for each of these groups. Site-specific sampling plans developed from these approaches are presented in Appendix D. Tables 17-1 through 17- 7 provide sampling design elements for all investigation approach groups specific to the SI stage. Tables 17-8 through 17-12 present sampling design elements for the different surface and subsurface release groups for the SC/RI stage (excludes Transformer and Unknown Source sites, which at present are included only as SI stage sites).

TABLE 17-1
Investigation Approach and Sampling Design Elements– POL Surface Releases, Site Inspection Stage

Step	SI
Inspection Approach Group	POL Surface Releases.
Objective	Investigate possible releases and determine need for further sampling.
Problem Statement	Historical releases of POL may have occurred from ASTs, drums, aboveground fueling system infrastructure, or other surface spill sources. Available data are insufficient to confirm the presence or absence of contamination.
Decision to Be Made	Determine whether historical surface releases of POL may have affected soil at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation (including MIS, if applicable). Sample locations and depths for site media. Field observations and measurements from current and historical sampling activities. SI screening levels (as described in Worksheet #15). 18 AAC 75 and ADEC guidance.
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Spatial Boundaries – Immediate vicinity of likely source or release location between surface and 5 feet bgs (for example, surface soil beneath fill ports). Deeper soil will be included if there is field evidence of contamination at 5 feet bgs. Chemical Boundaries – Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.
Optimize the Design	Perform site reconnaissance or historical record search to determine potential source areas, if unknown. If potential source areas are known, log soil cores continuously and collect discrete soil samples beneath and adjacent to the potential POL surface release area, with one soil sample from the upper 2 feet, a second at 5 feet bgs, and additional samples as needed to target intervals and locations with staining, elevated PID/FID readings, or other evidence of contamination. If there is field evidence of contamination at 5 feet bgs, collect at least one additional sample between 5 feet bgs and the top of the water table (the water table at the time of sampling). If there is field evidence of contamination at the top of the water table, collect at least one additional soil sample between the water table and the bottom of the smear zone. If there is evidence of contamination at the top of the water table, co-locate a groundwater sample with a saturated soil sample at the top of the water table both at one location in the source area and one location upgradient of the source area to determine potential impacts on groundwater.

TABLE 17-1
Investigation Approach and Sampling Design Elements– POL Surface Releases, Site Inspection Stage

Step	SI
	If potential source areas cannot be located to guide discrete sampling, consider MI sampling following procedures in SOP-30 (*Multi-incremental Sampling*) in Appendix H by collecting at least 30 surface soil sub-samples within each decision unit (using a systematically random approach to collect samples in each grid cell) to field sieve, composite, and analyze. If obstructions prevent soil sampling in appropriate areas (for example, buildings, tarmac pavement), supplemental soil vapor sampling at 5 feet bgs may be conducted, as close to the potential source area as possible, to help determine presence or absence of shallow soil contamination. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

AAC = *Alaska Administrative Code*
ADEC = Alaska Department of Environmental Conservation
AST = aboveground storage tank
bgs = below ground surface
DoD = U.S. Department of Defense
FID = flame ionization detector
MI = multi-increment
MIS = multi-incremental samples
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB = polychlorinated biphenyl
PID = photoionization detector
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation
RRO = residual-range organic
SC = Site Characterization
SI = Site Inspection
SI/RI/SC = Site Inspection/Remedial Investigation/Site Characterization
UST = underground storage tank

TABLE 17-2
Investigation Approach and Sampling Design Elements – POL Subsurface Releases, Site Inspection Stage (Non-UST)

Step	SI
Inspection Approach Group	POL Subsurface Releases.
Objective	Investigate possible releases and determine need for further sampling.
Problem Statement	Historical releases of POL may have occurred from belowground fueling system infrastructure, sumps, or other subsurface spill sources. Available data are insufficient to confirm the presence or absence of contamination.
Decision to Be Made	Determine whether historical subsurface releases of POL may have affected soil or groundwater at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities.
	Site reconnaissance records.
	Site improvements or development history since releases or sampling.
	Remote sensing information on location of piping or other subsurface features.
	Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation.
	Sample locations and depths for site media.
	Field observations and measurements from current and historical sampling activities.
	Depth to groundwater, groundwater elevation measurements, and NAPL thickness measurements.
	Site geologic and hydrogeologic information.
	SI screening levels (as described in Worksheet #15).
	18 AAC 75 and 78 and ADEC guidance
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential.
	Spatial Boundaries – Immediate vicinity of likely source or release location (for example, between the subsurface source and the historical low level groundwater elevation [bottom of variably saturated zone, or “smear zone”]).
	Chemical Boundaries – Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Levels on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.

TABLE 17-2
Investigation Approach and Sampling Design Elements – POL Subsurface Releases, Site Inspection Stage (Non-UST)

Step	SI
Optimize the Design	Perform site reconnaissance, historical record search, and/or geophysical surveys to determine potential source areas, if unknown. log soil cores continuously and collect a minimum of two soil samples beneath and adjacent to the potential release area, from the approximate depth of release to the top of the water table (typically between 5 and 15 feet bgs) and additional samples as needed to target intervals and locations with staining, elevated PID/FID readings, or other evidence of contamination. If there is field evidence of contamination at the top of the water table, collect at least one additional soil sample between the water table and the bottom of the smear zone. Co-locate a groundwater sample with a saturated soil sample at the top of the water table, both at one location in the source area and at one location upgradient of the source area to determine potential impacts on groundwater. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

AAC = *Alaska Administrative Code*
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bgs = below ground surface
DoD = U.S. Department of Defense
FID = flame ionization detector
MI = multi-increment
NAPL = nonaqueous phase liquid
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
PID = photo-ionization detector
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation
RRO = residual-range organic
SC = Site Characterization
SI = Site Inspection
SI/RI/SC = Site Inspection/Remedial Investigation/Site Characterization
UST = underground storage tank

TABLE 17-3
Investigation Approach and Sampling Design Elements– POL Subsurface Releases, Site Inspection Stage (USTs)

Step	SI
Inspection Approach Group	POL Subsurface Releases.
Objective	Investigate possible releases and determine need for further sampling.
Problem Statement	Historical releases of POL may have occurred from USTs. Available data are insufficient to confirm the presence or absence of contamination.
Decision to Be Made	Determine whether historical subsurface releases of POL from a UST may have affected soil or groundwater at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Remote sensing information on location of USTs and piping Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation. Sample locations and depths for site media. Field observations and measurements from current and historical sampling activities. Depth to groundwater, groundwater elevation measurements, and NAPL thickness measurements. Site geologic and hydrogeologic information. SI screening levels (as described in Worksheet #15). 18 AAC 75 and 78 and ADEC guidance.
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Spatial Boundaries – Immediate vicinity of likely source or release location (for example, between the UST and the historical low level groundwater elevation [bottom of variably saturated zone, or “smear zone”]). Chemical Boundaries – Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.

TABLE 17-3
Investigation Approach and Sampling Design Elements– POL Subsurface Releases, Site Inspection Stage (USTs)

Step	SI
Optimize the Design	Perform site reconnaissance, historical record search, and/or geophysical surveys to determine potential UST and piping locations if unknown. Collect samples per AAC requirements (18 AAC 78.090) to determine the presence/absence of UST-related contamination and support tank. Two borings are required for a tank occupying 250 square feet or less (one additional boring is required for each additional 250 square feet). Borings should be placed within 5 feet of the tank at the midpoint of the sides for USTs abandoned in place in areas most likely to have contamination (for example, fill port). For removed USTs, borings should be placed at the center of the tank and also along the longitudinal axis of the tank in areas most likely to have contamination. Log soil cores continuously and collect two samples at each boring (one at 2 feet below the bottom of the tank, another at the top of the water table), and additional samples as needed to target locations with staining, elevated PID/FID readings, or other evidence of contamination. If there is field evidence of contamination at the top of the water table, collect at least one additional soil sample between the water table and the bottom of the smear zone. Co-locate a groundwater sample with a saturated soil sample at the top of the water table, both at one location in the source area and at one location upgradient of the source area to determine potential impacts on groundwater. For associated pipelines, collect soil samples 2 feet below the pipe at 10-foot intervals (between the UST and the main fuel pipeline), targeting joints or locations with staining, elevated PID/FID readings, or other evidence of contamination, if possible. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

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ADEC = Alaska Department of Environmental Conservation
bgs = below ground surface
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FID = flame ionization detector
MI = multi-increment
NAPL = nonaqueous phase liquid
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
PID = photo-ionization detector
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation
SC = Site Characterization
SI = Site Inspection
SI/RI/SC = Site Inspection/Remedial Investigation/Site Characterization
UST = underground storage tank

TABLE 17-4
Investigation Approach and Sampling Design Elements – Multi-chemical Surface Releases, Site Inspection Stage

Step	SI
Inspection Approach Group	Multi-chemical Surface Releases.
Objective	Investigate possible releases and determine need for further sampling.
Problem Statement	Historical releases of non-POL chemicals (for example, solvents, metals, or a mixture of POL and non-POL chemicals) may have occurred from ASTs, drums, or other surface spill sources. Available data are insufficient to confirm the presence or absence of contamination.
Decision to Be Made	Determine whether historical surface releases of non-POL chemicals may have affected soil at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation. Sample locations and depths for site media. Field observations and measurements from current and historical sampling activities. SI screening levels (as described in Worksheet #15). CERCLA regulations and guidance.
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Spatial Boundaries – Immediate vicinity of likely source or release location between surface and 5 feet bgs (for example, surface soil in drum storage area). Deeper soil will be included if there is field evidence of contamination at 5 feet bgs. Chemical Boundaries – Use target analyte list appropriate for suspected source and release. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.
Optimize the Design	Perform site reconnaissance or historical record search to determine potential source areas, if unknown. If potential source areas are known, log soil cores continuously and collect discrete soil samples beneath and adjacent to the potential surface release area, with one soil sample from the upper 2 feet, a second at 5 feet bgs, and additional samples as needed to target intervals and locations with staining, elevated PID/FID readings, or other evidence of contamination. If there is field evidence of contamination at 5 feet bgs, collect at least one additional sample between 5 feet bgs and the top of the water table. If there is field evidence of contamination at the top of the water table, collect at least one additional soil sample between the water table and the bottom of the variably saturated zone. If there is evidence of contamination at the top of the water table, co-locate a groundwater

TABLE 17-4
Investigation Approach and Sampling Design Elements – Multi-chemical Surface Releases, Site Inspection Stage

Step	SI
	sample with a saturated soil sample at the top of the water table, both at one location in the source area and at one location upgradient of the source area to determine potential impacts on groundwater. If potential source areas cannot be located to guide discrete sampling, consider MI sampling following procedures in SOP-30 (Multi-incremental Sampling) in Appendix H by collecting at least 30 surface soil sub-samples within each decision unit (using a systematically random approach to collect samples in each grid cell) to field sieve, composite, and analyze. If target analytes are volatile and obstructions prevent soil sampling in appropriate areas (for example, buildings, tarmac pavement), supplemental soil vapor sampling at 5 feet bgs may be conducted as close to the potential source area as possible to help determine presence or absence of shallow soil contamination. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

AST	=	aboveground storage tank
bgs	=	below ground surface
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DoD	=	U.S. Department of Defense
FID	=	flame ionization detector
MI	=	multi-increment
PARCCS	=	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PID	=	photo-ionization detector
POL	=	petroleum, oils, and lubricants
QSM	=	Quality Systems Manual
RI	=	Remedial Investigation
SC	=	Site Characterization
SI	=	Site Inspection
SI/RI/SC	=	Site Inspection/Remedial Investigation/Site Characterization

TABLE 17-5
Investigation Approach and Sampling Design Elements – Multi-chemical Subsurface Releases, Site Inspection Stage

Step	SI
Inspection Approach Group	Multi-chemical Subsurface Releases.
Objective	Investigate possible releases and determine need for further sampling.
Problem Statement	Historical releases of non-POL chemicals (for example, solvents, metals, or a mixture of POL and non-POL chemicals) may have occurred from OWS, sumps, or other subsurface sources. Available data are insufficient to confirm the presence or absence of contamination.
Decision to Be Made	Determine whether historical subsurface releases of non-POL chemicals may have affected soil or groundwater at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Remote sensing information on location of sumps and piping. Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation. Sample locations and depths for site media. Field observations and measurements from current and historical sampling activities. Depth to groundwater, groundwater elevation measurements, and NAPL thickness measurements. Site geologic and hydrogeologic information. SI screening levels (as described in Worksheet #15). CERCLA regulations and guidance.
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Spatial Boundaries – Immediate vicinity of likely source or release location between surface and 5 feet bgs (for example, below bottom of sump). Chemical Boundaries – Use target analyte list appropriate for suspected source and release history. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.
Optimize the Design	Perform site reconnaissance, historical record search, and/or geophysical surveys to determine potential source areas, if unknown. Log soil cores continuously and collect a minimum of two soil samples beneath and adjacent to the potential release area, from the approximate depth of release to the top of the water table (typically between 5 and 15 feet bgs). If there is field evidence of contamination at the top of

TABLE 17-5
Investigation Approach and Sampling Design Elements – Multi-chemical Subsurface Releases, Site Inspection Stage

Step	SI
	the water table, collect at least one additional soil sample between the water table and the bottom of the variably saturated zone. Co-locate a groundwater sample with a saturated soil sample at the top of the water table, both at one location in the source area and at one location upgradient of the source area to determine potential impacts on groundwater. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

bgs = below ground surface
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DoD = U.S. Department of Defense
NAPL = nonaqueous phase liquid
OWS = oil-water separator
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation
SC = Site Characterization
SI = Site Inspection
SI/RI/SC = Site Inspection/Remedial Investigation/Site Characterization

TABLE 17-6
Investigation Approach and Sampling Design Elements—Site Inspection Stage, Transformer Site

Step	SI
Inspection Approach Group	Transformer Site.
Objective	Investigate possible releases of PCBs and determine the need for further sampling.
Problem Statement	Historical surface releases of PCBs may have occurred from transformers. Available data are insufficient to confirm the presence or absence of contamination.
Decision to Be Made	Determine whether historical surface releases of PCBs may have affected soil at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation (including MIS if applicable). Sample locations and depths for site media. Field observations and measurements from current and historical sampling activities. SI screening levels (as described in Worksheet #15). CERCLA regulations and guidance.
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Spatial Boundaries – Immediate vicinity of likely source or release location between surface and 5 feet bgs (for example, surface soil at former transformer pad) where contamination from a surface PCB release is most likely to affect soil. Deeper soil will be included if there is field evidence of contamination at 5 feet bgs. Chemical Boundaries – PCBs and RRO. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.
Optimize the Design	Perform site reconnaissance or historical record search to determine potential source areas, if unknown. If potential source areas cannot be located to guide discrete sampling, consider MI sampling following procedures in SOP-30 (Multi-incremental Sampling) in Appendix H by collecting at least 30 surface soil sub-samples within each decision unit (using a systematically random approach to collect samples in each grid cell) to field sieve, composite, and analyze. If potential source areas are known, log soil cores continuously and collect discrete soil samples beneath and adjacent to the potential surface release area, with one soil sample from the upper 2 feet, a second at 5 fee bgs, and additional samples as needed to target intervals and locations with staining, elevated PID/FID readings, or other evidence of contamination. If there is field evidence of contamination at 5 feet bgs, collect at least one additional sample between 5 feet bgs and the top of the water table. If there is evidence of contamination at the top of the water table, co-locate a groundwater

TABLE 17-6
Investigation Approach and Sampling Design Elements—Site Inspection Stage, Transformer Site

Step	SI
	sample with a saturated soil sample at the top of the water table, both at one location in the source area and at one location upgradient of the source area to determine potential impacts on groundwater. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

bgs	=	below ground surface
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DoD	=	U.S. Department of Defense
FID	=	flame ionization detector
MI	=	multi-increment
MIS	=	multi-incremental samples
PARCCS	=	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	=	polychlorinated biphenyl
PID	=	photo-ionization detector
POL	=	petroleum, oils, and lubricants
QSM	=	Quality Systems Manual
RI	=	Remedial Investigation
RRO	=	residual-range organic
SC	=	Site Characterization
SI	=	Site Inspection
SI/RI/SC	=	Site Inspection/Remedial Investigation/Site Characterization

TABLE 17-7
Investigation Approach and Sampling Design Elements—Site Inspection Stage, Unknown Source

Step	SI
Inspection Approach Group	Unknown Source.
Objective	Investigate possible releases and determine need for further sampling.
Problem Statement	Historical record searches, visual reconnaissance, and remote sensing results suggest that hazardous materials or chemicals may have been managed or disposed of at the site. Available data are insufficient to confirm the presence or absence of a source or contamination.
Decision to Be Made	Decide whether historical operations or waste disposal operations at the site may have affected soil at the site.
Inputs to Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Geophysical survey, remote sensing information. Test pit information. Analytical data for existing samples, if available (verify that sample collection and analytical quality conforms to current practices), and for samples collected as part of the current investigation (including MIS if applicable). Product fingerprinting analysis. Sample locations and depths for site media. Field observations and measurements from current and historical sampling activities. SI screening levels (as described in Worksheet #15). CERCLA and ADEC guidance.
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider constituent degradation potential. Spatial Boundaries – To be determined by historical records search, remote sensing, aerial photograph review, or detailed site reconnaissance and field screening data. Chemical Boundaries – Use broad target analyte list. Target analyte list may be narrowed by use of field test kit analyses. Use detection limits appropriate for SI screening levels.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10-2.
Decision Rule	See Site Inspection Decision Rules Listed in Table 10-2.
Optimize the Design	Conduct remote sensing to identify locations of suspected tanks, pipelines, or buried debris. Dig test pits as needed to investigate possible sources and prepare continuous test pit logs. If no potential surface or subsurface source or release location can be identified, then no further action is needed.

TABLE 17-7
Investigation Approach and Sampling Design Elements—Site Inspection Stage, Unknown Source

Step	SI
	Collect soil samples from test pits if warranted, targeting areas with staining, elevated PID/FID readings, or other evidence of contamination. If no field evidence of contamination is found but a source is suspected, collect a composite sample representative of the test pit. Use field screening and test kit analyses to narrow target analyte lists, if needed. If the surface or subsurface source or release location cannot be identified definitely but is suspected based on historical record reviews, then the sampling program may consist of MI surface soil sampling or collection of a minimum number of discrete soil samples to support risk assessment. Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.

Notes:

ADEC	=	Alaska Department of Environmental Conservation
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DoD	=	U.S. Department of Defense
FID	=	flame ionization detector
MIS	=	multi-incremental samples
PARCCS	=	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PID	=	photo-ionization detector
QSM	=	Quality Systems Manual
RI	=	Remedial Investigation
SC	=	Site Characterization
SI	=	Site Inspection
SI/RI/SC	=	Site Inspection/Remedial Investigation/Site Characterization

TABLE 17-8
SC Stage—Investigation Approach and Sampling Design Elements for POL Surface Release Sites

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
Problem Statement	Available data or reports suggest that a surface POL release occurred. However, the nature and extent of contamination is not adequately defined to characterize potential risks or to support a remedial decision.			
Decision to Be Made	Define the nature and extent of soil contamination.	Determine the nature and potential mobility of NAPL, if present.	Determine whether site contamination is causing or contributing to groundwater contamination at FOL.	Determine the nature and extent of groundwater contamination (isolated plumes only).
Input to the Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Analytical data for existing NAPL, soil, and groundwater samples (if sample collection and analytical quality conforms to current practices). Analytical data for soil samples (and potentially groundwater and NAPL samples) collected as part of the current investigation. Sample locations and depths for site media. Depth to groundwater, groundwater elevation, and NAPL thickness measurements. Site geologic and hydrogeologic information. Field observations and measurements from current and historical sampling activities. Soil extent screening levels and groundwater screening levels (as described in Worksheet #15). ADEC regulation 18 AAC 75 and ADEC guidance.			
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider seasonal groundwater fluctuation and constituent degradation potential. Sample collection ability will be limited by frozen soil and groundwater level conditions. Spatial Boundaries – Immediate vicinity of likely source or release location between ground surface and the deepest extent of site-specific soil contamination, up to the historical low level groundwater elevation (bottom of variably saturated zone, or "smear zone"). Soil samples collected at lateral and vertical limits of soil contamination (to below extent screening levels) in or above the smear zone. For groundwater, use groundwater samples from upgradient location and from beneath likely contaminant source area for sites within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area). For sites with isolated groundwater plumes, use groundwater samples collected at lateral and vertical limits of groundwater contamination (to below groundwater screening levels). Chemical Boundaries – Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for screening levels.			
Decision Rule	See Decision Rules for Nature and Extent of Soil Contamination in Table 10-2.	See Decision Rules for NAPL Characterization in Table 10-2.	See Decision Rules for Site-related Groundwater Contamination in Table 10-2.	See Decision Rules for Nature and Extent of Groundwater Contamination in Table 10-2.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10.2.			
Optimize the Design	Using existing data to determine data gaps in soil contamination nature and extent, log soil cores continuously and conduct soil sampling at appropriate locations between ground surface and the vertical extent of soil contamination up to the historical low water table depth (if there is evidence of contamination still observed at the top of the water table at the time of sampling) until the extent of soil contamination is defined laterally and vertically (that is, concentrations are less than the extent screening levels). Use target analyte list appropriate for POL releases (as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for extent screening levels.	Perform SC sampling for NAPL and/or evaluate existing NAPL data. Such additional data collection may consist of collecting soil and/or NAPL samples in NAPL source areas, measuring groundwater levels and NAPL thicknesses at existing monitoring wells, or installing new monitoring wells and sampling points if existing monitoring networks are inadequate.	Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Evaluate potential impacts of site-specific soil contamination on groundwater by collecting groundwater samples both upgradient of the site and beneath the source area at the top of the water table. Log soil cores continuously and co-locate groundwater samples with soil samples from the smear zone to provide data to assess contaminant partitioning. Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for groundwater screening levels.	Proceed to Decision Rule 4B. Result 4A2 – Perform SC groundwater sampling as part of an FOL-wide groundwater sampling program at appropriate locations to determine lateral extent of groundwater contamination (for commingled plumes). Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Perform SC groundwater sampling at appropriate locations to determine lateral and vertical extent of site-specific groundwater contamination. Incorporate groundwater results into overall understanding of groundwater contamination at FOL.

TABLE 17-8
SC Stage—Investigation Approach and Sampling Design Elements for POL Surface Release Sites

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
			If site is within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area), incorporate groundwater results into overall understanding of groundwater contamination at FOL and account for site as source of groundwater contamination in CSM.	
	Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.			

Notes:

POL surface release sites include AST, POL drum storage, aboveground fueling system infrastructure, and other known surface spill sites.

AAC = *Alaska Administrative Code*
ADEC = Alaska Department of Environmental Conservation
DoD = U.S. Department of Defense
FOL = Forward Operating Location
NAPL = nonaqueous phase liquid
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
SC = Site Characterization

TABLE 17-9
SC Stage—Investigation Approach and Sampling Design Elements for POL Subsurface Release Sites (Non-UST)

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
Problem Statement	Available data or reports suggest that a subsurface POL release occurred (not associated with a UST). However, the nature and extent of contamination is not adequately defined to characterize potential risks or to support a remedial decision.			
Decision to Be Made	Define the nature and extent of soil contamination.	Determine the nature and potential mobility of NAPL, if present.	Determine whether site contamination is causing or contributing to groundwater contamination at FOL.	Determine the nature and extent of groundwater contamination (isolated plumes only).
Input to the Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Remote sensing information on location of subsurface features. Analytical data for existing NAPL, soil, and groundwater samples (if sample collection and analytical quality conforms to current practices). Analytical data for soil samples (and potentially groundwater and NAPL samples) collected as part of the current investigation. Sample locations and depths for site media. Depth to groundwater, groundwater elevation, and NAPL thickness measurements. Site geologic and hydrogeologic information. Field observations and measurements from current and historical sampling activities. Soil extent screening levels and groundwater screening levels (as described in Worksheet #15). ADEC regulation 18 AAC 75 and 78 and ADEC guidance.			
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider seasonal groundwater fluctuation and constituent degradation potential. Sample collection ability will be limited by frozen soil and groundwater level conditions. Spatial Boundaries – Immediate vicinity of likely source or release location between the subsurface release and the deepest extent of site-specific soil contamination, up to the historical low level groundwater elevation (bottom of variably saturated zone, or “smear zone”). Collect soil samples at lateral and vertical limits of soil contamination (to below extent screening levels) in or above the smear zone. For groundwater, use groundwater samples from upgradient location and from beneath likely contaminant source area for sites within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area). For sites with isolated groundwater plumes, use groundwater samples collected at lateral and vertical limits of groundwater contamination (to below groundwater screening levels). Chemical Boundaries – Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for screening levels.			
Decision Rule	See Decision Rules for Nature and Extent of Soil Contamination in Table 10-2.	See Decision Rules for NAPL Characterization in Table 10-2.	See Decision Rules for Site-related Groundwater Contamination in Table 10-2.	See Decision Rules for Nature and Extent of Groundwater Contamination in Table 10-2.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10.2.			
Optimize the Design	Using existing data to determine data gaps in soil contamination nature and extent, log soil cores continuously and conduct soil sampling at appropriate locations between the subsurface release location and the vertical extent of soil contamination up to the historical low water table depth until the extent of soil contamination is defined laterally and vertically (that is, concentrations are less than the extent screening levels). Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for extent screening levels.	Perform SC sampling for NAPL and/or evaluate existing NAPL data. Such additional data collection may consist of collecting soil and/or NAPL samples in NAPL source areas, measuring groundwater levels and NAPL thicknesses at existing monitoring wells, or installing new monitoring wells and sampling points if existing monitoring networks are inadequate.	Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Evaluate potential impacts of site-specific soil contamination on groundwater by collecting groundwater samples both upgradient of the site and beneath the source area at the top of the water table. Log soil cores continuously and co-locate groundwater samples with soil samples from the smear zone to provide data to	Perform SC groundwater sampling as part of an FOL-wide groundwater sampling program at appropriate locations to determine lateral extent of groundwater contamination (for commingled plumes). Perform SC groundwater sampling at appropriate locations to determine lateral and vertical extent of site-specific groundwater contamination. Incorporate groundwater results into overall understanding of groundwater contamination at FOL.

TABLE 17-9
SC Stage—Investigation Approach and Sampling Design Elements for POL Subsurface Release Sites (Non-UST)

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
			assess contaminant partitioning. Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for groundwater screening levels. If site is within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area), incorporate groundwater results into overall understanding of groundwater contamination at FOL and account for site as source of groundwater contamination in CSM.	
	Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.			

Notes:

POL subsurface release sites include pipelines, valve pits, and sumps.

AAC = *Alaska Administrative Code*

ADEC = Alaska Department of Environmental Conservation

CSM = conceptual site model

DoD = U.S. Department of Defense

NAPL = nonaqueous phase liquid

PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity

POL = petroleum, oils, and lubricants

QSM = Quality Systems Manual

TABLE 17-10
SC Stage—Investigation Approach and Sampling Design Elements for POL Subsurface Release Sites (UST)

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
Problem Statement	Available data from samples collected during UST tank closure (either by excavation or in-place closure) suggest that a subsurface POL release occurred. However, the nature and extent of contamination is not adequately defined to characterize potential risks or to support a remedial decision.			
Decision to Be Made	Define the nature and extent of soil contamination.	Determine the nature and potential mobility of NAPL, if present.	Determine whether site contamination is causing or contributing to groundwater contamination at FOL.	Determine the nature and extent of groundwater contamination (isolated plumes only).
Input to the Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since UST closure sampling. Remote sensing information on location of USTs and piping. Analytical data for existing NAPL, soil, and groundwater samples (if sample collection and analytical quality conforms to current practices). Analytical data for soil samples (and potentially groundwater and NAPL samples) collected as part of the current investigation. Sample locations and depths for site media. Depth to groundwater, groundwater elevation, and NAPL thickness measurements. Site geologic and hydrogeologic information, including surface water drainage features. Field observations and measurements from current and historical sampling activities. Soil extent screening levels and groundwater screening levels (as described in Worksheet #15). ADEC regulation 18 AAC 75 and 78 and ADEC guidance.			
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider seasonal groundwater fluctuation and constituent degradation potential. Sample collection ability will be limited by frozen soil and groundwater level conditions. Spatial Boundaries – Immediate vicinity of likely source or release location between the UST or former UST area and any associated piping and the historical low level groundwater elevation (bottom of variably saturated zone, or “smear zone”). Collect soil samples at lateral and vertical limits of soil contamination (to below extent screening levels) in or above the smear zone. For groundwater, use groundwater samples from upgradient location and from beneath likely contaminant source area for sites within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area). For sites with isolated groundwater plumes, use groundwater samples collected at lateral and vertical limits of groundwater contamination (to below groundwater screening levels). Additional groundwater samples should be collected In the immediate vicinity of likely source or release location between the UST or former UST area and any associated piping. These samples should be collected vertically to the historical low level groundwater elevation (bottom of variably saturated zone, or “smear zone”). Chemical Boundaries – Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for screening levels.			
Decision Rule	See Decision Rules for Nature and Extent of Soil Contamination in Table 10-2.	See Decision Rules for NAPL Characterization in Table 10-2**.**	See Decision Rules for Site-related Groundwater Contamination in Table 10-2.	See Decision Rules for Nature and Extent of Groundwater Contamination in Table 10-2.
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10.2.			
Optimize the Design	Log soil cores continuously and conduct soil sampling at a sufficient number of locations between the UST and the vertical extent of soil contamination (up to the historical low water table depth) until the extent of soil contamination is defined laterally and vertically (that is, concentrations are less than the extent screening levels) and to identify soil properties that are likely to influence the type and rate of migration of the POL release. Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for extent screening levels.	Perform SC sampling for NAPL and/or evaluate existing NAPL data. Such additional data collection may consist of collecting soil and/or NAPL samples in NAPL source areas, measuring groundwater levels and NAPL thicknesses at existing monitoring wells, or installing new monitoring wells and sampling points if existing monitoring networks are inadequate.	Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Evaluate potential impacts of site-specific soil contamination on groundwater by collecting groundwater samples both upgradient of the site and beneath the source area at the top of the water table. Log soil cores continuously and co-locate groundwater samples with soil samples from the smear zone to provide data to assess	Perform SC groundwater sampling as part of an FOL-wide groundwater sampling program at appropriate locations to determine lateral extent of groundwater contamination (for commingled plumes). Perform SC groundwater sampling at appropriate locations to determine lateral and vertical extent of site-specific groundwater contamination. Incorporate groundwater results into overall understanding of groundwater contamination at FOL.

TABLE 17-10
SC Stage—Investigation Approach and Sampling Design Elements for POL Subsurface Release Sites (UST)

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
			contaminant partitioning. Use target analyte list appropriate for POL releases as described in Table 14-1 of Worksheet #14. Use detection limits appropriate for groundwater screening levels. If site is within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area), incorporate groundwater results into overall understanding of groundwater contamination at FOL and account for site as source of groundwater contamination in CSM.	
	Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.			

Notes:

AAC = *Alaska Administrative Code*
ADEC = Alaska Department of Environmental Conservation
CSM = conceptual site model
DoD = U.S. Department of Defense
FOL = Forward Operating Location
NAPL = nonaqueous phase liquid
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
SC = Site Characterization
UST = underground storage tank

TABLE 17-11
RI Stage—Investigation Approach and Sampling Design Elements for Multi-chemical Surface Release Sites

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
Problem Statement	Available data or reports suggest that a surface non-POL release occurred. However, the nature and extent of contamination is not adequately defined to characterize potential risks or to support a remedial decision.			
Decision to Be Made	Define the nature and extent of soil contamination.	Determine the nature and potential mobility of NAPL, if present.	Determine whether site contamination is causing or contributing to groundwater contamination at FOL.	Determine the nature and extent of groundwater contamination (isolated plumes only).
Input to the Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Analytical data for existing NAPL, soil, and groundwater samples (if sample collection and analytical quality conforms to current practices). Analytical data for soil samples (and potentially groundwater and NAPL samples) collected as part of the current investigation. Sample locations and depths for site media. Depth to groundwater, groundwater elevation, and NAPL thickness measurements. Site geologic and hydrogeologic information. Field observations and measurements from current and historical sampling activities. Soil extent screening levels and groundwater screening levels (as described in Worksheet #15). CERCLA regulations and guidance.			
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider seasonal groundwater fluctuation and constituent degradation potential. Sample collection ability will be limited by frozen soil and groundwater level conditions. Spatial Boundaries – Immediate vicinity of likely source or release location between ground surface and the deepest extent of site-specific soil contamination, up to the historical low level groundwater elevation (bottom of variably saturated zone, or "smear zone"). Soil samples collected at lateral and vertical limits of soil contamination (to below extent screening levels) in or above the smear zone. For groundwater, use groundwater samples from upgradient location and from beneath likely contaminant source area for sites within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area). For sites with isolated groundwater plumes, use groundwater samples collected at lateral and vertical limits of groundwater contamination (to below groundwater screening levels). Chemical Boundaries – Use target analyte list appropriate for suspected source and release. Use detection limits appropriate for screening levels.			
Decision Rule	See Decision Rules for Nature and Extent of Soil Contamination in Table 10-2.	See Decision Rules for NAPL Characterization in Table 10-2**.**	See Decision Rules for Site-related Groundwater Contamination in Table 10-2.	See Decision Rules for Nature and Extent of Groundwater Contamination in Table 10-2
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10.2.			
Optimize the Design	Using existing data to determine data gaps in soil contamination nature and extent, log soil cores continuously and conduct soil sampling at appropriate locations between ground surface and the vertical extent of soil contamination up to the historical low water table depth (if there is evidence of contamination still observed at the top of the water table at the time of sampling) until the extent of soil contamination is defined laterally and vertically (that is, concentrations are less than the extent screening levels). Use target analyte list appropriate for suspected source and releases. Use detection limits appropriate for extent screening levels.	Perform RI sampling for NAPL and/or evaluate existing NAPL data. Such additional data collection may consist of collecting soil and/or NAPL samples in NAPL source areas, measuring groundwater levels and NAPL thicknesses at existing monitoring wells, or installing new monitoring wells and sampling points if existing monitoring networks are inadequate.	Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Evaluate potential impacts of site-specific soil contamination on groundwater by collecting groundwater samples both upgradient of the site and beneath the source area at the top of the water table. Log soil cores continuously and co-locate groundwater samples with soil samples from the smear zone to provide data to assess contaminant partitioning. Use target analyte list appropriate for suspected source and release. Use detection limits appropriate for groundwater screening levels.	Perform RI groundwater sampling as part of an FOL-wide groundwater sampling program at appropriate locations to determine lateral extent of groundwater contamination (for commingled plumes). Perform RI groundwater sampling at appropriate locations to determine lateral and vertical extent of site-specific groundwater contamination. Incorporate groundwater results into overall understanding of groundwater contamination at FOL.

TABLE 17-11
RI Stage—Investigation Approach and Sampling Design Elements for Multi-chemical Surface Release Sites

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
			If site is within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area), incorporate groundwater results into overall understanding of groundwater contamination at FOL and account for site as source of groundwater contamination in CSM.	
	Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.			

Notes:

Multi-chemical surface release sites include sites with solvents, metals, pesticides, and/or polychlorinated biphenyls (PCBs) (could be a mixture of POL and non-POL chemicals) from aboveground storage tanks (ASTs), drums (waste management areas), or other surface spills.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM = conceptual site model
DoD = U.S. Department of Defense
FOL = Forward Operating Location
NAPL = nonaqueous phase liquid
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation

TABLE 17-12
RI Stage—Investigation Approach and Sampling Design Elements for Multi-chemical Subsurface Release Sites

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
Problem Statement	Available data or reports suggest that a subsurface non-POL release occurred. However, the nature and extent of contamination is not adequately defined to characterize potential risks or to support a remedial decision.			
Decision to Be Made	Define the nature and extent of soil contamination.	Determine the nature and potential mobility of NAPL, if present.	Determine whether site contamination is causing or contributing to groundwater contamination at FOL.	Determine the nature and extent of groundwater contamination (isolated plumes only).
Input to the Decision	Existing historical records on site use, releases, and other activities. Site reconnaissance records. Site improvements or development history since releases or sampling. Remote sensing information on location of subsurface features. Analytical data for existing NAPL, soil, and groundwater samples (if sample collection and analytical quality conforms to current practices). Analytical data for soil samples (and potentially groundwater and NAPL samples) collected as part of the current investigation. Sample locations and depths for site media. Depth to groundwater, groundwater elevation, and NAPL thickness measurements. Site geologic and hydrogeologic information. Field observations and measurements from current and historical sampling activities. Soil extent screening levels and groundwater screening levels (as described in Worksheet #15). CERCLA regulations and guidance.			
Study Area Boundaries	Temporal Boundaries – Use samples collected after release is suspected to have occurred, and taking into account any significant changes to the area (for example, soil removal, grading, construction). Consider seasonal groundwater fluctuation and constituent degradation potential. Sample collection ability will be limited by frozen soil and groundwater level conditions. Spatial Boundaries – Immediate vicinity of likely source or release location between the subsurface release and the deepest extent of site-specific soil contamination, up to the historical low level groundwater elevation (bottom of variably saturated zone, or “smear zone”). Soil samples collected at lateral and vertical limits of soil contamination (to below extent screening levels) in or above the smear zone. For groundwater, use groundwater samples from upgradient location and from beneath likely contaminant source area for sites within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area). For sites with isolated groundwater plumes, use groundwater samples collected at lateral and vertical limits of groundwater contamination (to below groundwater screening levels). Chemical Boundaries – Use target analyte list appropriate for suspected source and release. Use detection limits appropriate for screening levels.			
Decision Rule	See Decision Rules for Nature and Extent of Soil Contamination in Table 10-2.	See Decision Rules for NAPL Characterization in Table 10-2.	See Decision Rules for Site-related Groundwater Contamination in Table 10-2.	See Decision Rules for Nature and Extent of Groundwater Contamination in Table 10-2
Acceptable Limits on Decision Error	See Acceptable Limits on Decision Errors Listed in Table 10.2.			
Optimize the Design	Using existing data to determine data gaps in soil contamination nature and extent, log soil cores continuously and conduct soil sampling at appropriate locations between the subsurface release location and the vertical extent of soil contamination up to the historical low water table depth until the extent of soil contamination is defined laterally and vertically (that is, concentrations are less than the extent screening levels). Use target analyte list appropriate for suspected source and releases. Use detection limits appropriate for extent screening levels.	Perform RI sampling for NAPL and/or evaluate existing NAPL data. Such additional data collection may consist of collecting soil and/or NAPL samples in NAPL source areas, measuring groundwater levels and NAPL thicknesses at existing monitoring wells, or installing new monitoring wells and sampling points if existing monitoring networks are inadequate.	Incorporate groundwater results into overall understanding of groundwater conditions and delineation of groundwater contamination at FOL. Complete evaluation with available information and prepare decision documents. Evaluate potential impacts of site-specific soil contamination on groundwater by collecting groundwater samples both upgradient of the site and beneath the source area at the top of the water table. Log soil cores continuously and co-locate groundwater samples with soil samples from the smear zone to provide data to assess contaminant partitioning. Use target analyte list appropriate for suspected source and releases. Use	Perform RI groundwater sampling as part of an FOL-wide groundwater sampling program at appropriate locations to determine lateral extent of groundwater contamination (for commingled plumes). Perform RI groundwater sampling at appropriate locations to determine lateral and vertical extent of site-specific groundwater contamination. Incorporate groundwater results into overall understanding of groundwater contamination at FOL.

TABLE 17-12
RI Stage—Investigation Approach and Sampling Design Elements for Multi-chemical Subsurface Release Sites

Step	1. Nature and Extent of Soil Contamination	2. NAPL Characterization	3. Site-related Groundwater Impact Characterization	4. Nature and Extent of Groundwater Contamination
			detection limits appropriate for groundwater screening levels. If site is within the FOL-wide groundwater Operable Unit (part of the commingled groundwater plume contamination emanating from the Base triangle area), incorporate groundwater results into overall understanding of groundwater contamination at FOL and account for site as source of groundwater contamination in CSM.	
	Heaving sands are a known issue when drilling in saturated sediments at FOL. To the extent possible, soil borings will be advanced during periods when the seasonal water table is lower (June through October). If heaving sands are encountered, appropriate drilling techniques will be used to minimize impacts.			

Notes:

Multi-chemical subsurface release sites include sites with solvents, metals, pesticides, and/or polychlorinated biphenyls (PCBs) (could be a mixture of POL and non-POL chemicals) from oil-water separators (OWSs), sumps, or fire training area pits.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM = conceptual site model
DoD = U.S. Department of Defense
FOL = Forward Operating Location
NAPL = nonaqueous phase liquid
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
POL = petroleum, oils, and lubricants
QSM = Quality Systems Manual
RI = Remedial Investigation

Worksheet #18 – Sampling Locations and Sampling SOP Requirements

This worksheet provides a summary of sampling locations and sample types, matrices, and analyses. The rationale for the proposed sampling locations is discussed in Worksheet #17 *[Sampling Design and Rationale]* and in the site-specific attachments in Appendix D. QA/QC samples will be collected as specified in Worksheet #20 *[Field QC Sample Summary].* SOPs that will be used for sampling are specified in Worksheet #21 *[Project Sampling SOP References]* and are provided in Appendix H.

18.1 Site-specific Investigation Sampling

The Investigation Approach Group DQOs presented in Worksheet #17 were used to evaluate site conditions and determine the need for sampling at each FOL site. The site-specific sampling plans provided in Appendix D present the proposed sampling design that resulted from these evaluations. These site-specific plans contain information about site conditions, previous sampling results, and other information used to design the sampling program. In addition, they provide the site-specific criteria and decision rules that may be used during the course of the investigation to determine the need for additional samples and/or follow-up investigations. The sampling plan for each site contains a map showing the proposed sample locations and a table detailing the numbers of samples and the matrices to be collected, as well as the proposed sampling methods (and associated SOPs) and the proposed target analytical suites and analytical methods.

Table 18-1A (tables are located at the end of this worksheet) provides a summary of the site-specific sampling plans from Appendix D.

18.2 Risk Assessment Sampling

In general, data that are collected for SI investigations (to determine the presence or absence of contamination) and for SC or RI investigations (to determine the nature and extent of contamination) will also be used to conduct risk assessment. Additional sampling may be proposed for data collection that is specific to risk assessment evaluations. The types of data collection may include, but not be limited to, the following:

- Soil gas data to support vapor intrusion evaluations
- Hydrocarbon fractionation data (for example, State of Washington Department of Ecology Northwest Volatile Petroleum Hydrocarbons and Northwest Extractable Petroleum Hydrocarbons data) to support risk calculations for petroleum hydrocarbons
- Surface water, porewater, and/or sediment sampling to support ecological risk evaluations

Sampling for risk assessment evaluations will be added to this Work Plan by attachments.

18.3 Hydrogeological Characterization Sampling

Sampling to support evaluation of aquifer hydraulic properties, groundwater conditions, and surface water–groundwater interactions will be conducted at a larger scale than individual source area investigations, as described in Worksheet #14 *[Summary of Project Tasks]*, Section 14.2.5 *[Groundwater Approach]*. Identification of sampling locations for the hydrogeological evaluation will be proposed after data from the site-specific source area investigations are available, so that the most current information on locations and the nature and extent of source area contamination will be used in the planning. The types of data collection may include, but not be limited to, the following:

- Aquifer testing (pump or slug tests) to evaluate transmissivity, storage properties, and horizontal to vertical anisotropy.
- Manual water level readings and continuous water level monitoring to evaluate horizontal and vertical hydraulic gradients, groundwater flow directions, groundwater flow velocities, and surface water–groundwater interactions.
- Installation and sampling of monitoring wells at locations to evaluate contaminant movement, plume extent, and trends over time.
- Soil and groundwater sampling to support fate and transport analyses. The specific data elements include the following:
  - Soil bulk density
  - Soil porosity
  - Soil fraction organic carbon
  - Oxidation-reduction potential of the groundwater
  - Dissolved oxygen in groundwater
  - Natural attenuation parameters such as nitrate, sulfate, dissolved iron and manganese, and methane

Sampling for hydrogeological characterization will be added to this Work Plan by attachments.

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Tar Samples		
				TAR Speciation[b] ASTM D2887	Total Metals[b,d] SW6010B/SW6020/SW7471A	PAHs[b] SW8270C SIM
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	0	0	0
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	0	0	0
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	0	0	0
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	0	0	0
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	0	0	0
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	2	2	2
			TOTALS	**2**	**2**	**2**

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Sediment Samples										
				GRO[a] AK101	DRO[a] AK102	RRO[a] AK103	BTEX[a] Screening for TCE and PCE SW8021B	VOCs[b,c] SW8260B	SVOCs[b] SW8270C	PAHs[b,g] SW8270CSIM	Pesticides[b] SW8081A	PCBs[b] SW8082	Total Metals[b,d] SW6010B/SW6020/ SW7471A	Dioxins/Furans[b] SW8290
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	8	8	8	0	8	0	5	0	0	0	0
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	0	0	0	0	0	0	0	0	0	0	0
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0
			TOTALS	**8**	**8**	**8**	**0**	**8**	**0**	**5**	**0**	**0**	**0**	**0**

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Surface Soil (0-2 feet bgs) Samples										
				GRO[a] AK101	DRO[a] AK102	RRO[a] AK103	BTEX[a] Screening for TCE and PCE SW8021B	VOCs[b,c] SW8260B	SVOCs[b] SW8270C	PAHs[b] SW8270CSIM	Pesticides[b] SW8081A	PCBs[b] SW8082	Total Metals[b,d] SW6010B/SW6020/ SW7471A	Dioxins/Furans[b] SW8290
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	19	19	19	18	18	9	1	18	18	18	9
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	27	27	27	22	22	0	3	3	4	5	0
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	13	13	13	12	12	0	3	0	0	0	0
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	8	8	8	8	8	0	5	0	0	8	0
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	14	14	14	13	13	0	1	13	0	13	0
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
			TOTALS	**81**	**81**	**81**	**73**	**73**	**9**	**13**	**34**	**22**	**44**	**9**

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Subsurface Soil (>2 feet bgs) Samples										
				GRO[a] AK101	**DRO[a]** AK102	**RRO[a]** AK103	**BTEX[a] Screening for TCE and PCE** SW8021B	**VOCs[b,c]** SW8260B	**SVOCs[b]** SW8270C	**PAHs[b,g]** SW8270CSIM	**Pesticides[b]** SW8081A	**PCBs[b]** SW8082	**Total Metals[b,d]** SW6010B/SW6020/ SW7471A	**Dioxins/Furans[b]** SW8290
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	95	95	95	87	87	36	23	87	19	87	16
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	113	113	113	107	107	0	26	7	3	31	0
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	59	59	59	54	54	0	12	0	0	0	0
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	32	32	32	29	29	0	4	0	0	29	0
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	64	64	64	59	59	0	12	59	0	59	0
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
			TOTALS	**363**	**363**	**363**	**336**	**336**	**36**	**77**	**153**	**22**	**206**	**16**

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Groundwater Samples											
				GRO AK101	DRO AK102	RRO AK103	BTEX SW8021B	VOCs[c] SW8260B	1,2-DCA, EDB[g] E504.1	SVOCs SW8270C	PAHs[g] SW8270CSIM	Pesticides SW8081A	Total Metals[b,d] SW6010B/SW6020/SW7471A	Dissolved Metals[d] SW6010B/SW6020/SW7471A	Field Parameters[e]
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	22	22	22	0	22	11	7	7	22	22	22	18
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	11	11	11	0	11	0	0	5	0	0	7	8
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	22	22	22	0	22	0	0	11	0	0	0	18
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	7	7	7	0	7	0	0	3	0	0	7	5
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	18	18	18	0	18	6	0	6	18	0	18	14
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
			TOTALS	**80**	**80**	**80**	**0**	**80**	**17**	**7**	**32**	**40**	**22**	**54**	**63**

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Surface Water Samples											
				GRO AK101	DRO AK102	RRO AK103	BTEX SW8021B	VOCs[c] SW8260B	1,2-DCA, EDB[g] E504.1	SVOCs SW8270C	PAHs[g] SW8270CSIM	Pesticides SW8081A	Total Metals[b,d] SW6010B/SW6020/SW7471A	Dissolved Metals[d] SW6010B/SW6020/SW7471A	Field Parameters[e]
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0	0
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0	0
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	8	8	8	0	8	0	0	2	0	0	0	5
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	0	0	0	0	0	0	0	0	0	0	0	0
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0	0
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	0	0	0	0	0	0	0	0	0	0	0	0
			TOTALS	**8**	**8**	**8**	**0**	**8**	**0**	**0**	**2**	**0**	**0**	**0**	**5**

Table 18-1A
Summary of Proposed Sample Collection

Site	Investigation Pathway	Contamination Source/Type	Number of Sample Locations	Number of Equipment Blank and Trip Blank Samples												
				GRO AK101	DRO AK102	RRO AK103	BTEX SW8021	VOCs[c] SW8260B	1,2-DCA, EDB[g] E504.1	SVOCs SW8270C	PAHs[g] SW8270CSIM	Pesticides SW8081A	PCBs[b] SW8082	Total Metals[b,d] SW6010B/SW6020/S W7471A	Dissolved Metals[d] SW6010B/SW6020/S W7471A	Dioxins/Furans SW8290
FT001	RI	Various fuels (leaded gasoline, diesel, and aviation), potential liquids including chlorinated solvents, pesticides, and transformer oil	14 Soil Boring Locations 9 Co-located Hydropunch Locations	10	6	6	0	10	2	3	4	6	3	6	3	3
ST009	SC	JP-4; JP-8; Waste Oil; Diesel	18 Soil Boring Locations 4 Co-located Hydropunch Locations	6	4	4	0	6	0	0	3	1	1	2	1	0
ST010	SC	Diesel Spill from OAP	9 Soil Boring Locations 6 Co-located Hydropunch Locations 2 Hydropunch Only Locations 5 Surface Water/Sediment Sample Locations	10	7	7	0	10	0	0	5	0	0	0	0	0
OT099	SC	Drums Suspected to Contain POL	5 Soil Boring Locations 2 Co-located Hydropunch Locations Excavation Confirmation Samples	4	2	2	0	4	0	0	2	0	0	2	1	0
SS005	SC	MOGAS and Unknown Fuel	10 Soil Boring Locations 7 Co-located Hydropunch Locations	8	5	5	0	8	2	0	3	3	0	5	3	0
TAR[f]	SI	Tar Pits	Tar Sample Excavation Confirmation Samples 2 Hydropunch Locations	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
			TOTALS	**38**	**24**	**24**	**0**	**38**	**4**	**3**	**17**	**10**	**4**	**15**	**8**	**3**

[a]Analytical methods AK101, AK102, AK103, and SW8021B for soil will be performed at the on-site mobile lab; 10 percent of these samples have been identified for split analysis according to SOP-19.

[b]Soil/Tar sample analysis by this method will be performed at an off-site lab.

[c]Fuel site analysis will be conducted in accordance with target analytes on Table 14-1.

[d]Specific metals to be analyzed at a given site are listed in the proposed sample tables in Appendix D. In addition to site specific metals, all groundwater and surface water samples will be analyzed for calcium and magnesium.

[e]Field parameters will be analyzed for pH, temperature, specific conductivity, dissolved oxygen, and ORP using a water quality meter and flow-through cell as described in SOP-12.

[f]The full target analyte list for soil and groundwater samples will be determined based on the results of the tar speciation

[g]Per Guidance in Appendix F of ADEC, 2010: "*For each source area, PAH analysis must be performed on a sufficient percentage of the samples with the highest GRO, DRO and/or RRO concentrations to determine if PAHs are contaminants of concern. In general, 10% is recommended for site characterization. If PAH concentrations are less than applicable cleanup levels, further PAH analysis is generally not required. PAHs should be sampled in groundwater if soil samples concentrations are above applicable cleanup levels and groundwater sampling is required.*"

Notes:
Analysis of all groundwater, surface water, sediment, and split (SPT) soil samples will be performed at an off-site lab.
Soil, sediment, surface water and groundwater sample totals include normal samples, field duplicates, matrix spike samples, matrix spike duplicate, and split samples
Potential step-out samples are not included in totals.
NA = not applicable
TBD = to be determined

Worksheet #19 – Analytical SOP Requirements

This worksheet summarizes the analytical methods for each sampling matrix, including the required sample-volume, container, preservation, and holding-time requirements. Available analytical SOPs are provided in Appendix I of this Work Plan.

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume	Containers	Preservation Requirements	Maximum Holding Time
Soil/Sediment	VOCs	N/A	SW8260B Must be collected separately from AK101	35 grams	1 x 4-oz wide-mouth amber glass plus 2 x 40 ml VOA vials	Add 25-gram sample to 4-oz jar; add 25 ml methanol, 4 ±2ºC plus add 5 grams sample to each of two 40-mL VOA vials pre-preserved with 1 gram sodium bisulfate/5 mL water, 4 ±2ºC May use Terra Core kits for sample collection	14 days from date of collection
Soil/Sediment	GRO	N/A	AK101 Must be collected separately from SW8260B	25 grams	1 x 4-oz wide-mouth amber glass	Add 25-gram sample to 4-oz jar; add 25 ml methanol that is pre-spiked with surrogate 4 ±2ºC	28 days from date of collection
Soil/Sediment	GRO/BTEX and Field-Screened Chlorinated VOCs (field lab only)	N/A	AK101/SW8021B	25 grams	1 x 4-oz wide-mouth amber glass	Add 25-gram sample to 4-oz jar; add 25 ml methanol that is pre-spiked with surrogate 4 ±2ºC	14 days from date of collection
Soil/Sediment	SVOCs	N/A	SW8270C	30 grams	250-ml glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil/Sediment	PAHs	N/A	SW8270C SIM	30 grams	250-ml glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil/Sediment	Pesticides	N/A	SW8081A	30 grams	250-ml glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil/Sediment	PCBs	N/A	SW8082	30 grams	250-ml glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil/Sediment	Metals	N/A	SW6010B/SW6020/SW7471A	30 grams	250-ml glass	N/A	180 days from date of collection to analysis (28 days for mercury)
Soil/Sediment	Volatile TPH Speciation	N/A	NW VPH	3 different 5-gram aliquots	3 x 40-ml VOA vials	3 VOA vials with 10 ml methanol and stir bar; add 5-gram sample to each 40-ml VOA vial 4 ±2ºC	14 days from date of collection
Soil/Sediment	Extractable TPH Speciation	N/A	NW EPH	30 grams	250-ml glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil	Dioxins/Furans	N/A	SW8290	30 grams	250-ml glass	4 ±2ºC, store in dark	30 days from date of collection to extraction and 40 days from extraction to analysis
Soil/Sediment	DRO/RRO	N/A	AK102/AK103	30 grams	1 x 4-oz. wide-mouth amber glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Tar/Solid	TPH Speciation	N/A	ASTM D2887	30 grams	1 x 4-oz. wide-mouth amber glass	4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	VOCs	N/A	SW8260B	120 ml	3 x 40-ml VOA vials	No headspace, HCl to pH<2, 4 ±2ºC	14 days from date of collection

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume	Containers	Preservation Requirements	Maximum Holding Time
Water[1]	EDB and DBCP	N/A	SW8011	120 ml	3 x 40-ml VOA vials	No headspace, HCl to pH<2, 4 ±2ºC	14 days from date of collection
Water[1]	GRO	N/A	AK101	120 ml	3 x 40-ml amber glass, septa lid	No headspace, HCl to pH<2, 4 ±2ºC	14 days from date of collection
Water[1]	SVOCs	N/A	SW8270C	2 liters	2 x 1-liter amber glass	4 ±2ºC	7 days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	PAHs	N/A	SW8270C SIM	2 liters	2 x 1-liter amber glass	4 ±2ºC	7 days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	Pesticides	N/A	SW8081A	2 liters	2 x 1-liter amber glass	4 ±2ºC	7 days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	PCBs	N/A	SW8082	2 liters	2 x 1-liter amber glass	4 ±2ºC	7 days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	Metals	N/A	SW6010B/SW6020/SW7470A	500 ml	1 x 500-mL HDPE	HNO_3 to pH<2	180 days from date of collection to analysis (28 days for mercury)
Water[1]	Volatile TPH Speciation	N/A	NW VPH	120 ml	3 x 40-ml VOA vials	No headspace, HCl to pH<2, 4 ±2ºC	14 days from date of collection
Water[1]	Extractable TPH Speciation	N/A	NW EPH	1 liter	1 x 1-liter amber glass	4 ±2ºC	7 (14 days if preserved with HCl) days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	Dioxins/Furans	N/A	SW8290	2 liters	2 x 1-liter amber glass	4 ±2ºC, store in dark	30 days from date of collection to extraction and 40 days from extraction to analysis
Water[1]	DRO/RRO	N/A	AK102/AK103	2 liters	2 x 1-liter amber glass	HCl to pH<2, 4 ±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil Gas	VOCs	N/A	TO15	1 liter or 6 liters	1 x 6-liter Summa Canister	None	30 days from date of collection
Soil Gas	GRO	N/A	TO3	1 liter or 6 liters	1 x 6-liter Summa Canister	None	30 days from date of collection
Soil for Waste Characterization	TCLP metals, VOCs, SVOCs, organochlorine pesticides, chlorinated herbicides (The analytical suite required for waste disposal varies, depending on the types and levels of contamination found at a specific site)	N/A	Extraction: SW1311 Analysis: SW6010B for metals SW7470A for mercury SW8260B for VOCs SW8270C for SVOCs SW8081A for organochlorine pesticides SW8151A for herbicides	200 grams for extractable organics and metals; 25 grams for VOCs	500-ml glass container for extractable organics and metals; 250-ml glass container for VOCs	4 ±2ºC; minimize headspace for VOC samples	TCLP extraction within 14 days for organics and within 180 days for metals (except mercury within 28 days) Analysis of TCLP extracts: **VOCs:** Analysis within 14 days **Extractable organics (SVOCs/PAHs and organochlorine pesticides):** Extraction of leachate within 7 days and analysis within 40 days of extraction **Metals:** Analysis within 180 days (except mercury within 28 days)

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume	Containers	Preservation Requirements	Maximum Holding Time

[1] Additional filtered water samples may be collected for ecological risk evaluation purposes.

Notes:

BTEX = benzene, toluene, ethylbenzene, and xylenes
°C = degrees Celsius
DRO = diesel-range organics
GRO = gasoline-range organics
HCl = hydrochloric acid
HNO_3 = nitric acid
HDPE = high-density polyethylene
ml = milliliter(s)
N/A = not applicable
oz = ounce(s)
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RRO = residual-range organics
SVOCs = semivolatile organic compounds
TCLP = toxicity characteristic leaching procedure
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis
VOCs = volatile organic compounds

Worksheet #20 – Field QC Sample Summary

This worksheet summarizes the field QC samples to be collected during the sampling activities. The number of field QC samples for each sampling matrix and analytical parameter is provided in the site-specific FSP tables in Appendix D.

20.1 Field Duplicate Samples

Field duplicates are two (or more) field samples taken at the same time in the same location. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. These samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.

Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. The samples may be either co-located samples or sub samples of a single sample collection. Example of co-located samples includes side-by-side soil core samples, while sub-samples may be taken from one soil boring core. The sample containers are assigned a unique identification number in the field. Specific locations should be designated for collection of field duplicate samples before the beginning of sample collection. The standard collection frequency for duplicate samples is one for every 10 field samples.

20.2 Field Replicate and Triplicate Samples (Multi-incremental)

Multi-incremental (MI) sampling will be used during this project and is described in SOP 28 (in Appendix H). Replicate and triplicate samples must be collected with this sampling technique to verify that an MI sample is truly representative of the site from which it was collected. The collection of replicate and triplicate samples allows for the calculation of a relative standard deviation (RSD) and the 95 percent Upper Confidence Limit (UCL) of the contaminant as described in the *State of Alaska Department of Environmental Conservation, Division of Spill Prevention and Response, Contaminated Sites Program, Draft Guidance on Multi Increment Soil Sampling* (March 2009).

Replicate and triplicate samples will be collected as specified in the site-specific FSPs (provided in Appendix D). As required by ADEC Guidance, the 95 percent UCL will be calculated and reported for each MI sample.

20.3 Matrix Spike/Matrix Spike Duplicates

Matrix Spike (MS)/Matrix Spike Duplicates (MSD) is an aliquot of sample spiked with known concentrations of specific analytes. The spiking occurs before sample preparation and analysis at the laboratory. Additional sample will be collected in the field to provide

sufficient sample volume for performing MS/MSD analyses. One MS and one MSD sample will be analyzed at a rate of approximately every 20 samples collected.

20.4 Equipment Blanks

An equipment blank is a sample of American Society of Testing and Materials (ASTM) Type II reagent-grade water poured into, poured over, or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. These may also be called rinse blanks or rinsate blanks. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

Equipment blanks shall be collected immediately after the equipment has been decontaminated and included for each sampling event, as appropriate. At a minimum, equipment blanks will be collected at a frequency of one per week or one per event per sampling crew (whichever is more frequent) for each decontaminated equipment type. Analysis of the equipment blank samples will match the methods and analytes requested in the associated samples.

20.5 Trip Blanks

Trip blanks are used to assess the potential introduction of contaminants to sample containers during the field collection event, including transportation and storage procedures. The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent-grade water, transported to the sampling site, handled like an environmental sample (without being opened), and returned to the laboratory for analysis. Trip blanks will be used only when VOC, GRO or NW VPH samples are taken and will be analyzed only for VOC, GRO or NW VPH analytes. One trip blank will accompany each cooler of aqueous samples sent to the laboratory for analysis of VOCs, GRO, or NW VPH.

Worksheet #21 – Project Sampling SOP References

The field SOPs associated with the project sampling are listed in the following table. The actual field SOPs are provided in Appendix H of this Work Plan.

Reference Number	Title	Originating Organization
SOP-01	Note Taking and Field Log Books	CH2M HILL
SOP-02	Site Reconnaissance, Preparation, and Restoration	CH2M HILL
SOP-03	Utility Clearance for Intrusive Operations	CH2M HILL
SOP-04	Organic Vapor Monitoring and Air Monitoring	CH2M HILL
SOP-05	Hollow Stem Auger and Direct Push Drilling Methods	CH2M HILL
SOP-06	Boring Log Completion, Soil Classification, and Logging	CH2M HILL
SOP-07	Surface and Subsurface Soil Sampling	CH2M HILL
SOP-08	Monitoring Well/Piezometer Installation	CH2M HILL
SOP-09	Monitoring Well Development	CH2M HILL
SOP-10	Groundwater and NAPL Level Measurement	CH2M HILL
SOP-11	Continuous Water Level Monitoring	CH2M HILL
SOP-12	Field Water Quality Measurements and Calibration	CH2M HILL
SOP-13	Groundwater Sampling Procedures	CH2M HILL
SOP-14	Equipment Decontamination Procedures	CH2M HILL
SOP-15	Soil Vapor Probe Installation and Active Soil Vapor Sampling with a Summa™ Canister and Helium Leak Testing.	CH2M HILL
SOP-16	Global Positioning Satellite System (GPS) Surveying	CH2M HILL
SOP-17	Geographic Land Surveying	CH2M HILL

Reference Number	Title	Originating Organization
SOP-18	Packing and Shipping of Environmental Samples	CH2M HILL
SOP-19	Sample Handling and Custody	CH2M HILL
SOP-20	Field Procedure Change Management	CH2M HILL
SOP-21	Well Decommissioning and Abandonment	CH2M HILL
SOP-22	Field Test Kit Analyses	CH2M HILL
SOP-23	Soil Excavation and Confirmation Sampling	CH2M HILL
SOP-24	Direct Push HydroPunch Groundwater Sampling	CH2M HILL
SOP-25	Direct Push Soil Gas Sampling	CH2M HILL
SOP-26	Geophysical Survey	CH2M HILL
SOP-27	Passive Soil Vapor Surveys	CH2M HILL
SOP-28	Multi-increment® Sampling for Surface Soil	CH2M HILL
SOP-29	Test Pit Excavation and Sampling	CH2M HILL
SOP-30	Sediment Sampling	CH2M HILL
SOP-31	Surface Water Sampling	CH2M HILL
SOP-32	Aquifer Pumping Tests	CH2M HILL

Note:

NAPL = non-aqueous phase liquid

Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection

Field equipment and instruments to be used during the field investigation and requiring calibration, maintenance, testing, or inspection include the field equipment summarized on the following pages.

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Minimum Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Digital camera	N/A	Charge batteries. Perform regular maintenance per manufacturer's instructions.	Take photographs.	Per manufacturer's instructions	Daily before use	Take clear, high-resolution digital photographs.	If camera fails, follow manufacturer's troubleshooting instructions. Otherwise, do not use this camera.	Field Team Leader	SOP-02 (see Appendix H)
PID	Calibrate for organic vapors using compressed isobutylene gas cylinders, per manufacturer's instructions.	Charge batteries. Perform regular maintenance per manufacturer's instructions.	Screen for potential volatile compound concentrations.	Per manufacturer's instructions	Daily before use	Check operations manual for acceptable range of calibrated probe for the specific lamp model.	If meter fails to calibrate, follow manufacturer's troubleshooting instructions. Use a moisture tube if necessary. Otherwise, do not use this meter.	Field Team Leader	SOP-04 (see Appendix H)
FID	Calibrate for organic vapors using compressed methane gas cylinders, per manufacturer's instructions.	Charge batteries and refuel with hydrogen fuel. Perform regular maintenance per manufacturer's instructions.	Screen for potential volatile compound concentrations.	Per manufacturer's instructions	Daily before use	Check operations manual for acceptable range of calibrated probe.	If meter fails to calibrate, follow manufacturer's troubleshooting instructions. Recharge batteries and refuel if necessary. Otherwise, do not use this meter.	Field Team Leader	SOP-04 (see Appendix H)
Low-flow water pump	Calibrate per manufacturer's instructions.	Perform regular maintenance per manufacturer's instructions.	Draw groundwater from the aquifer for sampling.	Per manufacturer's instructions	Daily before use	Per manufacture's specifications.	If pump fails, follow manufacturer's troubleshooting instructions. Otherwise, do not use this pump.	Field Team Leader	SOP-09 SOP-13 (see Appendix H)
Water level indicator	Calibrate annually to determine the accuracy of the measurement.	Replace batteries. Perform maintenance per manufacturer's instructions.	Measure depth to groundwater and total well depth.	Per manufacturer's instructions	Daily before use	±0.01 foot.	If meter fails to calibrate, follow manufacturer's troubleshooting instructions. Replace batteries if necessary. Otherwise, do not use this meter.	Field Team Leader	SOP-10 (see Appendix H)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Minimum Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Oil-water interface indicator	Calibrate annually to determine the accuracy of the measurement.	Replace batteries. Perform maintenance per manufacturer's instructions.	Measure depth to NAPL layer, depth to groundwater, and total well depth.	Per manufacturer's instructions	Daily before use	±0.01 foot.	If meter fails to calibrate, follow manufacturer's troubleshooting instructions. Replace batteries if necessary. Otherwise, do not use this meter.	Field Team Leader	SOP-10 (see Appendix H)
Continuous water level datalogger	Calibrate annually to determine the accuracy of the measurement.	Perform regular maintenance per manufacturer's instructions.	Continuously measure groundwater elevation and barometric pressure.	Per manufacturer's instructions	Prior to deployment	Check operations manual for acceptable range of calibrated probes.	If meter fails to calibrate, follow manufacturer's troubleshooting instructions. Otherwise, do not use this meter.	Field Team Leader	SOP – 11 (see Appendix H)
Water quality multi-meter	Calibrate daily, prior to collecting water quality data, according to the manu-facturer's calibration specifications.	Perform regular maintenance per manufacturer's instructions.	Measure DO, ORP, conduc-tance, pH, and temperature.	Per manufacturer's instructions	Daily before use	Check operations manual for acceptable range of calibrated probes.	If meter fails to calibrate, follow manufacturer's troubleshooting instructions. Replace batteries if necessary. Otherwise, do not use this meter.	Field Team Leader	SOP-12 (see Appendix H)
Dielectric meter	Calibrate per manufacturer's instructions.	Charge batteries. Perform regular maintenance per manufacturer's instructions.	Detect helium leaks during soil gas leak testing.	Per manufacturer's instructions	Daily before use	Per manufacturer's specifications.	If meter fails, follow manufacturer's troubleshooting instructions. Otherwise, do not use this meter.	Field Team Leader	SOP-15 (see Appendix H)
Soil gas pump	Calibrate per manufacturer's instructions.	Perform regular maintenance per manufacturer's instructions.	Draw soil gas from the vadose zone for sampling.	Per manufacturer's instructions	Daily before use.	Per manufacturer's specifications.	If pump fails, follow manufacturer's troubleshooting instructions. Otherwise, do not use this pump.	Field Team Leader	SOP-15 (see Appendix H)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Minimum Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GPS	Calibrate per manufacturer's instructions.	Charge batteries. Perform regular maintenance per manufacturer's instructions.	Measure horizontal coordinates in reference to the World Geodetic System (WGS) 84 Universal Transverse Mercator (UTM) (Zone 4) meters coordinate system.	Per manufacturer's instructions	Daily before use	±3 feet.	If unit fails to calibrate, follow manufacturer's troubleshooting instructions. Otherwise, do not use this unit.	Field Team Leader	SOP-16 (see Appendix H)
Field Test Kits	Calibrate per manufacturer's instructions.	Perform regular maintenance per manufacturer's instructions.	Provides screening level concentrations of specific analytes.	Per manufacturer's instructions	Daily or before use.	Per manufacturer's specifications.	If concentrations of specific analytes fall outside the detectable range for a given test kit; laboratory analysis may be required.	Field Team Leader	SOP-22

Notes:

DO = dissolved oxygen
FID = flame ionization detector
GPS = global positioning system
N/A = not applicable
NAPL = nonaqueous phase liquid
ORP = oxidation-reduction potential
PID = photoionization detector
SOP = standard operating procedure
UTM = Universal Transverse Mercator
WGS = World Geodetic System

Worksheet #23 – Analytical SOP References

Tables 23-1 through 23-4 (tables are located at the end of this worksheet) provide LSOP references, which were provided by EMAX Laboratories, Inc. (Torrance, California; TestAmerica (West Sacramento, California); and Air Toxics Ltd. (Folsom, California). EMAX Laboratories, Inc., LSOPs are provided in Appendix I. TestAmerica and Air Toxics Ltd. LSOPs are proprietary and will be provided only if required, by specific request to the laboratories. Although the LSOPs of TestAmerica and Air Toxics Ltd. are not provided as part of this Work Plan, the project chemist will review them for compliance with project requirements. The LSOPs have not been modified specifically for this project and may not reflect the exact requirements of this Work Plan. The LSOPs are supplemented by internal communication systems within each laboratory to disseminate the project requirements to technical staff.

LSOPs for the field laboratory were provided by Applied Sciences Laboratory (Corvallis, Oregon). Applied Sciences Laboratory LSOPs are included in Appendix I.

TABLE 23-1
LSOP References for EMAX Laboratories, Inc., Torrance, California

LSOP Number	Title, Revision Number, and/or Date	Definitive/ Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
EMAX-8260	Volatile Organics by GC/MS, Rev. 4	Definitive	VOCs	GC/MS	EMAX	No
EMAX-8270	Semivolatile Organics by GC/MS, Rev. 3	Definitive	SVOCs	GC/MS	EMAX	No
EMAX- 8270SIM	Semivolatile Organics by GC/MS, Method 8270SIM, Rev. 1	Definitive	PAHs	GC/MS	EMAX	No
EMAX 8081	Organochlorine Pesticides by Gas Chromatography, Rev. 6	Definitive	Pesticides	GC	EMAX	No
EMAX 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Rev. 2	Definitive	PCBs	GC	EMAX	No
EMAX 6010	Inductive Coupled Plasma Emission Spectrometric Method for Trace Metals Analysis, Rev. 5	Definitive	Metals	ICP-AES	EMAX	No
EMAX 6020	Trace Metals by ICP-MS, Rev. 4	Definitive	Metals	ICP-MS	EMAX	No
EMAX-7470	Mercury in Liquid Waste, Rev. 4	Definitive	Metals	CVAA	EMAX	No
EMAX-7471	Mercury in Solid and Semisolid Waste, Rev. 4	Definitive	Metals	CVAA	EMAX	No
EMAX-AK102	AK Diesel-range Organics, Rev. 2	Definitive	TPH Diesel	GC	EMAX	No
EMAX AK103	AK Residual-range Organics, Rev. 2	Definitive	TPH Diesel Motor Oil	GC	EMAX	No
EMAX-AK101	AK Gasoline-range Organics, Rev. 1	Definitive	TPH Gasoline	GC	EMAX	No
EMAX-TO15	Determination of Volatile Compounds in Ambient Air, Rev. 0	Definitive	Vapor / VOCs	GC/MS	EMAX	No
EMAX-SM01	Sample Management, Rev. 4	N/A	N/A	N/A	EMAX	No
EMAX-SM02	Sample Receiving, Rev. 4	N/A	N/A	N/A	EMAX	No
EMAX-SM03	Waste Disposal, Rev. 4	N/A	N/A	N/A	EMAX	No

TABLE 23-1
LSOP References for EMAX Laboratories, Inc., Torrance, California

LSOP Number	Title, Revision Number, and/or Date	Definitive/ Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
EMAX-SM04	Sample Receiving, Rev. 4	N/A	N/A	N/A	EMAX	No
EMAX-1311	Toxicity Characteristic Leaching Procedure (TCLP) for Organic and Inorganic Analytes, Rev. 0, 5/06/02	Definitive	TCLP	Varies	EMAX	No

Notes:

EMAX LSOPs are reviewed annually

CVAA = cold vapor atomic absorption
GC = gas chromatograph
GC/MS = gas chromatograph/mass spectrometer
ICP-AES = inductively coupled plasma – atomic emission spectrometry
ICP-MS = inductively coupled plasma – mass spectrometry
PAHs = polynuclear aromatic hydrocarbons
TCLP = toxicity characteristic leaching procedure
TPH = total petroleum hydrocarbons
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 23-2
SOP References for TestAmerica Laboratory, West Sacramento, California

LSOP Number	Title, Revision Number, and/or Date	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
WS-GC-0007	Gas Chromatographic Analysis of Total Petroleum Hydrocarbons (Rev. 5.1, Effective 1/16/2009)	D	AK 102; water and soil	GC/FID	TestAmerica	No
WS-MS-0007	Determination of Volatile Organics and Total Purgeable Petroleum Hydrocarbons by GC/MS (Rev. 4.2, Effective 02/26/2010)	D	SW8260B/AK101; water and soil	GC/MS	TestAmerica	No
WS-OP-0001	Extraction of Semivolatile Organic Compounds for Analysis by Method 8270C, Based on SW-846 3500 Series and 3600 Series, and PAH-SIM by Internal Standard and Isotope Dilution Procedures (Rev. 3.3, Effective 02/09/2010)	D	SW8270C, SW8270C-SIM; water and soil	GC/MS	TestAmerica	No
WS-MS-0005	GC/MS Analysis Based on Method 8270C (Rev. 4.2, Effective 9/04/2009)	D	SW8270C; water and soil	GC/MS	TestAmerica	No
WS-MS-0008	Determination of Polynuclear Aromatic Hydrocarbons (PAHs) by GC/MS-SIM Internal Standard Technique (Rev. 2.1, Effective 9/04/2009)	D	SW8270C-SIM; water and soil	GC/MS	TestAmerica	No
WS-OP-0002	Extraction and Cleanup of Organic Compounds from Waters and Soils, Based on SW-846 3500 Series and 3600 Series Methods for Analysis by Methods 8081A and 8082 (Rev. 3.3, Effective 02/19/2010)	D	SW8081A/SW8082; water and soil	GC	TestAmerica	No

TABLE 23-2
SOP References for TestAmerica Laboratory, West Sacramento, California

LSOP Number	Title, Revision Number, and/or Date	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
WS-GC-0001	Chromatographic Analysis Based on SW-846 Methods 8000B, 8081A, and Compendium Methods TO-4, TO-4A, T0-10, and TO-10A (Rev. 4, Effective 3/02/2009)	D	SW8081A; water and soil	GC	TestAmerica	No
WS-GC-0002	Chromatographic Analysis Based on SW-846 Methods 8000B and 8082, and Compendium Methods TO-4, TO-4A, TO-10, and TO-10A (Rev. 4.1, Effective 6/24/2009)	D	SW8082; water and soil	GC	TestAmerica	No
WS-IP-0002	Acid Digestion of Soils, SW-846 Method 3050B (Rev. 5.1, Effective 10/19/09)	D	SW6010B, SW6020; soil	ICP–AES, ICP–MS	TestAmerica	No
WS-IP-0001	Acid Digestion of Aqueous Samples by SW-846 and MCAWW 200 Series Methods (Rev. 5.1, Effective 10/02/09)	D	SW6010B, SW6020; water	ICP–AES, ICP–MS	TestAmerica	No
WS-MT-0003	Inductively Coupled Plasma – Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW-846 Method 6010/6010C and EPA Method 200.7 (Rev. 5.1, Effective 9/04/2009)	D	SW6010B; water and soil	ICP–AES	TestAmerica	No
SAC-MT-0001	Analysis of Metals by Inductively Coupled Plasma/Mass Spectrometry (Rev. 3.2, Effective 1/15/2010)	D	SW6020; water and soil	ICP–MS	TestAmerica	No
WS-MT-0005	Preparation and Analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW846 7470A and MCAWW 245.1 (Rev. 5.2, Effective 2/17/2010)	D	SW7470A; water	CVAA	TestAmerica	No

TABLE 23-2
SOP References for TestAmerica Laboratory, West Sacramento, California

LSOP Number	Title, Revision Number, and/or Date	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
WS-MT-0007	Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption (Rev. 5.1, Effective 10/19/2009)	D	SW7471A; soil	CVAA	TestAmerica	No
WS-IDP-0005	Preparation of Samples for Analysis of Polychlorinated Dioxins and Furans for Analysis by HRGC/HRMS (Rev 1.1, Effective 2/05/2010)	D	SW8290; water and soil	HRGC/HRMS	TestAmerica	No
WS-ID-0005	Analysis of Samples for Polychlorinated Dioxins and Furans by HRGC/HRMS (Rev. 7.3, Effective 12/11/2009)	D	SW8290; water and soil	HRGC/HRMS	TestAmerica	No
WS-OP-0013	Determination of Percent Moisture (Rev.4, Effective 11/15/2008)	D	All soil samples	N/A	TestAmerica	No
TBD			NW EPH			
TBD			NW VPH			
WS-QA-0003	Sample Receipt & Procedures (Rev. 11.2, Effective 10/19/2009)	N/A	Sample Management & Receiving	N/A	TestAmerica	No
WS-EHS-0001	Waste Disposal (Rev. 4, Effective 02/13/2009)	N/A	Waste Disposal	N/A	TestAmerica	No

Notes:

GC/FID = gas chromatograph/flame ionization detector
GC/MS = gas chromatograph/mass spectrometer
HRGC = high resolution gas chromatography
HRMS = high resolution mass spectrometry
N/A = not applicable
NW EPH = Northwest extractable petroleum hydrocarbon
NW VPH = Northwest volatile petroleum hydrocarbon

TABLE 23-3
LSOP References for Air Toxics Ltd., Folsom, California

LSOP Number	Title, Revision Number, and/or Date	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
6	Volatile Organic Compounds in Air, Rev. 24, 12/4/08	D	VOCs	GC/MS	Air Toxics Ltd.	No
43	Gasoline Range Organics in Air, Rev. 16, 3/25/09	D	GRO	GC	Air Toxics Ltd.	No

Notes:

GC = gas chromatograph
GC/MS = gas chromatograph/mass spectrometer
GRO = gasoline-range organics
LSOP = laboratory standard operating procedure
VOCs = volatile organic compounds

TABLE 23-4
LSOP References for Applied Sciences Laboratory, Corvallis, Oregon

LSOP Number	Title, Revision Number, and/or Date	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
GAL01.01	Standard Operating Procedure, Determination of Total Petroleum Hydrocarbons as Gasoline by AK-101, EPA SW8021B, SW5030 and SW5035 for Use at the CH2M HILL, Inc. Galena AFB Field Lab (Rev. 1, Effective May 25, 2010)	D	GRO/Chlorinated VOCs	GC	Applied Sciences Laboratory	No
GAL02.01	Standard Operating Procedure, Determination of Diesel and Residual Range Organics in Water, Soil and Sediment by Gas Chromatography (GC) Following AK102 and AK103 for Use at the CH2M HILL, Inc. Galena AFB Field Lab (Rev. 1, Effective May 25, 2010)	D	DRO/RRO	GC	Applied Sciences Laboratory	No

Notes:

DRO = diesel-range organics
GC = gas chromatograph
GRO = gasoline-range organics
LSOP = laboratory standard operating procedure
RRO = residual-range organics

Worksheet #24 – Analytical Instrument Calibration

So that the analytical methods and the selected instrumentation meet the project requirements, each analytical instrument will be calibrated according to the procedures outlined in Appendix K of this Work Plan.

Specific analytical method SOP references are provided in Worksheet #23 (*Analytical SOP References*). While instrument calibration is requested as part of this worksheet, this information is included in Appendix K, along with full method QA/QC tables for ease of use by project chemists and the laboratory. This additional information provides documentation on corrective actions, flagging criteria for laboratory services, and expectations for analytical services, and it meets the requirements of Worksheet #28 (*Analytical QC Samples*).

Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection

So that the analytical instruments and equipment are available and in working order when needed, all laboratory analytical equipment will undergo maintenance and testing in accordance with the LSOPs, as provided in Appendix I of this Work Plan.

Worksheet #26 – Sampling Handling System

To ensure sample authenticity and data defensibility, a proper sample handing system will be followed from the time of sample collection to final sample disposal.

The Field Team Leader (FTL) or designee will be responsible for sample collection, sample packing, and coordination of sample shipment. The samples will be either hand-delivered to the CH2M HILL Former Galena FOL Field Laboratory or shipped to a predetermined project laboratory. If required, an expediter in Fairbanks may be contracted to transfer samples between airlines. Sample handling, custody, packing, and shipping procedures are provided in SOP-18 and SOP-19 of Appendix H.

The laboratory sample pick-up staff and/or custodian will acknowledge the sample receipts upon arrival. The laboratory analytical technicians will prepare and analyze the field samples in accordance with the analytical SOPs provided in Appendix I. The field samples and all extracts/digestates will be stored at the laboratory for 30 days after the final report has been submitted to CH2M HILL. The laboratory hazardous waste manager will be responsible for the final sample disposal upon notice from the CH2M HILL project chemist.

26.1 Sample Handling System

26.1.1 Sample Collection, Packaging, and Shipment

Sample Collection (Personnel/Organization): CH2M HILL Field Team Leader or designee

Sample Packaging (Personnel/Organization): CH2M HILL Field Team Leader or designee

Sample Delivery to CH2M HILL Former Galena FOL Field Laboratory (Personnel/Organization): CH2M HILL Field Team Leader or designee

Sample Shipment Coordination to Non-Field Laboratories (Personnel/Organization): CH2M HILL Field Team Leader or designee and expediter

Type of Shipment/Carrier: ERA Alaska/Frontier Alaska and Alaska Airlines Goldstreak to project laboratory

26.1.2 Sample Receipt and Analysis

Sample Receipt (Personnel/Organization): Laboratory sample pick-up person and/or custodian

Sample Custody and Storage (Personnel/Organization): Laboratory sample custodian

Sample Preparation (Personnel/Organization): Laboratory-specific analytical technicians

Sample Determinative Analysis (Personnel/Organization): Laboratory specific analytical technicians

26.1.3 Sample Archiving

Field Sample Storage (no. of days from sample collection): Laboratory sample custodian will store samples at the laboratory for 30 days after the final report has been submitted to CH2M HILL.

Sample Extract/Digestate Storage (no. of days from extraction/digestion): Laboratory-specific analytical technicians will store all extracts/digestates for 30 days after the final report has been submitted to CH2M HILL.

Biological Sample Storage (no. of days from sample collection): To be determined, if necessary.

26.1.4 Sample Disposal

Personnel/Organization: Laboratory hazardous waste manager.

Number of Days from Analysis: Samples may not be disposed of until 30 days after the final report has been submitted to CH2M HILL.

Worksheet #27 – Sampling Custody Requirements

Proper sample handling, sample shipment, and maintenance of a chain-of-custody are key components for building the documentation of and support for data that can be used to make project decisions. The following sections summarize the field and laboratory sample custody procedures to be followed during the project.

27.1 Field Sample Custody Procedures

Sample collection information, including sample name and time, will be recorded in the field notebook and field datasheets (such as groundwater sampling logs), as appropriate. The following sections provide general guidelines for field documentation, sample containers, sample labeling, sample handling and custody, and sample packing and shipping.

27.1.1 Field Documentation

Specific requirements on documentation procedures are outlined in SOP-01 of Appendix H. The FTL is responsible for ensuring that the field sampling team adheres to proper custody and documentation procedures. Field notebooks, field datasheets, and chain-of-custody forms will be the primary documentation mechanisms used to record and track information about each sample. Copies of the field notebooks and field datasheets will be retained in the project files.

The field sampling team is responsible for the following field documentation activities:

- Keeping clear and accurate written records of all onsite activities in the field notebooks and/or field datasheets.
- Ensuring that all entries are legible; are written in waterproof, black ink; and contain accurate and inclusive documentation of the field activities. This documentation must include field data and observations, any problems encountered, and actions taken to solve the problem(s).
- Recording the date and initialing daily entries.
- Noting errors or changes using a single-line strike-out to cross out the entry, then recording the date and initialing the change.

Field notebooks and field datasheets will be available for review during technical audits or at any other time for QC checks. This documentation will provide verification of sampling procedures.

When photographs or videos are taken for visual documentation of a site or procedure, they will be numbered to correspond to the field notebook or photographic log entries. If possible,

a reference point (such as a building or a sign) will be included to help verify the location of the photograph and provide an approximate scale. As photographs are taken, the name of the photographer, date, time, site location, site description, and direction in which the photograph was taken will be documented in the field notebook.

27.1.2 Sample Containers

Sample containers must be purchased pre-cleaned and treated according to EPA specifications for the analytical methods. Sample containers will not be reused for any reason. Containers should be stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Once sample containers have been taken to the field, unused containers will not be returned for later use. Unused bottles will be disposed of; they will not be returned to the laboratory. Amber glass bottles should be used for organic sampling to minimize the effects of ultraviolet light on compounds of interest.

27.1.3 Sample Labeling

All samples shall be uniquely identified and labeled in the field at the time of collection. A sample label will be affixed to each sample collected. At a minimum, sample labels will identify the sample with the following information:

- Unique identification number
- Sample type and media
- Analytical method(s) requested
- Sampler's initials
- Date collected
- Time collected
- Preservation method used

27.1.4 Sample Handling and Custody

The procedures for sample handling and custody are provided in SOP-19 (see Appendix H). Procedures to ensure the custody and integrity of the samples will begin at the time of sampling and continue through sample transport, receipt, preparation, analysis, storage, data generation, reporting, and disposal. Field and laboratory records maintain information about the custody and condition of the samples.

CH2M HILL will maintain the chain-of-custody records for all normal field and QC samples. A sample is defined as being under a person's custody if any of the following conditions exist:

- It is in their possession
- It is specified as within their scope of responsibility by the Field Supervisor or FTL, after being in their possession
- It was in their possession and they locked or sealed the sample(s) up
- It is in a designated secure area

The following sample information will be documented on the chain-of-custody form:

- Project name
- Project number
- Project Manager, address, and phone number
- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, sample type, and media)
- Number of sample containers
- Designation of MS/MSD
- Preservative used
- Analyses required
- Name(s) of sampler and/or sampling team
- Sample turnaround requirements
- Laboratory report requirements (if applicable)
- Pertinent field data (such as pH or temperature)
- Special instructions or comments (if applicable)
- Sample bottle number or Summa canister number and flow-controller number (if applicable)
- Serial numbers of custody seals and transportation cases (if applicable)
- Custody transfer signatures, and dates and times of sample transfer from the field to transporters and to the laboratory
- Shipping waybill or manifest tracking number (if applicable)
- Cooler identification number (if applicable)

27.1.5 Sample Packing and Shipping

The procedures for sample packing and shipping are provided in field SOP-18 (see Appendix H). In general, samples collected in the field will be transported to either the CH2M HILL Former Galena FOL Field Laboratory or a predetermined project laboratory as quickly as possible. The samples will be chilled in a cooler with an ice substitute (for example, blue ice) or ice in a resealable plastic bag to keep them cool (4 ±2°C) during collection and transportation. A temperature blank (a 40-milliliter [ml] volatile organic analysis [VOA] vial filled with water) will be included in every cooler and used to determine the internal temperature in the cooler upon its receipt at the laboratory. The chain-of-custody

form will be filled out in indelible ink, placed in a resealable plastic bag, and taped to the inside lid of the shipping cooler. It is anticipated that most project samples will be environmental samples in small volumes. Environmental samples are samples with contaminant concentrations significantly reduced by normal environmental weathering processes (such as volatilization to the air, degradation caused by exposure to sunlight and microbes, or simple mixing with soil or groundwater). Therefore, the samples present little shipping hazard in terms of corrosiveness, flammability, or explosiveness. If the coolers are to be shipped to the laboratory, the samples will be packaged for shipment according to U.S. Department of Transportation (DOT) regulations. Marking and labeling procedures will be consistent with DOT regulations. The method of shipment, courier name(s), and other pertinent information will be entered on the chain-of-custody form. Shipping waybills will be properly completed, and copies will be retained and placed in the project file.

27.1.6 Laboratory Sample Custody Procedures

A designated sample custodian will receive the samples and verify that they match those in the chain-of-custody record. The condition, temperature, and preservation of the samples shall be checked and documented on the chain-of-custody form. The occurrence of any anomalies in the received samples and their resolution shall be documented in the laboratory records. All sample information shall then be entered into a tracking system and unique analytical sample identifiers shall be assigned. The laboratory shall review a copy of this information for accuracy.

Sample holding time begins with the collection of samples and continues until the analysis is complete. Holding times for analytical methods required for this project are specified in Worksheet #19 (*Analytical SOP Requirements*). Subcontracted analyses shall be documented with the AFCEE chain-of-custody form. The laboratory shall also implement and document procedures that ensure internal laboratory chain-of-custody. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

Samples shall be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers shall be monitored for temperature 7 days a week. Acceptance criteria for the temperature of the refrigerators and coolers is 4 ±2°C. Acceptance criteria for the temperature of the freezers shall be lower than -7°C. Thermometers that have been calibrated with a National Institute of Standards and Technology (NIST)-traceable thermometer shall be used to monitor all of the cold storage areas. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained.

Samples for VOC analysis shall be stored separately from other samples and/or sample extracts. Refrigerators storing VOC samples shall contain a blank that is analyzed at a minimum of every 2 weeks. Samples shall be properly stored after analysis until they are disposed of. The samples will be disposed of in accordance with applicable local, State, and federal regulations. The laboratory shall maintain disposal records. The laboratory shall maintain SOPs describing sample control and custody. Refer to the analytical SOPs in Appendix I for further details on the laboratory sample custody procedures.

Worksheet #28 – Laboratory QC Sample Summary

This worksheet provides additional discussions relevant to the analytical QC requirements that laboratories producing definitive data will be required to follow. The purpose of the laboratory QC sample activities is to produce data of known quality that satisfy the project-specific DQOs. Appendix K provides the QA/QC summary tables for each method.

Laboratory QC samples shall be included in an analytical batch with the field samples. An analytical batch is a group of samples (not exceeding 20 environmental samples plus associated laboratory QC samples) that are:

- Similar in composition (matrix)
- Extracted or digested at the same time and with the same lot of reagents
- Analyzed together as a group

The analytical batch also extends to cover samples that do not need separate extraction or digestion (for example, VOC analysis by purge and trap). The identity of each analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the laboratory QC samples and the associated environmental samples. The type of laboratory QC samples and the frequency of use of these samples are discussed in the following sections and in method-specific analytical SOPs (see Appendix I).

28.1 Method Detection Limits

The MDL, as defined by Title 40, *Code of Federal Regulations* (CFR), Part 136, Appendix B, is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The laboratory will establish MDLs for each method, matrix, and analyte, and provide them to CH2M HILL at the beginning of the project (that is, before project samples are analyzed) and upon request. The MDL is used along with other measurements of sensitivity, such as the LOD and the LOQ.

Laboratories participating in this work will demonstrate the MDLs for each instrument, including confirmatory columns, method of analysis, analyte, and matrix, using the following steps:

1. Estimate the MDL using one of the following:

    - The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5

    - The concentration equivalent of three times the standard deviation of replicate measurement of the analyte in reagent water

- The region of the standard curve where there is a significant change in sensitivity (that is, a break in the slope of the standard curve)

2. Prepare (that is, extract or digest) and analyze seven MS samples (American Society for Testing and Materials [ASTM] Type II water for aqueous methods; Ottawa sand for soil organic methods; and glass beads of 1 millimeter diameter or smaller, or Teflon® chips, for soil metals) containing the analyte of interest at a concentration 3 to 5 times the estimated MDL. If more than seven replicates are analyzed, all results must be used to calculate the MDLs unless exclusion of a result is technically justified and documented. MDLs must be established for each extraction/cleanup method combination employed for samples.

3. Determine the variance (S2) for each analyte as follows:

$$S2 = \frac{1}{n-1}\left[\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2\right] \quad (1)$$

where:

x_i = the ith measurement of the variable x
$\bar{x}$ = the average value of x
S2 = variance

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (2)$$

4. Determine the standard deviation(s) for each analyte as follows:

$$s = (S2)1/2 \quad (3)$$

5. Determine the MDL for each analyte as follows:

$$MDL = 3.14(s) \quad (4)$$

(Note: 3.14 is the one-sided t-statistic at the 99 percent confidence level that is appropriate for determining the MDL using seven samples.)

6. If the spike level used in Step 2 is more than 10 times the calculated MDL, repeat the process using a smaller spiking level.

If multiple instruments are used, the MDL used for reporting purposes will represent the least sensitive instrument response for each compound or element spiked.

28.2 Limit of Detection

The MDL will be used to determine the LOD for each analyte and matrix and for all preparatory and cleanup methods routinely used on samples, as follows. After each MDL determination, the laboratory must immediately establish the LOD by spiking a quality system matrix at approximately two to three times the MDL (for a single-analyte standard)

or one to four times the MDL (for a multi-analyte standard). This spike concentration establishes the LOD; it is specific to each combination of analyte, matrix, method (including sample preparation), and instrument configuration. The LOD must be verified quarterly.

The following requirements apply to the initial MDL and LOD determinations and to the quarterly LOD verifications:

- The apparent signal-to-noise ratio at the LOD must be at least 3 and the results must meet all method requirements for analyte identification (for example, ion abundance, second-column confirmation, or pattern recognition). For data systems that do not provide a noise measurement, the signal produced by the verification sample must produce a result that is at least three standard deviations greater than the mean method blank concentrations.
- If a laboratory uses multiple instruments for a given method, the LOD must be verified for each.
- If the LOD verification fails, the laboratory must repeat the MDL determination and LOD verification at a higher concentration, or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.
- The laboratory will maintain documentation for all MDL determinations and LOD verifications.

28.3 Limit of Quantitation

The laboratory will compare the results of the LOD demonstrations with the LOQs for each method and analyte. The LOD may not be more than one-half the corresponding LOQ. The laboratory will also verify LOQs by including a standard equal to or below the LOQ as the lowest point on the calibration curve.

If a result is greater than the MDL and less than the LOQ, the result will be reported as a detected concentration and flagged "J." If no detected concentration is determined down to the MDL, the result will be reported to the MDL concentration (with the added variables of sample dilution, final volume, and sample mass included), reported as a nondetect result, and U-flagged. If a result is greater than the MDL and less than the LOQ, the result will be reported as a detected concentration and flagged "J." A detected result greater than or equal to the LOQ will be reported without a qualifying flag unless stated otherwise in Appendix K, Tables K18 through K25. No results below the MDL will be reported.

At a minimum, the LOQ must be verified quarterly. The laboratory procedure for establishing the LOQ must empirically demonstrate precision and bias at the LOQ. The LOQ and associated precision and bias must meet project-specific requirements and must be reported. If the method is modified, precision and bias at the new LOQ must be demonstrated and reported.

Project-specific estimated LODs and LOQs are provided in Worksheet #15 (Reference Limits and Evaluation). LODs will be specified by the laboratory at the time of reporting; LODs are

expected to be two to three times greater than the MDL and below the LOQ. The estimated LODs and LOQs were compared with the project-specific screening criteria to determine whether they will meet the analytical DQOs. Laboratory LODs and LOQs are expected to be at or below the estimated values in Worksheet #15 (Reference Limits and Evaluation). If the LOD is below the screening criterion, the LOQ is sufficient for project decision making. Otherwise, other analyte-specific factors (for example, potential use at the site, mobility, toxicity) may be discussed in the project quality objectives on a more qualitative basis.

Sample dilution due to target and or nontarget compound concentrations or matrix interference could prevent achievement of LOQs. Samples must be analyzed initially while undiluted, when reasonable. If dilution is necessary, both the original and the diluted results must be reported. Any samples that are not analyzed undiluted must have the express approval of CH2M HILL within extraction and analysis holding time and be supported by matrix interference documentation, such as sample viscosity, color, odor, or results from other analyses of the same sample, to show that undiluted analysis is not possible. Appropriate cleanup procedures must be followed to minimize matrix effects on LOQs.

28.4 Laboratory Control Sample

A laboratory control sample (LCS) is a sample of known composition that is spiked with all target analytes. The LCS is used with each analytical batch to determine whether the method is in control. Each analyte in the LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve, which is defined as the median point of the curve instead of the middle of the range. The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS cannot be used as the continuing calibration verification (CCV).

At least one LCS shall be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs shall be reported. A failure of an analyte in any of the LCSs shall require appropriate corrective action, including qualification of the failed analyte in all of the samples, as required.

28.4.1 LCS Control Limits

The LCS limits specified in Appendix K shall be used unless the laboratory determines that the limit cannot be met (in which case laboratory historical control limits will be used). The LCS limits are based on those in the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) (DoD, 2009). The performance of the LCS is evaluated against the QC acceptance limits. Whenever an analyte in the LCS is outside the acceptance limit, corrective action shall be performed. If an analyte in the LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action is ineffective, an appropriate flag, as described in Appendix K, shall be applied to all affected results.

28.4.2 Marginal Exceedance

A marginal exceedance is defined as one beyond the LCS control limits but within the MEs limits, which are set at four standard deviations around the mean. MEs must be sporadic

(that is, random). If the same analyte exceeds the LCS control limits repeatedly (for example, two out of three consecutive LCSs), that is an indication that the problem is systematic, not random. The source of error should be located and appropriate corrective actions should be taken.

A number of sporadic MEs of the LCS control limits are allowed but may be used only by the CH2M HILL project chemist as part of the data evaluation and flagging process. The laboratory may not use this process as part of its data review practice but is encouraged to contact the CH2M HILL project chemist to discuss compound-specific failures as needed. The number of MEs is based on the total number of analytes spiked into the LCS and may not exceed 5 percent of the total number of analytes in the LCS. The allowable number of MEs for a given number of analytes in the LCS is specified in Table 28-1 (tables are located at the end of this worksheet).

28.4.3 LCS Failure

Each LCS must be evaluated against the LCS control limits and ME limits before being accepted. The recoveries for the analytes spiked into the LCS should first be compared with the LCS control limits. If a recovery is less than the lower control limit or greater than the upper control limit, that is an exceedance. The laboratory should note which analytes exceeded the control limits and compare them with the list of project-specific analytes of concern. Once an LCS fails, corrective action is required. LCS failure occurs in the event of any of the following:

- Exceedance of an LCS control limit by any project-specific analyte of concern
- ME of the LCS control limits by more than the allowable number of analytes
- Exceedance of the ME limits by one or more analytes

28.4.4 Corrective Action

If an LCS fails, an attempt must be made to determine the source of error and find a solution. All findings and corrective actions should be documented. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch shall be re-prepared and reanalyzed for the out-of-control analyte(s), or the batch shall be rerun with a new LCS. The corrective action applied shall be based on professional judgment in the review of other QC measures (such as surrogates). If an analyte falls outside the LCS control limits a second time, or if sufficient sample material is not available to be reanalyzed, then all the results in the analytical batch for that analyte must be flagged. The recoveries of those analytes subject to corrective action must be documented in the case narrative, whether flagging is needed or not.

28.5 Matrix Spike/Matrix Spike Duplicate

An matrix spike (MS) or matrix spike duplicate (MSD) is an aliquot of sample collected in the field and spiked with known concentrations of all target analytes. The spiking occurs before sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for that analyte. The MS/MSD is

used to document potential matrix effects associated with a site and will not be used to control the analytical process. The MS/MSD results and flags will not be associated with or related to samples that are collected from the same site where the MS/MSD set was collected. The field team leader will select the samples for MS/MSDs, and the laboratory will use those samples to prepare the appropriate MS/MSDs.

The performance of the MS and MSD is evaluated against the QC acceptance limits outlined in Appendix K. If either the MS or the MSD is outside the QC acceptance limits, the data shall be evaluated to determine whether there is a matrix effect or analytical error. The analytes in the parent sample and associated samples collected at the same site (if applicable) shall be qualified according to the data flagging criteria provided in Appendix K.

If the sample concentration exceeds the spike concentration by a factor of four or more, the data shall be reported unflagged. The laboratory should communicate potential matrix difficulties to the CH2M HILL project chemist so an evaluation can be made with respect to the project-specific DQOs.

28.6 Surrogates

Surrogates are compounds similar to the target analytes in chemical composition and behavior, but not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been reestablished, the sample should be reprepared and reanalyzed. If corrective actions are not performed or are ineffective, an appropriate flag (as described in Appendix K) shall be applied to the sample results.

28.7 Internal Standards

Internal standards (ISs) are known amounts of standards that are added to a portion of a sample or sample extract and carried through the entire determination procedure. ISs are used as a reference for calibration and for controlling the precision and bias of the analytical method. ISs shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, an appropriate flag (as described in Appendix K) shall be applied to the sample results.

28.8 Retention Time Windows

Retention time (RT) windows are used in gas chromatography (GC), ion chromatography (IC), and high-performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. RT windows are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846, Method 8000C. The center of the RT window is established for each analyte and surrogate using the RT of the midpoint standard of the initial calibration. For non-mass spectrometry methods, these are updated daily using the absolute RT in the initial calibration verification (ICV).

If the RT is outside of the acceptance limits, corrective action shall be performed. This applies to all continuing calibration verification subsequent to the ICV and to LCSs. If corrective actions are not performed or are ineffective, an appropriate flag (as described in Appendix K) shall be applied to the sample results.

28.9 Interference Check Samples

Interference check samples (ICSs) are used in inductively coupled plasma – atomic emission spectrometry (ICP–AES) and inductively coupled plasma – mass spectrometry (ICP–MS) analyses only. The ICSs consist of two solutions, A and B:

- Solution A contains the interfering analytes
- Solution B contains both the analytes of interest and the interfering analytes

The ICSs are used to verify background and inter-element correction factors. The ICSs are run at the beginning of each run sequence for Methods SW6010B and SW6020B.

If the ICS results are outside of the acceptance limits, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, the ICS will be reanalyzed. If ICS results are acceptable, all affected samples will be reanalyzed. If corrective actions are not performed or are ineffective, an appropriate flag (as described in Appendix K) shall be applied to the sample results.

28.10 Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure, and is used to assess possible contamination resulting from the analytical process.

A method blank shall be included in every analytical batch. The presence of analytes in a method blank above the MDL indicates the need for further assessment of the data. The source of contamination should be investigated, and measures must be taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the LOQ. For common laboratory contaminants (for example, methylene chloride, acetone, or phthalates),

the method blank concentration must not exceed the LOQ. No analytical data shall be corrected for the presence of analytes in blanks.

If an analyte is detected in the method blank and at similar concentrations in the associated samples, and corrective actions are not performed or are ineffective, an appropriate flag (as described in Appendix K) shall be applied to the sample results.

28.11 QC Checks

28.11.1 Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. Some methods have more than one holding time requirement (for example, Methods SW8081A and SW8270C). For methods not requiring sample preparation, the holding time is calculated from the time of sample collection to the time of completion of all analytical runs. For methods requiring sample preparation before analysis:

- Preparation holding time is calculated from the time of sample collection to the time of completion of preparation
- Analytical holding time is calculated from the time of completion of preparation to the time of completion of all analytical runs

Holding times are determined on the basis of days, hours, and minutes. If the time of sample collection is not provided, the laboratory must assume the most conservative time of day. If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures described in Appendix K and identified in the data-package case narrative.

28.11.2 Confirmation

Results at or above the LOQ for samples analyzed by GC or HPLC require quantitative confirmation. The confirmation shall be completed within the method-required holding times. If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures described in Appendix K.

- For GC methods, a second column will be used for confirmation.
- For HPLC methods, a second column or a different detector will be used.

Unless otherwise specified or overlapping peaks are causing erroneously high results, data from the primary column or detector shall be reported as the primary result. The column used for both the primary and confirmation results shall be indicated on the sample reports. The associated calibration and laboratory QC results shall be submitted for both columns so that sample results can be appropriately evaluated.

28.11.3 Control Charts

Control charts are used to track laboratory performance over time. It is recommended that all analytes spiked into the LCS be tracked via control charts. These charts are useful for

identifying trends and problems in an analytical method. The laboratory shall use these charts to establish in-house LCS control limits. The control charts should be updated as needed (for example, when there is a significant change to the analytical system). At a minimum, the charts should be updated annually and reviewed each time a data point is generated so that corrective action can be taken in a timely manner. These charts can also be used to benchmark a laboratory's performance against this Work Plan's requirements to determine possible areas for improvement.

28.11.4 Standard Materials

Standard materials (including second source materials) used in calibration and to prepare samples shall be traceable to a National Institute of Standards and Technology (NIST), EPA, American Association of Laboratory Accreditation (A2LA), or other equivalent approved source, if available. If an NIST, EPA, or A2LA standard material is not available, the standard material proposed for use shall be included in an addendum to the project-specific Work Plan and approved before use.

The standard materials shall be current, and the following expiration policy shall be followed:

- Expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date or one year from the date of receipt, whichever comes first.
- Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first.
- Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions.

Expired standard materials shall be either revalidated before use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory shall label standard and QC materials with expiration dates.

A second source standard is used to independently confirm the initial calibration. A second source standard is a standard purchased from a vendor different from that supplying the material used in the initial calibration. The second source material can be used for the continuing calibration standards and/or for the LCS. Two different lot numbers from the same vendor do not normally constitute a second source. However, when a project requires analyses for which there is not a separate vendor source available, the use of different lot numbers from the same vendor will be acceptable to verify calibration.

28.11.5 Supplies and Consumables

The laboratory shall inspect supplies and consumables before their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored and

documented. An inventory and storage system for these materials shall make sure they are used before manufacturers' expiration dates and are stored under safe and chemically compatible conditions.

TABLE 28-1
Allowable Number of Marginal Exceedances

Number of Analytes in LCS	Allowable Number of Marginal Exceedances of LCS Control Limits
>90	5
71–90	4
51–70	3
31–50	2
11–30	1
<11	0

Worksheet #29 – Project Documents and Records

The required data package deliverables during every aspect of the project are identified in this worksheet. These include but are not limited to: (1) sample collection and field measurement records, (2) analytical records, and (3) data assessment records.

29.1 Sample Collection and Field Measurement Records

Sample collection and field measurement records generally include field log books, photographic documentation, equipment decontamination records, sampling instrument calibration records, soil boring logs, well development logs, well sampling logs, chain-of-custody forms, and air bills.

29.2 Analytical Records

29.2.1 Hardcopy Analytical Data Deliverables

The hardcopy data reports shall conform to the formats identified in Section 8.8 of the AFCEE QAPP Version 4.0.02 (AFCEE, May 2006). Note that substituted summary forms may be used for the applicable AFCEE form, as needed, as long as the information is equivalent to or exceeds the required content of the AFCEE form and pre-approval has been obtained from the CH2M HILL project chemist. A Portable Document Format (PDF) version of all hardcopy data will also be provided as part of the laboratory data deliverable. Supporting raw data information may be required. Raw data submittals, if required, will be included in the PDF submittal and defined in the CH2M HILL laboratory statement of work (SOW) for the project.

29.2.2 Electronic Data Reports from the Laboratory

The electronic data deliverable will be in the CH2M HILL Lab Spec 7 format, as defined in the project-specific SOW.

29.2.3 ERPIMS Electronic Data Reports

CH2M HILL shall provide an electronic deliverable report in the ERPIMS format. ERPIMS is a data management system designed to accommodate all types of data collected at the ERP sites. Specific codes and data forms have been developed to allow consistent and efficient input of information to the system. CH2M HILL shall provide the database information via American Standard Code Information Interchange (ASCII) files in specified ERPIMS format on compact disks (CDs). The information transferred shall include all required technical data, such as site information, well characteristics, and hydrogeologic, geologic, physical, and chemical analysis results. Electronic data reporting

formats and requirements are given in *Environmental Resources Program Information Management System, 2009 Data Loading Handbook,* Version 5.1.904 (AFCEE, September 2009).

29.3 Data Assessment Records

Data assessment records include, but are not limited to, data validation reports.

29.4 Triad Process Records

It is intended that a Triad process will be used during the planning and implementation of the fieldwork to involve stakeholders in the decision-making process, disseminate new information promptly, and adjust the investigation approaches based on new information, as outlined in Worksheet #10 (*Problem Definition*).

Once data are validated per the processes outlined in Worksheet #36 (*Validation [Steps IIa and IIb] Summary*), the Triad team will be presented with updated data summary tables of detections compared with screening levels and updated GIS figures.

29.5 Alaska Department of Environmental Conservation-required Laboratory Checklists

CH2M HILL shall provide with reports the current version of the ADEC Division of Spill Prevention and Response Contaminated Sites Program laboratory checklist. One checklist shall be provided for each analytical data deliverable as an appendix to the investigation reports.

Worksheet #30 – Analytical Services Table

The table below identifies the laboratories that will provide the analytical services. The field laboratory will obtain ADEC certification prior to project startup. Before going to the project site, the field laboratory will provide ADEC with: SOPs for all methods to be performed on-site, a field laboratory quality assurance plan, and an application for certification. Once on site, the field laboratory will set up instrumentation, perform MDL studies and analyze blind performance evaluation samples. MDL studies and performance evaluation sample results will be submitted to ADEC for certification.

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory Contact Information	Backup Laboratory Contact Information
Soil, Sediment, Groundwater, Surface Water	All analyte groups (except soil gas)	All sample locations identified in Worksheet #17 (*Sampling Design and Rationale*)	Analytical SOPs listed in Worksheet #23 (*Analytical SOP References*)	Standard turnaround time (21 calendar days from date of receipt at the laboratory)	EMAX Laboratories, Inc. Jim Carter 1835 W. 205th Street Torrance, CA 90501 Phone: (310) 618-8889 x109	TestAmerica Karen Sellers 880 Riverside Parkway West Sacramento, CA 95605 Phone: (916) 374-4442 Fax: (916) 372-1059
Soil, Sediment (Field Lab)	GRO, DRO/RRO, BTEX plus chlorinated hydrocarbon screening	All sample locations identified in Worksheet #17 (*Sampling Design and Rationale*)	Analytical SOPs listed in Worksheet #23 (*Analytical SOP References*)	Quick turnaround time, 24–72 hours	Applied Sciences Laboratory Ben Thompson 2300 NW Walnut Blvd. Corvallis, OR 97330 Phone: (541) 768-3132 Fax: (541) 752-0276	
Soil Gas	VOCs and TPH	All soil gas sample locations identified in Worksheet #17 (*Sampling Design and Rationale*)	Analytical SOPs listed in Worksheet #23 (*Analytical SOP References*)	Standard turnaround time (21 calendar days from date of receipt at the laboratory)	Air Toxics Ltd. Kelly Beuttner 180 Blue Ravine Road, Ste B Folsom, CA 95630 Phone: (916) 985-1000 Fax: (916) 605-3356	

Notes:

BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel-range organics
GRO = gasoline-range organics
ID = identification
RRO = residual-range organics
SOP = standard operating procedure

Worksheet #31 – Planned Project Assessments

Periodic assessments will be performed during the course of the project to help ensure that the planned project activities are implemented in accordance with this Work Plan. The type, frequency, and responsible parties of planned assessment activities for the project are summarized in the table below.

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Field Procedure Assessment and Work Plan Compliance	Weekly	Internal	CH2M HILL	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL	Field Team Leaders	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL
Field Documentation Reviews	Daily	Internal	CH2M HILL	Ronny Fields/CH2M HILL Jeremiah Knuth/ CH2M HILL	Field Team Leaders	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL
Health and Safety Audit	Once during field sampling activities	Internal	CH2M HILL	John Culley/CH2M HILL	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL	John Culley/ CH2M HILL	Ronny Fields/ CH2M HILL Jeremiah Knuth/ CH2M HILL

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Data Validation	After receiving data from laboratory	Internal and external	Berney Kidd/ CH2M HILL Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/AirToxics Laboratory QA Officer/ASL (field lab)	Berney Kidd/CH2M HILL Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/Air Toxics Ltd. Laboratory QA Officer/ASL (field lab)	Berney Kidd/ CH2M HILL Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/Air Toxics Ltd. Laboratory QA Officer/ASL (field lab)	Berney Kidd/ CH2M HILL Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/Air Toxics Ltd. Laboratory QA Officer/ASL (field lab)	Berney Kidd/ CH2M HILL Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/Air Toxics Ltd. Laboratory QA Officer/ASL (field lab)
Internal Project Reporting Reviews	Once per report and/or per report version	Internal	CH2M HILL	Rick Sturm/CH2M HILL Doug Downey/ CH2M HILL	Win Westervelt/ CH2M HILL	Win Westervelt/ CH2M HILL	Win Westervelt/ CH2M HILL
External Project Reporting Reviews	Once per report	External	CH2M HILL	Al Weilbacher/AFCEE Donna Kozak/BAH	Win Westervelt/ CH2M HILL	Win Westervelt/ CH2M HILL	Win Westervelt/ CH2M HILL

Notes:

QA = quality assurance
ASL = Applied Sciences Laboratory

Worksheet #32 – Assessment Findings and Corrective Action Responses

Based on the findings of the project assessments, corrective action may be required. For assessment findings that require corrective action, deficiencies will be documented and communicated to the appropriate project personnel. Corrective action will then be implemented and a follow-up assessment performed to verify the results of the corrective action. Procedures for handling Work Plan deviations during each type of assessment are summarized in the table below.

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Procedure Assessment and Work Plan Compliance	Internal memo	Ronny Fields/CH2M HILL Jeremiah Knuth/ CH2M HILL	1 business day	Internal email	Field Team Leaders	1 business day
Field Documentation Reviews	Internal memo	Ronny Fields/CH2M HILL Jeremiah Knuth/ CH2M HILL	3–5 business days	Internal email	Field Team Leaders	3–5 business days
Health and Safety Audit	Written audit report	John Culley/CH2M HILL	3–5 business days	Letter or memo	Ronny Fields/CH2M HILL Jeremiah Knuth/ CH2M HILL	3–5 business days

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Data Validation	Laboratory resubmissions	Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/ Air Toxics Ltd. Laboratory QA Officer/ASL (Field Lab)	After receiving data from the lab and during data validation	Corrective action reports, updated case narratives, and corrected data submissions	Berney Kidd/CH2M HILL	7 business days
Internal project reporting reviews	Report comments	Rick Sturm/CH2M HILL Doug Downey/ CH2M HILL	7–10 business days	Responses to comments and report revision	Win Westervelt/ CH2M HILL	7–10 business days
External project reporting reviews	Report comments	Al Weilbacher/AFCEE Donna Kozak/BAH	Per CDRLs	Responses to comments and report revision	Win Westervelt/ CH2M HILL	Per CDRLs

Notes:

QA = quality assurance
CDRLs = Contract Data Requirements Lists

Worksheet #33 – QA Management Reports

To meet the project quality objectives, periodic QA management reports will be prepared. They will help keep the project stakeholders updated on project status and results of QA assessments so that corrective actions can be implemented promptly and effectively. The frequency and type of planned QA management reports, the delivery date, the personnel responsible for report preparation, and the report recipients are identified in the table below.

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Data Usability Assessment Report	Once after all data are generated and validated	Submitted with Final Reports	Berney Kidd/CH2M HILL	Recipients listed in the Distribution Memo (see Worksheet #3 [*Distribution List*])
Health and Safety Audit	Once during the field activities	7 days after audit	John Culley/CH2M HILL	Win Westervelt, Ronny Fields, and Jeremiah Knuth/CH2M HILL
Monthly Status Report (Including Contractor's Progress, Status, and Management Report and Funds and Labor-Hour Expenditure Reports)	Once per month	By 20th of each month	Win Westervelt and Chris Kanae/CH2M HILL	Al Weilbacher/AFCEE

Worksheet #34 – Verification (Step I) Process

To ensure that scientifically sound data of known and documented quality are used in making environmental decisions, the following three-step data review will be performed:

Step 1 (verification) will confirm that all sampling and analytical requirements have been met.

Step II (validation) will assess whether the sampling and analytical processes comply with the contract-specific and the Work Plan-specific requirements.

Step III (usability assessment) will determine whether the resulting data are suitable as a basis for the decision being made.

Worksheets #34 (*Verification [Step I] Process*), #35 (*Validation [Steps IIa and IIb] Process*), and #36 (*Validation [Steps IIa and IIb] Summary*) describe the processes to be followed for the above three steps, respectively.

Worksheet #34 also establishes the procedures that will be followed to verify project data including, but not limited to, sampling documents and analytical data packages.

Verification Input	Description	Internal/ External	Person(s) Responsible for Verification
Chain-of-custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody form will be initialed by the reviewer, a copy of the chain-of-custody will be retained in the project file, and the original and remaining copies will be taped inside the cooler for shipment. See SOP-28 and SOP-29 in Appendix H for further details.	Internal	Ronny Fields or Jeremiah Knuth/ CH2M HILL
Field Notebooks	Field notes will be reviewed internally at the end of each working day and placed in the project file.	Internal	Ronny Fields or Jeremiah Knuth/ CH2M HILL

Verification Input	Description	Internal/ External	Person(s) Responsible for Verification
Laboratory Data	The laboratory performing the work will verify laboratory data packages for completeness and technical accuracy internally prior to submittal. The CH2M HILL project chemist or designee will validate received data packages internally.	Internal/ External	Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/AirToxics Laboratory QA Officer/Applied Sciences Laboratory (Field Lab) Berney Kidd/CH2M HILL
Project Reports	Internal CH2M HILL senior staff with applicable expertise will provide a quality assurance (QA) review of project reports.	Internal	Win Westervelt/CH2M HILL Marilyn Gauthier/CH2M HILL

Worksheet #35 – Validation (Steps IIa and IIb) Process

Step II (validation) will confirm whether the requirements for a specific intended use are fulfilled. The purpose of data validation is to assess the performance associated with the analysis to determine the quality of the data. Step IIa will verify whether the sampling and analytical data comply with the applicable methods, procedures, and contracts. Step IIb will compare the sampling and analytical data with the measurement performance criteria specified in Worksheet #12 (*Measurement Performance Criteria*).

Step IIa/IIb	Validation Input	Description	Person(s) Responsible for Validation
IIa	Field SOPs	Verify that the sampling SOPs were followed	Ronny Fields or Jeremiah Knuth/CH2M HILL
IIa	Analytical SOPs	Verify that the analytical SOPs were followed	Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/AirToxics Laboratory QA Officer/Applied Sciences Laboratory (Field Lab) Berney Kidd/CH2M HILL
IIa	Method Quality Control (QC) Results	Verify that the required QC samples were run and met required limits	Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/AirToxics Laboratory QA Officer/Applied Sciences Laboratory (Field Lab) Berney Kidd/CH2M HILL

Step IIa/IIb	Validation Input	Description	Person(s) Responsible for Validation
IIa/IIb	Data Validation	Validate 100 percent of the data to confirm quality as defined in Worksheet #14 (*Summary of Project Tasks*)	Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/AirToxics Laboratory QA Officer/Applied Sciences Laboratory (Field Lab) Berney Kidd/CH2M HILL
IIa/IIb	Data Usability Evaluation	Evaluate data based on precision, accuracy, representativeness, comparability, and completeness for project objectives	Berney Kidd/CH2M HILL
IIb	Onsite Screening (such as PID readings)	Verify that the field data meets this Work Plan's requirements for completeness and accuracy based on field calibration records	Ronny Fields or Jeremiah Knuth/CH2M HILL
IIb	Field Documentation	Verify accuracy and completeness of field notes	Ronny Fields or Jeremiah Knuth/CH2M HILL
IIb	Field QC Sample Results	Verify that the required field QC samples were run and met required limits	Laboratory QA Officer/EMAX Laboratory QA Officer/TestAmerica Laboratory QA Officer/AirToxics Laboratory QA Officer/Applied Sciences Laboratory (Field Lab) Berney Kidd/CH2M HILL
IIb	Quantification Limits	Verify that the sample results met the project quantification limit specified in this Work Plan.	Berney Kidd/CH2M HILL

Worksheet #36 – Validation (Steps IIa and IIb) Summary

The objective of data validation is to assess the performance associated with the analysis to determine the quality of the data. This will be accomplished by evaluating whether the collected data comply with the pre-defined requirements of the project (including method, procedural, and contractual requirements) and by comparing the collected data with criteria established based on the project DQOs. Table 36-1 (tables are located at the end of this worksheet) summarizes the validation process.

All types of data, including screening data and definitive data, are relevant to the usability assessment. The following sections focus on the data review requirements for definitive data only.

36.1 Data Review Requirements for Definitive Data

Scientifically sound data of known and documented quality that meet DQOs are essential for use in the decision-making process. Data review is the process whereby a variety of personnel who have different responsibilities within the data management process examine and evaluate data to varying levels of detail and specificity. This process includes verification, validation, and usability assessment. The records that document data review activities to effectively assess the data for quality and usability must be persuasive, that is complete and robust. The data can then move forward with associated qualifiers that indicate the overall usability of the data.

Data verification is the first step in data review. Data verification confirms that the specified requirements have been performed.

Data validation extends data verification and is used to confirm that the requirements for a specific intended use are fulfilled. Data validation is the systematic process of evaluating whether the data comply with the pre-defined requirements of the project (including method, procedural, and contractual requirements) and comparing the data with criteria based on the DQOs documented in this Work Plan. The purpose of data validation is to assess the performance associated with the analysis to determine the quality of the data. Data validation includes a determination, to the extent possible, of the reasons for any failure to meet performance requirements, and an evaluation of the effect of such failures on the usability of the data.

Data usability assessment is an evaluation based on the findings of data validation and verification, in the context of the overall project decisions or objectives. The assessment determines whether the project execution and resulting data meet the DQOs. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

36.2 Laboratory Requirements

The analytical data package must contain adequate information and be presented in a clear and concise manner. Minimum requirements include the following:

- Cover sheet, which identifies the project
- Table of contents
- Case narrative, which summarizes samples, provides analyses, and discusses any issues that may affect data usability
- Analytical results
- Laboratory MDLs, LODs, and LOQs
- Sample management records
- Internal laboratory QA/QC information

The laboratory's analytical data package should be organized so that the analytical results are reported on a per-analytical-batch basis, unless otherwise specified.

Using the information contained in the data package, a reviewer should be able to determine the PARCCS of the data. Additional information may be required, depending on the level of detail related to the data review performed.

A schedule should be established so that data packages (that is, sample delivery groups [SDGs]) are provided promptly to CH2M HILL for data review, validation, assessment, and use. This schedule should include identification of the anticipated number of these data packages to be generated for the project.

36.2.1 Laboratory Data Reporting Requirements

The case narrative of the analytical data package shall include, but not be limited to, the following:

- Table summarizing samples received, correlating field sample numbers, laboratory sample numbers, and laboratory tests completed
- Discussion of sample appearance and integrity issues that may affect data usability (such as temperature, preservation, pH, sample containers, air bubbles, and multi-phases)
- Samples received but not analyzed and the reasons why
- Discussion of holding-time deviations for sample preparation and analyses
- Analysis of all exceedances or discrepancies of calibrations, continuing calibrations or QC sample results; raw data/chromatograms; and corrective actions taken
- Identification of samples and analytes for which manual integration was necessary
- Discussion of all qualified data and definition of qualifying flags

- Discussion and recommendations of potential data usability of qualified data

In addition, the following requirements should be met for the reporting:

- MDLs and sample results should be reported to one decimal place more than the corresponding LOQ, unless the appropriate number of significant figures for the measurement dictates otherwise.
- Results for soil samples should be reported on a dry-weight basis. LOQs are project-specific requirements and are NOT adjusted for sample moisture. MDLs and LODs may have to be adjusted for moisture; however, the laboratory should ensure that the minimum relationships between adjusted MDLs and LODs and corresponding LOQs are maintained.
- Samples should be analyzed undiluted, if possible. Nondetects should be reported to the MDL.

36.2.2 Manual Integrations

Manual integrations, which are an integral part of the chromatographic analysis process, shall be done only as corrective action measures. Examples of instances where manual integration would be warranted include, but are not limited to, co-eluting compounds resulting in poor-peak resolution, a misidentified peak, an incorrect retention time, or a problematic baseline.

When manual integrations are used, the following procedures shall be implemented for documenting the event and for consistency in performing the manual integration:

- A laboratory SOP shall be followed for manual integrations. This SOP shall specify: (1) when automated integrations by the instrument are likely to be unreliable; (2) what constitutes an unacceptable automated integration; (3) how the problems should be resolved by the analyst; and (4) the procedures for the analyst to follow in documenting any required manual integrations.
- Raw data records shall include a complete audit trail for those manipulations, including: (1) results of both the automated and manual integrations; (2) notation of the cause and justification for performing the manual integrations; (3) date; and (4) signature or initials of person performing the manual operations.
- All manual integrations must be reviewed and approved by the section supervisor and/or the QA officer.
- All manual integrations must be identified in the case narrative.

36.2.3 Laboratory Data Review Requirements

All analytical data the laboratory generates shall be verified before submittal to CH2M HILL. This internal data review process, which is multi-tiered, shall include all aspects of data generation, reduction, and QC assessment. All definitive data shall be reviewed first by the analyst, and then by the supervisor of the respective analytical section using the same

criteria. Elements for review or verification at each level must include, but are not limited to, the following:

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate analytical SOPs and methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Verification of data transfers
- Documentation completeness
- Accuracy and completeness of data deliverables (hard copy and electronic)

36.2.4 Laboratory Data Evaluation

The calibration, QC, corrective actions, and flagging requirements for definitive data are shown in Appendix K. The laboratory shall apply data qualifiers as part of its internal validation activities. The allowable data qualifiers for definitive data are Q, J, B, U, and N. Table 36-2 provides the definitions of the laboratory data qualifiers. Flagging criteria apply when acceptance criteria are not met and corrective actions were not successful or not performed. The supervisor of the respective analytical sections shall review the data qualifiers.

The laboratory's Quality Assurance section shall perform a 100 percent review of 10 percent of the completed data packages, and the laboratory project representative shall complete a final review on all of the completed data packages.

CH2M HILL or its designee will subsequently evaluate the flags the laboratory applied as part of its data validation and usability assessment activities. The flags may be accepted, modified, or rejected. For all data qualifiers that are changed, clear justification must be provided.

36.2.5 Method Blank Evaluation Guidance

For method blanks, the source of contamination will be investigated. If one-half the LOQ is exceeded, the laboratory will evaluate whether the samples need to be reprocessed using the following criteria: (1) the method blank contamination exceeds a concentration greater than one-tenth of the measured concentration of any sample in the associated preparation batch, or (2) there is evidence that the blank contamination otherwise affects the sample results. Except when sample analysis results in a nondetect, all samples associated with method blank contamination and meeting these criteria will be reprocessed in a subsequent preparation batch. If insufficient sample volume remains for reprocessing, the results will be reported with a B-flag, along with any other appropriate data qualifier. If an analyte is detected only in the method blank, not in any batch samples, no flagging is necessary. Method blank contamination must be addressed in the case narrative.

36.3 CH2M HILL Requirements

CH2M HILL has overall responsibility for data quality, and external organizations may assist CH2M HILL in its review. Regardless of who performs the data review, the individual(s) should possess the disciplinary expertise, experience, and theoretical knowledge to perform the task, and have a complete understanding of the intended use of the data and the relationship of the QC results to the usability of the data.

36.3.1 Data Verification Guidelines

The data verification that the laboratory performs should be reviewed for completeness and accuracy. Data verification may be done electronically or manually, or by a combination of both methods. Data verification may include, but is not limited to, the following:

- Sampling documentation (such as the chain-of-custody form)
- Preservation summary and holding times
- Presence of all analyses and analytes requested
- Use of required sample preparation and analysis procedures
- MDLs, LODs, and LOQs
- Correctness of concentration units
- Case narrative

36.3.2 Data Validation Guidelines

The data validation process builds on data verification. The laboratory case narrative and data validation results should be reviewed, with data qualifiers removed or added, if needed. Project data will be validated on an analytical-batch basis by assessing QC samples and associated field-sample results. Data-validation guidelines have been developed with guidance from *AFCEE QAPP* Version 4.0.02, US EPA Contract Laboratory Program (CLP) National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (June 2008), USEPA CLP NFG for Inorganic Data Review (October 2004), USEPA CLP NFG for Chlorinated Dioxin/Furan Data Review (September 2005), and specific method guidance such as USEPA SW846 Third Edition (January 1993) (see Table 36-3). Note that information was added to Table 36-3 to help define additional general flagging criteria applied (in some cases based on professional judgment).

The following information will be reviewed as part of a Level III-type summary data validation:

- Chain-of-custody documentation
- Holding time
- QC sample frequencies
- Method blanks
- LCS
- Surrogate spikes
- MS/MSD
- Initial and continuing calibration information

- Internal standards
- Tuning criteria
- Field duplicate precision
- Case narrative review, laboratory flagging review and other method-specific criteria

A fully automated process may be used to make all of the comparisons against the limits for elements of QC that are available in the laboratory electronic deliverables. The automated process will include data flagging for issues related to method blanks, equipment blanks, trip blanks, ambient blanks, LCSs, MS/MSD samples, field duplicates, surrogate recoveries, holding time, and reconciliation of dilutions and re-extractions. All of the elements of QC, their limits, and the logic for applying flags will be incorporated in the computer application. Data flags, as well as the reason for each flag, will be entered into an electronic database and made available to the data users. The data validator/chemist will apply a final flag to the data after evaluating all flags entered into the database and selecting the most conservative flags.

Raw Data Review

As part of the usability assessment, data review can involve an in-depth review of the raw data to verify accuracy, followed by analysis and interpretation of the data in the context of the project objectives and end use. The review may include, but is not limited to, the following:

- Method-specific instrument calibration and QC parameters
- Raw data and chromatograms
- System performance
- Proper integration (if applicable)
- Spectral matches and/or retention times to verify analyte identification (where applicable)
- Random check of calculations
- Interference problems or system performance problems
- Estimated results
- The laboratory's resolution of any identified problems, as necessary

Data Analysis and Interpretation

This phase of the data validation process (assessment) may include, but is not limited to, the following:

- Laboratory and field blank contamination and parallel contamination in samples
- Duplicate and split sample analyses
- Matrix spike data

- LCS data
- Effect of multiple data issues on the final analytical results
- Deficiencies identified during data verification and assessment of their effect on the sample results
- Incorporation of site-specific factors and assessment of their effect on the data
- Assessment of data usability and assignment of final data qualifiers, as necessary
- Discussion of completeness, representativeness, and comparability

A data validation report will be prepared summarizing the findings and discussing their effect on overall data usability. This report may be incorporated into the final usability assessment.

Blank Evaluation Guidelines

CH2M HILL will evaluate method blanks, as well as other field blanks, based on the concentration of the analyte in the samples in relation to the concentration in the blank. CH2M HILL must discuss any blank contamination that may affect data usability in conjunction with project-specific goals. When a dataset contains low-level detects in field samples and has associated field or laboratory blanks that have detects at similar concentrations, this suggests that the low-level detects in these field samples may be artifacts because of either field or laboratory practices. A sample detect that is ≤ 5 times the blank contamination (≤ 10 times for common laboratory contaminants) will be flagged "B" at the detected concentration to document the associated blank contamination.

Duplicate and Replicate Evaluation Guidance

QC measures for precision include field duplicates, field replicates (multi incremental samples), laboratory duplicates, and MSDs. The laboratory will evaluate and quality these measures according to procedures outlined in Appendix K, with the exception of the field duplicates and field replicates.

Specifically, field duplicates should be sent to the laboratory as blind samples and should be given unique sample identification numbers. These sample results can be used to assess field-sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled. Flagging of results associated with field duplicates should be assigned so that the level of uncertainty required, as provided by the project-specific objectives, is taken into account.

Poor overall precision may result from one or more of the following:

- Field instrument variation
- Analytical measurement variation
- Poor sampling technique
- Sample transport problems
- Spatial variation (heterogeneous sample matrices)

To identify the cause of imprecision, the project team should evaluate the field sampling design rationale and sampling techniques, and review both field and analytical duplicate sample results. If poor precision is indicated in both the field and analytical duplicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular dataset or sample delivery group, then the reports must discuss the effect of that imprecision on usability.

Matrix Interference Evaluation Guidance

In the case of matrix interference, J-flags or UJ-flags should be applied to the associated parent sample and field duplicate, as applicable.

36.3.3 Flagging Conventions

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are R, J, B, UJ, U and NJ. Table 36-4 describes these usability assessment data qualifiers.

Tables 36-3 and 36-5 present the specific guidelines for applying these data usability qualifiers. The tables in Appendix K should be consulted for specific details.

TABLE 36-1
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
IIa/IIb	Soil, Sediment	All methods	N/A	Defined below	Berney Kidd/CH2M HILL or designated chemist
IIa/IIb	Groundwater, Surface Water	All methods	N/A	Defined below	Berney Kidd/CH2M HILL or designated chemist
IIa/IIb	Soil gas	All methods	N/A	Defined below	Berney Kidd/CH2M HILL or designated chemist

Note:

N/A = not applicable

TABLE 36-2
Laboratory Data Qualifiers

Qualifier	Description
Q	One or more QC criteria have failed. Data must be carefully assessed by CH2M HILL (or project team) with respect to the project-specific requirements and evaluated for usability. Subsequent assessment by the data validator may result in rejection of data based on the data qualifying conventions presented in Table 36-3.
J	The analyte was positively identified, but the associated concentration is estimated above the MDL and below the LOQ or the quantitation is an estimation because of discrepancies in meeting certain analyte-specific QC criteria.
B	The analyte was found in an associated blank above one-half the LOQ, as well as in the sample.
U	The analyte was analyzed for, but not detected.
N	The analyte is a tentatively identified compound (for mass spectrometry methods only).

Notes:

DoD = U.S. Department of Defense

LOQ = Limit of Quantitation

MDL = method detection limit

QC = quality control

TABLE 36-3
General Data Qualifying Conventions

QC Requirement	Criteria	Flag	Flag Applied to
Holding time	Time exceeded for extraction or analysis	J for positive results; R or UJ for nondetects[a]	All analytes in sample
Sample preservation	Sample not preserved; however, if sample preservation was not done in the field but was performed at the laboratory upon sample receipt, no flagging is required	J for positive results; R or UJ for nondetects[a]	Sample
	Temperature out of control	J for positive results; R or UJ for nondetects[a]	Sample
Sample integrity (SW8260)	Bubbles in VOA vial > 1/4 inch used for analysis	J for positive results; UJ for nondetects	Sample
Instrument tuning	Ion abundance method-specific criteria not met	R for all results	All associated samples in analytical batch
Initial calibration	All analytes must be within method-specified criteria	J for positive results; R for nondetects	All associated samples in analytical batch
Second source check or continuing calibration	All analytes must be within method-specified criteria	J for positive results; UJ for nondetects R for all nondetects greater than twice the control criteria	All associated samples in analytical batch
Low-level calibration check	All analytes must be within 50% of expected value	High bias: J for positive results Low bias: J for positive results; UJ for nondetects R for all nondetects greater than twice the control criteria	All associated samples in analytical batch
Interference check sample	All analytes must be within 20% of expected value	High bias: J for positive results Low bias: J for positive results; UJ for nondetects R for all nondetects greater than twice the control criteria	All associated samples in analytical batch
LCS	%R > UCL	J for positive results	The specific analyte(s) in all samples in associated analytical batch
	%R < LCL	J for positive results; UJ for nondetects	
	%R < LCL and <10%	J for positive results; R for nondetects	
Internal standards	Area > UCL	J for positive results; UJ for nondetects	Sample
	Area < LCL	J for positive results	
Surrogate spikes	%R > UCL	J for positive results	Sample
	%R < LCL and >10%	J for positive results; UJ for nondetects	
	%R <10%	J for positive results; R for nondetects	
	Excessive dilution[a]	No flag required	
Blanks (method, equipment, ambient, refrigerator, or trip)	Analyte(s) detected (use the blank of the highest concentration)	B for positive sample results ≤ 5 times highest blank concentration (10 times for common lab contaminants)	All samples in preparation, field or analytical batch, whichever applies

TABLE 36-3
General Data Qualifying Conventions

QC Requirement	Criteria	Flag	Flag Applied to
Field duplicates	RPD > CL and field duplicates > LOQs or One field duplicate > LOQ, one ND	J for positive results UJ for nondetects	The specific analyte(s) in all samples collected on same sampling date Note: No flagging is required for RPDs based on both concentrations less than the LOQs
Field replicates	RSD > 30% and all field replicates detected or One or more field replicates detected, one or more ND, and RSD > 30% (LOD used in RSD calculation for non-detected results)	J for positive results UJ for nondetects	The specific analyte(s) in all replicates Note: No flagging is required for RSDs based on all replicates being non-detect
MS/MSD	MS or MSD %R > UCL MS or MSD %R < LCL MS or MSD %R < LCL and <10% MS/MSD RPD > CL Sample concentration > 4 times spike concentration; excessive dilution[a]	J for positive results J for positive results; UJ for nondetects J for positive results; R for nondetects J for positive results No flag required	The specific analyte(s) in parent sample and associated samples collected at the same site.
Post-digestion spike	All analytes must be within 25% of expected value	High bias: J for positive results Low bias: J for positive results; UJ for nondetects	The specific analyte(s) in parent sample
Serial dilutions	All analytes must be within 10% of expected value	If Post Spike not analyzed; J for positive results	The specific analyte(s) in parent sample
Confirmation	RPD between primary and confirmation results > 40%	J for positive results	Sample
Retention time window	Analyte within established window	R for all results	Sample

[a]Based on analyte-specific review

Notes:

%R = percent recovery
CL = control limit
LCL = lower confidence limit
LCS = laboratory control sample
LOD = Limit of Detection
LOQ = Limit of Quantitation
MS = matrix spike
MSD = matrix spike duplicate
ND = not detected
RPD = relative percent difference
UCL = upper confidence limit
VOA = volatile organic analysis

TABLE 36-4
Usability Assessment Data Qualifiers

Qualifier	Description
R	The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision making.
UJ	The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.
U	The analyte was analyzed for, but not detected.
B	The analyte was detected in the sample at a concentration less than or equal to five times (10 times for common laboratory contaminants) the blank concentration.
J	The analyte was positively identified, and the quantitation is an estimation because of discrepancies in meeting certain analyte-specific quality control criteria. Or the analyte was positively identified, but the associated concentration is estimated above the MDL and below the LOQ.
NJ	The analyte is a tentatively identified compound.

Notes:

LOQ = Limit of Quantitation

MDL = method detection limit

QC = quality control

TABLE 36-5
Data Qualifying Conventions – Quantitation

Criteria	Flag
< MDL	U, UJ
≥ MDL < LOQ	J
≥ LOQ	As needed
≥ High standard/linear range	J

Notes:

LOQ = Limit of Quantitation
MDL = method detection limit

Example:

MDL = 2, LOD = 4, LOQ = 15, sample is undiluted.

Sample #1: Analytical result: not detected; reported result: < 2U.

Sample #2: Analytical result: 2; reported result: 2J.

Sample #3: Analytical result: 10; reported result: 10J.

Sample #4: Analytical result: 15; reported result: 15.

Worksheet #37 – Usability Assessment

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether the project execution and resulting data meet the project DQOs. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following sections summarize the processes used to determine whether the collected data are of the right type, quality, and quantity to support project decision making; how data quality issues will be addressed; and how limitations of the use of the data will be handled.

37.1 Summary of Usability Assessment Processes

Data gaps may be present if: (1) a sample is not collected; (2) a sample is not analyzed for the requested parameters; or (3) the data are determined to be unusable. The need for further investigation will be determined on a case-by-case basis. This determination will depend on whether data can be extrapolated from adjacent sample locations and whether the data are needed based on the results from adjacent sample locations.

The CH2M HILL project chemist and the laboratory will ensure that the collected data meet the LODs, LOQs, and laboratory QC limits specified in this Work Plan. During the data validation assessment, nonconformances will be documented, and data will be qualified accordingly. The CH2M HILL project chemist will determine whether the data are usable, based on the requirements of this Work Plan.

With the exception of rejected data, all data are usable as qualified by the CH2M HILL project chemist. Estimated and/or biased results are usable. Outliers, if present, can be addressed on a case-by-case basis. There is no generic formula for determining whether a result is an outlier. Potential outliers will be referred to a statistician and/or senior consultant, who will determine which formulas are appropriate for classifying data points in a statistically appropriate and defensible manner. Data will not be eliminated from consideration on the basis of statistical outlier testing. Additional detail on data evaluation procedures is provided in Appendices F and G.

37.2 Evaluative Procedures to Assess Project-Specific Overall Measurement Error

Overall measurement error is normally associated with both sampling design and quality, and with quantitative measures performed in both the field and laboratory. In-depth assessment will be performed during the data validation process to assess conformance with the field SOPs, analytical SOPs, and objectives of this Work Plan. Qualifiers will be used to indicate overall usability of the data.

37.3 Personnel Responsible for Performing Usability Assessment

- Berney Kidd/CH2M HILL Project Chemist
- Win Westervelt/CH2M HILL Project Manager
- Marilyn Gauthier/CH2M HILL RI Task Manager
- Harry Ohlendorf/CH2M HILL Ecological Risk Assessor
- Dennis Shelton/CH2M HILL Toxicologist

37.4 Usability Assessment Documentation

37.4.1 Precision

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS. Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

Total precision is the measurement of the variability associated with the entire sampling and analytical process. The required level of precision for each method, matrix, and analyte is provided in Appendix K. The level of precision, which is determined by analysis of duplicate field samples, measures variability introduced by both laboratory and field operations. Field duplicate samples and MSD samples shall be analyzed to assess field and laboratory precision at a frequency described in Worksheet #20 (*Field Quality Control Sample Summary*). For duplicate sample results, the precision is evaluated using the relative percent difference (RPD). For replicate results, the precision is measured using the RSD. The formulas for calculating RPD and RSD are provided below.

If calculated from duplicate measurements:

$$RPD = \frac{(C_1 - C_2)\ x\,100\%}{(C_1 + C_2)\ /\ 2} \qquad (1)$$

where:

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, RSD is used, rather than RPD:

$$RSD = (s\ /\ \overline{y})\ x\,100\% \qquad (2)$$

where:

RSD = relative standard deviation
s = standard deviation
$\bar{y}$ = mean of replicate analyses

Standard deviation, s, is defined as follows:

$$S = \sqrt{\sum_{i=1}^{n} \frac{(yi - \bar{y})^2}{n-1}} \tag{3}$$

where:

S = standard deviation
yi = measured value of the ith replicate
$\bar{y}$ = mean of replicate analyses
n = number of replicates

37.4.2 Accuracy

Accuracy reflects the total error associated with a measurement. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS with a control limit. For many methods of organic compound analysis, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy is included below as percent recovery (%R) from pure and sample matrices. Accuracy requirements are listed for each method, matrix, and analyte in Appendix K.

For measurements where matrix spikes are used:

$$\%R = 100\% \ x \left[\frac{S - U}{C_{sa}} \right] \tag{4}$$

where:

$\%R$ = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

For situations where a standard reference material (SRM) is used instead of, or in addition to, matrix spikes:

$$\%R = 100\% \; x \left[\frac{C_m}{C_{sm}} \right] \tag{5}$$

where:

$\%R$ = percent recovery
C_m = measured concentration of SRM
C_{sm} = actual concentration of SRM

37.4.3 Representativeness

Representativeness is a qualitative term that refers to the degree that data accurately and precisely depict the characteristics of a population, whether referring to the distribution of a contaminant within a sample, a sample within a matrix, or a contaminant at a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations; drilling and installation procedures; operations process locations; and sampling locations. Objectives for representativeness, which are defined for each sampling and analysis task, are a function of the investigative objectives. Assessment of representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Decisions regarding sample/well/boring locations, process, and numbers, and the statistical sampling design are documented in Worksheets #10 (*Problem Definition*), #11 (*Project Quality Objectives/Systematic Planning Process Statements*), and #17 (*Sampling Design and Rationale*).

37.4.4 Comparability

Comparability is a qualitative indicator of the confidence with which one dataset can be compared with another dataset. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by:

- Using standard methods for sampling and analysis
- Reporting data in standard units
- Normalizing results to standard conditions
- Using standard and comprehensive reporting formats

Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project. Assessment of comparability is primarily subjective. Experienced environmental professionals with a clear knowledge of the DQOs and project decisions should interpret the results.

37.4.5 Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples (for example, by site) as set out in the DQOs. Valid data are data that are usable in the context of the project goals. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the dataset. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment has been performed. Completeness should not be determined only on the basis of laboratory data qualifiers. The goal for completeness is 95 percent for aqueous and air samples and 90 percent for soil samples.

Percent completeness is defined as follows for all measurements:

$$\%C = 100\%\ x\left[\frac{V}{T}\right] \tag{6}$$

where:

$\%C$ = percent completeness
V = number of measurements judged valid
T = total number of measurements

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