From: Gerard, Henry
To: DHONT, JEFF
Subject: RE: Iron King Mine QAPP
Date: Tuesday, January 17, 2017 5:15:46 PM
Attachments: image003.png
SERAS-146-DQAPPA3-122313 2.pdf

From: DHONT, JEFF
Sent: Tuesday, January 17, 2017 4:56 PM
To: Gerard, Henry <Gerard.Henry@epa.gov>
Subject: RE: Iron King Mine QAPP

No.

Jeffrey A. Dhont
Environmental Scientist / Superfund Project Manager
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street Mail Stop SFD-6-2
San Francisco, CA 94105
(415) 972-3020
dhont.jeff@epa.gov

From: Gerard, Henry
Sent: Tuesday, January 17, 2017 4:55 PM
To: DHONT, JEFF <Dhont.Jeff@epa.gov>; Bussey, Donald <Bussey.Don@epa.gov>
Subject: RE: Iron King Mine QAPP

https://ertims.ert.org/site/login.aspx

Did you create a login for ERT-IMS before?

From: DHONT, JEFF
Sent: Tuesday, January 17, 2017 4:52 PM
To: Bussey, Donald <Bussey.Don@epa.gov>; Gerard, Henry <Gerard.Henry@epa.gov>
Subject: FW: Iron King Mine QAPP

Don or Henry,

Can you please tell me how to access ERT-IMS where I can find the file Donna Getty is referring to?

Thanks.

Jeff

Jeffrey A. Dhont
Environmental Scientist / Superfund Project Manager
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street Mail Stop SFD-6-2
San Francisco, CA 94105
(415) 972-3020
dhont.jeff@epa.gov

From: Getty, Donna J [mailto:Donna.J.Getty@leidos.com]
Sent: Monday, January 9, 2017 10:28 AM
To: DHONT, JEFF <Dhont.Jeff@epa.gov>; Bussey, Donald <Bussey.Don@epa.gov>; donna.j.getty <donna.j.getty@leidos.com>
Cc: deborah.a.killeen <deborah.a.killeen@leidos.com>; richard.m.leuser <richard.m.leuser@leidos.com>
Subject: RE: Iron King Mine QAPP

Jeff,

The QAPP was not included on the USB drive that we delivered the Final Report on. It is on the ERT-IMS website which you have access to.

The file name of the QAPP is:

SERAS-146-DQAPPA3-122313

Let me know if you need anything beyond the QAPP.

From: DHONT, JEFF [mailto:Dhont.Jeff@epa.gov]
Sent: Monday, January 09, 2017 12:52 PM
To: Bussey, Donald <Bussey.Don@epa.gov>; donna.j.getty <donna.j.getty@leidos.com>
Cc: deborah.a.killeen <deborah.a.killeen@leidos.com>; richard.m.leuser <richard.m.leuser@leidos.com>
Subject: EXTERNAL: RE: Iron King Mine QAPP

I think you mean CH2M, Don, right?

CDM has come after CH2M since yours-all work, to do the FS.

My apologies as I know we have all this information, and it is probably both on CD and in the files- it is just that I relied on CH2M to manage this voluminous information and now that they are leaving I need to reacquaint myself with it in the transfer.

Jeff

From: Bussey, Donald
Sent: Monday, January 09, 2017 9:50 AM
To: donna.j.getty <donna.j.getty@leidos.com>; DHONT, JEFF <Dhont.Jeff@epa.gov>
Cc: deborah.a.killeen <deborah.a.killeen@leidos.com>; richard.m.leuser <richard.m.leuser@leidos.com>
Subject: FW: Iron King Mine QAPP

Hey Donna,

I think the QAPP (Final) was transmitted to CDM with the report. Would this be correct? Can you get Jeff the specifics he has asked?

From: DHONT, JEFF
Sent: Monday, January 09, 2017 9:46 AM
To: Bussey, Donald <Bussey.Don@epa.gov>
Subject: RE: Iron King Mine QAPP

Don,

This would be helpful so I can download it for my own use … but I'm also very sure that CH2M had

the full data dump, and CH2M has now transferred what it has had to Gilbane/CDM. So I want to be able to identify the "capsule" if you will – i.e. file names, folders, whatever…to CDM as I'm assuming they already have it but just don't know they have it. So, both access for my purposes (give me some instructions) and also just identifying the files/folders for me…would be very helpful.
Thanks. Not wanting to over-rush Henry, but just stay abreast of the expected time frames and progress now that we are in the New Year.
Jeff

From: Bussey, Donald
Sent: Monday, January 09, 2017 9:20 AM
To: DHONT, JEFF <Dhont.Jeff@epa.gov>
Cc: deborah.a.killeen <deborah.a.killeen@leidos.com>
Subject: FW: Iron King Mine QAPP
Jeff, I think the most recent QAPP was included in the data dump of the SERAS report. It's posted to the ERT IMS web site. I'll have Deb Killeen grant you access, then you can download it (I understand it's too large to e-mail. You can contact Deb if you have any questions.
Deb – please grant Jeff access to the ERT IMS site for WA-146.

From: Getty, Donna J [mailto:Donna.J.Getty@leidos.com]
Sent: Monday, January 09, 2017 7:53 AM
To: richard.m.leuser <richard.m.leuser@leidos.com>; Bussey, Donald <Bussey.Don@epa.gov>
Cc: deborah.a.killeen <deborah.a.killeen@leidos.com>
Subject: RE: Iron King Mine QAPP
Don,
Yes, the most recent version of the Iron King QAPP contains ABA subcontracted to an outside lab by SERAS.
The file is too big to email you but it can be downloaded from ERT-IMS.
Call me if you need another means for acquiring the file.
Donna
(215)962-9929

From: Leuser, Richard M [mailto:Richard.M.Leuser@leidos.com]
Sent: Monday, January 09, 2017 10:29 AM
To: Getty, Donna J <Donna.J.Getty@leidos.com>
Cc: Killeen, Deborah A <Deborah.A.Killeen@leidos.com>
Subject: EXTERNAL: Iron King Mine QAPP
Donna, can you answer the question below for Don Bussey?
Richard M. Leuser, PE
Deputy Program Manager
Scientific, Engineering, Response and Analytical Contract
Leidos.com Civil
2890 Woodbridge Avenue, Building 209 Annex
Edison, NJ 08837
732-494-4060 Office
908-803-2556 Cell
richard.m.leuser@leidos.com

From: Bussey, Donald [mailto:Bussey.Don@epa.gov]
Sent: Monday, January 09, 2017 9:43 AM
To: richard.m.leuser <richard.m.leuser@leidos.com>
Subject: EXTERNAL: FW: IKHS

Can you advise if the most recent QAPP version includes this?

From: DHONT, JEFF
Sent: Friday, January 06, 2017 4:15 PM
To: Bussey, Donald <Bussey.Don@epa.gov>
Cc: Gerard, Henry <Gerard.Henry@epa.gov>
Subject: IKHS

Hi Don,

I've had someone ask about seeing the QAPP under which the ABA analyses were performed by SERAS. I'm not sure if you provided me with all the final project QAPP documents (or did you?). Do you know how to direct me on this?

Any updates in the contacts work – we can talk next week…

Jeff

Jeffrey A. Dhont
Environmental Scientist / Superfund Project Manager
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street Mail Stop SFD-6-2
San Francisco, CA 94105
(415) 972-3020
dhont.jeff@epa.gov

QUALITY ASSURANCE PROJECT PLAN
Iron King Mine Site
Dewey-Humboldt, Arizona

Amendment 3

Prepared for:
United States Environmental Protection Agency/Environmental Response Team
Edison, New Jersey

By:
Lockheed Martin/Scientific Engineering Response & Analytical Services (SERAS)
Work Assignment Number: SERAS-146

Based on the Intergovernmental Data Quality Task Force Uniform
Federal Policy for Quality Assurance Project Plans
(Final Version 1.1, June 2006)

December 23, 2013

TABLE OF CONTENTS

QAPP Worksheet #1
Title and Approval Page

Site Name/Project Name: Iron King Mine Site
Site Location: Dewey-Humboldt, Arizona (AZ)

Document Title: Quality Assurance Project Plan for Iron King Mine Site

Lead Organization: Environmental Protection Agency/Environmental Response Team (EPA/ERT)

Preparer's Name and Organizational Affiliation: Donna Getty - Lockheed Martin/Scientific Engineering Response Analytical Services (SERAS)

Preparer's Address, Telephone Number, and E-mail Address: 2890 Woodbridge Avenue, Edison, NJ 08837, (732) 321-4274, donna.j.getty@lmco.com

Preparation Date (Day/Month/Year): 12/23/13

Investigative Organization's Project Manager/Date: ____________ Signature

Printed Name/Organization: Terrence Johnson/ERT Work Assignment Manager

Investigative Organization's Project QA Officer/Date: ____________ 12/30/13 Signature

Printed Name/Organization: Stephen Blaze/ERT Quality Coordinator

Lead Organization's Project Manager/Date: ____________ 12/19/13 Signature

Printed Name/Organization: Dave Aloysius/SERAS Task Leader

Approval Signatures/Date: ____________ 12/23/13 Signature

Printed Name/Title: Deborah A. Killeen/SERAS QA/QC Officer

Approval Authority: Lockheed Martin/SERAS

Other Approval Signatures/Date: ____________ 12/23/13 Signature for Dennis Miller

Printed Name/Title: Dennis A. Miller/SERAS Program Manager

Document Control Numbering System: SERAS-146-DQAPPA3-122313

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Iron King Mine Site
Site Location: Dewey-Humboldt, AZ
Site Number/Code: 09MX
Operable Unit: N/A
Contractor Name: Lockheed Martin
Contractor Number: EP-W-09-031
Contract Title: SERAS
Work Assignment Number: SERAS-146

1. Identify regulatory program: Comprehensive Environmental Response, Liability and Compensation Act (CERCLA)
2. Identify approval entity: EPA/ERT
3. The QAPP is (select one): ☐Generic ☒Project Specific
4. List dates of scoping sessions that were held: 08/06/13, and 9/5/13
5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
SERAS UFP QAPP for Iron King Mine Site Hydrologic Restoration, document #SERAS-146-DQAPP-093011	01/03/12
SERAS UFP QAPP - Amendment 1, Iron King Mine Site Hydrologic Restoration, document #SERAS-146-DQAPP1-110512	11/05/12
SERAS UFP QAPP - Amendment 2, Iron King Mine Site Hydrologic Restoration, document #SERAS-146-DQAPP2-080813	08/18/13

6. List organizational partners (stakeholders) and connection with lead organization:
   EPA Region 9
7. List data users:
   EPA Region 9
8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

Worksheet 37: Usability of the data will be determined by EPA Region 9.

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	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 - QAPP Identifying Information	2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 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	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	9 10
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	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	 13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	14 15 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 3.1.2.3 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.4 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17 Attachment 1 Attachment 2 18 19 20 21 22
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	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	 23 24 25

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Required Documents
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	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	26 27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	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	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	29 30
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	 31 32
4.2 QA Management Reports	- QA Management Reports Table	33
4.3 Final Project Report		

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
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 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	34 35 36 NA
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		

QAPP Worksheet #3 – November 2013
Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Terrence Johnson	WAM	ERT	(702) 496-0703	(702) 784-8001	johnson.terrence@epa.gov	SERAS-146-DQAPP3-122313
Mark Sprenger	WAM	ERT	(732) 906-6826	(732) 321-6274	sprenger.mark@epa.gov	SERAS-146-DQAPP3-122313
Don Bussey	WAM	ERT	(702) 784-8016	(702) 784-8001	bussey.don@epa.gov	SERAS-146-DQAPP3-122313
Duane Newell	WAM	ERT	(702) 784-8015	(702) 784-8001	newell.duane@epa.gov	SERAS-146-DQAPP3-122313
Henry Gerard	WAM	ERT	(702) 501-8009	(702) 784-8001	gerard.henry@epa.gov	SERAS-146-DQAPP3-122313
Greg Powell	WAM	ERT	(513) 569-7533	(859) 372-0889	powell.greg@epa.gov	SERAS-146-DQAPP3-122313
Stephen Blaze	Quality Coordinator	ERT	(732) 906-6921	(732) 321-6274	blaze.stephen@epa.gov	SERAS-146-DQAPP3-122313
Jeffrey Dhont	Superfund Project Manager	EPA Region 9	(415) 972-3020	NA	dhont.jeff@epa.gov	SERAS-146-DQAPP3-122313
David Aloysius	Hydrogeologist/TL	SERAS	(732) 494-4058	(732) 494-4021	david.l.aloysius@lmco.com	SERAS-146-DQAPP3-122313
Scott Grossman	Environmental Scientist	SERAS	(732) 321-4230	(732) 494-4021	scott.c.grossman@lmco.com	SERAS-146-DQAPP3-122313
Chris Gussman	Phytoremediation Scientist/ Senior Biologist	SERAS	(732) 321-4237	(732) 494-4021	christopher.d.gussman@lmco.com	SERAS-146-DQAPP3-122313
Jay Patel	ICP/MS, ICP Chemist	SERAS	(732) 494-4052	(732) 494-4021	jay.r.patel@lmco.com	SERAS-146-DQAPP3-122313
Richard Leuser	Deputy Program Manager (DPM)	SERAS	(732) 494-4060	(732) 494-4021	richard.m.leuser@lmco.com	SERAS-146-DQAPP3-122313
Deborah Killeen	QA/QC Officer	SERAS	(732) 321-4225	(732) 494-4021	deborah.a.killeen@lmco.com	SERAS-146-DQAPP3-122313
Dennis Miller	Program Manager	SERAS	(732) 321-4216	(732) 494-4021	dennis.a.miller@lmco.com	SERAS-146-DQAPP3-122313

NA = Not available, ICP/MS – Inductively Coupled Plasma/Mass Spectrometry, ICP = Inductively Coupled Plasma, TL = Task Leader, QA/QC = Quality Assurance/Quality Control

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Organization: SERAS/ERT/EPA Region 9

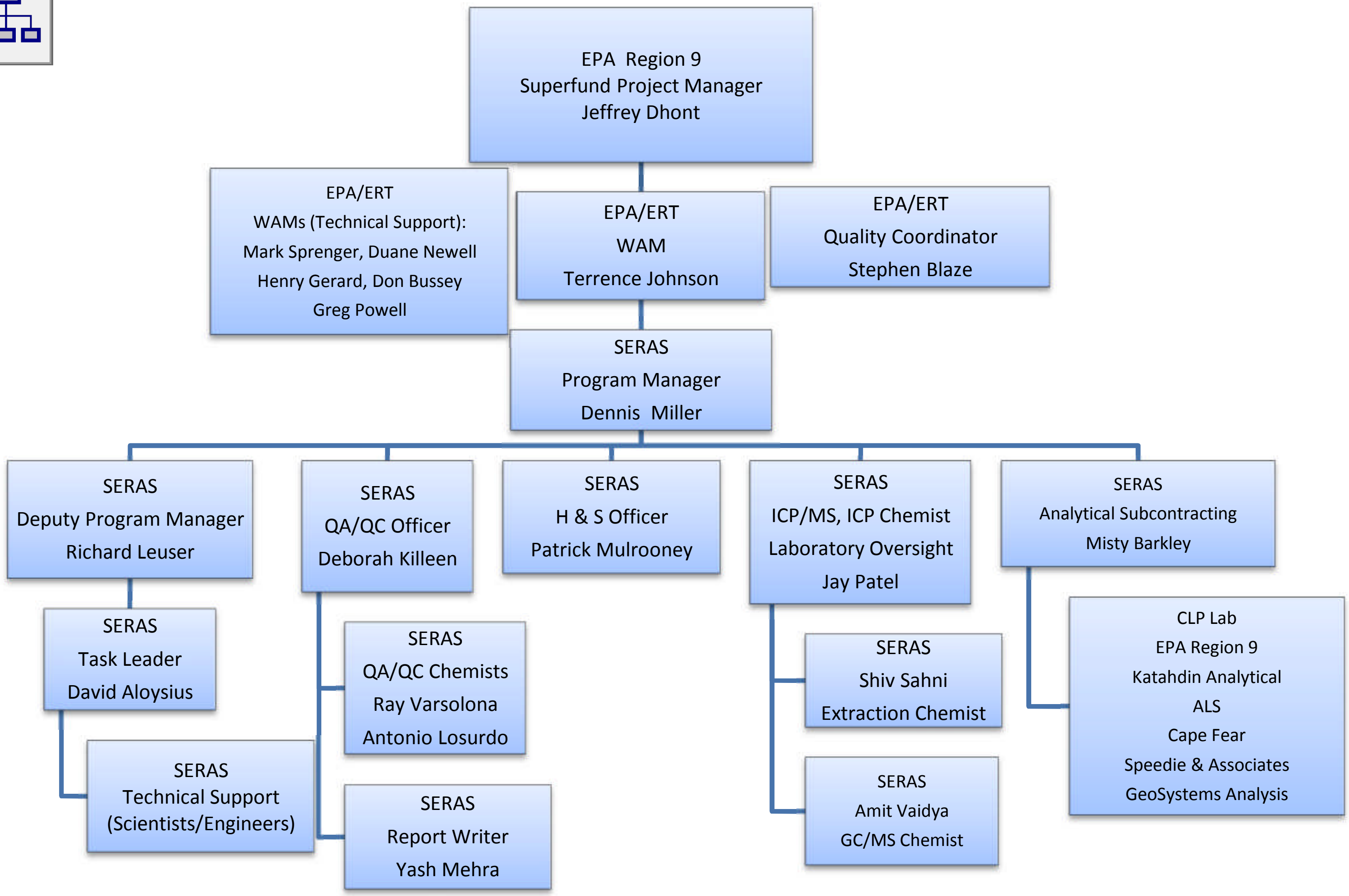
Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Terrence Johnson	ERT WAM	(702) 784-8022	[signature]	1/9/14
Jeffrey Dhont	EPA R9 Superfund Project Manager	(415) 972-3020	[signature]	2/13/14
Mark Sprenger	ERT WAM	(732) 906-6826		
Don Bussey	ERT WAM	(702) 784-8016	[signature]	1/3/14
Duane Newell	ERT WAM	(702) 784-8015	D. Newell	1/15/14
Henry Gerard	ERT WAM	(702) 501-8009	[signature]	1/3/14
Greg Powell	ERT WAM	(513) 569-7533		
David Aloysius	SERAS Hydrogeologist/TL	(732) 494-4058	DJ Aloysius	
Jay Patel	SERAS ICP-MS, ICP Chemist	(732) 494-4052	Jay Patel	02/06/14
Shiv Sahni	SERAS Extraction Chemist	(732) 321-4226	[signature]	02/19/14
Amit Vaidya	SERAS GC/MS Chemist	(732) 321-4251	[signature]	01/22/14
Scott Grossman	SERAS Environmental Scientist	(732) 321-4230	[signature]	1/7/14
Sandra Richards	SERAS Environmental Technician	(732) 494-4265	Sandra Richards	1/22/2014
Chris French	SERAS Environmental Technician	(732) 494-4040	[signature]	1/3/14
Jean Bolduc	SERAS Hydrogeologist	(732) 321-4280	[signature]	2/19/14
Chris Gussman	SERAS Phytoremediation Scientist	(732) 321-4237	[signature]	
Dave Adams	SERAS Environmental Scientist (Air Response)	(732) 494-4008		
Ray Leadbetter	ERT EPA	(702) 784-8008	[signature]	1/5/14
D. Edgerton	EMCO	732-321-4200	[signature]	1/30/14

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Organization: SERAS/ERT/EPA Region 9

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Joe Brandine	SERAS Industrial Hygienist (Air Response)	(732) 321-4220		
Martin Ebel	SERAS Geophysicist	(732) 321-4241	[illegible]	1-3-14
David Edgerton	SERAS Groundwater Modeler	(732) 494-4057	[illegible]	1/29/14
Buck Gabriel	SERAS Hydrogeologist	(315) 558-3824		
Rick Leuser	SERAS DPM	(732) 494-4060		
Rich Magan	SERAS Environmental Scientist	(732) 321-4234		
Jon McBurney	SERAS Project Engineer	(732) 321-4244	[illegible]	1-11-14
Pete Roesner	SERAS Environmental Scientist	(702) 784-8030	F.W. Roesner	1-3-14
Stewart Sandberg	SERAS Sr. Geophysicist	(207) 233-9948	[illegible]	1/3/14
Colleen Steffensen	SERAS Environmental Scientist	(732) 321-4211		
Rafael Volker	SERAS Air Response Scientist	(732) 321-4278	[illegible]	2/3/14
Amanda Wagner	SERAS Environmental Scientist	(702) 784-8043	[illegible]	1/7/14
Josephine Yosephan	SERAS Environmental Scientist	(732) 321-4284	[illegible]	2/19/14
Gail Heath	University of Arizona-Mining Expert	(208) 521-4776	[illegible]	1 3 14
NEIL KAUFMAN	SERAS IH	908-217-0274	[illegible]	1/22/14
RAJ SINGH	EPA	609-865-2991	[illegible]	1/27/14
Lena Wright	SERAS - Environmental Engineer Asc	702-575-8790	Lena Wright	2/3/14
Lyndsey Nguyen	EPA/IH	702-595-0778	Lyndsey Nguyen	2/19/14
David Kappelman	EPA/ERT	513-240-6840	David J. Kappelman	2/19/14

QAPP Worksheet #5
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Approval of initial QAPP and any amendments	ERT WAM ERT Quality Coordinator SERAS Program Manager SERAS QA/QC Officer SERAS TL	Terrence Johnson Steve Blaze Dennis Miller Deborah Killeen David Aloysius	702-496-0703 732-906-6921 732-321-4216 732-321-4245 732-494-4058	SERAS internal peer review, followed by ERT approval, implementation of changes effective only with approved QAPP or QAPP Change Form
Nonconformance and Corrective Action	SERAS TL ERT WAM SERAS QA/QC Officer SERAS ICP-MS/ICP Chemist SERAS Extraction Chemist SERAS GC/MS Chemist	David Aloysius Terrence Johnson Deborah Killeen Jay Patel Shiv Sahni Amit Vaidya	732-494-4058 702-496-0703 732-321-4245 732-494-4052 732-494-9312 732-321-4251	Use of the Work Assignment Field Change Form for field issues. Use of nonconformance memos to document laboratory deficiencies.
Posting of Deliverables to ERT-Information Management System (IMS) website	SERAS TL SERAS QA/QC Officer SERAS Deputy Program Manager SERAS Administrative Support	David Aloysius Deborah Killeen Richard Leuser Eileen Ciambotti	732-494-4058 732-321-4245 732-494-4060 732-321-4255	As per work assignments, posting of deliverables to ERT-IMS website constitutes delivery to the WAM.
Work Assignment	SERAS Program Manager	Dennis Miller	732-321-4216	Describes scope of work to SERAS personnel from the ERT WAM.
Health and Safety On-Site Meeting	SERAS TL, Site Health and Safety Officer	David Aloysius Scott Grossman	732-494-4058 732-321-4230	Explains site hazards, personal protective equipment, local hospital

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
David Aloysius	Hydrogeologist/TL	SERAS	Project Supervision/Field Investigation, Field Sampling, Field Health and Safety, Reporting	M.A. Geology and 25 years environmental experience/Lockheed Martin Employee Files
Jay Patel	ICP/MS, ICP Chemist	SERAS	Field Portable X-ray Fluorescence (FP XRF) Operation	Minimum B.S. Degree with 14 yrs. related experience/ Lockheed Martin Employee Files
Shiv Sahni	Extraction Chemist	SERAS	FP XRF Operation	Minimum B.S. Degree with 3 yrs. related experience/ Lockheed Martin Employee Files
Amit Vaidya	GC/MS Chemist	SERAS	FP XRF Operation	Minimum B.S. Degree with 8 yrs. related experience/ Lockheed Martin Employee Files
Scott Grossman	Environmental Scientist	SERAS	Residential Field Investigation & Sampling	B.S. Biology, M.S. and 8 years environmental experience/Lockheed Martin Employee Files
Sandra Richards	Environmental Technician	SERAS	Field Investigation, Field Sampling, Sample Management	Environmental sampling experience/ Lockheed Martin Employee Files
Chris French	Environmental Technician	SERAS	Field Investigation, Field Sampling	Environmental sampling experience/ Lockheed Martin Employee Files
Jean Bolduc	Hydrogeologist	SERAS	Field Investigation, Field Sampling	Minimum B.S. Degree with 8 yrs. related experience/ Lockheed Martin Employee Files
Chris Gussman	Phytoremediation Scientist	SERAS	Field Investigation, Field Sampling	B.S. Biology, M.S. and 10 years environmental experieince/ Lockheed Martin Employee Files
Donna Getty	Statistician	SERAS	QAPP Development	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Nesya Belyarchik	ACAD	SERAS	Map Making	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Mingling Li	GIS Information Specialist	SERAS	GIS/Map Making	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Deborah Killeen	QA/QC Officer	SERAS	Quality Assurance	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Yash Mehra	Report Writer	SERAS	Final Analytical Report and EDD	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Ray Varsolona/ Antonio Losurdo	QA/QC Chemist	SERAS	Validation of Subcontract Laboratory Analytical Results	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Dave Adams	Environmental Scientist (Air Response)	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Joe Brandine	Industrial Hygienist (Air Response)	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Martin Ebel	Geophysicist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
David Edgerton	Groundwater Modeler	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Buck Gabriel	Hydrogeologist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Rick Leuser	DPM	SERAS	Personnel & Activity Oversight	Minimum B.S. degree plus 8 years of related experience/Lockheed Martin Employee Files
Rich Magan	Environmental Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree /Lockheed Martin Employee Files

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jon McBurney	Project Engineer	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Pete Roesner	Environmental Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Stewart Sandberg	Sr. Geophysicist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 14 years of related experience/Lockheed Martin Employee Files
Colleen Steffensen	Environmental Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Rafael Volker	Air Response Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Amanda Wagner	Environmental Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Josephine Yosephan	Environmental Scientist	SERAS	Field Investigation, Field Sampling	Minimum B.S. degree /Lockheed Martin Employee Files
Gail Heath	Geophysicist	University of Arizona/SERAS	Field Investigation, Mining Expertise	Minimum B.S. degree plus related experience/Lockheed Martin Employee Files
Terrence Johnson	Work Assignment Manager (WAM)	EPA/ERT	Technical Direction	Project Management & Coordination Expert/EPA Files
Jeffrey Dhont	Superfund Project Manager	EPA Region 9	Project Oversight	Project Management & Coordination Expert/EPA files
Mark Sprenger	WAM	ERT	Technical Direction of Biological Assessment and Survey	EPA job-related qualifications/EPA Files

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Stephen Blaze	Quality Coordinator	ERT	Quality Assurance Oversight	EPA job-related qualifications/EPA Files
Don Bussey	WAM	ERT	Drilling Oversight	EPA job-related qualifications/EPA Files
Duane Newell	WAM	ERT	Oversight of Residential Sampling	EPA job-related qualifications/EPA Files
Henry Gerard	WAM	ERT	Technical Direction and Oversight	EPA job-related qualifications/EPA Files
Greg Powell	WAM	ERT	Oversight of Geophysical Work	EPA job-related qualifications/EPA Files

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project Oversight	Health & Safety Training	SERAS	Mar 2013	David Aloysius	Hydrogeologist/TL/SERAS	SERAS H&S Files
XRF Analysis - Niton	Data Integrity Training	SERAS	June 2012	Jay Patel	ICP/MS, ICP Chemist/SERAS	SERAS Quality Files
XRF Analysis - Niton	Demonstration of Capability	SERAS	Oct 2012	Jay Patel	ICP/MS, ICP Chemist/SERAS	SERAS Quality Files
On-site XRF Analysis	Health & Safety Training	SERAS	Jan 2013	Jay Patel	ICP/MS, ICP Chemist/SERAS	SERAS Quality Files
XRF Analysis - Niton	Data Integrity Training	SERAS	June 2012	Shiv Sahni	Extraction Chemist/SERAS	SERAS Quality Files
XRF Analysis - Niton	Demonstration of Capability	SERAS	Aug 2013	Shiv Sahni	Extraction Chemist/SERAS	SERAS Quality Files
On-site XRF Analysis	Health & Safety Training	SERAS	Dec 2012	Shiv Sahni	Extraction Chemist/SERAS	SERAS Quality Files
XRF Analysis - Niton	Data Integrity Training	SERAS	June 2012	Amit Vaidya	GC/MS Chemist/SERAS	SERAS Quality Files
XRF Analysis - Niton	Demonstration of Capability	SERAS	Dec 2013	Amit Vaidya	GC/MS Chemist/SERAS	SERAS Quality Files
On-site XRF Analysis	Health & Safety Training	SERAS	Dec 2012	Amit Vaidya	GC/MS Chemist/SERAS	SERAS Quality Files
QA Oversight	Changes to Environmental Laboratory Accreditation	Advanced Systems	May 2009	Deborah Killeen	QA/QC Officer/SERAS	SERAS Quality Files
QA Oversight	Lead Auditor Training	IT Corp	Sept 1991	Deborah Killeen	QA/QC Officer/SERAS	SERAS Quality Files

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
QA Oversight	Data Review & Validation	Laboratory Data Consultants	Jan 2007	Deborah Killeen	QA/QC Officer/SERAS	SERAS Quality Files
QA Oversight	Uniform Federal Policy for Quality Assurance Project Plans	Advanced Systems	Jan 2006	Deborah Killeen	QA/QC Officer/SERAS	SERAS Quality Files
Field Operations	Health & Safety Training	SERAS	Nov 2012	Scott Grossman	Environmental Scientist/SERAS	SERAS H&S Files
Field Operations/ Scribe	Health & Safety Training	SERAS	Apr 2013	Sandra Richards	Environmental Technician/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Nov 2012	Chris French	Environmental Technician/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Sept 2013	Jean Bolduc	Hydrogeologist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Nov 2012	Chris Gussman	Phytoremediation Scientist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Jan 2013	Dave Adams	Environmental Scientist (Air Response)/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Feb 2013	Joe Brandine	Industrial Hygienist (Air Response)/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Oct 2012	Martin Ebel	Geophysicist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Apr 2013	David Edgerton	Groundwater Modeler/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Sep 2012	Buck Gabriel	Hydrogeologist/ SERAS	SERAS H&S Files

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Personnel/ Project Oversight	Health & Safety Training	SERAS	Jan 2013	Rick Leuser	DPM/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Dec 2012	Rich Magan	Environmental Scientist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Dec 2012	Jon McBurney	Project Engineer/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Mar 2013	Pete Roesner	Environmental Scientist/ SERAS	SERAS H&S Files
Field Operations/ Geophysics	Health & Safety Training	SERAS	Oct 2012	Stewart Sandberg	Geophysicist/SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	Feb 2013	Colleen Steffensen	Environmental Scientist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	May 2013	Rafael Volker	Air Response Scientist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	June 2013	Amanda Wagner	Environmental Scientist/ SERAS	SERAS H&S Files
Field Operations	Health & Safety Training	SERAS	March 2013	Josephine Yosephan	Environmental Scientist/ SERAS	SERAS H&S Files
Field Operations/ Geophysics	Health & Safety Training	*	*	Gail Heath	Geophysicist/SERAS	*

*In progress – to be completed prior to site mobilization

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Project Name: Iron King Mine Site Hydrologic Restoration **Previous Field Work Dates:** 8/6/13 **Projected Field Work Dates:** November 2013 through 2014 **Project Manager:** David Aloysius	**Site Name:** Iron King Mine Site **Site Location:** Dewey-Humboldt, AZ

Dates of Sessions8/6/13, 9/15/13
Scoping Session Purpose: Discuss project-related tasks

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
8/6/13 - Accelerated Lead Sampling Event					
Dennis Miller	Program Manager	SERAS	732-321-4216	dennis.a.miller@lmco.com	Contract oversight
Scott Grossman	Environmental Scientist	SERAS	732-321-4230	scott.c.grossman@lmco.com	Response oversight
Jay Patel	ICP-MS, ICP Chemist	SERAS	732-494-4052	jay.r.patel@lmco.com	XRF Operations
Deborah Killeen	QA/QC Officer	SERAS	732-321-4245	deborah.a.killeen@lmco.com	QA/QC
Donna Getty	Statistician	SERAS	732-321-4274	donna.j.getty@lmco.com	QAPP Development
Terrence Johnson	WAM	ERT	702-496-0703	johnson.terrence@epamail.epa.gov	Technical Direction
9/5/13 – Extended Study to Fill in Data Gaps (November 2013 through Spring 2014)					
David Aloysius	Hydrogeologist	SERAS	732-494-4058	david.l.aloysius@lmco.com	Task Leader
Terrence Johnson	WAM	ERT	702-496-0703	johnson.terrence@epamail.epa.gov	Technical Direction
Deborah Killeen	QA/QC Officer	SERAS	732-321-4245	deborah.a.killeen@lmco.com	QA/QC
Donna Getty	Statistician	SERAS	732-321-4274	donna.j.getty@lmco.com	QAPP Development
Misty Barkley	Property Coordinator	SERAS	732-321-4205	misty.barkley@lmco.com	Laboratory Subcontracting
Rick Leuser	Deputy Program Manager	SERAS	732-494-4060	richard.m.leuser@lmco.com	Project & Personnel Oversight

8/6/13: Discussion on scope of work for the accelerated lead sampling event.

- Surface soil (0 to 6 inches) sampling on 7 properties; approximately 70 surface locations using a hand trowel; additional samples at depth (using a hand auger) based on XRF reading.
- Locations will be based on where sampling has been previously conducted; do not want to replicate locations but final determination will be made in the field by the WAM and RPM.
- Samples will be screened for lead and arsenic using FP XRF. Samples will be collected in a baggie. Two XRF readings per sample. Reading on one-side then flip bag over and take an additional reading.
- Action level is 150 mg/kg for both lead and arsenic. This benchmark was determined by the EPA Region 9 RPM.

- Surface samples which have XRF readings >150 mg/kg will trigger additional sampling up to 3 feet (ft) below ground (bg).
- Surface samples will be collected first across all the properties to facilitate the XRF work. If reading exceeds 150 mg/kg, after all surface samples have been collected return to that location and collect samples at 6”-12”, 12”-18”, 18”-24”, and 24”- 36”.
- XRF work on the subsurface samples will be based on time constraints.
- RPM received access to all but 1 of the properties; RPM hopes to have access to all of the properties by the time sampling activities begin.
- SERAS will travel on Monday, August 12, 2013 with sampling 2-3 days of work beginning on Tuesday.
- Jay Patel can analyze (FP XRF) approximately 70 samples a day.
- RPM will be on-site at 10:30 on Tuesday, August 13, 2013.
- Do sampling teams need to use respirators? Consult Pat Mulrooney. Half or full face?
- 100% of samples will be shipped by SERAS to a location which will be determined by the WAM and RPM.
- Region 9 will determine which samples will be run for confirmatory analysis.
- Region 9 Lab is currently backed-up with work but metals have a 6 month holding time so they may be able to hold the samples until their workload allows for analysis.
- No XRF duplicates will be collected because each sample will be analyzed twice by the XRF.
- No rinsate blanks; decon between “holes”.
- Focus of efforts is on obtaining a volume estimate for removal.

Action Items:

- Terrence will speak with the RPM to find out who is going to submit the Analytical Request Form (ARF) for the confirmatory samples. He will also establish whether the samples will be shipped to the Region 9 Laboratory.

Updated 8/6/2013: SERAS will submit the ARF and choose the confirmatory samples at a rate of 10%. Samples will be shipped to a Contract Laboratory Program (CLP) Laboratory.

Updated 8/7/2013: Toxicity Characteristic Leaching Procedure (TCLP) metals are added to the list of analyses. Resource Conservation and Recovery Act list of 8 metals (RCRA-8). Same samples going for confirmatory analysis will also go for TCLP.   Confirmatory analysis will be for metals full target analyte list (TAL), not just As and Pb.

EPA Region 9 can handle TCLP sample analysis.

9/5/13:

- QAPP will be written to encompass all the sampling and analysis events extending into 2014.
- All data and analyses need to be delivered to EPA Region 9 by April 31, 2014.
- Per the WAM surface is defined as 0-2 inches.
- Analytical data will be validated. Analytical work performed by the EPA Region 9 Laboratory will be validated by Region 9. Subcontracted analytical work will be validated by SERAS (Hexavalent Chromium [Cr(VI)]).
- SERAS will submit the Analytical Request Form (ARF) to the Region 9 Laboratory for standard turn-around time (TAT): 30 days for preliminary results, 45 days for final results.
- Water samples being sent for dissolved metals analysis will be filtered in the field.
- Sampling locations have been pre-selected by EPA Region 9 and their contractor.

- Mobilization is planned for November 13, 2013 beginning with soil borings in the Main Tailings Pile (MTP). Two drilling rigs will be subcontracted.
- Reporting limits for dioxin analyses need to be in the range of parts per trillion (ppt).
- Field duplicates will be collected at a rate of 5%.
- Matrix spike/matrix spike duplicates (MS/MSDs) at a rate of 5%.
- Five request for proposals (RFPs) are required for this project (drilling, wells, borehole geophysics, professional surveying, and dust control).
- Pre-bid walk-through of the site will be required for some of the RFPs.
- EPA will obtain property access but will need a SERAS person to log the information. The TL will put together a list of priorities for access to properties. Access to Chaparral Gulch is needed first. He will need to locate the monitoring wells and determine if they are located on private property.
- The TL will submit a Draft Sampling and Analysis Summary Plan (DSAP) to the Region on 9/6/13 when he meets with the RPM. The WAM will be present for this meeting.
- A preliminary project schedule was discussed and will be presented to the Region separate from the DSAP.
- Personnel needs were identified for each phase of the project.

Action Items:

- The WAM and TL will talk to the RPM/OSC about sending samples back to the SERAS laboratory for XRF analysis if the results won't drive the step-out assessment or on-site work.
- Schedule of field work needs to be submitted and approved by Region 9.
- WAM will discuss with the RPM how many metals will be analyzed for using the Synthetic Precipitation Leaching Procedure (SPLP) analyses? RCRA 8? Total Analyte List (TAL) metals (23)?
    - On 9/9/13 SERAS was told SPLP metals analysis will be for the Resource Conservation and Recovery Act list of 8 metals (RCRA-8) plus zinc (Zn), copper (Cu), aluminum (Al), iron (Fe) and manganese (Mn).
- TL will put together a Projected Work Assignment (PWA) for M. Barkley so she can begin the subcontracting process.
- Investigate whether temperature will affect the copolymer application for dust control.

QAPP Worksheet #10
Problem Definition

The problem to be addressed by the project:
The Iron King Mine (IKM) Site is located in the Town of Dewey-Humboldt, AZ. The site, which occupies approximately 153 acres, was periodically operated from 1906 to 1969 for extraction of gold, silver, copper, lead and zinc. The Iron King Mine is bordered by Chaparral Gulch to the north, Galena Gulch to the south, State Highway 69 to the east, and undeveloped land to the west.

There are two tailings piles at the site: the Large Tailings Pile (LTP) and the Small Tailings Pile (STP). The LTP, located just west of Highway 69, covers over 55 acres, is over 100 feet (ft) in height and contains over six million cubic yards of mine tailings. The STP is located approximately 600 ft north of the LTP and was found to contain approximately 21,500 cubic yards of tailings (based on field delineation and excavation in November 2011). Chaparral Gulch borders the STP along the northern and eastern sides and is impacted by both runoff and sediment transport from the pile. This pile was an accumulation of tailings materials that resulted from surface water-related sediment transport over many decades, which began as early as 1940.

The EPA Region 9 Removal Program proposed to excavate and move materials from the STP, and subsequently consolidate the materials immediately adjacent to the LTP, within a temporary storage pile (TSP). Based on the physical characteristics of the site and the general nature of the proposed work, EPA Region 9 requested assistance from the ERT to provide technical support for area restoration of the STP and adjoining areas. This request included a combination of hydrologic, open channel, and slope stabilization designs for minimizing runoff, erosion, and sediment transport. In addition, interim measures were also required for stabilization of the tailings within the TSP and minimizing surface erosion.

In the summer of 2011, the EPA Region 9 Removal Program removed surface mine tailings from a number of residential properties in the vicinity of the site. As part of the post-removal restoration effort, riprap spillways (or rock chutes) were installed to direct storm water runoff away from backyard areas (along S. Sweet Pea Lane, off of Third Street). These spillways failed during the 2012 rainy season resulting in severe soil erosion. On August 31, 2012, SERAS staff visited the site and met with the WAM to perform a site walkover. During the site visit, a number of hydrologic restoration efforts were discussed and defined.

August 2013 – Accelerated Lead Sampling Event
In June 2013, EPA Region 9 requested assistance from the ERT in conducting a site investigation to address data gaps in order to complete the Site Feasibility Study. In July and August 2013, while ERT was preparing to conduct the investigation to fill the data gaps, additional and immediate assistance was requested to support a removal action assessment of arsenic (As) and lead (Pb) concentrations found on seven residential properties located on Wells Street and Jones Street in downtown Humboldt.

The problem to be addressed by the project (con't):

The focus of this time-critical As/Pb sampling event will be to determine the volume and range of contamination on the seven residential properties to facilitate a cost analysis for removal of any contaminated material found to be present on the properties. The full distribution of the residential As/Pb contamination is currently unknown. Region 9 requested soil sampling and field portable x-ray fluorescence (FP XRF) screening support for Pb and As in surface soil (0 to 6 inches) and at depths up to 3 ft below ground surface (bgs). Ten percent (%) of the samples collected and analyzed by XRF will be shipped by SERAS to a CLP laboratory for TAL metals confirmation analysis. The same samples will be analyzed for TCLP metals at the EPA R9 Laboratory.

2013-2014 Extended Study: The overall objective of this study is to fill in data gaps which were identified in the *Draft Data Gap Analysis Report (April 2013)* prepared for EPA Region 9 by their contractors. The ERT has requested support from SERAS in implementing an extensive and multi-phased field investigation which will fill in the identified data gaps. Details of this investigation can be found in the attached *Supplemental Field Investigation Work Plan*. Specific objectives are listed below:

Iron King Mine Main Tailings Pile (MTP)

- Determine stability of pile, buffering capacity, acid rock drainage (ARD) potential, loading and moisture
- Refine bioaccessibility values used in risk assessment
- Determine durability, chemical properties and degradation characteristics of waste rock materials for evaluation of use as cover
- Assess seasonal groundwater fluctuations within the pile
- Determine local off-site sources of materials that could be used for: erosion protection, low permeability cover soil, drainage material and engineered fill

Iron King Mine Property (IKM; excluding tailings pile and including Galena Gulch [GAL])

- Conduct an extent of contamination study on lands within the IKM property operating area yet outside the MTP
- Fill in data gaps from previous studies by collecting more samples, going to greater depths, in a side gulch that drains to the small tailings pile
- Investigate levels of contamination in Galena Gulch at the back of the mine to confirm only waste rock is present at this location
- Determine volume of tailings on lower bench
- Refine bioaccessibility values used in risk assessment
- Refine volume estimates of tailings in Galena Gulch to aid in selecting a remedy

Undeveloped Areas (UND)

- Characterize the extent and distribution of lead and arsenic in shallow soil within areas that have not been previously sampled.
- Estimate the extent of aerial deposition of dust generated from the MTP

Smelter Plateau Soil (PS)/Dross(ASH)/Slag (SL)

- Determine depth and volume of dross material
- Enhance knowledge of the chemical properties of the dross material
- Establish nature and extent of contamination on the plateau and determine the nature of soils in the area where a future containment cell for dross might be built

The problem to be addressed by the project (cont'd):

- Collect geotechnical testing data to be used in the FS as part of the conceptual design of the containment cell
- Establish stability of the slag given the presence of crevasses
- Confirm differences in slag chemical characteristics identified in the RI between the main and satellite slag piles

Smelter Tailings Swale (STS)

- Determine total depth and volume of tailings material in tailings swale
- Assess AMD potential
- Assess potential to move and consolidate tailings in this area for the FS
- Collect geotechnical testing data to be used in the FS as part of the conceptual design of an in-place closure of tailings
- Conduct a surface geophysical investigation to determine the thickness of the tailings and the topography of the underlying materials

Chaparral Gulch Floodplain (CHF)

- Determine depth and volume of tailings material in the floodplain
- Evaluate AMD potential and metals content
- Evaluate moisture content and occurrence of perched water
- Evaluate chemical properties and layering within the alluvium
- Collect geotechnical testing data to be used in the FS for constructability/foundation of potential conveyance channel and to determine erosive nature of tailings
- Refine bioaccessibility values used in risk assessment

Dam and Area Behind Dam (DAM)

- Determine the batter (slope angle) of upstream surface of the concrete dam
- Determine total depth and volume of material and metals
- Assess loading on the dam, dam stability, water levels and weight of materials
- Evaluate AMD potential behind the dam
- Assess dam width, dam stability, and the suitability for long term retainment of materials

The problem to be addressed by the project (con't):

Upper Chaparral Gulch (CH; near 3rd Street)

- Determine depth and volume of contaminated soils and tailings material
- Assess layering with alluvium
- Collect geotechnical testing data to be used in the FS for constructability/foundation of potential conveyance channel and to determine erosive nature of tailings

Chaparral Gulch (CH; between 3rd Street and Smelter)

- Determine depth and volume of contaminated soils and tailings material
- Assess layering with alluvium
- Collect geotechnical testing data to be used in the FS for constructability/foundation of potential conveyance channel and to determine erosive nature of tailings

Residential Properties: Area Screening (Soil)

- Conduct initial soil screening of homes (specifically for Pb and As) near the periphery of potential site impacts to determine if full risk characterization is required.

Residential Properties: Full Risk Characterization (Soil)

- Determine properties that need to be cleaned-up based on criteria to be determined by Region 9

Site-wide Groundwater: Installation of New Wells

- Further evaluate both groundwater flow conditions and contaminant distributions

Groundwater Sampling: New & Existing Wells

- Develop detailed knowledge of groundwater chemistry for assessing chemical signatures of groundwater and understanding reactions that are occurring along flow paths

Biological Survey & Bioassessment Sampling

- Assess riparian corridors and upland areas within the site boundaries that would provide suitable habitat for wildlife
- Estimate bioaccessibility for ecological risk assessment

Other Tasks:

- Obtain aerial imagery and 2 –foot contour data for the site and surrounding areas (Yavapai County GIS Department) to be used for estimation of mine waste volumes, identification of parcels to obtain access agreements for sampling and for removal activities, and site for site restoration activities.

The problem to be addressed by the project (con't):

- Provide support with and maintaining property access requests
- Retain a subcontractor to apply a copolymer liquid over the entire area (approximately 15 acres) for site dust control
- Conduct hydrologic monitoring and surface water sampling to assess the impact of site sources on surface water quality in the Chaparral Gulch and Agua Fria River.
- Assess stability of smelter smoke stack

The environmental questions being asked:

- Can future erosion rates (soil loss) be minimized (i.e., for specific areas of concern)?
- Can uncontrolled surface water runoff, sediment yield, and sediment transport be minimized?
- What is the extent and depth of Pb and As concentrations exceeding the site-specific benchmarks in matrices of concern (soil, sediment, surface water, groundwater, dross, slag)?
- Can local off-site sources of natural materials be used for future site restoration?
- What is the ecological and human health risk associated with the surface runoff, and sediment and aerial transport of Pb and As?

Observations from any site reconnaissance reports:

Exposed native hillsides and abutments confine the LTP on the north and south sides. The west extent of the LTP is limited by the rising slope of the valley bottom. The natural valley area located east (down slope) of the LTP has been filled to a depth of about 40 ft with tailings deposited primarily as a result of a 1964 slope failure and from subsequent erosion of the LTP. The east limit of the tailings is constrained by a site access road (constructed on a former railway embankment). A portion of the post-failure tailings have been excavated to form a small storm water detention pond at the eastern limit of the site.

The current contaminants of concern at the site include arsenic, lead, and other metals that have contaminated soil, sediments, surface water and groundwater in concentrations significantly above background levels. The full extent of off-site soil contamination and possible groundwater contamination has not been fully assessed. Runoff from the mine tailings along the Chaparral Gulch may be entering the Aqua Fria River, further downstream.

A synopsis of secondary data or information from site reports:

Site Geology: The Iron King mine is approximately located in the geographical center of the Humboldt region. The underlying bedrock is Precambrian in age. Late Cenozoic unconsolidated river wash and valley fill, with some interbedded basalt, locally mantle the Precambrian rocks, especially in the north-central part of the region. The Precambrian rocks consist of two metamorphosed volcanic formations and intrusive rocks that range in composition from quartz porphyry to gabbro. The volcanic formations originally were flows, volcanic breccias, and tuffaceous sedimentary rocks. Dynamo-thermal metamorphism of these rocks formed textures, structures, and mineral assemblages, characteristic of low-grade metamorphic rocks; however, sufficient relict textures and structures remain to permit delineation of formations. The Precambrian rocks strike north to northwest and steeply dip in a predominant westward direction.

Groundwater: Unconfined groundwater is encountered at depths between 30 and 50 ft bgs and generally the flow follows the local topography. Shallow groundwater is thought to flow east from the mine towards the Aqua Fria River and along the Chaparral Gulch. Deeper confined groundwater moves within the fracture system of the underlying metamorphic bedrock. Bedrock wells have been drilled to depths ranging from 200 to 1,000 ft bgs. The regional groundwater flow direction is not fully understood.

It is possible that the contaminated soil (material) was placed on residential properties before homes and/or fences were built and may not follow property lines. It has been noted from previous sampling events that the high concentration material is fine-grained but not necessarily distinguishable from other soils on the properties.

The possible classes of contaminants and the affected matrices: Soil: Metals (primarily As and Pb) across the site; Cr(VI) in the MTP, STS, and CHF; SPLP metals in the MTP, dross & slag materials in the Smelter Plateau area, STS, CHF, and DAM; dioxin/furans in dross from the Smelter Plateau Sediment (Agua Fria River): Metals (primarily As and Pb); dioxins/furans Surface water: Metals (primarily As and Pb); water quality parameters (field and laboratory measurements); total organic carbon (TOC) Groundwater: Metals (primarily As and Pb); water quality parameters (field and laboratory measurements)
The rationale for inclusion of chemical and nonchemical analyses: Matrices and parameters for analysis/measurement were selected to fill in data gaps identified by EPA Region 9.
Information concerning various environmental indicators: Mine tailings, surrounding soils and stream sediments are contaminated with arsenic, lead and other heavy metals. Dioxin/furans and Cr (VI) have also been identified at potential levels of concern during previous sampling efforts.
Project decision conditions ("If..., then..." statements): If FP XRF measurements exceed benchmarks identified in Worksheet 15, then step-out sampling will be initiated to delineate horizontal and vertical Pb and As contamination. If sufficient data is collected, then EPA Region 9 will develop and evaluate remedial alternatives for the IKM site. If sufficient data is collected, then EPA Region 9 will complete the FS, and a human health and ecological risk assessment for the site. If surface soil FP XRF measurements and/or TAL metals laboratory results for a residential property exceed criteria determined by Region 9, then a full risk characterization will be conducted on that property.

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

Who will use the data?
EPA Region 9, ERT, SERAS

What will the data be used for?
Data will be used to:

- evaluate and determine final site stabilization designs
- address the data gaps identified by EPA Region 9's contractor (CH2MHILL)
- develop and evaluate remedial alternatives
- complete the FS
- assess human health and ecological risk

What types of data are needed (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)?

Digital elevation data (collected by Granite Basin Engineering), rainfall data, land cover data, soil and sediment physical property data, site aerial, topographic and parcel data, property access data, material boundary and volume estimates, construction material survey data, bedrock characteristics, acid mine drainage potential (AMD), waste rock characterization, bioavailability and bioaccessibility data, horizontal and vertical delineation of Pb and As, slag wall stability measurements, surface geophysical measurements, physical measurements of the dam, borehole geophysics, slug testing data, depth of water column at the base of the dam, groundwater chemistry, biological assessment data within riparian corridors and upland areas, benthic community and fish observations within the streams and riparian corridors, plant density, plant community and associated vegetative coverage, and plant biomass determination.

Geotechnical Laboratory Testing (off-site subcontracted laboratory measurements):

- Geotechnical property data collected from soil borings at the MTP including: Atterberg limits (A-L), in-place moisture density (M-D), specific gravity (SG), hydraulic conductivity (permeability) 1-D consolidation (Consol), direct shear test (Shear), consolidated-undrained triaxial shear test with pore pressure measurements (CU) and soil-water characteristic curves (SWCC)
- Waste rock characterization – slake durability (Slake)
- Geotechnical property data collected from borings in the Smelter Plateau soils, STS, CHF, DAM, and upper and lower sections of CH. Properties which will be measured include grain size with a sieve and hydrometer, natural moisture content (Moisture) and A-L.
- SG of slag material from the Smelter Plateau area

Water Quality Measurements (off-site subcontracted laboratory [alkalinity, chloride, nitrate, sulfate, phosphate, silica, dissolved organic carbon, total dissolved solids, and fluoride] and field [pH, oxidation reduction potential (ORP; Eh), ferrous iron (Fe^{2+}), specific conductivity, temperature, dissolved oxygen, turbidity]) taken from:

- Surface water from the Agua Fria River and downstream of the Dam (excluding Fe^{2+})
- Groundwater from 11 existing wells
- Groundwater from 11 new wells

Acid Base Accounting ([ABA]; off-site subcontracted laboratory analysis for total moisture, neutralization potential, saturated paste pH, sulfur forms, and acid potential and ABA calculations)
collected from:

- soil borings at the MTP
- waste rock characterization from the MTP
- borings into the dross material in the Smelter Plateau area
- slag from the Smelter Plateau area
- borings in the STS
- borings in the CHF
- borings at the DAM

What types of data are needed (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)? Continued:

In Vitro Bioaccessibility Testing for Pb and As (off-site laboratory; Region 9 Laboratory) on surface samples collected from the :

- MTP
- GAL
- CHF
- CH
- Residential properties during the full assessment phase

Off-site subcontracted laboratory analysis for Cr(VI) on samples collected from borings in the:

- MTP
- STS
- CHF

Off-site subcontracted laboratory analysis for dioxins/furans and total organic carbon (TOC) on sediment samples collected from the Aqua Fria River.
Off-site subcontracted laboratory analysis for dioxins/furans in dross material.

Off-site laboratory (Region 9) synthetic precipitation leaching procedure (SPLP) for the RCRA-8 metals plus Zn, Cu, Al , and Mg for samples collected from:

- Soil borings in the MTP,
- Waste rock from the MTP,
- Borings into the dross material in the Smelter Plateau area,
- Slag from the Smelter Plateau area,
- Borings in the STS,
- Borings into the CHF, and
- Borings in the DAM.

Off-site laboratory (CLP) analysis for TAL Metals (including Hg) for:

- Soil borings in the MTP,
- Waste rock characterization in the MTP
- Soil borings from GAL (confirmation of XRF results)
- Slag samples in the Smelter Plateau area
- Soil borings from IKM (confirmation of XRF results)
- Soil borings from UND (confirmation of XRF results)
- Dross and soils from the Smelter Plateau area (confirmation of XRF results)
- Borings from the STS (confirmation of XRF results)
- Borings from the CHF (confirmation of XRF results)
- Borings from the DAM (confirmation of XRF results)
- Borings from CH (confirmation of XRF results)

What types of data are needed (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)? Continued:

- Residential properties during the screening phase of the risk assessment (confirmation of XRF results)
- Sediment from downstream of the dam (confirmation of XRF results)
- Sediment and surface water from the lower Chaparral Gulch/Dam confluence
- Groundwater from 11 existing monitoring wells and 11 new monitoring wells to be installed as a part of this project
- Residential properties during the full risk characterization (confirmation of XRF results)
- Plant matter and soil as part of the bioaccumulation study
- Sediment and surface water samples from the Agua Fria River and downstream of the dam
- Sediment from the upper, middle and lower Chaparral Gulch
- Groundwater seeps below the dam

Field screening for Pb and As in soils (using the FP XRF) in:

- Hand borings on the IKM property for delineation of contamination
- Borings in the lower tailings on the IKM property
- The Galena Gulch area
- Borings in the UND
- Borings in dross material and in soils in the Smelter Plateau area
- Borings in the STS
- Borings in the CHF
- Borings at the dam, the area behind the dam, and downstream of the dam
- Borings in the upper and lower sections of Chaparral Gulch
- Soils from residential properties for the screening phase of the risk assessment and the full risk characterization phase

How "good" do the data need to be in order to support the environmental decision?

- Screening level data will include: FP XRF measurements, field water quality measurements (pH, ORP/Eh, Fe^{2+}, specific conductivity, temperature, dissolved oxygen, turbidity), geotechnical properties (A-L, M-D, SG, HC, Consol, Shear, CU and SWCC, Slake, grain size, Moisture], ABA parameters and calculations, GPS coordinates, site aerial and topographic data, water depth measurements, slag wall stability measurements, construction materials and biological survey data, and geophysical (electrical resistivity, frequency-domain electromagnetic, ground penetrating radar [GPR]) readings.
- Definitive level data will include analytical results for TAL metals (including mercury [Hg]), SPLP, IVBA, TOC, dioxins/furans, Cr(VI), alkalinity, chloride, nitrate, sulfate, phosphate, silica, dissolved organic carbon, total dissolved solids (TDS), fluoride and dissolved and total Pb and As.

Worksheets #12 and #28 show the measurement performance criteria that are needed for the quality indicators. Worksheet #20 shows the field quality control (QC) samples required. The EPA Region 9 Laboratory and CLP laboratory analytical data will be validated by the EPA Environmental Services Assistance Team (ESAT) contractors. Analytical data from subcontracted laboratories will be validated by SERAS QA/QC Chemists.

How much data are needed (number of samples for each analytical group, matrix, and concentration)?

Refer to Tables 1 thru 3 in the attached FWP.

Where, when, and how should the data be collected/generated?

Field work is projected to occur from January 2014 through the Spring of 2014. A detailed description of sampling and monitoring methods, types of data to be collected, how and where the data will be collected can be found in the attached FWP and Residential Sampling Plan. See Worksheets 18 and 19 for summaries of sampling and analytical activities.

Samples to be analyzed for Pb and As using the Niton FP XRF will be screened at an on-site laboratory. Samples will be screened through the baggie twice, one on each side. A minimum of 10% of the samples from the residential properties, analyzed by the FP XRF will be submitted to a CLP laboratory for confirmation analysis for TAL metals (including Hg). A minimum of 5% of the samples from each non-residential area will be sent to a CLP laboratory for confirmation analysis for TAL metals (including Hg).

Site aerial and topographic data will be acquired from Yavapai County.

A site-wide reconnaissance-level biological survey will be conducted in accordance with the US *EPA Ecological Risk assessment Guidance for Superfund: Process for Designing and Conducting Ecological Assessmen*ts, Interim Final (EPA/540-R-97-005). At each location, SERAS will spend sufficient time quietly observing the area, allowing the local fauna to return to normal behaviour. Observations of the local fauna will be documented. Photographic documentation of the local habitat at each sampling location will be collected. Plant species and coverage will also be photographed. Representative voucher specimens of plants will be collected for later taxonomic identification/verification.

Cores will be logged in accordance with SERAS SOP #2074, *Description and Identification of Soils.*

Prior to groundwater sampling at the new and existing area-wide monitoring wells, static water levels will be measured using an electronic indicator and recorded in conformance with SERAS SOP # 2043, *Water Level Measurement*. Field water quality parameters will be collected using the Horiba U-52 Multi-parameter Water Quality Meter with flow chamber. Fe^{+2} will be measured by the 1,10-phenanthrolene method using a Hach test kit.

A handheld GPS (Trimble GeoExplorer) will be used to collect borehole, sampling, and monitoring well location coordinates for the length of the project.

Surface geophysical readings will be collected using an Iris Instruments Pro Resistivity Meter, Geonics® EM31-MK2 and a Sensors & Software Smartcart Noggin GPR unit.

United States Geological Survey (USGS)-developed automated water samplers and rain gauges will be deployed for hydrologic monitoring and surface water sampling within the Chaparral Gulch, downstream of the dam, and in the Agua Fria River.

Who will collect and generate the data?

SERAS, ERT, EPA R9, Granit Basin Engineering (survey data), Katahdin Analytical, Cape Fear Analytical, ACZ Laboratories, ALS Environmental, Speedie & Associates, GeoSystems Analysis, Inc, and CLP personnel.

How will the data be reported? GPS coordinates, borehole logs and geophysical logs, construction details for monitoring wells, top of casing and ground surface elevations for new wells, laboratory results, lists of raw construction material sources, construction details of the on-site dam, horizontal corodinates and elevations of slag pins, transect data for major cracks in the slag, results from surface geophysical investigations and hydrologic monitoring, volume estimate of mine-related wastes and impacted areas, and results from the biological survey, surface and borehole geophysical surveys, and hydrologic monitoring data will be reported in Technical Memorandums, prepared in accordance with SERAS Standard Operating Procedure (SOP) #4018, *Preparation of Interim or Status Reports*. Sample collection information, sample data, and GPS coordinates for samples will be documented in SCRIBE. A final SCRIBE file will be posted to the ERT-IMS website. Validated data for the sampling event will be reported in analytical reports prepared in accordance with SERAS SOP #4020, *Analytical Report Preparation.* The SERAS TL will be responsible for reviewing, evaluating, summarizing, and presenting all of the data generated from this project. All reports will be posted on the project-specific ERT-Information Management System (IMS) website. Data will be disseminated to EPA Region 9 by the WAM.
How will the data be archived? Hard copies of all deliverables will be stored in SERAS Central Files and e-copies will be stored on SERAS Local Area Network (LAN). Data will be archived by SERAS in accordance with Administrative Procedure (AP) #34, *Archiving Data Electronic Files.* CLP and Region 9 laboratories will be archive their analytical data. Analytical data packages subcontracted to all outside laboratories will be archived by the SERAS QA/QC Group.

QAPP Worksheet #12-1
Measurement Performance Criteria Table

Matrix	Soil/Sediment/Dross/ Slag
Analytical Group	Metals (FP XRF)
Concentration Level	NA

Sampling Procedure[1]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)**
SERAS SOP #2012 SERAS SOP #2016	SERAS SOP # 1720	Sensitivity	< Reporting Limit (RL)	Zero check sample	A
		Precision		Laboratory Duplicate	A
		Precision	%RSD ± 20%	Precision check sample	A
		Accuracy/Bias	Element results typically within ± 20% of true values for concentrations at least 5X the RL	Certified Reference Standard(s)	A
		Completeness	>90% Sampling Completed >90% Laboratory Analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-2
Measurement Performance Criteria Table

Matrix	Soil/Sediment/Slag/ Waste Rock/Dross
Analytical Group	TAL metals
Concentration Level	ICP-AES (mg/kg)

Sampling Procedure[1]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)**
SERAS SOP #2012 SERAS SOP #2016	ISM01.3	Precision (field)	≤ 35% RPD	Field Duplicate	S & A
		Accuracy (field)	Blank Concentration ≤ CRQL	Preparation Blank	A
		Precision (laboratory)	± 20% RPD	Duplicate Sample **	A
		Accuracy (laboratory)	75–125% Within control limits	*** Matrix Spike; LCSS****	A
		Accuracy	± of the true value or ± 1 times the CRQL, whichever is greater	Interference Check Sample (ICS)	A
		Accuracy	%R = 75-125 (exception Ag)	Post Digestion Spike	A
		Precision	%D ± 10% (minimum sample concentration 50x MDL	Serial Dilution	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
**Reference USEPA CLP ISM01.3, Exhibit D of ICP-AES for Duplicate Sample Criteria
***Reference USEPA CLP ISM01.3, Exhibit D of ICP-AES for Spike Sample Criteria
****Reference USEPA CLP ISM01.3, Exhibit D of ICP-AES for solid Laboratory Control Sample (LCSS)
Note: Control Limits established by USEPA for LCSS

QAPP Worksheet #12-3
Measurement Performance Criteria Table

Matrix	Surface and Groundwater
Analytical Group	TAL metals
Concentration Level	ICP-AES (µg/L)

Sampling Procedure[1]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)**
SERAS SOP #2013 SERAS SOP #2007	ISM01.3	Precision (field)	$\leq$ 20% RPD	Field Duplicate	S & A
		Accuracy (field)	Blank concentration $\leq$ CRQL*	Preparation Blank	A
		Accuracy/Bias (Contamination)	No analyte > CRQL	Field Blank	S & A
		Precision (laboratory)	$\leq$ 20% RPD	Duplicate Sample **	A
		Accuracy (laboratory)	75–125%; 70–130 % (50 – 150% for Ag and Sb)	*** Matrix Spike; LCSW	A
		Accuracy	±20% of true value or ±1 times the CRQL, whichever is greater	Interference Check Sample (ICS)	A
		Accuracy	%R = 75-125 (exception Ag)	Post Digestion Spike	A
		Precision	%D ±10% (minimum sample concentration 50x MDL)	Serial Dilution	A
		Completeness	> 90% sampling completed > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
**Reference USEPA CLP ISM01.3, Exhibit D of ICP-AES for Duplicate Sample Criteria
***Reference USEPA CLP ISM01.3, Exhibit D of ICP-AES for Spike Sample Criteria

QAPP Worksheet #12-4 (Samples Relinquished by Region 9 to SERAS)
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Metals
Concentration Level	ICP-AES

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2012	SERAS SOP #1811	Precision	RPD ± 20%	Laboratory Duplicates (Matrix Spike Duplicate)	S & A
		Precision	RPD ± 35%)	Field duplicates	S & A
		Accuracy/Bias	%R = 75-125%	Matrix Spike (inorganic)	S & A
		Accuracy/Bias	%R = 80-120% or within performance acceptance limits	LCS	A
		Accuracy/Bias (Contamination)	< Reporting Limit	Method Blank	A
		Accuracy/Bias	+/-20% for elements in ICSA, < RL for others	ICS	A
		Accuracy/Bias	+/-10% if analyte concentration > 10 times RL	Serial Dilution	A
		Accuracy/Bias	%R = 90 – 110%	LAR	A
		Accuracy/Bias	%R ± 30% true value	LLQC	A
		Accuracy/Bias	%R = 80 -120	Post Digestion Spike	A
		Completeness	>90% Sampling Completed >90% Laboratory Analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

QAPP Worksheet #12-5 (Samples Relinquished by Region 9 to SERAS)
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Mercury
Concentration Level	Low

Sampling Procedure[1]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)**
SERAS SOP #2012	SERAS SOP #1832	Precision	RPD ± 20%	Laboratory Duplicates (Matrix Spike Duplicate)	S & A
		Precision	RPD ± 35%	Field duplicates	S & A
		Accuracy/Bias	%R = 80-120%	Matrix Spike (inorganic)	A
		Accuracy/Bias	%R = 80-120% or within performance acceptance limits	LCS	A
		Accuracy/Bias (Contamination)	< RL	Method Blank	A
		Completeness	>90% Sampling Completed >90% Laboratory Analysis	Data Completeness Check	S & A
		Accuracy/Bias (Contamination)	< RL	Field Blank	S & A

[1]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (see Section 3.2)

QAPP Worksheet #12-6
Measurement Performance Criteria Table

Matrix	Soil/Dross/Slag/ Waste Rock
Analytical Group	SPLP Metals
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A), or Both (S&A)
SERAS SOP #2012	EPA R9 SOP 254 EPA R9 SOP 407 EPA R9 SOP 503 EPA R9 SOP 515	Accuracy/Bias (Contamination)	<1/2 RL	Method Blank	A
		Precision	RPD ± 20%	Sample Duplicate	A
		Precision	RPD ± 20%	Laboratory Duplicates (MS/MSD or sample and duplicate)	A
		Accuracy/Bias	<±1/2QL or calculated acceptance window, whichever is greater	Spectral Interference Check (SIC) (not for Hg)	A
		Accuracy/Bias	60-125%	Internal Standard	A
		Accuracy/Bias	%R = 90 – 110%	Linear Dynamic Range (LDR) (not for Hg)	A
		Accuracy/Bias	ICP & Hg: 85-115%	LCS	A
			ICP: 75-125% Hg: 70-130%	Matrix Spikes	S & A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-7
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group[1]	Cr(VI)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SERAS SOP #2012	Katahdin SOP #CA-625-06	Accuracy	%R = 80-120%	LCS	A
		Accuracy	±25% of true value	Soluble and Insoluble Pre-Digestion Matrix Spikes	A
		Accuracy	±15% of true value	Post-Digestion Matrix Spike	A
		Precision	RPD ≤ 20%	Duplicate Sample	A
		Precision (field)	±35% RPD	Field Duplicate	S & A
		Accuracy	< RL	Method Blank	A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-8
Measurement Performance Criteria Table

Matrix	Sediment/Dross
Analytical Group[1]	Dioxins/furans
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2012 SERAS SOP #2016	Cape Fear SOP #CF-OA-E-001 & -002	Accuracy	70 – 130%	Matrix Spike	A
		Precision (field)	±35% RPD	Field Duplicate	S & A
		Accuracy	35-197%	Labeled Cleanup Standard	A
		Accuracy	Recoveries within established laboratory limits	Labeled Extraction Standards	A
		Accuracy	Recoveries within established laboratory limits	Ongoing Precision Recovery (OPR)	A
		Precision	%RPD<20	OPR Duplicate	A
		Precision	%RPD<20	Lab Duplicate MS/MSD	A
		Accuracy	<RL or <10% of level in related samples	Method Blank	A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-9a
Measurement Performance Criteria Table

Matrix	Water
Analytical Group[1]	Nitrite/Nitrate & Fluoride
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2013 SERAS SOP #2007	Katahdin SOP #CA-728-08 (nitrite/nitrate) Katahdin SOP #CA-742-09 (fluoride)	Accuracy	90-110%	LCS	A
		Precision (field)	±20% RPD	Field Duplicate	S & A
		Accuracy	90-110%	Matrix Spike	A
		Precision	Fluoride: RPD ± 15%	MS/MSD	A
		Precision	Nitrate: RPD ± 20 for samples >3x the PQL; <100% for samples<3x the PQL Fluoride: RPD ± 20%	Sample Duplicate	A
		Accuracy	<RL	Method Blank	A
		Accuracy/Bias (Contamination)	<RL	Field Blank	S & A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-9b
Measurement Performance Criteria Table

Matrix	Water
Analytical Group[1]	Dissolved Organic Carbon
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2013 SERAS SOP #2007	Katahdin SOP #CA-763-07	Accuracy	90-110%	LCS	A
		Precision (field)	±20% RPD	Field Duplicate	S & A
		Accuracy	%R: 80-120%	Matrix Spike	A
		Precision	±20% RPD	Sample Duplicate	A
		Accuracy	<RL	Method Blank	A
		Accuracy/Bias (Contamination)	<RL	Field Blank	S & A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-9c
Measurement Performance Criteria Table

Matrix	Water
Analytical Group[1]	Sulfate Phosphate Alkalinity Chloride
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SERAS SOP #2013 SERAS SOP #2007	Katahdin SOP #CA-721-03 (sulfate) Katahdin SOP #CA-715-06 (phosphate) Katahdin SOP #CA-739-09 (alkalinity) Katahdin SOP #CA-768-03 (chloride)	Accuracy	80-120%	LCS	A
		Precision	Sulfate & Alkalinity: ±20% RPD for concentrations >3x the PQL; RPD≤100 for results<3x PQL Phosphate & Chloride: RPD≤20	Sample Duplicate	A
		Precision (field)	±20% RPD	Field Duplicate	S & A
		Accuracy	Sulfate, Phosphate, Chloride: 75-125% Alkalinity: 80-120%	Matrix Spike	A
		Accuracy	<RL	Method Blank	A
		Accuracy/Bias (Contamination)	<RL	Field Blank	S & A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-9d
Measurement Performance Criteria Table

Matrix	Water
Analytical Group[1]	Total Dissolved Solids
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2013 SERAS SOP #2007	Katahdin SOP #CA-719-07 (TDS)	Accuracy	80-120%	LCS	A
		Precision (field)	±20% RPD	Field Duplicate	S & A
		Precision	RPD≤20	Sample Duplicate	A
		Accuracy	<RL	Method Blank	A
		Accuracy/Bias (Contamination)	<RL	Field Blank	S & A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-10
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group[1]	Total Organic Carbon
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SERAS SOP #2016	Katahdin SOP #CA-741-05	Accuracy	R = 80-120%	LCS	A
		Precision (field)	±35% RPD	Field Duplicate	S & A
		Accuracy	R = 75-125%	Matrix Spike	A
		Accuracy	<RL	Method Blank	A
		Precision	RPD ±20%	Sample Duplicate	A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-11
Measurement Performance Criteria Table

Matrix	Water
Analytical Group[1]	Silicon
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SERAS SOP #2013 SERAS SOP #2007	Katahdin SOP #CA-627-09	Precision	RPD ± 20% if sample conc>100x IDL	Duplicate Sample	A
		Precision	RPD ± 20%	Field Duplicate	S & A
		Accuracy/Bias	%R = 80-120 limits or within performance acceptance limits	LCS	A
		Accuracy/Bias (Contamination)	< RL	Method Blank	A
		Accuracy/Bias	Interferents: ±20% of true value	ICS-A	A
		Accuracy/Bias	±20% of true value	ICS-AB	A
		Accuracy/Bias	+/-10% if analyte concentration > 50 times LOQ	Serial Dilution	A
		Accuracy/Bias	IS intensity within 70-120% of IS in ICB	Internal Standard	A
		Accuracy/Bias (Contamination)	<RL	Field Blank	S & A
		Accuracy/Bias	%R = 80-120	Post Digestion Spike	A
		Completeness	>90% Sampling Completed >90% Laboratory Analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-12 (Relinquished by Region 9 to SERAS - ACZ Laboratories)
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group[1]	IVBA (Pb & As)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SERAS SOP #2012	SOPS0048.06.13.05 SOP0028.08.13.10 SOPII022.07.13.09	Accuracy	R=80-120%	LCSW	A
		Precision	RPD ± 20%	Sample Duplicate	A
		Accuracy	R = 75-125%	Matrix Spike	A
		Precision	RPD ± 20%	Matrix Spike Duplicate	A
		Accuracy/Bias (Contamination)	Lead < 25 µg/L Arsenic < 5 µg/L	Extraction Fluid	A
		Accuracy/Bias (Contamination)	Lead < 50 µg/L Arsenic < 10 µg/L	Bottle Blank	A
		Accuracy/Bias (Contamination)	<RL	Method Blank	A
		Accuracy/Bias	R = 80-120%	ICS	A
		Accuracy/Bias	R = 30-120%	Internal Standard	A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)
[3]Represents extraction, digestion and analytical methods

QAPP Worksheet #12-13 (EPA Region 9 Laboratory)
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group[1]	IVBA (Pb & As)
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2012	EPA R9 SOP 256 EPA R9 SOP 407 EPA R9 SOP 503	Accuracy/Bias (Contamination)	<1/2 RL	Method Blank	A
		Precision	RPD ± 20%	Sample Duplicate	S & A
		Precision	RPD ± 20%	MS/MSD	A
		Accuracy/Bias	<±1/2QL or calculated acceptance window, whichever is greater	SIC	A
		Accuracy/Bias	60-125%	Internal Standard	A
		Accuracy/Bias	%R = 90 – 110%	Linear Dynamic Range (LDR)	A
		Accuracy/Bias	85-115%	LCS (extract)	A
		Accuracy/Bias	Element specific (<25 µg/L Pb)	Reagent Blank	A
		Accuracy/Bias	RPD ± 10%	SRM	A
		Accuracy/Bias	%R 75-125%	Matrix Spikes	S & A
		Completeness	>90% sample collection >90% sample analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-14
Measurement Performance Criteria Table

Matrix	Plant Tissue
Analytical Group[1]	Metals
Concentration Level	ICP-MS - Low

Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2034	Katahdin SOP #CA-627-09	Precision	RPD ± 20% if sample concentration >100x IDL	Duplicate Sample	A
		Accuracy/Bias	%R = 80-120 or performance acceptance limits	LCS	A
		Accuracy/Bias (Contamination)	< RL	Method Blank	A
		Accuracy/Bias	±20% for elements in ICSA	ICS	A
		Accuracy/Bias	±10% if analyte concentration > 50 times instrument detection limit	Serial Dilution	A
		Accuracy/Bias	%R = 80 -120	Post Digestion Spike	A
		Accuracy/Bias	IS intensity within 70-120% of ICB	Internal Standard	A
		Completeness	>90% Sampling Completed >90% Laboratory Analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #12-15
Measurement Performance Criteria Table

Matrix	Plant Tissue
Analytical Group[1]	Hg
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP[3]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SERAS SOP #2034	Katahdin SOP #CA-611	Precision	RPD ± 20%	Laboratory Duplicates (Matrix Spike Duplicate)	S & A
		Accuracy/Bias	%R = 75-125%	Matrix Spike (inorganic)	A
		Accuracy/Bias	%R = 80-120% or within performance acceptance limits	LCS	A
		Accuracy/Bias (Contamination)	< RL	Method Blank	A
		Accuracy/Bias	%R = 80-120	Post Digestion Spike	A
		Precision	%D ± 10%	Serial Dilution	A
		Sensitivity/ Accuracy	LOD = 2-3x MDL LOQ > LOD	LOD/LOQ Study	A
		Sensitivity	IDL < RL	IDL Study	A
		Completeness	>90% Sampling Completed >90% Laboratory Analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21 (See Section 3.1.2)
[2]Reference number from QAPP Worksheet #23 (See Section 3.2)

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Data gap analysis	Draft - Data Gap Analysis Report Iron King Mine–Humboldt Smelter Superfund Site, Dewey-Humboldt, Yavapai County, Arizona, CH2MHILL, April 2013	CH2MHILL; data gap analysis of historical work conducted on the site; includes maps and recommendations for future sampling and analysis activities	Guidance for sampling objectives	Unknown quality of the data
Previous site investigation	EA Engineering, Science, and Technology, Inc. Feasibility Study, Iron King Mine Superfund Site. May 2011.	EA Engineering, Science, and Technology, Inc. Feasibility Study, Iron King Mine Superfund Site. Pre-2010 physical/chemical data.	Background info	Possibility of limited data
Previous site investigation	EA Engineering, Science, and Technology, Inc. Remedial Investigation Report, Iron King Mine Superfund Site. March 2010.	EA Engineering, Science, and Technology, Inc. Remedial Investigation Report, Iron King Mine Superfund Site. Pre-2010 physical/chemical data.	Background info	Possibility of limited data
Previous site-specific data	GEI Consultants. Evaluation of Tailings Consolidation Options, Iron King Mine Superfund Site. June 30, 2011.	GEI Consultants. Evaluation of Tailings Consolidation Options, Iron King Mine Superfund Site. Design scenarios.	Background info	Possibility of limited data
Guidance document	Environmental Protection Agency (EPA), 2002. Guidance for Quality Assurance Project Plans for Modeling. EPA/240/R-02/007. December 2002.	U.S. EPA, reference document	Guidance for modeling	None
Text book	McCuen, R. H., 2002. Modeling Hydrologic Change: Statistical Methods. CRC Press.	Private author, methods and procedures	Hydrologic and hydraulic modeling	None

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Computer model	Natural Resources Conservation Service (NRCS), 2009. EFH2 Computer Program: Estimating Runoff and Peak Discharge. USDA, August 2009.	USDA/NRCS, reference documentation	Guidance for hydrologic model implementation and use.	Some model input data may need to be estimated or averaged over space and time, which could affect the accuracy.
Computer model	Maynord, S.T., M.T. Hebler, and S.F. Knight, 1998. User's Manual for CHANLPRO, PC Program for Channel Protection Design. U.S. Army Corps of Engineers, Waterways Experiment Station, Coastal & Hydraulics Laboratory, Vicksburg, Mississippi. Technical Report CHL-98-20. July 1998.	Corps of Engineers, reference documentation	Guidance for riprap design	Some model input data may need to be estimated or averaged, which could affect the accuracy.
Procedure/methodology	Blodgett, J.C. and C.E. McConaughy, 1986. Rock Riprap Design for Protection of Stream Channels near Highway Structures, Volume 2: Evaluation of Riprap Design Procedures. U.S. Geological Survey Water Resources Investigation Report 86-4128. Prepared in cooperation with the Federal Highway Administration.	USGS, reference document	Guidance for riprap design	Some of the calculation parameters may need to be estimated or averaged.

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Procedure/methodology	Federal Highway Administration (FHWA), 2001. Urban Drainage Design Manual. Hydrologic Engineering Circular No. 22, 2nd edition. Publication No. FHWA-NHI-01-021. U.S. Department of Transportation. Prepared in cooperation with the National Highway Institute. August 2001.	FHWA, reference document	Guidance for surface water drainage design	Some of the calculation parameters may need to be estimated or averaged.
Procedure/methodology	Natural Resources Conservation Service (NRCS), 2001. Water Management (Drainage). National Engineering Handbook, Part 650 – Engineering Field Handbook, Chapter 14. April 2001.	NRCS, reference document	Guidance for french drain design	Some parameters, such as soil properties, may need to be estimated.
Rainfall data	National Oceanic and Atmospheric Administration (NOAA). Point Precipitation Frequency Estimates, NOAA Atlas 14. National Weather Service (NWS), Hydro-meteorological Design Studies Center.	NOAA/NWS rainfall data	Determine peak runoff and channel flow discharge at the site.	Data are estimated from historical rainfall values and probability of occurrence. The longer the historical record, the more reliable are the data.

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Ecological Assessment	EPA, Ecological Risk Assessment guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. Office of Solid Waste and Emergency Response, Washington, D.C., EPA/540-R-97-005	EPA, reference document	Completion of EPA required checklists as a part of ecological risk assessment: ecological assessment/sampling checklist; terrestrial habitat checklist; aquatic habitat checklist	None

QAPP Worksheet #14
Summary of Project Tasks

Sampling and Monitoring Tasks:

January 2014 to Spring 2014:

Sampling activities will be in conducted in accordance with the following SERAS SOPs:
SERAS SOP #2001, *General Field Sampling Guidelines*
SERAS SOP #2002, *Sample Documentation*
SERAS SOP #2003, *Sample Storage, Preservation and Handling*
SERAS SOP #2004, *Sample Packing and Shipment*
SERAS SOP #2007, *Groundwater Sampling*
SERAS SOP #2012, *Soil Sampling*
SERAS SOP #2013, *Surface Water Sampling*
SERAS SOP #2016, *Sediment Sampling*
SERAS SOP #2037, *Terrestrial Plant Community Sampling*
SERAS SOP #2038, *Vegetation Assessment Field Protocol*
SERAS SOP #2043, *Water Level Measurement*
SERAS SOP #2044, *Well Development*
SERAS SOP #2048, *Monitor Well Installation*
SERAS SOP #2052, *Operation of EM-31*
SERAS SOP #2056, *Ground Penetrating Radar*
SERAS SOP #2074, *Description and Identification of Soils*

Details of all sampling can tasks can be found in Attachment 1 (Supplemental Field Investigation Work Plan), Attachment 2 (Residential Sampling Approach) and in Worksheets 17 and 18.

Analysis Tasks:
20 soil samples collected by EPA Region 9 and relinquished to SERAS were analyzed by the SERAS Laboratory for TAL metals and by the ACZ Laboratories for Pb and As using IVBA to determine the biaoaccessibility of the metals.

The following analytical work has been projected for the remainder of this project. Sample numbers do not include field duplicates (Refer to Worksheet 20 for QC samples):

- 3,638 soil/dross samples for analysis by FPXRF (this represents a minimum number of samples to be analyzed as a step-out approach for delineation of contamination will be applied)
- 33 soil samples for Pb and As using IVBA by the Region 9 Laboratory
- 30 soil, 5 waste rock, 4 dross material, and 3 slag samples for SPLP RCRA-8 metals plus Zn, Cu, Al, Fe, and Mn by the Region 9 Laboratory
- 305 soil, 5 waste rock, 3 slag, 20 dross, 25 sediment, 16 surface water, and 44 groundwater samples for TAL metals by CLP (this represents a minimum number of samples to be analyzed as a step-out approach for delineation of contamination will be applied)
- 10 plant tissue samples for TAL metals analysis by Katahdin Analytical Services
- 24 soil samples for analysis of Cr(IV) by Katahdin Analytical Services
- 2 dross material and 5 sediment samples for analysis of dioxins/furans by Katahdin Analytical Services
- 5 surface water and 44 groundwater samples for water quality parameters (alkalinity, chloride, nitrate, sulfate, phosphate, silica, dissolved organic carbon, total dissolved solids, and fluoride) by Katahdin Analytical Services.
- 5 sediment samples for TOC by Katahdin Analytical Services
- 30 soil, 4 dross material, 5 waste rock, and 3 slag samples for ABA by Katahdin Analytical Services
- Geotechnical parameters which will be measured by Speedie & Associates:
    - 56 soil samples for grain size and Atterberg Limits
    - 36 soil samples for moisture
    - 24 soil samples for in-place moisture-density
    - 9 soil samples for specific gravity
    - 6 soil samples for hydraulic conductivity
    - 3 soil samples for 1-D consolidation, direct shear test, and consolidated-undrained triaxial shear tests
- Geotechnical parameters which will be measured by GeoSystems Analysis, Inc:
    - 5 waste rock samples for slake durability
    - 3 soil-water characteristic curves

Quality Control Tasks:
Refer to Worksheet #20 for field QC samples and Worksheets #12 and #28 for analytical QC Samples.

Secondary Data: Described in Worksheet #13.

Data Management Tasks:
Field observations and data will be recorded in field notebooks. All sampling locations will be identified by a field assigned number. Field sampling data will be recorded on field data sheets or in field books. Project reports (Technical Memorandums) will be posted to the ERT/Information Management System (IMS) website for this WA. Posting of the reports will be considered as completion of the deliverable.

Documentation and Records: All observations noted during field efforts will be documented in accordance with SERAS SOP #4001, *Logbook Documentation* and SERAS SOP #2002, *Sample Documentation*. Documents and records that will be generated during this project include: WP, UFP-QAPP, HASP, Field and Laboratory Logbooks, Site Map, Sample Labels, COC Records, Field Change Forms, Analytical Reports, Borehole Logs, and Project Reports (Technical Memorandums). Project Reports will be prepared in accordance with SERAS SOP #4018, *Preparation of Interim or Status Reports*. Analytical Reports will be prepared in accordance with SERAS SOP #4020, *Analytical Report Preparation.*
Assessment/Audit Tasks: No performance audit of field operations is anticipated for this project. Management system reviews establish compliance with prevailing management structure, policies and procedures, and ensures that the required data are obtained.
Data Review Tasks: All SERAS project deliverables will receive an internal peer review prior to release, per guidelines established in the SERAS AP #22, *Peer Review of SERAS Deliverables*. Analytical data will be reviewed by the individual laboratories prior to release of the data.

QAPP Worksheet #15-1

Matrix: Soil/Sediment/Dross (FP XRF Metals)

Analytical Group: Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method (SERAS SOP #1720)		Achievable Laboratory Limits (mg/kg) [a]	
				MDLs	Method QLs (mg/kg)	MDLs	QLs
Arsenic	7440-38-2	150*	TBD	15	NS	TBD	1-5X MDL
Lead	7439-92-1		TBD	15	NS	TBD	1-5X MDL

[a] Achievable Laboratory Limits (MDLs) based on 120 second measurements of NIST reference standards and/or SiO_2 blank sample
NS – Not specified
mg/kg – milligrams per kilogram
TBD – Quantitation limits will be established in the field prior to sample analysis.
* This value was determined by the Region 9 RPM as a conservative measure of potential risk.

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Soil/Sediment/Slag/Dross/Waste Rock

Analytical Group: TAL Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit (Residential/ Nonresidential/ Ecological*) (mg/kg)	Project Quantitation Limit (mg/kg)	ISM01.3 Analytical Method	
				MDLs (mg/kg)	CRQLs (mg/kg)
Aluminum	7429-90-5	--/--/--	20	Lab Specific	20
Antimony	7440-36-0	--/--/0.27	6	Lab Specific	6
Arsenic	7440-38-2	61/200/18	1	Lab Specific	1
Barium	7440-39-3	--/--/330	20	Lab Specific	20
Beryllium	7440-41-7	--/--/21	0.5	Lab Specific	0.5
Cadmium	7440-43-9	--/--/**0.36***	0.5	Lab Specific	0.5
Calcium	7440-70-2	--/--/--	500	Lab Specific	500
Chromium	7440-47-3	--/--/--	1	Lab Specific	1
Cobalt	7440-48-4	--/--/13	5	Lab Specific	5
Copper	7440-50-8	--/--/28	2.5	Lab Specific	2.5
Iron	7439-89-6	--/--/--	10	Lab Specific	10
Lead	7439-92-1	400/400/11	1	Lab Specific	1
Magnesium	7439-95-4	--/--/--	500	Lab Specific	500
Manganese	7439-96-5	--/--/220	1.5	Lab Specific	1.5
Mercury	7439-97-6	--/--/--	0.1	Lab Specific	0.1
Nickel	7440-02-0	--/--/38	4	Lab Specific	4

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Soil/Sediment/Slag/Dross/Waste Rock

Analytical Group: TAL Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit (Residential/ Nonresidential/ Ecological*) (mg/kg)	Project Quantitation Limit (mg/kg)	ISM01.3 Analytical Method	
				MDLs (mg/kg)	CRQLs (mg/kg)
Potassium	7440-09-7	--/--/--	500	Lab Specific	500
Selenium	7782-49-2	--/--/**0.52***	3.5	Lab Specific	3.5
Silver	7440-22-4	--/--/4.2	1	Lab Specific	1
Sodium	7440-23-5	--/--/--	500	Lab Specific	500
Thallium	7440-28-0	--/--/--	2.5	Lab Specific	2.5
Vanadium	7440-62-2	--/--/7.8	5	Lab Specific	5
Zinc	7440-66-6	--/--/46	6	Lab Specific	6

* Site specific action level determined by Region 9/human health risk assessment criteria\ most conservative Ecological Soil Screening Levels (EcoSSLs) for properties where ecological pathways exist (http://www.epa.gov/ecotox/ecossl/). Cadmium and selenium benchmarks are under those RLs achievable by ICP. ICP-MS should be used for those metals.

QAPP Worksheet #15-3a
Reference Limits and Evaluation Table

Matrix: Surface Water

Analytical Group: TAL Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit * (µg/L)	Project Quantitation Limit (µg/L)	ISM01.3 (ICP-AES) Analytical Method	
				MDLs (µg/L)	CRQLs (µg/L)
Aluminum	7429-90-5	87[a]	200	Lab Specific	200
Antimony	7440-36-0	--	60	Lab Specific	60
Arsenic	7440-38-2	150	10	Lab Specific	10
Barium	7440-39-3	--	200	Lab Specific	200
Beryllium	7440-41-7	--	5	Lab Specific	5
Cadmium	7440-43-9	0.25	5	Lab Specific	5
Calcium	7440-70-2	--	5000	Lab Specific	5000
Chromium	7440-47-3	--	10	Lab Specific	10
Cobalt	7440-48-4	--	50	Lab Specific	50
Copper	7440-50-8	Calculated[b]	25	Lab Specific	25
Iron	7439-89-6	1,000	100	Lab Specific	100
Lead	7439-92-1	2.5	10	Lab Specific	10
Magnesium	7439-95-4	--	5000	Lab Specific	5000
Manganese	7439-96-5	--	15	Lab Specific	15
Mercury	7439-97-6	0.77	0.2	Lab Specific	0.2
Nickel	7440-02-0	52	40	Lab Specific	40

QAPP Worksheet #15-3a
Reference Limits and Evaluation Table

Matrix: Surface Water

Analytical Group: TAL Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit * (µg/L)	Project Quantitation Limit (µg/L)	ISM01.3 (ICP-AES) Analytical Method	
				MDLs (µg/L)	CRQLs (µg/L)
Potassium	7440-09-7	--	5000	Lab Specific	5000
Selenium	7782-49-2	5.0	35	Lab Specific	35
Silver	7440-22-4	--	10	Lab Specific	10
Sodium	7440-23-5	--	5000	Lab Specific	5000
Thallium	7440-28-0	--	25	Lab Specific	25
Vanadium	7440-62-2	--	50	Lab Specific	50
Zinc	7440-66-6	--	60	Lab Specific	60

*Action limits for surface water collected for the Ecological Assessment are based on the freshwater chronic criteria listed in the EPA Aquatic Life Criteria Table, http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm .

[a] With a pH between 6.5 and 9.5
[b]Calculated based on method described in the above reference using the Biotic Ligand Model

QAPP Worksheet #15-3b
Reference Limits and Evaluation Table

Matrix: Groundwater

Analytical Group: TAL Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit* (µg/L)	Project Quantitation Limit (µg/L)	ISM01.3 (ICP-AES) Analytical Method	
				MDLs (µg/L)	CRQLs (µg/L)
Aluminum	7429-90-5	--	200	Lab Specific	200
Antimony	7440-36-0	6	60	Lab Specific	60
Arsenic	7440-38-2	10	10	Lab Specific	10
Barium	7440-39-3	2000	200	Lab Specific	200
Beryllium	7440-41-7	4	5	Lab Specific	5
Cadmium	7440-43-9	5	5	Lab Specific	5
Calcium	7440-70-2	--	5000	Lab Specific	5000
Chromium	7440-47-3	100	10	Lab Specific	10
Cobalt	7440-48-4	--	50	Lab Specific	50
Copper	7440-50-8	1,300	25	Lab Specific	25
Iron	7439-89-6	1,000	100	Lab Specific	100
Lead	7439-92-1	15	10	Lab Specific	10
Magnesium	7439-95-4	--	5000	Lab Specific	5000
Manganese	7439-96-5	--	15	Lab Specific	15
Mercury	7439-97-6	2	0.2	Lab Specific	0.2
Nickel	7440-02-0	--	40	Lab Specific	40

QAPP Worksheet #15-3b
Reference Limits and Evaluation Table

Matrix: Groundwater

Analytical Group: TAL Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit* (µg/L)	Project Quantitation Limit (µg/L)	ISM01.3 (ICP-AES) Analytical Method	
				MDLs (µg/L)	CRQLs (µg/L)
Potassium	7440-09-7	--	5000	Lab Specific	5000
Selenium	7782-49-2	50	35	Lab Specific	35
Silver	7440-22-4	--	10	Lab Specific	10
Sodium	7440-23-5	--	5000	Lab Specific	5000
Thallium	7440-28-0	2	25	Lab Specific	25
Vanadium	7440-62-2	--	50	Lab Specific	50
Zinc	7440-66-6	--	60	Lab Specific	60

*Based on Federal Maximum Contaminant Levels (MCLs). Sampling data from 2006 through 2012 indicate that groundwater has been impacted by arsenic and lead.

http://water.epa.gov/drink/contaminants/index.cfm

QAPP Worksheet #15-4 (SERAS Laboratory -Samples Relinquished by Region 9 to SERAS) Reference Limits and Evaluation Table

Matrix: Soil (ICP Metals, Microwave Digestion)

Analytical Group: Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit (Residential/ Nonresidential)* (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits (mg/kg) [a]	
				MDLs	Method QLs (mg/kg)	MDLs	QLs
Aluminum	7429-90-5	--	8.5	NS	NS	0.67	8.5
Antimony	7440-36-0	--	1.2	NS	NS	0.28	1.2
Arsenic	7440-38-2	61/200	1	NS	NS	0.30	1
Barium	7440-39-3	--	0.3	NS	NS	0.035	0.3
Beryllium	7440-41-7	--	0.1	NS	NS	0.016	0.1
Boron	7440-42-8	--	1	NS	NS	0.076	1
Cadmium	7440-43-9	--	0.2	NS	NS	0.0082	0.2
Calcium	7440-70-2	--	6	NS	NS	1.14	6
Chromium	7440-47-3	--	0.4	NS	NS	0.046	0.4
Cobalt	7440-48-4	--	0.2	NS	NS	0.029	0.2
Copper	7440-50-8	--	0.5	NS	NS	0.057	0.5
Iron (2599)	7439-89-6	--	7.7	NS	NS	0.407	7.7
Iron (2714)	7439-89-6	--	30	NS	NS	4.03	30
Lead	7439-92-1	400/400	1	NS	NS	0.138	1
Magnesium	7439-95-4	--	20	NS	NS	1.71	20
Manganese	7439-96-5	--	0.2	NS	NS	0.0606	0.2
Molybdenum	7439-98-7	--	0.5	NS	NS	0.0314	0.5
Nickel	7440-02-0	--	0.5	NS	NS	0.049	0.5
Potassium	7440-09-7	--	50	NS	NS	6.31	50
Selenium	7782-49-2	--	1.8	NS	NS	0.275	1.8
Silver	7440-22-4	--	0.5	NS	NS	0.0573	0.5
Sodium	7440-23-5	--	30	NS	NS	2.05	30

QAPP Worksheet #15-4 (SERAS Laboratory -Samples Relinquished by Region 9 to SERAS) Reference Limits and Evaluation Table

Matrix: Soil (ICP Metals, Microwave Digestion)

Analytical Group: Metals

Concentration Level: Low to high

Analyte	CAS Number	Project Action Limit (Residential/ Nonresidential)* (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits (mg/kg) [a]	
				MDLs	Method QLs (mg/kg)	MDLs	QLs
Strontium	7440-24-6	--	0.2	NS	NS	0.0064	0.2
Thallium	7440-28-0	--	1.2	NS	NS	0.095	1.2
Tin	7440-31-5	--	2	NS	NS	0.088	2
Vanadium	7440-62-2	--	0.4	NS	NS	0.082	0.4
Zinc	7440-66-6	--	2.5	NS	NS	0.90	2.5

[a] Achievable Laboratory Limits based on microwave digestion of 0.50 g (dry weight) soil in 50 mL final volume. Based on 01/29/2013 MDL study
NS –Not specified
mg/kg – milligrams per kilogram
* Site specific action level determined by Region 9/human health risk assessment criteria

QAPP Worksheet #15-5 (SERAS Laboratory - Samples Relinquished by Region 9 to SERAS)
Reference Limits and Evaluation Table

Matrix: Soil (Mercury only)

Analytical Group: Metals

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits (mg/kg) [a]	
				MDLs	Method QLs	MDLs	QLs
Mercury	7439-97-6	--	0.040	NS	0.040	NA	0.040

[a] Achievable Laboratory Limits based on digestion of 0.50 g (dry weight) soil in 100 mL final volume
mg/kg – milligrams per kilogram
NA – Not applicable; MDL determined by lowest calibration standard
NS = Not specified
mg/kg – milligrams per kilogram

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Soil/Dross/Slag/Waste Rock

Analytical Group: SPLP Metals

Concentration Level: Low

Analyte	CAS Number	Project Action Limit* (mg/L)	Project Quantitation Limit (mg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs (mg/L)	Method QLs (mg/L)	MDLs (mg/L)	QLs (mg/L)
Arsenic	7440-38-2	0.006	0.2	NS	NS	Lab-specific	0.2
Aluminum	7429-90-5	0.010	10	NS	NS	Lab-specific	10
Barium	7440-39-3	2	0.5	NS	NS	Lab-specific	0.5
Cadmium	7440-43-9	--	0.005	NS	NS	Lab-specific	0.05
Chromium	7440-47-3	0.100	0.1	NS	NS	Lab-specific	0.1
Copper	7440-50-8	1.3	0.4	NS	NS	Lab-specific	0.4
Iron	7439-89-6	--	10	NS	NS	Lab-specific	10
Lead	7439-92-1	0.015	0.3	NS	NS	Lab-specific	0.3
Manganese	7439-96-5	--	0.5	NS	NS	Lab-specific	0.5
Mercury	7439-97-6	0.002	0.00003	NS	NS	Lab-specific	0.00003
Selenium	7782-49-2	0.050	0.2	NS	NS	Lab-specific	0.2
Silver	7440-22-4	--	0.1	NS	NS	Lab-specific	0.1
Zinc	7440-66-6	0.120	0.8	NS	NS	Lab-specific	0.8

NA = Not applicable. Will be used to determine mobility of inorganic analytes present in soil, dross, slag and waste rock materials.
NS = Not Specified

*Based on Federal Maximum Contaminant Levels (MCLs). http://water.epa.gov/drink/contaminants/index.cfm

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: Cr (VI)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit* (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Cr(VI)	7740-47-3	0.29	0.50	NS	NS	0.228	0.50

NS = Not Specified
MDL Study – 4/4/2008
*Human health risk assessment criteria

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Sediment/Dross

Analytical Group: Dioxins/Furans

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (pg/g)	Project Quantitation Limit (pg/g)	Analytical Method		Achievable Laboratory Limits	
				MDLs (pg/g)	Method QLs (pg/g)	MDLs* (pg/g)	QLs (pg/g)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	4.5[a]/0.85	1.00	NS	NS	0.333	1.00
1,2,3,7,8-Pentachloro-dibenzo-p-dioxin (PeCDD)	40321-76-4	--	5.00	NS	NS	1.67	5.00
1,2,3,4,7,8-Hexachloro-dibenzo-p-dioxin (HxCDD)	39227-28-6	--	5.00	NS	NS	1.67	5.00
1,2,3,6,7,8-HxCDD	57653-85-7	--	5.00	NS	NS	1.67	5.00
1,2,3,7,8,9-HxCDD	19408-74-3	--	5.00	NS	NS	1.67	5.00
1,2,3,4,6,7,8-Heptachloro-dibenzo-p-dioxin (HpCDD)	35822-39-4	--	5.00	NS	NS	1.67	5.00
1,2,3,4,6,7,8.9-Octachloro-dibenzo-p-dioxin (OCDD)	3268-87-9	--	10.0	NS	NS	3.33	10.0
2,3,7,8-Tetrachlorodibenzo-furan (TCDF)	51207-31-9	--	1.00	NS	NS	0.333	1.00
1,2,3,7,8-Pentachloro-dibenzofuran (PeCDF)	57117-41-6	--	5.00	NS	NS	1.67	5.00
2,3,4,7,8-PeCDF	57117-31-4	--	5.00	NS	NS	1.67	5.00
1,2,3,4,7,8-Hexachloro-dibenzofuran (HxCDF)	70648-26-9	--	5.00	NS	NS	1.67	5.00
1,2,3,6,7,8-HxCDF	57117-44-9	--	5.00	NS	NS	1.67	5.00

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Sediment/Dross

Analytical Group: Dioxins/Furans

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (pg/g)	Project Quantitation Limit (pg/g)	Analytical Method		Achievable Laboratory Limits	
				MDLs (pg/g)	Method QLs (pg/g)	MDLs* (pg/g)	QLs (pg/g)
1,2,3,7,8,9-HxCDF	72918-21-9	--	5.00	NS	NS	1.67	5.00
2,3,4,6,7,8-HxCDF	60851-34-5	--	5.00	NS	NS	1.67	5.00
1,2,3,4,6,7,8-Heptachloro-dibenzofuran (HpCDF)	67562-39-4	--	5.00	NS	NS	1.67	5.00
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	5.00	NS	NS	1.67	5.00
1,2,3,4,6,7,8,9-Octachloro-dibenzofuran (OCDF)	39001-02-0	--	10.0	NS	NS	3.33	10.0

*MDL based on study from 5/20/2013 Cape Fear Analytical, LLC
NS = Not Specified
[a] Human health risk assessment criteria.
[B] Ecological risk assessment criteria based on EPA Region 3 freshwater sediment benchmark:
http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fwsed/screenbench.htm

QAPP Worksheet #15-9
Reference Limits and Evaluation Table

Matrix: Surface Water and Groundwater

Analytical Group: Water Quality Parameters

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/L)	Project Quantitation Limit (mg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs (mg/L)	Method QLs (mg/L)	MDLs (mg/L)	QLs (mg/L)
Alkalinity	NA	NA	5.0	NS	NS	0.228	5.0
Chloride	7782-50-5	250	2.0	NS	NS	0.595	2.0
Nitrite/Nitrate	14797-55-8	NA	0.05	NS	NS	0.00324	0.05
Sulfate	18785-72-3	250	1.0	NS	NS	0.289	1.0
Phosphate	98059-61-1	NA	0.10	NS	NS	0.0461	0.10
Dissolved Organic Carbon	NA	NA	1.0	NS	NS	0.102	1.0
TDS	NA	500	10	NS	NS	5.02	10
Fluoride	7782-41-4	2.0	0.10	NS	NS	0.007	0.10
Silica (SiO2)	99439-28-8	NA	0.5	NS	NS	0.034	0.5

NS = Not Specified
*Based on secondary MCLs. Groundwater data collected fro2006 through 2012 indicate that the groundwater has been impacted by sulfate, chloride and TDS.

QAPP Worksheet #15-10
Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: Total Organic Carbon (TOC)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (μg/g)	Project Quantitation Limit (μg/g)	Analytical Method		Achievable Laboratory Limits	
				MDLs (μg/g)	Method QLs (μg/g)	MDLs (μg/g)	QLs (μg/g)
TOC	7440-44-0	NA	400	NS	NS	84.8	400

NA = Not applicable
NS = Not specified

QAPP Worksheet #15-11 (ACZ Laboratories – Samples Relinquished by Region 9 to SERAS)
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: IVBA Metals (Pb & As)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (mg/L)	Project Quantitation Limit (mg/L)	Analytical Method		Achievable Laboratory Limits (mg/L)	
				MDLs (mg/L)	Method QLs (mg/L)	MDLs	QLs
Arsenic	7740-38-2	--	0.02	NS	NS	0.004	0.02
Lead	7439-92-1	--	0.01	NS	NS	0.002	0.01

NS = Not specified
Analytical results will be used to compare bioaccessibility of As and Pb among residential and non-residential areas.

QAPP Worksheet #15-12
Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: IVBA Metals (Pb & As)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/L)	Project Quantitation Limit (mg/L)	Analytical Method		Achievable Laboratory Limits (mg/L)	
				MDLs (mg/L)	Method QLs (mg/L)	MDLs	QLs
Arsenic	7740-38-2	--	0.2	NS	NS	Lab Specific	0.2
Lead	7439-92-1	--	0.3	NS	NS	Lab Specific	0.3

NS = Not specified
Analytical results will be used to compare bioaccessibility of As and Pb among residential and non-residential areas.

QAPP Worksheet #15-13
Reference Limits and Evaluation Table

Matrix: Plant Tissue

Analytical Group: Metals

Concentration Level: Low

Analyte	CAS Number	Project Action Limit* (mg/kg dry weight)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (mg/kg)	MDLs (mg/kg)	QLs[1] (mg/kg)
Aluminum	7429-90-5	NS	30	NS	NS	0.51	30
Antimony	7440-36-0	NS	0.10	NS	NS	0.020	0.10
Arsenic	7440-38-2	18	0.50	NS	NS	0.15	0.50
Barium	7440-39-3	NS	0.20	NS	NS	0.037	0.20
Beryllium	7440-41-7	NS	0.10	NS	NS	0.0041	0.10
Cadmium	7440-43-9	32	10	NS	NS	0.0076	0.10
Calcium	7440-70-2	NS	0.40	NS	NS	3.83	10
Chromium	7440-47-3	NS	0.10	NS	NS	0.05	0.40
Cobalt	7440-48-4	13	0.30	NS	NS	0.0054	0.10
Copper	7440-50-8	70	10	NS	NS	0.071	0.30
Iron	7439-89-6	NS	0.10	NS	NS	2.40	10
Lead	7439-92-1	120	0.20	NS	NS	0.0070	0.10
Magnesium	7439-95-4	NS	0.20	NS	NS	1.37	10
Manganese	7439-96-5	220	100	NS	NS	0.042	0.20
Nickel	7440-02-0	38	0.10	NS	NS	0.026	0.20
Potassium	7440-09-7	NS	100	NS	NS	4.6	100
Selenium	7782-49-2	0.52	0.10	NS	NS	0.039	0.50
Silver	7440-22-4	560	0.50	NS	NS	0.0066	0.10
Sodium	7440-23-5	NS	1.0	NS	NS	2.6	100

QAPP Worksheet #15-13
Reference Limits and Evaluation Table

Matrix: Plant Tissue

Analytical Group: Metals

Concentration Level: Low

Analyte	CAS Number	Project Action Limit* (mg/kg dry weight)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (mg/kg)	MDLs (mg/kg)	QLs[1] (mg/kg)
Thallium	7440-28-0	NS	0.10	NS	NS	0.0094	0.10
Vanadium	7440-62-2	NS	0.20	NS	NS	0.11	0.50
Zinc	7440-66-6	160	0.10	NS	NS	0.13	1.0

[1]QLs are based on a solid material without any solids adjustment for moisture

* Project action limits are based on Ecological Soil Screening Levels for plants listed at http://www.epa.gov/ecotox/ecossl/

NS = Not specified

QAPP Worksheet #15-14
Reference Limits and Evaluation Table

Matrix: Plant Tissue

Analytical Group: Hg

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs	**Method QLs (mg/kg)**	**MDLs (mg/kg)**	**QLs (mg/kg)**
Mercury	7439-97-6	NL	0.040	NS	NS	NS	0.040

NS = Not specified
NL – Not listed in Eco-Tox database

QAPP Worksheet #16
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY) Anticipated Date(s) of Initiation	Dates (MM/DD/YY) Anticipated Date of Completion	Deliverable	Deliverable Due Date
Accelerated Lead Sampling	SERAS	8/12/13	8/16/13	Trip Report	TBD
FP XRF Analysis	SERAS	8/12/13	8/16/13	Technical Memo	TBD
Site Historic Railway Survey	SERAS	8/27/13	9/20/13	Survey	TBD
Construction Material Survey	SERAS	8/27/13	9/13/13	Survey	TBD
Site Aerial Survey & Topo	SERAS, EPA R9	8/27/13	8/30/13	Survey	TBD
Initial SAP	SERAS	8/27/13	9/20/13	SAP	9/20/13
H&S Plan	SERAS	9/5/13	10/23/13	H&S Plan	Prior to field activities
Work Plan Preparation	SERAS	9/6/13	9/25/13	Work Plan (WP)	9/25/13
QAPP Preparation	SERAS	9/6/13	12/23/13	QAPP	12/23/13
Surveying Subcontract – RFP thru Award	SERAS	9/17/13	11/13/13	NA	NA
Dust Suppression - RFP thru Award	SERAS	9/17/13	12/3/13	NA	NA
Draft Expanded SAP	SERAS	9/20/13	11/7/13	DRAFT Final Field Sampling Plan (FSP)	11/7/13
EPA Review of Draft FSP	ERT, EPA R9	11/7/13	11/14/13	NA	NA
Final FSP	SERAS	11/14/13	11/20/13	Final FSP	11/20/13
Drilling – RFP thru Award (Borings)	SERAS	1/13/14	4/14/14	NA	NA
Obtain Access to Private Properties	SERAS, ERT, EPA R9	11/3/13	2/14/14	NA	NA

QAPP Worksheet #16
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Drilling Subcontract – RFP thru Award (11 New Wells)	SERAS	11/7/13	1/7/14	NA	NA
Site Mobilization – Set-up field office and field laboratory; handle logistics	SERAS, ERT, EPA R9	11/12/13	11/14/13	Technical Memo	TBD
Borehole Geophysics - RFP thru Award (11 New Wells)	SERAS	11/8/13	12/12/13	NA	NA
Survey Dam and Pin Installation	SERAS	1/13/14	1/17/14	Survey	TBD
Residential; MTP, Smelter and Clayton Property Sampling	SERAS, ERT	1/21/14	3/11/14	Technical Memo	TBD
Shallow Borings, MTP, Smelter Tailings, Chapparal Gulch and Dam	SERAS	2/24/14	4/4/14	Technical Memo	TBD
Dross Sampling	SERAS, ERT	1/21/14	2/5/14	Technical Memo	TBD
Sample Analysis	EPA R9	12/9/13	6/13/14	Technical Memo	TBD
Surface Geophysics of Smelter Tailings	SERAS, ERT	1/2/14	1/8/14	Technical Memo	TBD
Drill 11 New Wells and Collect Borehole Geophysics	SERAS	1/13/14	2/21/1	Technical Memo	TBD
Install and Initiate Stream Monitoring Stations	SERAS, ERT	3/7/14	4/4/14	Technical Memo	TBD
Acquire Stream Monitoring Data	SERAS, ERT	4/7/14	9/22/14	Technical Memo	TBD

QAPP Worksheet #16
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
3 Borings/Wells MTP (Geotechnical Sampling, CPT, Well Completion)	SERAS	4/7/14	4/30/14	TBD	TBD
Well Survey	SERAS	5/1/14	5/8/14	Survey	TBD
Groundwater Sampling	SERAS	5/9/14	5/29/14	Technical Memo	TBD
Biological Survey and Assessment	SERAS, ERT	4/7/14	4/10/14	Technical Memo	TBD
Groundwater Sample Analysis		5/30/14	6/26/14	Analytical report	TBD
Dust Control activities	SERAS	4/7/14	4/18/14	NA	NA
Waste volume Estimate	SERAS	TBD	TBD	Letter Report of Waste Rock Volume	TBD
Final Technical Memo	SERAS	5/27/14	9/22/14	Technical memorandum	TBD

NA Not applicable
TBD To be determined

QAPP Worksheet #17
Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach): Sampling designs and approaches were determined by Region 9 and their contractor (CH2MHILL). Sampling locations and depths, matrices to be sampled, and sample numbers were chosen by Region 9 to fill data gaps identified in the Iron King Mine-Humboldt Smelter Superfund Site *Draft Data Gap Analysis Report* (April 2013). Additional data is required to develop and evaluate remedial alternatives, further delineate potentially impacted areas, evaluate the impact of groundwater and surface water transport of smelter-related materials to the surrounding areas, and to complete an ecological and human health risk assessment.
Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]: Field duplicates will be collected at a rate of 5% for all matrices. Matrix spike/matrix spike duplicates (MS/MSDs) will also be collected at a rate of 5%. FP XRF results will be confirmed at a rate of 5% for non-residential areas and 10% for residential properties. Refer to Attachments 1 and 2 for a detailed description of sampling & monitoring designs, rationales and methodologies.

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2)])	Sampling SOP Reference	Rationale for Sampling Location
January 2014 through Spring 2014							
MTP-SB*-# (3 deep borings; 2 in Upper MTP, 1 in Lower MTP)	Soil	Undisturbed & unconsolidated samples at 10 foot intervals	M-D HC SG SWCC GS A-L Consol Shear CU	NA	24 6 6 3 20 20 3 3 3	2012	Delineation
		Per borehole: at surface, at perched water zones, in saturated tailings, below tailings	TAL ABA Cr(VI) SPLP	Low to High	12	2012	Delineation
WR-*	Waste Rock	Surface	Slake TAL ABA SPLP	Low to High	5	2012	Delineation
MTP-IVBA-*	Soil	Surface	IVBA (Pb & As)	Low	10	2012	Bioaccessibility
IKM-SB*-# (minimum of 11 borings)	Soil	Minimum: top and bottom of borehole	Pb & As (FP XRF)	Low to High	22	2012	Delineation
			TAL	Low to High	~2	2012	Confirmation

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2)])	Sampling SOP Reference	Rationale for Sampling Location
IKM-SB*-# (130 hand borings)	Soil	NE of main retention pond: 2 @ surface & 1 ft.; 2 @ surface, 1ft. & 2 ft. North of MTP: surface 1 ft. & 3 ft. N/NE of MTP: Surface & 1 ft. Waste Rock Area: surface & 1 ft South of MTP: surface & 1 ft.	Pb & As (FP XRF)	Low to High	285	2012	Delineation
			TAL	Low to High	~15	2012	Confirmation
GAL-SB*-# (12 hand borings)	Soil	Surface & 1 ft.	Pb & As (FP XRF)	Low to High	24	2012	Delineation
			TAL	Low to High	2	2012	Confirmation
GAL-IVBA-*	Soil	Surface	IVBA (Pb & As)	Low	5	2012	Bioaccessibility
UND*-* (~38-40 hand borings)	Soil	Surface & 1 ft.	Pb & As (FP XRF)	Low to High	~80	2012	Delineation
			TAL	Low to High	~7	2012	Confirmation
ASH-SB*-#	Dross	Top & Bottom of Dross	Pb & As (FP XRF)	Low to High	400	2012	Delineation
			TAL	Low to High	20	2012	Confirmation

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2)])	Sampling SOP Reference	Rationale for Sampling Location
ASH-* (unconslidated)	Dross	Surface	SPLP Metals ABA	Low	≤4	2012	Delineation
			Dioxins/Furans	Low	2	2012	Delineation
PS-SB*-# (15 borings)	Soil	Surface, intermediate depth TBD, bottom	Pb & As (FP XRF)	Low to High	45	2012	Delineation
			TAL	Low to High	3	2012	Confirmation
		TBD (to include range of materials encountered)	GS Moisture A-L	NA	6	2012	Characterization
SL-SS-#	Slag	Surface	TAL Metals SPLP Metals ABA SG	Low to High	3	2012	Characterization/ Delineation
STS-SB*-# (40 borings)	Soil	Surface & at 5 ft intervals to bottom	Pb & As (FP XRF)	Low to High	>120	2012	Delineation
			TAL	Low to High	6	2012	Delineation/ Confirmation
		From 2 of the 40 borings: 1 from upper portion of tailings, 1 from lower portion of tailings	SPLP Metals Cr(VI) ABA	Low to High	4	2012	Delineation

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2)])	Sampling SOP Reference	Rationale for Sampling Location
STS-SB*-# (40 borings)	Soil	TBD	GS Moisture A-L	NA	2	2012	Characterization
CHF-SB*-# (50 borings)	Soil	Surface & at 5 ft intervals to bottom	Pb & As (FP XRF)	Low to High	<150	2012	Transects/ delineation
			TAL	Low to High	8	2012	Confirmation/ delineation
		From 4 of the 50 borings: 1 from upper portion of tailings, 1 from lower portion of tailings	SPLP Metals Cr(VI) ABA	Low to High	8	2012	Delineation
		Between 2 & 4 ft.	GS Moisture A-L	NA	10	2012	Characterization
CHF-IVBA-*	Soil	Surface	IVBA (Pb & As)	Low	5	2012	
DAM-SB*-# (6 borings)	Soil	Surface, bottom , and 3 intermediate depths TBD	Pb & As (FP XRF)	Low to High	30	2012	Delineation
			TAL	Low to High	2	2012	Confirmation
		From 3 borings: middle inteval TBD and bottom	GS Moisture A-L	NA	6	2012	Characterization
		From 3 borings: upper and lower zone	TAL Metals SPLP Metals ABA	Low to High	6	2012	Delineation

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2])	Sampling SOP Reference	Rationale for Sampling Location
CH-SB*-# (15 borings; near 3rd Street)	Soil	Surface, & 5ft. intervals to bottom depth	Pb & As (FP XRF)	Low to High	>45	2012	Delineation
			TAL	Low to High	3	2012	Confirmation
		2 to 4 ft. interval	GS Moisture A-L	NA	6	2012	Characterization
CH-IVBA-* (Chaparral Gulch near 3rd Street)	Soil	Surface	IVBA (Pb & As)	Low	2	2012	Bioaccessibility
CH-SB*-# (29 borings; between 3rd Street & Smelter)	Soil	Surface, & 5ft. intervals to bottom depth	Pb & As (FP XRF)	Low to High	>69	2012	Delineation
			TAL	Low to High	4	2012	Confirmation
		2 to 4 ft. interval	GS Moisture A-L	NA	6	2012	Characterization
CH-IVBA-* (Chaparral Gulch between 3rd Street & Smelter)	Soil	Surface	IVBA (Pb & As)	Low	1	2012	Bioaccessibility
BIOPL-*	Plant tissue	NA	TAL Metals	Low	10	2037	Ecological Assessment
BIOSS-*	Soil	Near surface	TAL Metals	Low	10	2012	Ecological Assessment
AG-SED-*	Sediment	Near surface	TAL Metals	Low to high	12	2016	Delineation
AG-SED-*	Sediment	Near surface	Dioxins/Furans TOC	Low	5	2016	Delineation

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2)])	Sampling SOP Reference	Rationale for Sampling Location
AG-SW-*	Surface Water	Surface	TAL Metals	Low to high	12	2013	Delineation
			WQ	Low	3	2013	Characterization
BIOSED-*	Sediment	Near surface	TAL Metals	Low to high	12	2016	Ecological Assessment
CHD-SED*-#	Sediment	Surface and total depth	Pb & As (FP XRF)	Low to High	18	2016	Delineation
			TAL Metals	Low to high	1	2016	Confirmation
CHD-SW-*	Groundwater Seep	Subsurface	TAL Metals WQ	Low to high	2	2013	Delineation
RA-* (Residential Screening)	Soil	<0.2 ft	Pb & As (FP XRF)	Low to High	150	2012	Delineation
			TAL Metals	Low to High	15	2012	Confirmation
RS-*	Soil	<0.2 ft	Pb & As (FP XRF)	Low to High	2200	2012	Risk Assessment
			TAL Metals	Low to High	220	2012	Confirmation
			Pb & As (IVBA)	Low to High	10	2012	Bioaccessibility

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

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples[1] (identify field duplicates[2])	Sampling SOP Reference	Rationale for Sampling Location
BIOSW-*	Surface Water	Surface	TAL Metals	Low to High	2	2007	Bioaccessibility/ Delineation
MW-* (11 new wells; 11 existing wells)	Groundwater	TBD	WQ Parameters TAL Metals	Low	44	2007	Delineation

[1]The number of samples listed in this column is the initial number of samples to be collected. Because the objective in most areas is to further delineate impacted matrices and a step-out sampling approach will be employed, the number of samples per area and matrix are expected to increase.
[2]Field duplicates will be collected at rates/numbers specified in Worksheets 17 and 20. Determination of where to collect field duplicates will be made in the field.

RS = Residential Risk Assessment Screening
MTP = IKM Main Tailings Pile
IKM = Iron King Property (peripheral areas))
UND = Undeveloped Areas
SL = Smelter Plateau Area – slag material
STS = Smelter Tailings Swale (above floodplain)
CHF = Chaparral Gulch Floodplain
CHD = Chaparral Gulch (downstream of Dam)
MW = Monitor Wells

RA = Residential Full Risk Assessment Characterization
WR = IKM Main Tailings Pile – waste rock
GAL = Galena Gulch
ASH = Smelter Plateau Area – dross material
PS = Smelter Plateau Area – Plateau soils
CH = Chaparral Gulch (upstream of floodplain)
DAM = Dam/Area behind the Dam
AF = Agua Fria

SS = surface soil
SB = soil boring
SED = sediment
SW = surface Water

IVBA = Bioaccessibility Soil Sample (*In Vitro* Bioaccessibility Testing)
BIOPL = Bioassessment Plant Samples
BIOSS = Bioassessment Soil Samples
BIOSED = Bioassessment Sediment Samples

WQ = water quality parameters
FP XRF = Field Portable X-ray Fluorescence
ABA = Acid Base Accounting
TOC = Total Organic Carbon

TAL = Target Analyte List – 23 metals
SPLP = Synthetic Precipitation Leaching Procedure
Cr(VI) = Hexavalent Chromium

* = Incremental number starting at 1 for each sampling area (e.g., WR, PS) or type (e.g. IVBA, borehole) and incrementing upwards to the total number of boreholes and/or samples in that area or of that type.
# = depth
TBD = to be determined
~ = approximately
dup=duplicate

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Samples Collected by EPA Region 9 and Relinquished to SERAS September 2013							
Soil	TAL Metals	Low to high	SERAS SOP #1811/1832	0.5 - 2.0 g	1, 8 oz., glass	Cool to <6 ^{o} C	6 months Hg: 28 days
Soil	Metals: IVBA (Pb & As)	Low	ACZ SOP #SOPII022.07.13.09	NS	1, 8-oz glass	Filtered extracts: Cool to 4^{o} C	6 months until extraction/ One week from extraction
January 2014 – Spring 2014							
Soil (NITON XLt792YW)	Metals: As & Pb	Low to high	SERAS SOP#1720	10- 20 g	1 ziptop baggie	Dried/seived	NA
Soil/Sediment/Slag/ Waste Rock	TAL Metals	Low to high	ISM01.3	250 grams	(1) 8 oz. wide mouth glass jar w/Teflon lined cap	Cool to <6 ^{o} C	6 months 28 days for Hg
Plant tissue (seeds/grasses)	TAL Metals	Low	Katahdin SOPs #CA-627-09 #CA-611-09	--	1 ziptop baggie	Cool to 4^{o} C	Dried/6 months 28 days for Hg
Sediment	TOC	NA	Katahdin SOP #CA-741-05	100 g	1, 4 oz. glass jar	Cool to 4^{o} C	28 days
Sediment/Dross material	Dioxins/furans	Low	Cape Fear SOP #CF-OA-E-001 and -002	10 g	1, 8 oz amber glass jar	Cool to <6 ^{o} C	30 days to extract; 45 days to analyze
Water	TAL Metals	Low	ISM01.3	1 L	1, 1-L poly MS/MSD: 2, 1-L poly	Acidify to pH<2 with HNO_3 and cool to <6 ^{o} C	Hg: 28 days; Other Metals: 6 months

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil (SPLP extracts)	SPLP (RCRA 8 + 5)	Low to high	EPA R9 SOP 254 EPA R9 SOP 407 EPA R9 SOP 503 EPA R9 SOP 515	--	1, 16 oz. jar	Cool to ≤ 6 °C	SPLP Extraction with in 28 days for Hg and 6 months for all other metals; From preparation/ extraction to analysis 28 days for Hg and 6 months for all other metals
Soil	Cr (VI)	Low to high	Katahdin SOP #CA-625-06	2.5 g	1, 4 oz. amber glass jar w/Teflon lined cap (zero head space)	Cool to 4°C	30 days to digest/ and additional 7 days to analyze
Soil	Acid Base Accounting (ABA)	NA	ASTM D2974-07a; Neutralization Potential; Grind; Saturated Paste pH; ASTM E1915-09; ABA	250-500 g	2, 8 oz. glass	None	NA
Soil	IVBA (As and Pb)	Low to high	EPA R9 SOP 256 EPA R9 SOP 407 EPA R9 SOP 503	50 g of air dried soil <2mm	1, 8-oz glass	Filtered extracts: Cool to 4° C	One week from extraction
Geotechnical Testing							
Soil	Moisture-Density	NA	ASTM D2937	NA	6 inches	Undisturbed; room temperature; indirect sunlight	NA
Soil	Hydraulic conductivity	NA	ASTM D5084	NA	6 inches – Shelby Tube	Undisturbed; room temperature; indirect sunlight	NA
Soil	Specific Gravity	NA	ASTM D854	8 oz., <0.475 mm	8 oz., <0.475 mm	Room temperature; indirect sunlight	NA

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	Grain Size	NA	ASTM D422	~1 pound	3, 16n oz. jars	Room temperature; indirect sunlight	NA
Soil	Atterberg Limits	NA	ASTM D4318	8 oz., <0.425 mm	8 oz., <0.425 mm	Room temperature; indirect sunlight	NA
Soil	Moisture	NA	ASTM D2216	NA	2, 8 oz. jars	Room temperature; indirect sunlight	NA
Soil	Consolidation Test	NA	ASTM D2435	NA	6 inches	Undisturbed; room temperature; indirect sunlight	NA
Soil	Direct Shear Test	NA	ASTM D2080	NA	6 inches (6 rings min.)	Undisturbed; room temperature; indirect sunlight	NA
Soil	Consolidation Test	NA	ASTM D4767	NA	18 inches	Undisturbed; room temperature; indirect sunlight	NA
Soil	Soil Water Characteristic Curves	NA	ASTM D6836	NA	1, 8 oz. jar	Room temperature; indirect sunlight	NA
Rock	Slake durability	NA	ASTM D4644	10 pieces (~1”)	10 pieces (~1”)	Room temperature; indirect sunlight	NA
Water Quality Parameters							
Water	Alkalinity	Low	Katahdin SOP #CA-739-09	100 mL	1, 1-L poly	Cool to 4^o C; settled	14 days
Water	Chloride	Low	Katahdin SOP #CA-768-03	100 mL	1, 1-L poly	Cool to 4^o C	28 days
Water	Nitrate	Low	Katahdin SOP #CA-728-08	100 mL	1, 1-L poly	Cool to 4^o C Acidify to pH<2 with H_2SO_4	28 days

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Water	Sulfate	Low	Katahdin SOP #CA-721-03	100 mL	1, 1-L poly	Cool to <6^{o} C	28 days
Water	Phosphate	Low	Katahdin SOP #CA-715-06	100 mL	1, 1-L poly	Cool to 4^{o} C; Acidify to pH<2 with H_2SO_4	28 days
Water	Silicon	Low	Katahdin SOP #CA-627-09	100 mL	1, 1-L poly	Acidify to pH<2 with HNO_3	6 months
Water	Dissolved Organic Carbon	Low	Katahdin SOP #CA-763-07	80 mL	(2) 40 mL VOA vial	Filtered then preserve with H_2SO_4; Cool to 4^{o} C	28 days
Water	TDS	Low	Katahdin SOP #CA-719-07	100 mL	1, 1-L poly	Cool to 4^{o} C	7 days
Water	Fluoride	Low	Katahdin SOP #CA-742-09	100 mL	1, 1-L poly	Cool to 4^{o} C	28 days

NS: not specified

QAPP Worksheet #20 (January 2014 – Spring 2014)
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Samples	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Field Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Soil/Sediment Dross/Slag (NITON XLt792YW)	Metals: As & Pb	Low to high	SOP#1720	3,638	NA	NA	NA	NA	NA	3,638
Soil	TAL Metals	Low to high	ISM01.3	315	16	16	NA	NA	NA	331
Waste Rock	TAL Metals	Low to high	ISM01.3	5	1	1	NA	NA	NA	6
Dross	TAL Metals	Low to high	ISM01.3	20	1	1	NA	NA	NA	21
Sediment	TAL Metals	Low to high	ISM01.3	25	2	2	NA	NA	NA	27
Slag	TAL Metals	Low to high	ISM01.3	3	1	1	NA	NA	NA	4
Soil (SPLP extracts)	SPLP (RCRA 8 + 5)	Low	EPA R9 SOP 254 EPA R9 SOP 407 EPA R9 SOP 503 EPA R9 SOP 515	30	NA	2	NA	NA	NA	32
Waste Rock (SPLP extracts)	SPLP (RCRA 8 + 5)	Low	EPA R9 SOP 254 EPA R9 SOP 407 EPA R9 SOP 503 EPA R9 SOP 515	5	NA	1	NA	NA	NA	5
Dross (SPLP extracts)	SPLP (RCRA 8 + 5)	Low	EPA R9 SOP 254 EPA R9 SOP 407 EPA R9 SOP 503 EPA R9 SOP 515	4	NA	1	NA	NA	NA	4
Slag (SPLP extracts)	SPLP (RCRA 8 + 5)	Low	EPA R9 SOP 254 EPA R9 SOP 407 EPA R9 SOP 503 EPA R9 SOP 515	3	NA	1	NA	NA	NA	3
Soil	IVBA (As and Pb)	Low	EPA R9 SOP 256 EPA R9 SOP 407 EPA R9 SOP 503	33	NA	2	NA	NA	NA	33
Soil	Cr (VI)	Low to high	Katahdin SOP #CA-625-06	24	2	2	NA	NA	NA	26

QAPP Worksheet #20 (January 2014 – Spring 2014)
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Samples	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Field Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Soil	Acid Base Accounting (ABA)	NA	ASTM D2974-07a; Neutralization Potential; Grind; Saturated Paste pH; ASTM E1915-09; ABA	30	NA	NA	NA	NA	NA	30
Dross	Acid Base Accounting (ABA)	NA	ASTM D2974-07a; Neutralization Potential; Grind; Saturated Paste pH; ASTM E1915-09; ABA	4	NA	NA	NA	NA	NA	2
Slag	Acid Base Accounting (ABA)	NA	ASTM D2974-07a; Neutralization Potential; Grind; Saturated Paste pH; ASTM E1915-09; ABA	3	NA	NA	NA	NA	NA	3
Waste Rock	Acid Base Accounting (ABA)	NA	ASTM D2974-07a; Neutralization Potential; Grind; Saturated Paste pH; ASTM E1915-09; ABA	5	NA	NA	NA	NA	NA	5
Plant tissue (seeds/ grasses)	TAL Metals	Low	Katahdin SOPs #CA-627-09 #CA-611-09	10	NA	1	NA	NA	NA	10
Sediment	TOC	NA	Katahdin SOP #CA-741-05	5	1	NA	NA	NA	NA	6
Sediment	Dioxins/ furans	Low	Cape Fear SOP #CF-OA-E-001 and -002	5	1	NA	NA	NA	NA	6

QAPP Worksheet #20 (January 2014 – Spring 2014)
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Samples	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Field Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Dross	Dioxins/ furans	Low	Cape Fear SOP #CF-OA-E-001 and -002	2	1	NA	NA	NA	NA	3
Surface Water	TAL Metals	Low	ISM01.3	16	1	1	NA	NA	NA	17
Groundwater	TAL Metals	Low	ISM01.3	44	3	3	NA	NA	NA	47
Groundwater/ Surface water	Alkalinity	Low	Katahdin SOP #CA-739-09	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Chloride	Low	Katahdin SOP #CA-768-03	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Nitrite/Nitrate	Low	Katahdin SOP #CA-728-08	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Sulfate	Low	Katahdin SOP #CA-721-03	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Phosphate	Low	Katahdin SOP #CA-715-06	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Silica	Low	Katahdin SOP #CA-627-09	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Dissolved Organic Carbon	Low	Katahdin SOP #CA-763-07	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	TDS	Low	Katahdin SOP #CA-719-07	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53
Groundwater/ Surface water	Fluoride	Low	Katahdin SOP #CA-742-09	44 groundwater 5 surface water	3 groundwater 1 surface water	NA	NA	NA	NA	53

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
1720	Operation of the Niton XLT 792YW Field Portable X-Ray Fluorescence Unit, Revision 2, 12/7/12	SERAS	Field X-ray Fluorescence Analyzer	No	
2001	General Field Sampling Guidelines, Rev.1, 6/7/13	SERAS		No	
2002	Sample Documentation, 10/03/94	SERAS		No	
2003	Sample Storage, Preservation and Handling, 8/11/94	SERAS		No	
2004	Sample Packing and Shipment, 11/30/2001	SERAS		No	
2005	Quality Assurance/Quality Control Samples, 8/11/94	SERAS		No	
2006	Sampling Equipment Decontamination, 08/11/94	SERAS		No	
2007	Groundwater Well Sampling, 1/26/95	SERAS	Peristalic pump	No	
2012	Soil Sampling, 2/18/00	SERAS	Hand trowel Hand auger Soil Borings	No	
2013	Surface Water Sampling, 2/15/02	SERAS		No	
2016	Sediment Sampling, 11/17/94	SERAS		No	
2034	Plant Biomass Determination, 11/17/94	SERAS		No	
2037	Terrestrial Plant Community Sampling, 10/19/94	SERAS		No	
2038	Vegetation Assessment Field Protocol, 6/24/1996	SERAS		No	
2043	Water Level Measurement, Rev. 1, 5/28/13	SERAS	Electronic indicator	No	

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
2044	Well Development, Rev. 0.1, 9/06/01	SERAS		No	
2048	Monitor Well Installation, 07/12/01	SERAS		No	
2052	Operation of the Geonics EM-31-MK2 Terrain Conductivity Meter, 9/30/2010	SERAS	Conductivity Meter	No	
2056	Ground Penetrating Radar, 9/30/2010	SERAS	Smartcart	No	
2074	Description and identification of Soils, 02/23/04	SERAS		No	
4005	Chain of Custody Procedures, 10/13/01	SERAS		No	
June 2003	Syscal Pro User's Manual	SERAS	Resistivity Meter	No	
Jan 2002	Protem 47D Operating Manual for 20/30 Gate Model	Geonics	Transient Electromagnetic Meter	No	
Version 1.0, Rev B, May 2012	GeoExplorer 3000 Series	Trimble	GPS	No	

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
NITON XLt792YW	NA	Check condition of connectors and cables	NA	NA	With each use	Good condition	Replace or send in for factory service	XRF Analyst	1720
	Check energy calibration	NA	Perform energy calibration	NA	With each use and every 4 to 6 hours during sample analysis	Proper calibration	Power down, power up, logon, wait 10 minutes, re-check calibration; if continues to fail, send in for factory service	XRF Analyst	1720
	Check resolution	NA	After energy calibration	NA	With each use	Consistent with previous performance, typically less than 250 eV	If significantly higher than 250 eV, check SRMs and/or send in for factory service	XRF Analyst	1720
	NA	Check battery condition	NA	NA	With each use	Charged	Replace and/or charge as necessary	XRF Analyst	1720
	Check zero sample	NA	Analyze SiO_2 or sand blank	NA	With each use	All results non-detects	Repeat, if continues to fail, check SRMs and/or send in for factory service/calibration	XRF Analyst	1720
	Check target element response with reference standard	NA	Analyze reference standards	NA	With each use	Element results typically within ±20% of true values for concentrations 5x RL. For ERA SRM, %RSD ±20%	Repeat. If still fails, send in for factory service/calibration	XRF Analyst	1720

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Trimble GPS	NA	As per manufacturer's instructions	As per manufacturer's instructions	Check Battery	Daily	Able to pick up signal	Recharge or replace battery	Field personnel	Trimble Users Manual
Horiba Multiparameter Water Quality Meter	pH/ORP Probe	Clean probe/keep moist	Calibration relative to standardized solutions	Visual Inspection	Monthly and/or Before each use	Reads standard solution within +/- 10 percent	Clean, Recalibrate; Send to manufacturer for repair and calibration	Field personnel	Per manufacturer's recommen-dations.
	DO Probe	Clean probe/keep moist	Calibration relative to standardized solutions	Visual Inspection	Monthly and/or Before each use	Reads standard solution within +/- 10 percent	Replace membrane and HCL solution, Recalibrate; Send to manufacturer for repair and calibration	Field personnel	Per manufacturer's recommen-dations.
	Turbidity Probe	Clean probe/keep moist	Calibration relative to standardized solutions	Visual Inspection	Monthly and/or Before each use	Reads standard solution within +/- 10 percent	Clean, Recalibrate; Send to manufacturer for repair and calibration	Field personnel	Per manufacturer's recommen-dations.
	Conductivity Probe	Clean probe/keep moist	Calibration relative to standardized solutions	Visual Inspection	Monthly and/or Before each use	Reads standard solution within +/- 10 percent	Clean, Recalibrate; Send to manufacturer for repair and calibration	Field personnel	Per manufacturer's recommen-dations..
Syscal Pro Resistivity Meter	Resistivity check for electrode coupling	Keep batteries charged	Comparison with standardized area	Visual inspection	Annually	Reproducible data in standardized area	Send to manufacturer for repair and calibration	Geo personnel	User's Manual
Geonics EM31-MK2 Terrain Conductivity Meter	Nulling	Keep batteries charged. Set polycorder clock prior to survey	Functional checks, battery check and comparison with standardized area	Visual inspection	Prior to each use	Functional checks Zero reading: +/- 0.1 ppt; Phase check: +/- 0.2 mS/m; Sensitivity 22 -26 mS/m and reproducible data in standardized area	Send to manufacturer for repair and calibration	Geo personnel	SERAS SOP #2052

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Ground Penetrating Radar SmartCart Noggin	Calibrate Odometer with measuring Tape	Keep batteries charged	Comparison with standardized area	Visual inspection	Annually	Reproducible data in standardized area	Send to manufacturer for repair and calibration	Geo personnel	SERAS SOP #2056
Water level meter	NA	Check batteries	NA	Visual inspection	Annually	Three consecutive measurements from same location within 0.02 ft	Document	Geo personnel	SERAS SOP #2043

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
Samples Collected by EPA Region 9 and Relinquished to SERAS September 2013						
SOPII022.07.13.09	Elemental Analysis by Agilent 7500ce ICPMS EPA M200.8/M6020; July 19, 2012	Definitive	IVBA for Pb and As	ICP-MS	ACZ Laboratories, Inc.	No
SOPSO048.06.13	In Vitro Bioaccessibility Assay for Metals in Soil, June 14, 2013	Definitive	IVBA for Pb and As	NA	ACZ Laboratories, Inc.	No
SERAS SOP 1811	Digestion and Analysis of Metals by Inductively Coupled Plasma/Atomic Emission Spectrometry (ICP-AES); 1/10/12, Rev. 4.0	Definitive	Metals	ICP-AES	ERT/SERAS Laboratory	No
SERAS SOP 1832	Digestion and Analysis of Mercury by Cold-Vapor atomic Absorption (CVAA); 01/10/12; Rev. 4.0	Definitive	Mercury	Leeman Hg Analyzer	ERT/SERAS Laboratory	No
January 2014 through Spring 2014						
ISM01.3	USEPA Contract Laboratory Program Statement of Work for Multi-Media, Multi-Concentration Inorganic Analysis; December 2006	Definitive	Target Analyte List Metals	ICP-AES	CLP Laboratory	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
EPA R9 SOP 254	Standard Operating Procedure 254, Bioaccessibility SPLP Extraction; 03/01/11, Rev. 1	NA	SPLP (extraction)	NA	EPA Region 9 Laboratory	No
EPA R9 SOP 256	Standard Operating Procedure 256, Bioaccessibility Extraction; 06/03/11, Rev. 1	NA	IVBA – Pb & As (extraction)	NA	EPA Region 9 Laboratory	No
EPA R9 SOP 407	Standard Operating Procedure 407, Preparation of Leachate Procedure Extracts for Metals Analysis; 10/10/11, Rev. 2	Definitive	IVBA – Pb & As and SPLP (digestion)	NA	EPA Region 9 Laboratory	No
EPA R9 SOP 503	Standard Operating Procedure 503, Standard Determination of Trace Elements in Solids and Leachate Procedure Extracts by ICP-AES; 12/14/12 Rev. 5	Definitive	IVBA – Pb & As and SPLP (determination)	ICP-AES	EPA Region 9 Laboratory	No
EPA R9 SOP 515	Standard Operating Procedure 515, Determination of Mercury in Water by CVAA Spectrometry; 7/98, Rev. 8	Definitive	Hg	Cetac M-7500 Mercury Analyzer	EPA Region 9 Laboratory	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
ASTM D2974	ASTM D2974-07a Standard Methods for Moisture, Ash and Organic Matter of Peat and Other Organic Soils	Screening	Total Moisture	NA	ALS Environmental through Katahdin Analytical Services	No
Neutralization Potential	Field and Laboratory Methods Applicable to Overburden and Minesoils; US EPA Industrial Environmental Research Laboratory, March 1978; EPA-600/2-78-054, Section 3.2.3, p.47	Screening	Neutralization Potential	NA	ALS Environmental through Katahdin Analytical Services	No
Grind	Field and Laboratory Methods Applicable to Overburden and Minesoils; US EPA Industrial Environmental Research Laboratory, March 1978; EPA-600/2-78-054, Section 3.1.2, p.42	Screening	Sample Preparation - Grind	NA	ALS Environmental through Katahdin Analytical Services	No
Saturated Paste pH	Field and Laboratory Methods Applicable to Overburden and Minesoils; US EPA Industrial Environmental Research Laboratory, March 1978; EPA-600/2-78-054, Section 3.2.2, p.45	Screening	Saturated Paste pH	NA	ALS Environmental through Katahdin Analytical Services	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
ASTM E1915	ASTM E1915-09 Standard Test Methods for Analysis of Metal Boring Ores and Relate materials for Carbon, Sulfur and Acid-Base Characteristics	Screening	Sulfur forms	NA	ALS Environmental through Katahdin Analytical Services	No
Acid-base accounting	Field and Laboratory Methods Applicable to Overburden and Minesoils; US EPA Industrial Environmental Research Laboratory, March 1978; EPA-600/2-78-054, Section 1.3.1, p.3	Screening	Acid potential and acid-base accounting	NA	ALS Environmental through Katahdin Analytical Services	No
CF-OA-E-001	Standard Operating Procedure for Dioxin/Furan/PCB Congener Sample Processing; August 2013, Rev.11	Definitive	Dioxin/furans	HRGC/HRMS	Cape Fear Analytical through Katahdin Analytical Services	No
CA-627-09	Trace Metals Analysis by ICP-MS Using USEPA Method 6020, August 2013, Rev. 9	Definitive	TAL Metals (Plant Tissue)	ICP-MS	Katahdin Analytical Services	No
CA-611-09	Digestion and Analysis of Solid Samples for Mercury by USEPA Method 7471, April 2012, Rev. 9	Definitive	TAL Metals (Plant Tissue)	CETAC M6100 Mercury Analyzer	Katahdin Analytical Services	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
CA-625-06	Alkaline Digestion and Subsequent Determination of Hexavalent Chromium in Solid Samples Using EPA SW846 Methods 3060 and 7196, CA-625-06; May 2013, Rev. 6	Definitive	Cr(VI)	Spectrophotometer	Katahdin Analytical Services	No
CA-741-05	Determination of Total Organic Carbon in Solids Using the EPA Region II Method Lloyd Kahn and SW846 9060 Mod, CA-741-05; February 2013, Rev.5	Definitive	TOC	Carbonaceous Analyzer	Katahdin Analytical Services	No
ASTM-2216	ASTM D2216-10 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass	Screening	Natural Moisture Content	NA	Speedie & Associates, Inc.	No
ASTM D2937	ASTM D2937-10, Standard Test method for Density of Soil in Place by the Drive-Cylinder Method	Screening	Moisture Density	NA	Speedie & Associates, Inc.	No
ASTM D5084	ASTM D5084-10, Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter	Screening	Saturated Hydraulic Conductivity	NA	Speedie & Associates, Inc.	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
ASTM D854	ASTM D854-10, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer	Screening	Specific Gravity	NA	Speedie & Associates, Inc.	No
ASTM D4664	ASTM D4664-08, Standard Test Method for Slake Durability of Shales and Similar Weak Rocks	Screening	Slake Durability	NA	GeoSystems Analysis, Inc.	No
ASTM D6836	ASTM D6836 - 02(2008)e2, Standard Test Methods for Determination of the Soil Water Characteristic Curve for Desorption Using a Hanging Column, Pressure Extractor, Chilled Mirror Hygrometer, and/or Centrifuge	Screening	Moisture Characteristic Curves	NA	GeoSystems Analysis, Inc.	No
ASTM D422	ASTM D422 - 63(2007) Standard Test Method for Particle-Size Analysis of Soils	Screening	Gradation	NA	Speedie & Associates, Inc.	No
ASTM D4318	ASTM D4318 - 10 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	Screening	Atterberg Limits	NA	Speedie & Associates, Inc.	No
ASTM D2435	ASTM D2435 / D2435M - 11 Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading	Screening	Consolidation Test	NA	Speedie & Associates, Inc.	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
ASTM D3080	ASTM D3080 / D3080M - 11 Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions	Screening	Direct Shear test	NA	Speedie & Associates, Inc.	No
ASTM D4767	ASTM D4767 - 11 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils	Screening	Consolidated-Undrained Triaxial Shear test with Pore Pressure	NA	Speedie & Associates, Inc.	No
CA-739-09	Titrimetric Determination of Total Alkalinity by EPA Method 310.1 and SM 2320 B Using the Mettler DL25 Autotritaor, and Calculation of the Component Forms of Alkalinity by SM 4500-CO_2D, CA-739-09; May 2012, Rev. 9	Definitive	Alkalinity	Autotitrator	Katahdin Analytical Services	No
CA-768-03	Colorimetric Analysis of Chloride Using the Automated Konelab Multiwavelength Photometric Analyzer, CA-768-03; May 2012, Rev. 3	Definitive	Chloride	Automated Konelab Multiwavelength Photometric Analyzer	Katahdin Analytical Services	No
CA-728-08	Total Nitrate/Nitrite, Nitrite & Nitrate with cadmium Reduction by Automated Colorimetry, CA-728-08; May 2012, Rev. 8	Definitive	Nitrite/Nitrate	LACHAT Automated Analyzer	Katahdin Analytical Services	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
CA-721-03	Turbidmetric Determination of Sulfate: EPA Method 375.4, Standard methods 4500SO_4E (18th) and 426C (15th), EPA SW846 Method 9038 and ASTM Method D516-02, CA-721-03; April 2007, Rev. 3	Definitive	Sulfate	Turbidimeter	Katahdin Analytical Services	No
CA-715-06	Analysis of TPO4 (Total Phosphorous) Using Block Digestion and Flow Injection Colorimetry (LACHAT); EPA Method 365.4, CA-715-06; June 2010, Rev. 6	Definitive	Phosphate	LACHAT Automated Analyzer	Katahdin Analytical Services	No
CA-627-09	4500 Silica - Standard Methods for the Examination of Water and Wastewater	Definitive	Silicon	ICP-MS	Katahdin Analytical Services	No
CA-763-07	Analysis of TOC, DOC, and TIC in Aqueous Samples Using the Shimadzu Carbon Analyzer: EPA Method 415.1, SW846 9060 and SM 5310B, CA-763-07; May 2012, Rev. 7	Definitive	Dissolved Organic Carbon	Shimadzu Carbon Analyzer	Katahdin Analytical Services	No
CA-719-07	Total Dissolved Solids (Filterable Residue) by EPA Method 160.1 and Standard Methods 2540 C, CA-719-07; May 2012, Rev. 7	Definitive	TDS	NA	Katahdin Analytical Services	No

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
CA-742-09	Anions by Ion Chromatography Using EPA Method 300.0 and SW-846 9056, CA-742-09; June 2012, Rev. 9	Definitive	Fluoride	Ion Chromatograph	Katahdin Analytical Services	No

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Samples Relinquished by Region 9 to SERAS						
ICP	Blank and high standard, ICV/ICB after calibration, CCV/CCB every 10 samples	Each day of use	ICV/CCV +/-10% ICB/CCB < RL	Perform maintenance, rerun calibration	Analyst	SERAS SOPs #1811
Leeman Hg Analyzer	Initial 5-point, ICV/ICB after calibration, CCV/CCB after every 10 samples	Each day of use	r=0.995 (initial), ICV & CCV = +/-10%, ICB/CCB < +/- RL	Perform maintenance, rerun calibration	Analyst	SERAS SOPs #1832 and 1827
ICP-MS	Initial calibration (ICAL), ICV/ICB after calibration, CCV/CCB every 10 samples and at end of run, ICSA and ICSB after ICV/ICB	Prior to each analytical workgroup	ICV/CCV ± 10%	Re-analyze	ACZ Laboratories Analyst	SOPII022.07.013.09
			r >0.995	Recalibrate/ reanalyze		
			ICB/CCB <3X MDL	Reanalyze all associated samples that are <10X the blank and >0; Recalibrate if ICB outside of acceptance criteria.		
			Recovery of analytes with known mass interferences <PQL	Recalibrate and re-analyze		
			Recovery ± 20%	Re-analyze		

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
ICP-AES / ICP-MS / CCVA	See ISM01.3; as per instrument manufacturer's recommended procedures	ICP-AES or ICP-MS Initial calibration: daily or once every 24 hours and each time the instrument is set up. ICP-AES or ICP-MS Continuing calibration: beginning and end of run and frequency of 10% or every 2 hours during an analysis run.	ICP-AES: As per instrument manufacturer's recommended procedures, with at least 2 standards. ICP-MS: As per instrument manufacturer's recommended procedures, with at least 2 standards. A minimum of three replicate integrations are required for data acquisition.	ICP-AES or ICP-MS: inspect the system, correct problem, re-calibrate, and reanalyze samples.	EPA CLP RAS Laboratory ICP-AES/ICP-MS Technician	ISM01.3
Spectrophotometer	ICAL: minimum of 5 points plus calibration blank, ICV after calibration, CCV/CCB after every 10 samples and at end of run	ICAL quarterly and prior to sample analysis	Correlation coefficient ≥0.995 ICV±10% CCV within 10% of true value, CCB <RL Post-digestate recovery ± 15% if sample <4X spike	Inspect instrument; correct problem; rerun calibration and re-extract and/or reanalyze affected samples	Katahdin Analyst	CA-625-06
ICP-AES	ICAL: blank and calibration standard for each analyte, followed by ICV, and CCV every 10 samples, CB after each ICV/CCV, QLS (after ICAL and after every 40 samples)	ICAL: beginning of each analytical sequence	ICV/CCV±10% and RSD<5% CB < ½ QL QLS ± 30%	Inspect instrument; correct problem; rerun calibration and re-extract and/or reanalyze affected samples	EPA Region 9 Analyst	R9 SOP 503

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Cetac M-7500 Mercury Analyzer	ICAL: 5 point calibration, ICV & SCV after each ICAL, CCV every 10 samples and end of run, CB after each ICV/CCV, QLS after each batch and after 40 analytical samples	ICAL: daily or for every batch	Correlation coefficient ≥0.995 ICV/SCV ±5 % CCV ± 10% CB < ½ QL QLS ± 40%	Inspect instrument; correct problem; rerun calibration and re-extract and/or reanalyze affected samples	EPA Region 9 Analyst	R9 SOP 515
HRGC/HRMS	Initial 5 point calibration	Prior to analysis, whenever the continuing calibration falls outside the acceptance criteria, and at a minimum annually	Ratio of areas of integrated ion current for homologous series quantitation ions must be within control limits (Table 3) simultaneously in one run. For each selected ion current profile (SICP) and for each GC signal, the signal to noise (S/N) ratio must be better than or equal to 10. %RSD for the mean RFs must be within ±20% for the natives and ±35% for the internal standards	Re-calibrate	Cape Fear Analyst	CF-OA-E-001
	Continuing Calibration	Once every 12 hours	Concentrations within limits listed in Table 7, ion ratios within limits in Table 3	Identify source of problem, correct problem, re-calibrate		

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
LACHAT Auto Analyzer	Initial 5 point calibration, followed by ICV, CCV every 10 samples and end of run	ICAL prior to analysis	Correlation coefficient ≥0.995 ICV/CCV ± 10%	Investigate source of problem, recalibrate and/or reanalyze	Katahdin Analyst	CA-728-08
LACHAT Auto Analyzer	Initial 6 point calibration, ICV (1 per prep batch), CCV (after every 10 samples), CCB (after every 10 samples and at close of run)	ICAL prior to sample analysis	r≥0.995 ICV ± 20% CCV ± 10% CCB<RL	Investigate source of problem, recalibrate and/or reanalyze	Katahdin Analyst	CA-715-06
Shimadzu Carbon Analyzer	Initial 5 point calibration plus blank, followed by CCV (at beginning of run, after every 10 samples, and at end of run) and CCB (after every CCV)	ICAL at a minimum every 3 months or as necessary	r≥0.995 CCV ± 10% CCB<RL	Investigate, re-digest, recalibrate, reanalyze	Katahdin Analyst	CA-763-07
CETAC M6100 Mercury Analyzer	Initial 5 point calibration plus blank, followed by ICV & ICB (before beginning sample run), CCV & CCB (at beginning of run, after every 10 samples, and at end of run)	Daily ICAL, and prior to analysis	r≥0.995 ICV/CCV ± 20% ICB/CCB<RL	Investigate, recalibrate, reanalyze	Katahdin Analyst	CA-611-09

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Automated Konelab Multiwavelength Photometric Analyzer	Initial 6 point calibration, ICV (1 per prep batch of 20) CCV (at beginning of run, after every 10 samples, and at end of run)	ICAL: Prior to sample analysis	r≥0.995 ICV/CCV ± 20%	Investigate source of problem, recalibrate, reanalyze samples back to last acceptable CCV	Katahdin Analyst	CA-768-03
Turbidimeter	ICAL: blank = 5 standards, ICV (1 per prep batch of 20), CCV (after every 4 samples)	ICAL: At a minimum when the conditioning reagent and/or $BaCl_2$ solution is made. Prior to sample analysis.	r≥0.995 ICV/CCV ± 20%	Investigate source of problem, recalibrate, reanalyze samples back to last acceptable CCV	Katahdin Analyst	CA-721-03
Ion Chromatograph	ICAL: blank + 5 standards (lowest standard at or below PQL), ICV (one per batch of 20), CCV (at beginning of run, after every 10 samples, and at end of run), CCB immediately following each CCV	ICAL: Every 6 months or with each change in instrument operating conditions or instrument	r≥0.995 Recovery of lowest standard 50-150% ICV±10% CCV±10% and all analytes within established RT windows CCB<RL	Investigate, recalibrate, reanalyze	Katahdin Analyst	CA-742-09
ICP-MS	Initial 3 point calibration plus a calibration blank (ICB), followed by ICV and. CCV. CCV every 10 samples thereafter and at end of run	Daily ICAL and prior to analysis	r≥0.998 ICV/CCV ±10% ICB/CCB<RL	Investigate and correct problem, recalibrate, reanalyze	Katahdin Analyst	CA-627-09

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Samples Relinquished by Region 9 to SERAS								
ICP-MS	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	ACZ Laboratories Analyst/ Technician	NA
ICP-AES	Check Argon Supply Pressure	NA	NA	With each use	Sufficient Argon for ICP operation	Change tank	SERAS Analyst	SERAS SOP #1811
	Inspect Drainage Container	NA	NA	With each use	Sufficient space	Empty		
	Check Chiller System	NA	NA	With each use	Normal operation	Call Service Engineer		
	Check Autosampler	NA	NA	With each use	Normal operation	Call Service Engineer		
	Check IS Mix Kit Tubing	NA	NA	With each use	NA	Replace as necessary		
	Check Argon Pressure to Instrument	NA	NA	With each use	100 lbs psig	Call Service Engineer		
	Check Nebulizer	NA	NA	With each use	Normal spray	Replace or Call Service Engineer		
	Check Spray Chamber	NA	NA	With each use	Clean	Clean and/or replace spray chamber/O-rings		
	Check Torch/ Radial Window	NA	NA	With each use	Clean	Ultrasonic, acid or mild soap cleaning as appropriate		
	Check exhaust system	NA	NA	With each use	Normal operation	Call maintenance		
Leeman Hg Analyzer	Drainage container	NA	NA	With each use	NA	Empty	SERAS Analyst	SERAS SOP 1832
	Check sampling probe	NA	NA	With each use	NA	Replace		
	Check stannous chloride line to pump	NA	NA	With each use	NA	Replace line/clean		

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
	Check pump winding tube	NA	NA	With each use	NA	Clean/replace		
	Check optical cell	NA	NA	As required	NA	Clean		
	Check autosampler arm	NA	NA	As required	NA	Lubricate		
	Check lamp alignment	NA	NA	As required	NA	Adjust		
	Check drying tube	NA	NA	As required	NA	Replace		
Spectro-Photometer, ICP- MS, CETAC M6100 Mercury Analyzer Carbonaceous Analyzer, Autotitrator, Automated Konelab Multiwavelength Photometric Analyzer, LACHAT Automated Analyzer, Shimadzu Carbon Analyzer, Ion Chromatograph, Turbidimeter	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Katahdin Laboratory Services Analyst/ Technician	NA
ICP-AES / ICP-MS / CVAA	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable re-calibration; see ISM01.3	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA CLP Laboratory ICP-AES / ICP-MS Technician	ISM01.3
ICP-AES	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	EPA Region 9 Analyst/ Technician	NA

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Cetac M-7500 Mercury Analyzer	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	EPA Region 9 Analyst/ Technician	NA
HRGC/HRMS	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Cape Fear Analyst/ Technician	NA
ICP-MS	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Katahdin Laboratory Services Analyst/ Technician	NA

[1]Specify the appropriate reference letter or number from Analytical SOP References table (Worksheet #23)

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): SERAS, ERT, EPA R9
Sample Packaging (Personnel/Organization): SERAS, ERT
Coordination of Shipment (Personnel/Organization): SERAS
Type of Shipment/Carrier: Overnight carrier, Fed Ex
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Jay Patel, SERAS ICP/MS; CLP Laboratory; EPA R9 Laboratory, Katahdin Analytical Services, ALS Environmental, Cape Fear Analytical, Speedie & Associates; GeoSystems analysis, Inc., ACZ Laboratories, Lawrence Martin, SERAS Sample Receiving/Hazardous Waste,
Sample Custody and Storage (Personnel/Organization): Jay Patel, SERAS ICP/MS; CLP Laboratory; EPA R9 Laboratory, Katahdin Analytical Services, ALS Environmental, Cape Fear Analytical, Speedie & Associates; GeoSystems analysis, Inc., ACZ Laboratories, Lawrence Martin, SERAS Sample Receiving/Hazardous Waste
Sample Preparation (Personnel/Organization): Jay Patel, SERAS ICP/MS; CLP Laboratory; EPA R9 Laboratory, Katahdin Analytical Services, ALS Environmental, Cape Fear Analytical, Speedie & Associates; GeoSystems Analysis, Inc., ACZ Laboratories, Shiv Sahni, SERAS Extraction Chemist; Amit Vaidya, SERAS GC/MS Chemist
Sample Determinative Analysis (Personnel/Organization): CLP Laboratory; EPA R9 Laboratory, Katahdin Analytical Services, ALS Environmental, ACZ Laboratories, Jay Patel, SERAS ICP/MS, Cape Fear Analytical
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): To be determined in the field.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Per laboratory SOP
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: EPA Region 9, CLP Laboratory, Lawrence Martin/SERAS, Katahdin Analytical Services, ALS Environmental, Cape fear analytical, Speedie & Associates; GeoSystems Analysis, Inc., ACZ Laboratories
Number of Days from Analysis: 60 days

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Samples for analysis by FP XRF will be hand delivered to the on-site XRF Operator. Following analysis by FP XRF, samples will be stored on-site. Confirmation samples for the FP XRF will be submitted to a CLP laboratory for analysis for TAL Metals. Sample packaging and shipment will be done in accordance with SERAS SOP #2004, *Sample Packaging and Shipment.* Scribe will be used for sample management, as well as generation of sample documentation, such as, labels and COC records. All COC records will receive a peer review in the field prior to shipment of samples in accordance with SERAS SOP # 4005, *Chain of Custody Procedures* and shipped according to SERAS SOP #2005.
Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal): A sample custodian at the designated laboratory will accept custody of the shipped samples, check them for discrepancies, integrity, etc., and relinquish them to the appropriate department for analysis.
Sample Identification Procedures: Will be in accordance with SERAS SOP #2002, *Sample Documentation*. In addition, sample identification numbering scheme will be devised and implemented in a manner that will facilitate clear and easy association of the analytical data. See Table 4 of Attachment .
Chain-of-custody Procedures: In accordance with SERAS SOP #4005, *Chain of Custody Procedures.*

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil/Sediment/Dross/ Slag
Analytical Group	Metals (FP XRF)
Concentration Level	Low to high
Sampling SOP	SERAS SOP #2012 SERAS SOP #2016
Analytical Method/ SOP Reference	SERAS SOP #1720
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS/ERT
Analytical Organization	SERAS/ERT
No. of Sample Locations	3638

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Zero Check Sample	Pre-operation check; Every 4 to 6 hours of sample analysis	< RL	Repeat, if continues to fail, check SRMs and/or send in for factory service or calibration	Analyst	Sensitivity	Same as Method/SOP QC Acceptance Limits
Precision Check Sample(s)	Every 10 samples	RSD ± 20%	Calculated after site activities completed; Qualify data if > 20%	Analyst	Precision	Same as Method/SOP QC Acceptance Limits
Certified Reference Standard(s)	Pre-operation check and every 10-20 samples	Element results typically within ± 20% of true values for concentrations at least 5-times the RL	Repeat. If continues to fail, send in for factory service/or calibration	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-2
QC Samples Table

Matrix	Soil/Sediment/Slag/ Waste Rock
Analytical Group	TAL Metals
Concentration Level	Low to high
Sampling SOP	SERAS SOP #2012 SERAS SOP #2016
Analytical Method/ SOP Reference	CLP ISM01.3
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	CLP
No. of Sample Locations	315 soil 5 waste rock 25 sediment 3 slag 20 dross

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±35%
Preparation Blank	1 per ≤ 20 samples	Blank concentration < CRQL	Suspend analysis until source rectified; redigest and reanalyze affected samples	EPA CLP RAS Laboratory ICP-AES/ICP-MS Technician	Accuracy	Blank concentration < CRQL
Spike	1 per ≤ 20 samples	%R = 75-125% within control chart limits	Flag outliers	EPA CLP RAS Laboratory ICP-AES/ICP-MS Technician	Accuracy	%R = 75-125% within control chart limits
Duplicate Sample	1 per ≤ 20 samples	± 20% RPD**	Flag outliers	EPA CLP RAS Laboratory ICP-AES/ICP-MS Technician	Precision	± 20% RPD**
Post-Digestion Spike	after any analyte (except Ag and Hg) fails spike %R	%R = 75-125	Flag outliers	EPA CLP RAS Laboratory ICP-AES/ICP-MS Technician	Accuracy	%R = 75-125

QAPP Worksheet #28-2
QC Samples Table

Matrix	Soil/Sediment/Slag/ Waste Rock
Analytical Group	TAL Metals
Concentration Level	Low to high
Sampling SOP	SERAS SOP #2012 SERAS SOP #2016
Analytical Method/ SOP Reference	CLP ISM01.3
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	CLP
No. of Sample Locations	315 soil 5 waste rock 25 sediment 3 slag 20 dross

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Interference Check Sample [ICP Analysis Only]	beginning, end and periodically during run (2 times every 8 hours)	± 20% of true value or ± 1 times the CRQL, whichever is greater	Check calculations and instruments, reanalyze affected samples	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Accuracy	± 20% of true value or ± 1 times the CRQL, whichever is greater
Serial Dilution	1 per batch	%D ±10% (minimum sample concentration 50x MDL)	Document	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Precision	%D ±10% (minimum sample concentration 50x MDL)

QAPP Worksheet #28-3
QC Samples Table

Matrix	Water
Analytical Group	TAL Metals
Concentration Level	Low to high
Sampling SOP(s)	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/SOP Reference	CLP ISM01.3
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	CLP
No. of Sample Locations	16 surface water 44 groundwater

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±20%
Preparation Blank	1 per ≤ 20 samples	Blank concentration< CRQL	Suspend analysis until source rectified; re-digest and reanalyze affected samples	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Accuracy	Blank concentration< CRQL
Matrix Spike; LCSW	1 per ≤ 20 samples	75-125%; 70-130% (50-150% for Ag and Sb)	Flag outliers	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Accuracy	75-125%; 70-130% (50-150% for Ag and Sb)
Duplicate Sample	1 per ≤ 20 samples	NA	Flag outliers	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Precision	± 20% RPD
Post-Digestion Spike	after any analyte (except Ag) fails spike %R	%R = 75-125% (exception Ag)	Flag outliers	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Accuracy	%R = 75-125% (exception Ag)
Serial Dilution	1 per batch	%D ±10% (minimum sample concentration 50x MDL)	Document	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Precision	%D ±10% (minimum sample concentration 50x MDL)

QAPP Worksheet #28-3
QC Samples Table

Matrix	Water
Analytical Group	TAL Metals
Concentration Level	Low to high
Sampling SOP(s)	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/SOP Reference	CLP ISM01.3
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	CLP
No. of Sample Locations	16 surface water 44 groundwater

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Interference Check Sample [ICP Analysis Only]	beginning, end and periodically (not less than once per 20 samples)	± 20% of true value or ± 1 times the CRQL, whichever is greater	Check calculations and instruments, reanalyze affected samples	EPA CLP Laboratory ICP-AES/ICP-MS Technician	Sensitivity	± 20% of true value or ± 1 times the CRQL, whichever is greater

QAPP Worksheet #28-4 (Relinquished to SERAS by Region 9)
QC Samples Table

Matrix	Soil
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	SERAS SOP #1811
Sampler's Name	Region 9
Field Sampling Organization	Region 9
Analytical Organization	SERAS/ERT
No. of Sample Locations	20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Matrix Spikes (inorganic)	Every 20 samples	75-125%	Rerun - no reprep is necessary; Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Matrix Spikes Duplicates	Every 20 samples (between MS/MSD)	RPD ± 20%	Rerun first, reprep if necessary or Qualify data	Analyst/Group Leader	Precision	Same as Method/SOP QC Acceptance Limits
LCS	Every 20 samples of same matrix	80-120% or within vendor PALs	Reanalyze first, then rerun batch or Qualify data	Analyst/Group Leader	Accuracy/Precision	Same as Method/SOP QC Acceptance Limits
Lower Level Check Std	At beginning and end of each analytical run	Within upper and lower control limits or +/- 30% of the true value)	Rerun, recalibrate if necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
ICS (Interference Check Sample)	Once each 8-hour shift	+/-20% for elements in ICSA, <RL for others	Rerun or recalibrate	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
ICV/CCV (Initial Calibration Verification/Continuing Calibration Verification)	ICV Immediately following calibration and CCV every 10 samples	+/- 10% of true value; RSD between replicate injections<5%	Check instrument, reanalyze, Recalibrate	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-4 (Relinquished to SERAS by Region 9)
QC Samples Table

Matrix	Soil
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	SERAS SOP #1811
Sampler's Name	Region 9
Field Sampling Organization	Region 9
Analytical Organization	SERAS/ERT
No. of Sample Locations	20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
ICB/CCB (Initial Calibration Blank/Continuing Calibration Blank)	ICB Immediately following the ICV and CCB following each CCV	< RL	Rerun samples unless sample concentration is >10X the concentration in the CCB; investigate source of contamination	Analyst	Accuracy/Bias Contamination	Same as Method/SOP QC Acceptance Limits
Method Blank	One per batch of 20 samples/same matrix	< RL	Reprep if concentration in samples is not at least 10X concentration in blank, investigate source of contamination	Analyst	Accuracy/Bias Contamination	Same as Method/SOP QC Acceptance Limits
Field Duplicate	1:20 samples or per project specifications	NA	Document in final deliverable	Task Leader	Precision	RPD ± 35%

QAPP Worksheet #28-4 (Relinquished to SERAS by Region 9)
QC Samples Table

Matrix	Soil
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	SERAS SOP #1811
Sampler's Name	Region 9
Field Sampling Organization	Region 9
Analytical Organization	SERAS/ERT
No. of Sample Locations	20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Serial Dilution Test	Matrix spike sample	RPD < 10% if analyte concentration >10x RL	Qualify data	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LAR (Linear analytical range)	Semi-annually	%R = 90 -110%	New LAR is determined based on LAR study	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Post Digestion Spike	If the MS/MSD recoveries are unacceptable, one per batch of 20 samples/same matrix.	%R = 80 -120%	Qualify data or run dilution test	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MDL Study	Annual	MDL times 5 must be less than RL	Elevate RLs	Analyst	Sensitivity	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-5 (Relinquished to SERAS by Region 9)
QC Samples Table

Matrix	Soil
Analytical Group	Metals (Mercury)
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	SERAS SOP #1832
Sampler's Name	Region 9
Field Sampling Organization	Region 9
Analytical Organization	SERAS/ERT
No. of Sample Locations	20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike (inorganics)	Every 20 samples	80-120%	Rerun - no reprep is necessary	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Duplicates (Matrix Spike Duplicates)	Every 20 samples (between MS/MSD)	± 20%	Rerun first, reprep if necessary	Analyst/Group Leader	Precision	Same as Method/SOP QC Acceptance Limits
Field Duplicate	1:20 samples or per project specifications	NA	Document in final deliverable	Task Leader	Precision	± 35%
LCS	Every 20 samples of same matrix	80-120% or within vendor PALs	Reanalyze first, then rerun batch	Analyst/Group Leader	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	One per batch of 20 samples/same matrix	< RL	Reprep if concentration in samples is not at least 10X concentration in blank	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-6
QC Samples Table

Matrix	Soil/Dross/Slag/Waste Rock
Analytical Group	SPLP
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	EPA R9 SOPs 254, 407, 503,515
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	EPA Region 9
No. of Sample Locations	30 soil 4 dross 3 slag 5 waste rock

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample Duplicate	Per extraction fluid per day	RPD ± 20%	Document, Report	Analyst	Precision	RPD ± 20%
Method Blank (MB)	Per extraction fluid per day	< ½ RL	If result<5x MB rerun to verify and if still unacceptable re-prep and re-analyze associated samples. If result is ND or >5x MB report without qualification	Analyst	Accuracy/Bias	< ½ RL
LCS	Every 20 samples of same matrix	85-115%	Reanalyze first, then rerun batch	Analyst	Accuracy/Bias	80-120%
Matrix Spike	Every 20 samples of same matrix	ICP: 75-125% Hg: 70-130%	Reanalyze and qualify	Analyst	Accuracy/Bias	75-125%
Matrix Spike Duplicate	Every 20 samples of same matrix	80-120%	Qualify results	Analyst	Precision	80-120%

QAPP Worksheet #28-6
QC Samples Table

Matrix	Soil/Dross/Slag/Waste Rock
Analytical Group	SPLP
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	EPA R9 SOPs 254, 407, 503,515
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	EPA Region 9
No. of Sample Locations	30 soil 4 dross 3 slag 5 waste rock

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
SIC	After ICAL as needed per analyte (not for Hg)	±1/2 QL or calculated acceptance window, whichever is greater	Re-run or re-calibrate	Analyst	Accuracy/Bias	±1/2 QL or calculated acceptance window, whichever is greater
LDR	Annually (not for Hg)	%R = 90 -110%	Dilute and re-analyze	Analyst	Accuracy/Bias	%R = 90 -110%
Internal Standard	Every sample (not for Hg)	60-125%	Flush instrument with rinsate blank and re-analyze	Analyst	Accuracy/Bias	60-125%
Field Duplicate	1:20 samples or per project specifications	NA	Document, report	Task Leader	Accuracy/Bias	RPD ±35%
MDL Study	Annual	MDL < ½ QL	Elevate RLs	Analyst	Sensitivity	MDL < ½ QL

QAPP Worksheet #28-7
QC Samples Table

Matrix	Soil
Analytical Group	Cr(VI)
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	Katahdin SOP #CA-625-06
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	24

QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field Duplicate	1 in 20	RPD ±35%	Document, report	Task Leader	Precision	RPD ±35%
LCS	1 per digestion batch of 20 or fewer samples	%R = 80-120%	Investigate source of problem; re-digest & re-analyze batch	Analyst	Accuracy	%R = 80-120
Soluble & Insoluble Pre-digestion Matrix Spike	1 per digestion batch of 20 or fewer samples	R ±25% of true value, if sample <4x spike added	Correct problem and re-homogenize, re-digest and re-analyze	Analyst	Accuracy	R ±25% of true value, if sample <4x spike added
Laboratory Duplicate	1 per digestion batch of 20 or fewer samples	RPD ±20%, if both the sample and duplicate are ≥ four times the PQL	Flag results	Analyst	Precision	RPD ±20%, if both the sample and duplicate are ≥ four times the PQL
Method Blank	One per batch of 20 samples/same matrix	< RL	Re-prep, re-analyze	Analyst	Accuracy/Bias	< RL

QAPP Worksheet #28-7
QC Samples Table

Matrix	Soil
Analytical Group	Cr(VI)
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	Katahdin SOP #CA-625-06
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	24

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Post-digestion matrix spike	1 per digestion batch of 20 or fewer samples	R ±15% of true value, if sample <4x spike added	If check indicates interference, dilute and re-analyze sample	Analyst	Accuracy	R ±15% of true value, if sample <4x spike added

QAPP Worksheet #28-8
QC Samples Table

Matrix	Sediment/Dross
Analytical Group	Dioxins/furans
Concentration Level	Low
Sampling SOP	SERAS SOP #2012 SERAS SOP #2016
Analytical Method/ SOP Reference	Cape Fear SOP #CF-OA-E-002
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Cape Fear thru Katahdin Analytical
No. of Sample Locations	2 dross 5 sediment

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per batch of 20 or less	Target analyte< QL or <10% of level in related samples	Re-extract, re-analyze	Analyst	Accuracy/Bias (Contamination)	Target analyte< QL or <10% of level in related samples
Field Duplicate	1 in 20	NA	Document, report	Task Leader	Precision	± 35%
Labeled Extraction Standards	All samples	Recoveries within established laboratory limits (Table 7 of SOP)	Evaluate data quality. If needed, re-extract and re-analyze the sample.	Analyst	Accuracy	Recoveries within established laboratory limits (Table 7 of SOP)
Labeled Cleanup Standard	All samples	35-197%	Evaluate data quality. If needed, re-extract and re-analyze the sample.	Analyst	Accuracy	35-197%

QAPP Worksheet #28-8
QC Samples Table

Matrix	Sediment/Dross
Analytical Group	Dioxins/furans
Concentration Level	Low
Sampling SOP	SERAS SOP #2012 SERAS SOP #2016
Analytical Method/ SOP Reference	Cape Fear SOP #CF-OA-E-002
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Cape Fear thru Katahdin Analytical
No. of Sample Locations	2 dross 5 sediment

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
OPR	1 per batch of 20 or less	Recoveries within established laboratory limits (Table 6 of SOP)	Perform routine instrument maintenance	Analyst	Accuracy	Recoveries within established laboratory limits (Table 6 of SOP)
Matrix Spike	1 per batch of 20 or less	70-130%	Investigate source of problem. Document.	Analyst	Accuracy	70-130%
Matrix Spike Duplicate	1 per batch of 20 or less	%RPD < 20%	Investigate source of problem. Document.	Analyst	Precision	%RPD < 20%
Lab Duplicate	1 per batch of 20 or less	%RPD < 20%	Contact client for guidance	Analyst	Precision	%RPD < 20%
OPRD	1 per batch of 20 or less	Same as OPR and %RPD < 20%	Perform routine instrument maintenance. Document.	Analyst	Precision	Same as OPR and %RPD < 20%

QAPP Worksheet #28-9a
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: Nitrate & Fluoride
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOPs #CA-728-08 #CA-742-09
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method blank	1 per batch of 20 or less	< RL	Investigate source of contamination. Report results <PQL. Report and flag results >10x blank result. Re-analyze all other samples associated with the failing blank.	Analyst	Accuracy/Bias (Contamination)	< RL
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±20%
LCS	1 per batch of 20 or less	90 – 110% R	Report samples <PQL if it fails high; Recalibrate and/or re-analyze other samples	Analyst	Accuracy	90 – 110% R

QAPP Worksheet #28-9a
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: Nitrate & Fluoride
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOPs #CA-728-08 #CA-742-09
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Matrix Spike (MS)	1 per batch of 10 or less	90 – 110% R	Evaluate samples and associated QC. If LCS results are acceptable. Flag data. If LCS and MS are unacceptable re-prep and re-analyze samples and QC	Analyst	Accuracy	90 – 110% R
Matrix Spike Duplicate	1 per batch of 20 or less	RPD ±15%	Investigate, re-analyze sample in duplicate, if RPD is still out, report original result with flag	Analyst	Precision	RPD ±15%

QAPP Worksheet #28-9a
QC Samples Table

Matrix	Surface Water and Groundwater					
Analytical Group	WQ: Nitrate & Fluoride					
Concentration Level	Low					
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007					
Analytical Method/ SOP Reference	Katahdin SOPs #CA-728-08 #CA-742-09					
Sampler's Name	SERAS Field Personnel					
Field Sampling Organization	SERAS					
Analytical Organization	Katahdin Analytical					
No. of Sample Locations	49					
QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Lab Duplicate	1 per batch of 20 or less	Nitrate: RPD ± 20 for samples >3x the PQL; <100% for samples<3x the PQL Fluoride: %RPD ± 20%	Investigate, re-analyze sample in duplicate, if RPD is still out, report original result with flag	Analyst	Precision	Nitrate: RPD ± 20 for samples >3x the PQL; <100% for samples<3x the PQL Fluoride: %RPD ± 20%

QAPP Worksheet #28-9b
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: DOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-763-075
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Blank	1 per day	<RL	Flag data	SERAS QA/QC Chemist	Accuracy/Bias (Contamination)	<RL
Method blank	1 per batch of 20 or less	<RL	Investigate source of contamination. Report results <PQL. Report and flag results >10x blank result. Re-analyze all other samples associated with the failing blank.	Analyst	Accuracy/Bias (Contamination)	<RL
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±20%
LCS	1 per batch of 20 or less	90 – 110% R	Report samples <PQL if it fails high; Recalibrate and/or re-analyze other samples	Analyst	Accuracy	90 – 110% R

QAPP Worksheet #28-9b
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: DOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-763-075
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike (MS)	1 per batch of 10 or less	80 – 120% R	Evaluate samples and associated QC. If LCS results are acceptable. Flag data.	Analyst	Accuracy	80 – 120% R
Sample Duplicate	1 per batch of 20 or less	%RPD < 20%	If lab QC in criteria and matrix interference suspected, flag data	Analyst	Precision	%RPD < 20%

QAPP Worksheet #28-9c
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: Sulfate, phosphate, alkalinity, chloride
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-721-03 #CA-715-06 #CA-739-09 #CA-768-03
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±20%
LCS	1 per batch of 20 or less	80 – 120% R	Report samples <PQL if it fails high; Recalibrate and/or re-analyze other samples	Analyst	Accuracy	80 – 120% R
Method blank	1 per batch of 20 or less	<RL	Investigate source of contamination. Report results <PQL. Flag results >10x blank result. Re-analyze all other samples associated with the failing blank.	Analyst	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-9c
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: Sulfate, phosphate, alkalinity, chloride
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-721-03 #CA-715-06 #CA-739-09 #CA-768-03
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Matrix Spike (MS)	1 per batch of 10 or less	Sulfate, Phosphate, Chloride: 75-125% Alkalinity: 80 – 120%	Evaluate samples and associated QC. If LCS results are acceptable. Flag data.	Analyst	Accuracy	Sulfate, Phosphate, Chloride: 75-125% Alkalinity: 80 – 120%
Field Blank	1 per day	<RL	Flag data	SERAS QA/QC Chemist	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-9c
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ: Sulfate, phosphate, alkalinity, chloride
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-721-03 #CA-715-06 #CA-739-09 #CA-768-03
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample Duplicate	1 per batch of 20 or less	Sulfate & Alkalinity: ±20% RPD for concentrations >3x the PQL; RPD≤100 for results<3x PQL Phosphate & Chloride: RPD≤20	Alkalinity, Phosphate, Chloride: Investigate & re-analyze in duplicate; if RPD still >20 report with notation. Sulfate: If QC in criteria, flag data, else reanalyze	Analyst	Precision	Sulfate & Alkalinity: ±20% RPD for concentrations >3x the PQL; RPD≤100 for results<3x PQL Phosphate & Chloride: RPD≤20

QAPP Worksheet #28-9d
QC Samples Table

Matrix	Surface Water and Groundwater
Analytical Group	WQ:TDS
Concentration Level	Low
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007
Analytical Method/ SOP Reference	Katahdin SOP # CA-719-07
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±20%
Field Blank	1 per day	<RL	Flag data	SERAS QA/QC Chemist	Accuracy/Bias (Contamination)	<RL
LCS	1 per batch of 20 or less	80 – 120% R	Report samples <PQL if it fails high; Recalibrate and/or re-analyze other samples	Analyst	Accuracy	80 – 120% R
Method blank	1 per batch of 20 or less	TDS < PQL	Investigate source of contamination. Report results <PQL. Flag results >10x blank result. Re-analyze all other samples associated with the failing blank.	Analyst	Accuracy/Bias (Contamination)	TDS < PQL

QAPP Worksheet #28-9d
QC Samples Table

Matrix	Surface Water and Groundwater					
Analytical Group	WQ:TDS					
Concentration Level	Low					
Sampling SOP	SERAS SOP #2013 SERAS SOP #2007					
Analytical Method/ SOP Reference	Katahdin SOP # CA-719-07					
Sampler's Name	SERAS Field Personnel					
Field Sampling Organization	SERAS					
Analytical Organization	Katahdin Analytical					
No. of Sample Locations	49					
QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Sample Duplicate	1 per batch of 10 or less	RPD $\leq$ 20	Investigate & re-analyze in duplicate; if RPD still >20 report with notation.	Analyst	Precision	RPD $\leq$ 20

QAPP Worksheet #28-10
QC Samples Table

Matrix	Sediment
Analytical Group	TOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2016
Analytical Method/ SOP Reference	Katahdin SOP #CA-741-05
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	5

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 in 20	NA	Document, report	SERAS TL	Precision	±35%
LCS	1 per batch of 20 or less	80 – 120% R	Report samples <PQL if it fails high; Recalibrate and/or re-analyze other samples	Analyst	Accuracy	80 – 120% R
Method blank	1 per batch of 20 or less	<RL	Investigate source of contamination. Report results <PQL. Flag results >10x blank result. Re-analyze all other samples associated with the failing blank	Analyst	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-10
QC Samples Table

Matrix	Sediment
Analytical Group	TOC
Concentration Level	Low
Sampling SOP	SERAS SOP #2016
Analytical Method/ SOP Reference	Katahdin SOP #CA-741-05
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	5

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix spike	1 per 10	75-125%	If LCS in criteria and matrix interference suspected, flag data; else re-analyze.	Analyst	Accuracy	75-125%
Sample Duplicate	1 per batch of 10 or less	RPD ± 20	Investigate & re-analyze in duplicate; if RPD still >20 report with notation.	Analyst	Precision	RPD ± 20

QAPP Worksheet #28-11
QC Samples Table

Matrix	Surface Water Groundwater
Analytical Group	WQ: Silicon
Concentration Level	Low
Sampling SOP	SERAS SOP 2013 SERAS SOP 2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-627-09
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Post-digestion matrix spike	Every 20 samples	%R = 80 -120	Flag results and/or analyze sample by method of standard additions	Analyst	Accuracy/Bias	%R = 80 -120
Duplicate Sample	Every 20 samples	RPD ± 20% if sample conc > 100x IDL	Flag results	Analyst	Precision	RPD ± 20% if sample conc > 100x IDL
LCS	Every 20 samples of same matrix	80-120% or within performance acceptance limits	Investigate source of problem; re-digest & re-analyze all associated samples, unless LCS>120% and sample result <PQL	Analyst	Accuracy/Bias	80-120% or within performance acceptance limits
Field Duplicate	1:20	NA	Document, report	SERAS TL	Precision	RPD ±20%

QAPP Worksheet #28-11
QC Samples Table

Matrix	Surface Water Groundwater
Analytical Group	WQ: Silicon
Concentration Level	Low
Sampling SOP	SERAS SOP 2013 SERAS SOP 2007
Analytical Method/ SOP Reference	Katahdin SOP #CA-627-09
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	49

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
ICS A	Before analyzing samples; every 12 hours during a run	Interferents: ±20% of true value	Do not use sample results for failing elements	Analyst	Accuracy/Bias Contamination	Interferents: ±20% of true value
ICS AB	Before analyzing samples; every 12 hours during a run	±20% of true value	Do not use sample results for failing elements, unless ICS-AB >120% and sample result <PQL	Analyst	Accuracy/Bias Contamination	±20% of true value
Serial Dilution	1 per digestion batch	+/-10% if analyte concentration > 50 times instrument detection limit	Flag result or dilute and re-analyze sample to eliminate interference	Analyst	Accuracy/Bias	+/-10% if analyte concentration > 50 times instrument detection limit
Internal Standard	Every sample, every standard	IS intensity within 70-120% of IS in ICB		Analyst	Accuracy/Bias	IS intensity within 70-120% of IS in ICB
Field Blank	1 per day	<RL	Flag data	SERAS QA/QC Chemist	Accuracy/Bias	<RL

QAPP Worksheet #28-12 (Relinquished to SERAS by Region 9)
QC Samples Table

Matrix	Soil
Analytical Group	Metals: IVBA (Pb & As)
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	ACZ SOP #SOPII022.07.13.09
Sampler's Name	Region 9
Field Sampling Organization	Region 9
Analytical Organization	SERAS/ERT
No. of Sample Locations	20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCSW	1 per batch of 20 or less	R = 80-120%	Re-prep; re-analyze	Analyst	Accuracy	R = 80-120%
Sample Duplicate		RPD ±20%		Analyst	Precision	RPD ±20%
Matrix Spike	1 per batch of 10 or less	R= 75–125%	If sample < 4 X the spike concentration, qualify data	Analyst	Accuracy	R= 75–125%
Matrix Spike Duplicate	1 per batch of 10 or less	RPD ±20%	Qualify data	Analyst	Precision	RPD ±20%
Extraction Fluid	1 per 10	Lead < 25 µg/L Arsenic < 5 µg/L	Remake solution	Analyst	Accuracy/Bias (Contamination)	Lead < 25 µg/L Arsenic < 5 µg/L
Bottle Blank	1 per batch of 20 or less	Lead < 50 µg/L Arsenic < 10 µg/L	Investigate, correct, re-extract	Analyst	Accuracy/Bias (Contamination)	Lead < 50 µg/L Arsenic < 10 µg/L
Method Blank	1 per batch of 20 or less	<RL		Analyst	Accuracy/Bias (Contamination)	<RL
ICS		R = 80-120%		Analyst	Accuracy/Bias	R = 80-120%

QAPP Worksheet #28-12 (Relinquished to SERAS by Region 9)
QC Samples Table

Matrix	Soil
Analytical Group	Metals: IVBA (Pb & As)
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	ACZ SOP #SOPII022.07.13.09
Sampler's Name	Region 9
Field Sampling Organization	Region 9
Analytical Organization	SERAS/ERT
No. of Sample Locations	20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Every sample	R = 30-120%	Recalculate using an alternative IS; if all IS are outside criteria, re-analyze on a 5X greater dilution. If samples are 'U' and ISTD recovery is high, qualify the data.	Analyst	Accuracy/Bias	R = 30-120%

QAPP Worksheet #28-13
QC Samples Table

Matrix	Soil
Analytical Group	Metals: IVBA (Pb & As)
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	EPA R9 SOPs 256, 407, 503
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Region 9
No. of Sample Locations	33

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spikes	1 per batch of 20 or less	75-125%	Qualify data	Analyst	Accuracy/Bias	75-125%
Matrix Spike Duplicates	1 per batch of 20 or less	RPD ± 20%	Qualify data	Analyst	Precision	RPD ± 20%
LCS (extract)	1 per batch of 20 or less	85-115%	Reanalyze first, then rerun batch or qualify data	Analyst	Accuracy/Bias	85-115%
SIC	Daily	<± 1/2 QL or calculated acceptance window, whichever is greater	Rerun or recalibrate	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-13
QC Samples Table

Matrix	Soil
Analytical Group	Metals: IVBA (Pb & As)
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	EPA R9 SOPs 256, 407, 503
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Region 9
No. of Sample Locations	33

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch of 20 or fewer samples	< ½ RL	If sample result< 5x MB rerun MB once to verify, if still outside criteria re-prep and re-run samples; If sample result> 5x MB or nondetect report without qualification	Analyst	Accuracy/Bias Contamination	< ½ RL
Sample Duplicate	1:20	±20%	Document, report	SERAS TL	Precision	±20%
LDR	Annually or when analytical conditions are changed	%R =% 90 -110%	Sample results > 90% of the upper LDR limit must be diluted and reanalyzed	Analyst	Accuracy/Bias	%R =% 90 -110%
Reagent Blank (extraction fluid)	1 per batch of 20 or fewer samples	Specific per analyte (< 25µg/L Pb)		Analyst	Accuracy/Bias	Specific per analyte (< 25µg/L Pb)

QAPP Worksheet #28-13
QC Samples Table

Matrix	Soil
Analytical Group	Metals: IVBA (Pb & As)
Concentration Level	Low
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	EPA R9 SOPs 256, 407, 503
Sampler's Name	SERAS Field Personnel
Field Sampling Organization	SERAS
Analytical Organization	Region 9
No. of Sample Locations	33

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Every standard and sample	60-125%	Re-extract, reanalyze affected samples, document	Analyst	Accuracy/Bias	60-125%

QAPP Worksheet #28-14
QC Samples Table

Matrix	Plant Tissue
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	SERAS SOP #2037
Analytical Method/ SOP Reference	Katahdin SOP #CA-627-09
Sampler's Name	Gussman
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	10

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Post-digestion matrix spike	Every 20 samples	%R = 80 -120	Flag results and/or analyze sample by method of standard additions	Analyst	Accuracy/Bias	%R = 80 -120
Duplicate Sample	Every 20 samples	RPD ±20% if sample conc >100x IDL	Flag results	Analyst	Precision	RPD ±20% if sample conc >100x IDL
Field Duplicate	1 in 20	±35%	Document, report	SERAS Task Leader	Precision	±35%
LCS	Every 20 samples of same matrix	80-120% or performance acceptance limits	Investigate source of problem; re-digest & re-analyze all associated samples, unless LCS>120% and sample result <PQL	Analyst	Accuracy/Bias	80-120% or performance acceptance limits
Method Blank	1 in 20	<RL		Analyst	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-14
QC Samples Table

Matrix	Plant Tissue
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	SERAS SOP #2037
Analytical Method/ SOP Reference	Katahdin SOP #CA-627-09
Sampler's Name	Gussman
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	10

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
ICS	Before analyzing samples; every 12 hours during a run	±20% of true value		Analyst	Accuracy/Bias Contamination	±20% of true value
Serial Dilution	1 per digestion batch	±10% if analyte concentration > 50 times instrument detection limit	Flag result or dilute and re-analyze sample to eliminate interference	Analyst	Accuracy/Bias	±10% if analyte concentration > 50 times instrument detection limit

QAPP Worksheet #28-15
QC Samples Table

Matrix	Plant Tissue
Analytical Group	Metals (Hg)
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	Katahdin SOP #CA-611
Sampler's Name	Gussman
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	10

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Post-digestion matrix spike	Every 20 samples	%R = 80 -120	Flag results and/or analyze sample by method of standard additions	Analyst	Accuracy/Bias	%R = 80 -120
Laboratory Duplicate Sample	Every 20 samples	RPD ±20%	Flag results	Analyst	Precision	RPD ±20%
Field Duplicate	1 in 20	NA	Document, report	SERAS Task Leader	Precision	±35%
LCS	Every 20 samples of same matrix	80-120% or performance acceptance limits	Investigate source of problem; re-digest & re-analyze all associated samples, unless LCS>120% and sample result <PQL	Analyst	Accuracy/Bias	80-120% or performance acceptance limits
Method Blank	1 in 20	<RL		Analyst	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-15
QC Samples Table

Matrix	Plant Tissue
Analytical Group	Metals (Hg)
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	Katahdin SOP #CA-611
Sampler's Name	Gussman
Field Sampling Organization	SERAS
Analytical Organization	Katahdin Analytical
No. of Sample Locations	10

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	Every 20 samples	75-125%		Analyst	Accuracy/Bias	75-125%
IDL Study	Prior to analysis of samples	IDL <RL		Analyst	Sensitivity	IDL <RL
LOD/LOQ Study	Prior to analysis of samples	LOD = 2-3x MDL LOQ > LOD		Analyst	Sensitivity/Accuracy	LOD = 2-3x MDL LOQ > LOD
Serial Dilution	1 per digestion batch	±10%	Flag result or dilute and re-analyze sample to eliminate interference	Analyst	Accuracy/Bias	±10%

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Site Logbook Chain of Custody Records Sample Labels Field Change Form (if necessary)	XRF Logbook	Digestion and Analysis Logs TCLP Extraction Logs Preventive Maintenance Logs Instrument Printouts Calibration Data Internal COC Records Spreadsheet summaries, graphical analysis, maps, specific model data inputs, GIS digital elevation data and aerial imagery	Validation Report Model simulation data and results	Technical Memorandum QAPP XRF Trip Report WP

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Samples Collected by Region 9 in August 2013							
Soil	IVBA (As & Pb)	Low	NA	SOPSO048.06.13.05 & SOPII022.07.13.09	10 business days	ACZ Laboratories 2773 Downhill Drive Steamboat Springs, Co 80487 Tim VanWyngarden (970) 879-6590 ext 103	NA
Soil	TAL Metals, % Solids	Low to High	NA	SERAS SOP 1811 & SERAS SOP 1832	20 business days following receipt of samples	Jay Patel ERT/SERAS Laboratory Edison, NJ (732) 494-4052	NA
November 2013 – Spring 2014							
Soil/Sediment/ Slag/Dross/ Waste Rock/ Groundwater/ Surface Water	TAL Metals	Low to High	Refer to Worksheet 18	ISM01.3	35 days	CLP-assigned Laboratory	USEPA R9 Laboratory
Soil/ Waste Rock/ Dross/Slag	SPLP Metals (RCRA 8 + Zn, Cu, Al, Fe and Mn)	Low to High	Refer to Worksheet 18	R9 SOP 254 R9 SOP 407 R9 SOP 503 R9 SOP 515	35 days	Sample Receiving USEPA R9 Laboratory 1337 South 46th Street, Bldg 201 Richmond, CA 94804 (510) 412-2389	NA
Tissue	TAL Metals	Low	Refer to Worksheet 18	SW846 6020A	Prelims 10 business days from receipt of the samples; complete data package 15 business days from receipt of the samples	Gregory Lull Katahdin Analytical 600 technology Way Scarborough, ME 04074 (207) 874-2400	NA

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Soil	IVBA (As & Pb)	Low to High	Refer to Worksheet 18	R9 SOP 256 R9 SOP 407 R9 SOP 503	35 days	Sample Receiving USEPA R9 Laboratory 1337 South 46th Street, Bldg 201 Richmond, CA 94804 (510) 412-2389	NA
Soil	Cr(VI)	Low	Refer to Worksheet 18	EPA 7196	Prelims 10 business days from receipt of the samples; complete data package 15 business days from receipt of the samples	Gregory Lull Katahdin Analytical 600 technology Way Scarborough, ME 04074 (207) 874-2400	NA
Soil/Dross Material	Dioxin	Low	Refer to Worksheet 18	SW 846/8290 (EPA 1613)	Prelims 15 business days from receipt of the samples; complete data package 20 business days from receipt of samples	Gregory Lull Katahdin Analytical 600 technology Way Scarborough, ME 04074 (207) 874-2400 (Cape Fear Analytical, LLC)	NA
Sediment	TOC	NA	Refer to Worksheet 18	SW 846 9060A mod	Prelims 10 business days from receipt of the samples; complete data package 15 business days from receipt of the samples	Gregory Lull Katahdin Analytical 600 technology Way Scarborough, ME 04074 (207) 874-2400	NA

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Groundwater/ Surface Water	Alkalinity; Chloride; Nitrie/Nitrate; Sulfate; Phosphate; Silicon; Dissolved Organic Carbon; TDS; Fluoride	NA	Refer to Worksheet 18	SM2320B EPA 325.2 EPA 353.2 EPA 375.4 EPA 365.4 SW 846 6010 SM5310B SM2540C EPA 300	Prelims 10 business days from receipt of the samples; complete data package 15 business days from receipt of the samples	Gregory Lull Katahdin Analytical 600 technology Way Scarborough, ME 04074 (207) 874-2400	NA
Soil/ Waste Rock/ Dross/ Slag	ABA	NA	Refer to Worksheet 18	ASTM D2974-07a; Neutralization Potential; Grind; Saturated Paste pH; ASTM E1915-09; ABA	15 business days from receipt of the samples	Gregory Lull Katahdin Analytical 600 technology Way Scarborough, ME 04074 (207) 874-2400 (ALS Environmental)	NA
Soil	Geotechnical Measurements (moisture density, hydraulic conductivity, specific gravity, grain size, Atterberg limits, natural moisture, consolidation, shear test, consolidated undrained triaxial shear test)	NA	Refer to Worksheet 18	ASTM D2937 ASTM D5084 ASTM D854 ASTM D422 ASTM D4318 ASTM D2216 ASTM D2435 ASTM D3080 ASTM D4767	15 business days from receipt of each batch of samples	Adam Arp-Romero, P.E. Speedie & Associates, Inc. 4025 E. Huntington Dr. Ste. #140 Flagstaff, AZ 86004 (928) 526-6681	NA

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Soil	Geotechnical Parameter – Soil Water Characteristic Curves	NA	Refer to Worksheet 18	ASTM 6836	15 business days from receipt of each batch of samples	Mike Yao, Ph.D. GeoSystems Analysis Inc. 393 N. Dodge Blvd. Tucson, AZ 85716 Phone: 520-628-9330 Cell: 520-270-8252	NA
Rock	Geotechnical Parameter – Slake Durability	NA	Refer to Worksheet 18	ASTM D4644	15 business days from receipt of each batch of samples	Mike Yao, Ph.D. GeoSystems Analysis Inc. 393 N. Dodge Blvd. Tucson, AZ 85716 Phone: 520-628-9330 Cell: 520-270-8252	NA

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Laboratory Accreditation Audit	Every 3 years	Internal	NELAC accrediting agency	Regulatory Agency	Debbie Killeen, QA/QC Officer SERAS Laboratory	Debbie Killeen, QA/QC Officer SERAS Laboratory	NELAC Accrediting Authority
Laboratory Audit	Annual	Internal	ERT/SERAS Laboratory	Debbie Killeen, QA/QC Officer SERAS Laboratory	Lab Operations Personnel	Lab Operations Personnel	QA/QC Officer
Performance Evaluation Samples	Annual	Internal	Regulatory Agency	Regulatory Agency	Debbie Killeen, QA/QC Officer SERAS Laboratory	Debbie Killeen, QA/QC Officer SERAS Laboratory	Regulatory Agency
Laboratory Technical Systems/ Performance Audits	As per regulatory program	External	Regulatory Agency	Regulatory Agency	EPA CLP RAS Laboratory	EPA CLP RAS Laboratory	EPA or other Regulatory Agency
Performance Evaluation Samples	As per regulatory program	External	Regulatory Agency	Regulatory Agency	EPA CLP RAS Laboratory	EPA CLP RAS Laboratory	EPA or other Regulatory Agency
Laboratory Technical Systems/ Performance Audits	As per regulatory program	External	Regulatory Agency	Regulatory Agency	QA/QC Officer, EPA R9 Lab	Laboratory Manager, EPA R9 Lab	EPA or other Regulatory Agency
Performance Evaluation Samples	As per regulatory program	External	Regulatory Agency	Regulatory Agency	QA/QC Officer, EPA R9 Lab	Laboratory Manager, EPA R9 Lab	EPA or other Regulatory Agency
Laboratory Accreditation Audit	Every 2 years	External	NELAC Accrediting Agency	New Jersey Department of Environmental Protection (NJ DEP)	QA Officer, Katahdin Analytical Services	QA Officer, Katahdin Analytical Services	NJ DEP

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Laboratory Accreditation Audit	Every 2 years	External	NELAC Accrediting Agency	Utah Department of Health (DOH)	QA Officer, Cape Fear Analytical Services QA Officer, ACZ Laboratories	QA Officer, Cape Fear Analytical Services QA Officer, ACZ Laboratories	Utah DOH
Laboratory Accreditation Audit	Every 2 years	External	NELAC Accrediting Agency	Texas Commission on Environmental Quality	QA Officer, ALS Environmental	QA Officer, ALS Environmental	Texas Commission on Environmental Quality

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Observations/ Deviations from Work Plan	Logbook	D. Aloysius, Response TL, SERAS	Immediately	Field Change Form	D. Aloysius, Response TL, SERAS	Within 24 hours of change
Peer review of reports	Directly on deliverable	D. Aloysius, TL, SERAS	Prior to deliverable due date	Comments directly on deliverable	D. Aloysius, TL, SERAS	Prior to deliverable due date
Laboratory Accreditation Audit	Audit Report	Debbie Killeen, QA/QC Officer, SERAS	30 days	Corrective Action Plan	Regulatory Agency	Within 30 Days
Laboratory Audit	Audit Report	Jay Patel, ICP/ICP-MS. Chemist, SERAS	45 days	Corrective Action Plan	Debbie Killeen, QA/QC Officer, SERAS	Within 45 Days
Laboratory Accreditation Audit	Audit Report	QA Officer, Katahdin Analytical Services	30 days	Corrective Action Plan	QA Officer, Katahdin Analytical Services	Within 30 Days
Laboratory Accreditation Audit	Audit Report	QA Officer, Cape Fear Analytical Services QA Officer, ACZ Laboratories	30 days	Corrective Action Plan	QA Officer, Cape Fear Analytical Services QA Officer, ACZ Laboratories	Within 30 Days
Laboratory Accreditation Audit	Audit Report	QA Officer, ALS Environmental	30 days	Corrective Action Plan	QA Officer, ALS Environmental	Within 30 Days
Laboratory Technical Systems/ Performance Audits	Written Report	EPA CLP Laboratory	30 days	Letter	Laboratory Manager, EPA CLP Laboratory	14 days
Performance Evaluation Samples	Electronic Report	EPA CLP Laboratory	30 days	Letter or Written Report	Laboratory Manager, EPA CLP Laboratory	14 days

Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Laboratory Technical Systems/ Performance Audits	Written Report	Region 9 Laboratory	30 days	Letter	Laboratory Manager, EPA R9 Laboratory	14 days
Performance Evaluation Samples	Electronic Report	Region 9 Laboratory	30 days	Letter or Written Report	Laboratory Manager, EPA R9 Laboratory	14 days

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Technical Report	Monthly	20th of the month following performance period	Dave Aloysius, Task Leader/SERAS	ERT Project Officer and WAM
QA Report	Quarterly	February, May, August, November	Deborah Killeen, QA/QC Officer/SERAS	ERT Project Officer and Quality Coordinator

QAPP Worksheet #34
Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Raw data	Verify that all acquired data have been backed-up, either to a shared drive or external storage media (e.g., compact disc).	Internal	D. Aloysius/SERAS
Processed data	Verify that all processed and graphed data are correct	Internal	D. Aloysius/SERAS
Model assessment	Review model theory, mathematical structure and required input parameters to verify that the model will perform the required tasks in order to meet the objectives of the study.	Internal	D. Aloysius/SERAS
Modeling and related calculations	Verify correct data input	Internal	D. Aloysius/SERAS
Technical memorandums	Verify that transcription errors are not present	Internal	Peer Review team
FP XRF Report/Trip Report	Reviewed for accuracy	Internal	Peer Review Team
Chain of Custody Record	Reviewed by field sampling personnel in field.	Internal	D. Aloysius/SERAS S. Grossman/SERAS C. Gussman/SERAS
Completeness Check	Review of Planning Documents, Analytical Data Package, Sampling Documents and External Reports, as applicable, using the UFP-QAPP Checklist	Internal	D. Aloysius/SERAS S. Grossman/SERAS C. Gussman/SERAS SERAS QA/QC Chemists

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

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
January 2014 – Spring 2014			
IIa	SOPs	Ensure that the sampling methods/procedures outlined in the QAPP were followed and any deviations noted. Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	D. Aloysius/SERAS T. Johnson/ERT WAM
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	D. Aloysius/SERAS
IIa	COC Records	Examine COC records and match with requested analyses.	J. Patel, SERAS A.Vaidya, SERAS S.Sahni, SERAS
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	QA/QC Chemist, SERAS Laboratory Personnel Data Validation Personnel
IIb	Laboratory data package	Determine potential impacts from noted/approved deviations, in regard to PQOs. Examples include PQLs and QC sample limits (precision/accuracy).	QA/QC Chemist, SERAS ESAT and EPA R9 Data Validation Personnel

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

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
Samples Collected by Region 9 in August 2013					
IIa/IIb	Soil	TAL Metals	Low to high	SERAS SOP #1017, *Data Validation Procedures for Routine Inorganic Analysis*	SERAS QA/QC Chemist
IIa/IIb	Soil	IVBA (Pb & As)	Low to high	SERAS SOP #1017, *Data Validation Procedures for Routine Inorganic Analysis*	SERAS QA/QC Chemist
January 2014 through Spring 2014					
IIa/IIb	Soil/Sediment/Slag/ Dross/Rock/Water	TAL Metals	Low to high	Data Validation SOP for Inorganic Analysis of Low/Medium Concentration Total Metals under SOW ILM0 5.4	ESAT Data Validation Personnel
IIa/IIb	Soil/Sediment	SPLP Metals; IVBA	Low to high	Data Validation SOP for Inorganic Analysis of Low/Medium Concentration Total Metals under SOW ILM0 5.4	EPA Region 9 Personnel
IIa/IIb	Soil/Water	Cr(VI), Water Quality Parameters, IVBA, TOC	Low	SERAS SOP #1017, *Data Validation Procedures for Routine Inorganic Analysis*	SERAS QA/QC Chemist
IIa/IIb	Sediment/ Dross	Dioxins/furans	Low	SERAS SOP #1019, *Data Validation Procedures for Dioxin/Furan Analysis by HRGC/HRMS*	SERAS QA/QC Chemist

☑ Worksheet Not Applicable (State Reason) Usability of the data will be determined by EPA Region 9 and EPA ERT.

QAPP Worksheet #37
Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
Describe the evaluative procedures used to assess overall measurement error associated with the project:
Identify the personnel responsible for performing the usability assessment:
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

ATTACHMENT 1
Draft Supplemental Field Investigation Workplan
Iron King Mine Site UFP-QAPP
December 2013

DRAFT
SUPPLEMENTAL FIELD INVESTIGATION WORK PLAN
Iron King Mine-Humboldt Smelter Superfund Site, Dewey-Humboldt, Arizona

Prepared for:
United States Environmental Protection Agency/Environmental Response Team
Las Vegas, Nevada

By:
Lockheed Martin/Scientific Engineering Response & Analytical Services (SERAS)
Work Assignment Number: SERAS-146

December 20, 2013

Table of Contents

1.0 INTRODUCTION

The Environmental Protection Agency (EPA) Region 9 (the Region) has requested assistance from the EPA/Environmental Response Team (ERT) in conducting a data gap assessment at the Iron King Mine (IKM) - Humboldt Smelter Superfund Site (Site) in Dewey-Humboldt, Yavapai County, Arizona. Lockheed Martin personnel from the Scientific, Engineering, Response and Analytical Services (SERAS) contract will assist the EPA/ERT in completing this work.

This Supplemental Field Investigation Work Plan (FWP) outlines the objectives, approaches, and methods that will be used to address field tasks in source and potentially impacted areas, and further evaluate site-wide groundwater and surface water impacts. It was developed from information gathered from a recent draft Data Gap Analysis Report (CH2M Hill, 2013), conference calls between the Region, ERT, SERAS, CH2M Hill (Region 9 contractor), and site reconnaissance. The source areas include the IKM property and main tailings pile (MTP), the Humboldt Smelter Area (smelter dross, smelter slag, and smelter tailings), Lower Chaparral Gulch, Chaparral Gulch Dam, and the Agua Fria River (Figure 1). Potentially impacted areas include peripheral or undeveloped areas around the IKM property, Galena Gulch, upper and middle sections of Chaparral Gulch, and in-town residential parcels.

The primary contaminants of concern are lead (Pb) and arsenic (As). The Region has defined the cut-off concentrations for source delineation of 400 and 200 milligrams per kilogram (mg/kg) for Pb and As, respectively. Throughout the document, Pb and As concentrations above these thresholds are considered elevated. Materials (dross, tailings, soil, etc) with concentrations above these thresholds are referred to as impacted.

1.1 Work Scope Overview

In addition to the site-specific tasks and general site assessment methods outlined in this plan, a number of supporting tables (pertaining to sample types, approximate number of samples, and types of analyses) and figures (showing approximate or proposed sampling locations) are also attached. Sample matrix tables (Tables 1 through 3) include information for geotechnical laboratory testing, analytical laboratory testing, and bioassessment sampling and analysis. A fourth table (Table 4) outlines the sample identification protocol for this project.

The detailed quality assurance and quality control (QA/QC) protocols for the analytical and testing methods are outlined in a site-specific Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP; SERAS, 2013).

Prior to initiating intrusive sampling at the site, a subset of sampling locations (excluding residential properties) will be field-marked with labeled pin flags. As the sampling proceeds, additional locations will be added to meet each specific task objective. During field activities, preliminary analysis of data will be presented to ERT's or the Region's personnel to ensure that data acquired from each area of interest meet project objectives.

An attached schedule chart (Attachments section) presents the estimated task-specific timelines. The bulk of the work is projected to be completed from December 2013 through mid May 2014; however, tasks such as groundwater and surface water sampling and monitoring are expected to continue through March 2015.

2.0 SITE BACKGROUND

The Iron King-Humboldt-Smelter Superfund site is located in Dewey-Humboldt, Yavapai County, Arizona (Figure 1). The Site is a combination of sources and releases from two areas: the Iron King Mine (IKM) and the Humboldt Smelter. A portion of the Town of Dewey-Humboldt is situated between the Mine and the Smelter. Three waterways (Chaparral Gulch, Galena Gulch, and Agua Fria River) also transect the Iron King-Humboldt-Smelter Superfund site.

The IKM occupies approximately 153 acres and is bordered by Chaparral Gulch to the north, Galena Gulch to the south, Highway 69 to the east, and undeveloped land to the west. The IKM is comprised of the Iron King Mine proper area, the operations area, and the former fertilizer plant. The mine was periodically operated from 1906 to 1969 for extraction of gold, silver, copper, lead, and zinc. The Main Tailing Pile (MTP) on the property covers over 55 acres, is over 100 feet high, and contains over 6,000,000 cubic yards of tailings.

The Humboldt Smelter area, located east of Highway 69, occupies approximately 182 acres along Chaparral Gulch including property at the east end of Main Street in the Town of Dewey-Humboldt around the old smelter stack. This area is covered in approximately 763,800 square feet of yellow-orange tailings, 653,000 square feet of grey smelter ash, and 456,000 square feet of slag. These mine and smelter wastes are sources of lead and arsenic contamination to neighboring residential soils through air transport, surface deposition, and use as yard fill material in some cases. In addition to nearby residential areas, the investigation area around the smelter also includes sections of Chaparral Gulch, the Agua Fria River, and adjoining drainage channels and outfalls.

3.0 PROJECT PLANNING AND SUPPORT ACTIVITIES

3.1 Health and Safety Plan

During work at the site, SERAS personnel may be exposed to a number of occupational and environmental hazards. These will be covered in detail in a site-specific health and safety plan (HASP). All SERAS personnel will be required to read, understand, and sign the HASP prior to initiating any work at the site. SERAS personnel will adhere to the following SERAS Health & Safety SOPs for all site-related activities:

#3001 *SERAS Health and Safety Program Policy and Implementation*
#3012 *SERAS Health and Safety Guidelines for Field Activities*

#3020 *Inclement Weather and Temperature Extremes*

3.2 Quality Assurance Project Plan

Project management, measurement, assessment, and usability elements applicable to this FWP are included in a corresponding site-specific Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP).

3.3 Subcontractor Procurement

A number of *Requests for Proposals* (RFPs) will be prepared and subsequently transmitted to qualified subcontractors for the following services. These include:

- Drilling and subsurface sampling
- Field surveying (dam, slag pins, new monitor wells)
- Dust control
- Monitor well installation
- Borehole geophysics

Pre-bid meetings and area walkovers will take place at the site with prospective subcontractors prior to submittal of final bids for the various work elements above.

Additionally, arrangements will be made with qualified geotechnical and analytical laboratories for analysis/testing of select parameters on a number of soil and other environmental samples as requested by the Region.

3.4 Field Support Facilities and Site Access

Arrangements will be made to mobilize a large office trailer to the site, which will remain in place for an extended period of time (tentatively, mid November 2013 through May 2014). It is anticipated that the trailer will reside on the Iron King Mine property and therefore, unrestricted site access will be required for the duration of the project. Arrangements for on-site power over the extended period will also be made (i.e., utility pole hook-up). Necessary office furniture, related office supplies and materials, and at least two porta-johns will be rented from local suppliers. In addition, a conex box will be rented to store sampling equipment, glassware, and archived samples. This box will be collocated with the large office trailer and mobile laboratory for easy accessibility to field staff.

ERT West in Las Vegas, Nevada will transport a mobile laboratory to the site, which will be dedicated to sample analysis using field portable x-ray fluorescence (XRF) analyzers. The lab will be co-located with the office trailer.

Note: Additional, unrestricted site access will also be required for the smelter tailings area (i.e., through the locked gate at the end of Sweat Pea Lane).

3.5 Mark Outs of Proposed Sampling Locations

Prior to initiating field activities, most of the proposed sampling locations (excluding residential properties) will be marked and identified with either flagged stakes or pin flags. During this activity, representatives from ERT and/or the Region will be on site to provide direction, guidance, and to concur with the mark-outs. It is assumed that this effort will occur as a separate mobilization to the site, which will be tied into the field support facilities and site access arrangements (above). Based on timing, this work may be linked to one or more pre-bid meetings with prospective subcontractors (especially, the drilling and subsurface sampling work element). This initial field work will also serve as an orientation to a number of SERAS staff that will work on the various field tasks.

3.6 Project Staffing

A number of SERAS staff will participate in field and/or office-related activities, including: hydrogeologists, geologists, geophysicists, chemists, environmental scientists, environmental technicians, GIS and AutoCAD specialists, data validation chemists, and subcontracting personnel. Other SERAS technical and/or administrative personnel and subcontractors may work on this project as needed.

4.0 SITE-SPECIFIC TASKS

4.1 Site Aerial, Topographic & Parcel Data

Objective: Obtain available data from Yavapai County, which will be useful for volume estimations of mine wastes, identification of parcels (requiring property access) where future sampling efforts and removal activities are planned, and future site restoration activities (e.g., site grading plans, stormwater routing, and waste consolidation and capping evaluations).

- The Yavapai County Geographic Information Systems (GIS) Department will be contacted to obtain 2010 aerial imagery and 2-foot topographic contour coverage for the entire site and surrounding areas. Parcel data will also be acquired for identifying property boundaries and owners. All data will be in electronic format (shape and image files), compatible with ArcGIS version 9.0 (or later versions).

4.2 Property Access and Data Management

Objective: To ensure that EPA obtains signed property access agreements for all residential properties to be sampled prior to sampling.

- ERT will conduct the research to determine the owners of all parcels to be sampled - i.e., parcels designated for both area-based risk screening and yard-specific risk characterization. Property owners will be determined through a combination of county records, utility companies' databases, public meetings, door-to-door visits, telephone calls, and internet searches.

Property access will be requested mainly through door-to-door visits; however, mass mailings of the access agreements will also be conducted. Multiple teams will be deployed to conduct door-to-door visits. Each team will consist of at least one EPA representative and a SERAS contractor. Each team member will wear appropriate identification clothing, and EPA personnel will also have their EPA identification. EPA personnel will explain the need for access and present occupants with a copy of the Access Agreement and the site Fact Sheet provided by the Region. If the property is not owner-occupied, signed access agreement will be required from both owner and occupant. If additional information is required by an owner/occupant that is not covered by the Fact Sheet, that individual will be referred to a Regional contact, such as the Regional Community Coordinator.

The signed access agreement shall be scanned and backed up electronically and the original will be filed accordingly for easy access. ERT's Scribe software will be used as an electronic repository for all access agreement data. The Scribe property access database will contain the following fields: property sampling identifier; property address (sub division); property owner(s) name; property owner(s) address(es), if different from property address; contact information (telephone and email); occupant/tenant name(s), if property not owner-occupied; access-request date; status of access (approved; denied; or nonresponsive); approval/denial date; sampling date; an electronic copy of signed access agreements; and comments. Biweekly updates of the Scribe access agreement database will be made available to the Region and other stakeholders identified by the Region.

4.3 Construction Materials Survey

Objective: Determine local off-site sources of natural materials that can be used for future site restoration efforts (e.g., erosion protection, low permeability soil cover, drainage material, and engineered fill).

- Suppliers local to the site will be contacted by phone to inquire as to what types of products are available. Materials of interest include riprap (quarried rock), angular gravel, bank-run gravel, pea gravel, sand (various grain sizes), clayey and non-cohesive backfill materials, road base material (mixed soil & gravel), and organic topsoil.

4.4 IKM Main Tailings Pile (MTP)

Overview and Objectives:

1. Bedrock Integrity: Assess bedrock characteristics beneath pile (rock quality, fracturing, etc.).

2. Geotechnical Properties of Tailings: Assess moisture conditions with depth; stability analysis of the pile; liquefaction potential.

3. Acid Mine Drainage Potential: Assess buffering capacity of tailings and acid mine drainage potential.

4. Perched Groundwater Level Monitoring: Assess seasonal groundwater level fluctuations within the pile.

5. Mine Waste Rock Characterization: Assess durability, chemical properties, and degradation characteristics of waste rock for evaluation of use as cover material during the remedy implementation phase.

6. Bioaccessibility Analysis: Refine bioaccessibility values to be used in the site risk assessment.

- **Bedrock Integrity**: Sonic drilling will be used to advance three borings into the MTP and the underlying bedrock. Two borings will be drilled on the Upper MTP and one on the Lower MTP (Figure 2). Borings on the Upper MTP will be drilled to approximately 110 feet and the one on the Lower MTP will be drilled to approximately 50 feet (estimated depths to bedrock). The borings will be advanced an additional 20 feet into the underlying bedrock. Rock core samples will be collected to assess the bedrock integrity. Suitable bedrock integrity may also be inferred by coring refusal.

- **Geotechnical Properties:** During drilling in unconsolidated materials, Standard Penetration Tests (SPTs) will be conducted at 5-foot intervals. In addition, undisturbed samples of unconsolidated materials will be collected at 10-foot intervals. The following geotechnical tests will be performed on unconsolidated samples: moisture-density, saturated hydraulic conductivity, specific gravity, soil-water characteristic curve, in-place moisture-density, natural moisture content, gradation (also referred to as grain size), Atterberg limits, consolidation tests, direct shear tests, and consolidated triaxial shear tests with pore pressure measurements. Table 1 provides a summary of the total number of samples per test.

- **Acid Mine Drainage (AMD) Potential:** Four unconsolidated samples will be collected per boring and analyzed for AMD potential. Samples will be collected at or near ground surface, at perched water zones (where present), in the saturated tailings, and in native material below the tailings. AMD analyses will include Target Analyte List (TAL) metals, acid base accounting (ABA) measurements (rinse and paste pH, sulfur species, neutralization potential, and acid generation potential), hexavalent chromium, and synthetic precipitation leaching procedure (SPLP; EPA Method 1312) followed by analysis of the leachate extract for Resource Conservation and Recovery Act (RCRA) metals (a total of eight) plus five additional metals (aluminum, copper, iron, manganese, and zinc).

- **Perched Groundwater Level Monitoring:** The three boreholes will be backfilled to the base of the tailings and completed as monitor wells. The wells will be constructed with 4-inch diameter, Schedule 80 PVC riser pipe and 20-foot, 10-slot screens (positioned at the base of the tailings). Pressure transducers (with data logging capability) will be installed in the wells to monitor water-level fluctuations in the MTP over a one year period. These wells will be included in the area-wide monitoring well network and will be sampled on two occasions for analysis of the following water quality (WQ) parameters: alkalinity, chloride, fluoride, nitrate, phosphate, silica, sulfate, dissolved organic carbon (DOC), total dissolved solids (TDS]), and TAL Metals.

- **Mine Waste Rock Characterization:** During a field reconnaissance of the area, visual observations will be made to determine a median size of the waste rock (Figure 3). The volume of the waste rock will be estimated using a combination of field measurements and digital topographic contour data. Field measurements will employ a Global Positioning System (GPS) for measuring total area and distances, a survey rod (or similar device) for measuring material thickness, and a Brunton compass (or similar device) for measuring slope angles (where applicable).

  The total rock volume will be estimated from a series of total thickness and footprint measurements, and then assuming a particular geometric shape; for example, a hexagonal prism. The waste rock footprint will be mapped using a handheld GPS and total thicknesses will be measured at a minimum of six locations throughout the area. Assuming a relatively flat, level surface beneath the waste rock, digital topographic contour data may be useful for both refining volume estimates and comparing the results to those derived from manual measurements.

  Five (5) waste rock samples (i.e., fine-grained material) will be collected for the following tests/analyses: slake durability (ASTM D4644), TAL metals, ABA measurements, and SPLP metals.

- **Bioaccessibility Analysis:** Ten surface samples of tailings material will be collected from the MTP for *in vitro* bioaccessibility (IVBA) testing for lead and arsenic. The samples will be sent to the EPA Region 9 Laboratory for analysis.

4.5 IKM Peripheral Areas

Objectives:

1. Determine the extent of contamination beyond the MTP.

2. Refine bioaccessibility values to be used in the site risk assessment.

- **Soil Borings (up to 20 feet):** A minimum of 11 borings will be drilled in two areas (Figure 2) to depths ranging from 5 to 20 feet using a small, track-mounted sonic or direct-push drilling rig. The borings will be logged for lithology, moisture conditions, presence of perched water, and depth of the tailings. Sampling intervals will be determined from field observations; however, a minimum of two samples will be collected per boring for XRF field analysis (one from the top and one from the bottom). Soil samples will be collected from the borings in accordance with SERAS SOP #2012, *Soil Sampling*. A minimum of 22 bag samples will be analyzed for lead and arsenic using a field portable XRF (Table 2). Five percent (%) of the XRF samples will be sent for confirmation laboratory analysis (TAL metals) as recommended in the draft Data Gap

Analysis Report (CH2M Hill, 2013). After soil sampling is completed, the borings will be backfilled with hydrated bentonite chips (below the water table or within saturated intervals) and then with clean fine sand (within the unsaturated zone) up to grade.

The areas and approximate number of borings for each are as follows:

- Area west of MTP, in apparent native material: 5 borings

- Area southwest of main retention ponds (below blowout area): 6 borings

Additional step-out sample borings may be required to define the three-dimensional extents of impacted soil. Locations and spacing of step-out samples will require adjustment in the field based on visual observations. Where samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to delineate the impacted area. Step-out sampling will continue both laterally and vertically until tailings and impacted native materials are no longer encountered. Hand augers will be used to collect samples around or near perceived boundaries or where the tailings are thought to be less than four feet thick.

- **Hand Augering (up to 4.5 feet):** In each area of interest, discussed below (Figure 3), shallow borings will be hand-augered to a maximum depth of 4.5 feet. Soil samples will be collected from each boring location in accordance with SERAS SOP #2012, *Soil Sampling*. A minimum of 287 bag samples will be analyzed in the field for lead and arsenic using a field portable XRF (Table 2). Laboratory confirmation analysis for TAL metals will be conducted on 5% of the XRF samples. The shallow borings will be backfilled with clean fine sand up to ground surface after sampling is completed.

  The areas are listed below indicating the minimum number of borings and proposed sampling depths:

  - Areas northeast of main retention ponds: 2 hand borings (samples from surface and 1 foot depth); 2 hand borings (samples from surface, 1 foot and 3 feet)

  - Area immediately north of the MTP: 25 hand borings (samples from surface, 1 foot and 3 feet)

  - Areas north/northeast of the MTP – around or near to property boundary: approximately 60 hand borings (samples from surface and 1 foot)

  - Waste Rock area: 18 hand borings (sample from surface and 1 foot)

  - Galena Gulch: 12 hand borings (samples from surface and 1 foot)

- Areas south of the former Fertilizer Plant and MTP - north of Galena Gulch: 11 hand borings (samples from surface and 1-foot)

Additional step-out sample borings may be required to define the three dimensional extents of impacted soil. Locations and spacing of step-out samples will require adjustment in the field based on visual observations. Where samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to delineate the impacted area. Step-out sampling will continue both laterally and vertically until source impact is fully delineated. Hand augers will be used to collect samples around or near perceived boundaries or where the tailings are thought to be less than four feet in thickness.

- **Galena Gulch - Bioaccessibility Analysis:** Five surface samples will be collected from Galena Gulch for *in vitro* bioaccessibility (IVBA) testing for lead and arsenic. The samples will be sent to the EPA Region 9 Laboratory for analysis.

4.6 Undeveloped Areas

Objectives:

1. Characterize the extent and distribution of lead and arsenic in shallow soil within areas that have not been previously sampled.

2. Estimate the extent of aerial deposition of dust generated from the MTP

- **Hand Augering:** In each area of interest, discussed below (Figure 4), shallow borings will be hand-augered to a maximum depth of one foot. The borings will be backfilled with clean fine sand after sampling is completed and capped to match the existing grade. The areas and approximate number of borings for each are as follows:

    - Barren-undeveloped areas west of Waste Rock area: 4 hand borings
    - Undeveloped area south of Galena Gulch: 11 hand borings
    - Legion Field: 11 hand borings
    - Undeveloped areas north of the IKM and Smelter area: 8 to 10 hand borings
    - Area east of the Chaparral Gulch Dam and Agua Fria River: 4 hand borings

Soil samples will be collected from the ground surface and one foot depth at each boring location in accordance with SERAS SOP #2012, *Soil Sampling*. A minimum of 76 samples will be analyzed in the field for lead and arsenic using a field portable XRF (Table 2), with 5% selected for laboratory confirmatory analysis.

4.7 Smelter Plateau: Dross Material, Slag, and Plateau Soils

Overview and Objectives:

1. Dross Material: Determine depth and volume of material; assess extent of lead and arsenic contamination; assess AMD potential and the presence of dioxins/furans.

2. Plateau Soils: Characterize the nature and extent of contamination on the plateau and secondarily, the basic geotechnical properties of soils in the area where a future containment cell for the dross material might be built. Data from the geotechnical testing will be used in the future Feasibility Study (FS) for conceptual design of the containment cell.

3. Slag: Evaluate the stability of the main slag pile given that cracks are present. Confirm differences in the chemical characteristics between the main and satellite slag piles, as identified in the previous Remedial Investigation (RI) report for the site.

- **Dross Material Investigation:** A 50-by-50-foot sampling grid (Figure 4) will be established over the major dross area using labeled pin flags, which will produce approximately 200 sampling locations (Figure 5). At each grid location, hand auger borings will be advanced through the dross to one foot into the underlying native material. Samples will be collected at the surface, at one foot intervals, and at final depth (expected to be no greater than 4.5 feet). Initially, two samples (surface and final depth) will be submitted for XRF analysis of lead and arsenic from each location. Additional depth samples will be collected at locations where lead or arsenic concentrations at total depth are elevated. Five percent of all XRF samples will be selected for laboratory confirmatory analysis. To capture the extent of contamination beyond the visible dross material, step-out samples will be collected to define the total impacted source area in three-dimensional space. Step-out sampling will be performed, both horizontally and vertically, until lead and arsenic concentrations in samples are below 400 and 200 mg/kg, respectively. Horizontal step-out sampling locations will be added to be consistent with the 50-by-50-foot grid (Figure 4). Horizontal coordinates of all step-out locations will be determined using a handheld GPS. The horizontal coordinates and final depth information for each boring will be imported into geographic information system (GIS) software, which will be used to interpolate the data and estimate the volumes of both dross and impacted (contaminated) native material. Upon completion, the borings will be backfilled with clean fine sand and capped to match the existing grade.

  Within the major dross area, there are a number of randomly scattered smaller dross piles. The volume of the smaller piles will be determined individually and independent of the grid sampling effort. First, all the smaller piles will be identified using pin flags; secondly, the volume of each pile will be determined by assuming a particular geometric shape (for example, a hexagonal prism or a cone) and its basic dimensions: aerial foot print, length, width, height, and average side slope. Basic dimensions will be determined using a GPS for measuring total area and distances, a survey rod (or similar device) for measuring material thickness, and a Brunton compass (or similar device) for measuring slope angles (where applicable). The total volume of dross impacted material will be determined as the sum of the major dross impacted area and the individual smaller piles.

Dross Sampling and Analysis: Up to four unconsolidated samples will be collected from the dross material for laboratory analysis. Samples will be collected at or near ground surface. Analyses will include Target Analyte List (TAL) metals, acid base accounting (ABA) measurements (rinse and paste pH, sulfur species, neutralization potential, and acid generation potential), and SPLP metals. Two samples of the dross material will also be collected for analysis of dioxins/furans.

- **Plateau Soils - Shallow Borings:** Approximately 15 borings will be drilled in the Plateau soils to a maximum depth of six feet using a small, track-mounted sonic or direct-push drill rig (Figure 5). Soil samples for XRF field analysis will be collected from the borings at ground surface, at some intermediate depth (based on visual observations), and at the bottom of the hole (6 feet) in accordance with SERAS SOP #2012, *Soil Sampling*. Approximately 45 samples will be analyzed for lead and arsenic using a field portable XRF (Table 2), with 5% of all XRF samples confirmed by fixed laboratory analysis. Six soil samples for geotechnical analysis will also be collected from the range of materials encountered in the borings (Table 1). The geotechnical samples will be analyzed for gradation, moisture content, and Atterberg limits. The borings will be backfilled with hydrated bentonite chips after the soil sampling is completed.

- **Slag Wall Stability Measurements:** The slag pile at Humboldt Smelter consists of a vitrified mass that has properties similar to a massive rock formation. There are large cracks in the top of the slag materials that may be the result of cooling of the slag pile rather than tension cracks from slag pile deformation. To determine if the cracks are still widening, differential leveling with sub-millimeter accuracy will be used to survey the coordinates and elevations of stainless steel pins installed on each side of three cracks (total of eight pins) twice: at the beginning and end of the 10-month-post-installation period. The slag will expand and contract with temperature differences; therefore, contemporaneous temperature and weather conditions will be recorded along with the survey measurements to assist in interpretation of the data.

  Transects along cracks through the most critical sections of the slag pile will additionally be surveyed by the subcontracted surveyor and the crack locations will be plotted on detailed planimetric maps (also prepared by the surveyor). The cracks will be identified by Lockheed Martin/SERAS in advance of the surveying activities to assist the subcontractor with the surveying. Critical sections for stability will be where the slag pile is tallest or steepest.

- **Main and Satellite Slag Pile Sampling**: Surficial samples of fine-grained materials will be collected from the Main and Satellite Slag Piles in accordance with SERAS SOP ##2012, *Soil Sampling*. One sample will be collected from the Main Slag Pile and two samples will be collected from the Satellite Slag Pile. Clean, dedicated sampling equipment will be used at each location. The samples (total of three) will be analyzed for TAL metals, ABA measurements, SPLP metals, and specific gravity (refer to Tables 1 and 2).

4.8 Smelter Tailings Swale

Objectives:

1. Use borings and surface geophysics to evaluate the depth and volume of tailings and impacted native material within this area.

2. Assess AMD potential of the tailings.

3. Generate chemical and geotechnical data that will be used in the FS to evaluate the potential to move or consolidate tailings in this area, and prepare a conceptual design for in-place closure of the tailings material in this area.

- **Shallow Borings with XRF Field and Geotechnical Analyses:** Up to 40 borings will be drilled in the tailings swale to depths between 5 and 25 feet (average of 10 feet) using a small, track-mounted sonic or direct-push drilling rig (Figure 6). The borings will be logged for lithologic layering, presence of perched water, depth of the tailings, and depth to bedrock, where present. Soil samples for XRF field analysis will be collected from the borings at the ground surface and at 5 foot intervals in accordance with SERAS SOP #2012, *Soil Sampling*. A minimum of 120 samples will be analyzed for lead and arsenic using a field portable XRF (Table 2). Five percent of all XRF samples will be sent for laboratory confirmatory analysis. Based on visual observations, two samples will be collected from two borings for laboratory analysis. One sample will be collected from the upper portion of the tailings, corresponding to the oxidized zone, and one sample will be collected from the lower portion in the reduced zone. A total of four samples will be analyzed for TAL metals, ABA measurements, SPLP metals, and hexavalent chromium (Table 2). Two soil samples will also be collected from the borings for geotechnical analysis (Table 1). The geotechnical samples will be analyzed for gradation, moisture content, and Atterberg limits. After soil sampling is completed, the borings will be backfilled with hydrated bentonite chips (below the water table or within saturated intervals) and then with clean fine sand (within the unsaturated zone) up to grade.

  Additional step-out samples maybe required in order to define the extent of the tailings and contaminated native materials. Locations and spacing of step-out samples will require adjustment in the field based on visual observations. Where samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to delineate the impacted area. Step-out sampling will continue both laterally and vertically until tailings and contaminated native materials are not encountered. Hand augers will be used to collect samples around or near perceived boundaries or where the tailings are thought to be less than four feet in thickness.

- **Surface Geophysical Investigation:** The smelter tailings swale will be investigated using a combination of surface geophysical methods (electrical resistivity, frequency-domain electromagnetic, and ground penetrating radar [GPR]) to determine the thickness of the tailings and the topography of the underlying native material. An Iris Instruments Syscal Pro Resistivity Meter may be used for the investigation, which provides pseudo-geological cross sections based on varying electrical resistance of materials in the subsurface. An array of electrodes are inserted into the ground and electricity is transmitted between a pair of electrodes while a second pair of electrodes measures voltage and current that are used to internally calculate resistance (via Ohms Law). This process is repeated along the array to determine the thickness and lateral variations of the tailings (including the edges of the tailings) along with the topography of the underlying native material.

  Assuming the tailings are less than 20 feet thick, a dipole-dipole array will be employed with an approximate spacing of 6.5 feet. The assumption that this array will penetrate the full thickness of the tailings will be tested by collecting data on two arrays: one on the north end of the investigation area and the other on the southern end. This should represent both the thinnest and thickest sections of the tailings. Adjustments in the array parameters can be made based on these two lines. Schlumberger arrays will also be run along the same lines of electrodes for greater penetration.

  To cover the investigation area, data will be collected both perpendicular and parallel to two primary north-south trending gullies that cut across the tailings. Ten arrays of data will be collected perpendicular to the gullies at approximately 100 foot interval spacing, with the lengths being adjusted to match the gully widths. Five additional arrays will be collected parallel to the gullies: two in the north, two in the south, and one along the tributary. Adjustments will be made in the field based on field conditions. GPS coordinates will be collected along each array at regular intervals and at changes in slope, or more precise line leveling methods to measure relief along the arrays may be necessary. Initial processing of the data will be completed in the field to confirm that robust and sufficient data is collected. Note the rough terrain at the site may result in processing artifacts, which may preclude effective interpretation.

  Profiles of apparent resistivity will be generated by software that runs an inversion model. Variations in resistivity will be interpreted based on the local geology (calibrated to borehole data), where a sharp contrast is expected between the tailings and the underlying native material. GPS coordinates and topographic relief (from digital contour data) will be included in the model. The volume of the tailings material, as estimated from the geophysical survey, will be adjusted upwards (possibly by 10 percent or more) using XRF data from borehole samples to provide a better estimate as to the total volume of impacted materials (including native materials) that are above site action levels (concentrations) for lead or arsenic. Additional information pertaining to material volume estimates is presented under General Site Assessment Methods.

  A Geonics® EM31-MK2 (EM31) will be used for the frequency-domain electromagnetic investigation. The EM31 is a one-man portable EM system with a 12-foot long boom that separates the transmitter and receiver coils that set up an electromagnetic (EM) dipole. The ground in turn generates a secondary field that is measured by the receiver coil. The EM field measured by the receiver is comprised of both the field generated by the transmitter and the secondary field. The measured field is broken into two components by the instrument based on phase and identified as the inphase and quadrature components. The quadrature component is 90 degrees out of phase with the primary field and is proportional to the conductivity of the soil. The quadrature component is called the terrain conductivity and is measured in millisiemens per meter (mS/m). Terrain conductivity provides information on the near surface geology and is affected by many factors including porosity, moisture content, clay content, and layer thickness. The inphase component is sensitive to metal, which is not expected to be present in the investigation area. The EM31 will be carried across the site along lines spaced approximately 6.5 feet apart with the data being collected simultaneously with GPS location data. The data will be augmented with supplemental measurements obtained from discrete points where the instrument will be laid directly on the surface above both tailings and native material. An inverse model will be used to convert the terrain conductivity into thickness.

The GPR unit will be a Sensors & Software Smartcart Noggin with a 250-megahertz (MHz) antenna. The GPR will used around the perimeter of the smelter tailings swale to map the thickness of the tailings in areas where it is expected to be thin. The GPR allows for real-time interpretation for immediate results.

4.9 Chaparral Gulch Floodplain (below Smelter Tailings Swale)

Objectives:

1. Evaluate the depth and horizontal extent of tailings material in the floodplain below the smelter tailings swale.

2. Assess layering and moisture content of alluvium, perched groundwater zones, AMD potential, and metal concentrations.

3. Generate geotechnical data that will be used in the FS to evaluate the erosive nature of the tailings and for design of a potential conveyance channel.

4. Refine bioaccessibility values to be used in the site risk assessment.

- **Shallow Borings with XRF Field and Geotechnical Analyses:** Up to 50 borings will be drilled within the Chaparral Gulch floodplain below the swale to depths between 5 and 25 feet (average of 10 feet) along transects using a small, track-mounted sonic or direct-push drilling rig (Figure 6). The borings will be logged for lithologic layering, presence of perched water, moisture content, and depth of tailings. Soil samples for XRF field analysis will be collected from the borings at the ground surface, at 5-foot intervals, and at maximum depth in accordance with SERAS SOP #2012, *Soil Sampling*. Up to 150 samples will be analyzed for lead and arsenic using a field portable XRF (Table 2), with 5% of the samples selected and sent for confirmatory analysis.

Based on visual observations, two samples will be collected from four borings (8 samples total) and analyzed for TAL metals, ABA measurements, SPLP metals, and hexavalent chromium (Table 2). One sample will be collected from the upper unsaturated (oxidized) zone and one from the lower saturated (reduced) zone. A total of ten samples will also be collected between depths of two and four feet for analysis of gradation, moisture content, and Atterberg limits (Table 1). The borings will be backfilled with hydrated bentonite chips after the soil sampling is completed.

Additional step-out samples may be required in order to define the extent of the tailings and contaminated native materials. Locations and spacing of step-out samples will require adjustment in the field based on visual observations of the depositional environment, with the objective of delineating lenses of impacted material. Where samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to delineate the impacted area. Step-out sampling will continue both laterally and vertically until tailings and contaminated native materials are not encountered. Hand augers will be used to collect samples around or near perceived boundaries or where impacted materials are thought to be less than four feet in thickness.

- **Bioaccessibility Analysis:** Five surface samples of tailings material will be collected from the floodplain for IVBA testing for lead and arsenic. The samples will be sent to the EPA Region 9 Laboratory for analysis.

4.10 Dam and Area behind the Dam

Overview and Objectives:

1. Borings: Soil borings will be drilled and sampled to determine the batter (slope angle) of the upstream surface of the concrete tailings dam. That surface is currently buried under mine tailings and cannot be inspected. Observations made during the drilling and analytical results for samples collected from the borings will be used to assess the total depth and volume of the mine tailings, concentrations of lead and arsenic, loading on the dam, groundwater levels, and acid mine drainage potential of the tailings behind the dam.

2. Physical Measurements: Physical measurements of the tailings dam will be used to assess its structural stability in relation to the imposed loads.

- **Upstream Surface Batter of Dam:** A minimum of six soil borings will be drilled behind the tailings dam with three borings located along each of two transects aligned perpendicular to the dam (Figure 6). The borings will be advanced to an estimated maximum depth of 25 feet using a small track-mounted sonic or direct-push drilling rig. The depth to dam concrete and presence of groundwater will be noted in each boring. The borings will be backfilled with hydrated bentonite chips and surveyed to determine their horizontal and vertical locations by an Arizona professional land surveyor.

- **Lead and Arsenic Concentrations:** Soil samples will be collected for XRF field analysis of lead and arsenic from five depths at each of the six borings: one at the surface and one at total depth. A total of 30 XRF bag samples will be collected in accordance with SERAS SOP #2012, *Soil Sampling*. Confirmatory laboratory analysis will be performed on 5% of the samples.

- **Geotechnical Properties:** Two soil samples will be collected in conformance with SERAS SOP #2012 for geotechnical analysis from each of three borings. The samples will be collected from the middle and bottom of the borings. The six soil samples will be analyzed for moisture content, gradation, and Atterberg limits.

- **AMD Potential:** Two soil samples will be collected from each of three borings per SERAS SOP #2012 for analysis of AMD potential. The samples will be obtained from the upper oxidized (unsaturated) zone and lower reduced (saturated) zone in the borings. The six soil samples will be analyzed for TAL metals, ABA measurements, and SPLP metals.

- **Physical Measurements of Dam:** The dam is more or less a retaining wall for overburden on the upstream side. The downstream side of the dam is fully exposed; whereas, the upstream side of the dam is completely obscured by overburden. The dam is currently not showing any signs of distress. However, an analysis of the overall stability of the dam is required to evaluate the long-term stability of the structure. The stability analysis will require knowledge of the dimensions, particularly the width at the base, of the dam. The exposed top, apron, and base of the dam on the downstream side will be professionally surveyed by a local, subcontracted engineering firm. Horizontal and vertical measurements will be to sub-centimeter accuracy at each survey location.

  The depth of the contact between the concrete dam and the retained materials will be identified in the six boreholes by a Lockheed Martin/SERAS geologist. The depth data, combined with the surveyed borehole locations, will be used to determine the batter of the dam on the upstream side. The subcontractor will prepare up to three scaled drawings showing the size, height, and thickness of the tailings dam.

4.11 Upper Chaparral Gulch (near 3rd Street)

Objectives:

1. Evaluate the depth and extent of contaminated native materials and tailings and assess layering within the alluvium found in that area.

2. Generate geotechnical data that will be used in the FS to evaluate the erosive nature of the tailings and for design of a potential conveyance channel in this area.

- **Shallow Borings with XRF Field and Geotechnical Analyses:** A minimum of 15 borings will be drilled in the Upper Chaparral Gulch near 3rd Street to depths between 5 and 15 feet (average of 10 feet) using a small track-mounted sonic or direct-push drilling rig (Figure 7). The borings will be logged for lithologic layering, presence of perched water, depth of the tailings, and depth to bedrock, where present. Soil samples for XRF field analysis will be collected from the borings at the ground surface, at 5-foot intervals, and at total depth in accordance with SERAS SOP #2012, *Soil Sampling*. Five percent will also be sent for laboratory confirmatory analysis. A minimum of 45 bag samples will be analyzed for lead and arsenic using a field portable XRF (Table 2). Six (6) soil samples for geotechnical analysis will also be collected between depths of 2 and 4 feet from the range of materials encountered in the borings (Table 1). The geotechnical samples will be analyzed for gradation, moisture content, and Atterberg limits. After soil sampling is completed, the borings will be backfilled with hydrated bentonite chips (below the water table or within saturated intervals) and then with clean fine sand (within the unsaturated zone) up to grade.

  Additional step-out samples may be required in order to define the extent of the tailings and contaminated native materials. Locations and spacing of step-out samples will require adjustment in the field based on visual observations of the depositional environment, with the objective of delineating lenses of impacted material. Where samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to complete delineation. Step-out sampling will continue both laterally and vertically until tailings and contaminated native materials are not encountered. Hand augers will be used to collect samples around or near perceived boundaries or where the tailings are thought to be less than four feet in thickness.

- **Bioaccessibility Analysis:** Two surface samples of tailings material will be collected for *in vitro* bioaccessibility (IVBA) testing for lead and arsenic. The samples will be sent to the EPA Region 9 Laboratory for analysis.

4.12 Chaparral Gulch (between 3rd Street and Smelter)

Objectives:

1. Evaluate the depth and extent of contaminated native materials and tailings and assess layering within the alluvium found in that area.

2. Generate geotechnical data that will be used in the FS to evaluate the erosive nature of the tailings and for design of a potential conveyance channel in this area.

- **Shallow Borings with XRF Field and Geotechnical Analyses:** Approximately 29 initial soil borings will be drilled along transects in Chaparral Gulch, between 3rd Street and the smelter, to depths ranging from 5 to 15 feet (average of 10 feet) using a small, track-mounted sonic or direct-push drilling rig (Figure 7). The borings will be logged for lithologic layering, presence of perched water, depth of the tailings, and depth to bedrock, where present. Soil samples for XRF field analysis will be collected from the borings at the ground surface, at 5-foot intervals, and at total depth in accordance with SERAS SOP #2012, *Soil Sampling*. A minimum of 69 bag samples will be analyzed for lead and arsenic using a field portable XRF (Table 2). Confirmatory laboratory analysis will be conducted at a rate of 5%. Six (6) soil samples for geotechnical analysis will also be collected between depths of 2 and 4 feet from the range of materials encountered in the borings (Table 1). The geotechnical samples will be analyzed for gradation, moisture content, and Atterberg limits. The borings will be backfilled with hydrated bentonite chips after the soil sampling is completed.

Additional step-out samples may be required in order to define the extent of the tailings and contaminated native materials. Locations and spacing of step-out samples will require adjustment in the field based on visual observations of the depositional environment, with the objective of delineating lenses of impacted material. Where samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to delineate the impacted area. Step-out sampling will continue both laterally and vertically until tailings and contaminated native materials are not encountered. Hand augers will be used to collect samples around or near perceived boundaries or where the tailings are thought to be less than four feet in thickness.

- **Bioaccessibility Analysis:** One surface sample of tailings material will be collected for IVBA testing for lead and arsenic, which will be sent to the EPA Region 9 Laboratory for analysis.

4.13 Site-Wide Groundwater: Installation of New Monitor Wells

Objectives:

1. Better define groundwater flow directions and gradients in the water table and bedrock aquifers north and south of the IKM site.

2. Develop a better understanding of vertical movement of groundwater and dissolved contaminants and further define the lateral and vertical extent of dissolved contamination.

3. Further define the hydrogeology and hydrostratigraphy such that reliable cross sections can be constructed, including north-south cross sections. The lithologic information from these wells will also be used for identifying possible preferential pathways for groundwater flow and the contaminant migration routes.

4. Assist in developing a robust conceptual site model (CSM) of groundwater flow and contaminant fate and transport.

- **Drilling:** Three deep wells in bedrock (250 to 350 feet) and eight shallow wells in unconsolidated deposits (30 to 75 feet) will be drilled by an Arizona-licensed driller in accordance with local and State regulations and SERAS SOP #2048, *Monitor Well Installation*. The proposed well locations are shown in Figure 8.

Sonic drilling will be used to install pilot boreholes through the unconsolidated deposits to targeted depths (for overburden wells) or into competent bedrock (for bedrock wells). A 9- to 10-inch diameter surface casing and sonic drill-through tub will be installed at each location so any fluids that may overtop the casing will be captured and contained. A 6-inch diameter core barrel and 7-inch diameter override casing will be used to continuously core through the overburden to the target depth or competent bedrock. An 8-inch diameter override casing will be drilled over the 7-inch casing to provide the necessary annular space in the overburden or weathered bedrock for the well installation.

Subsequent to reaching competent bedrock at the three bedrock well locations, flush-joint steel casing will be installed into each borehole and grouted in-place using an appropriate cement-bentonite grout mixture. To simplify the casing installation, the following procedure may be used: 1) a temporary cement plug can be placed at the bottom of each casing; 2) the borehole can be filled with grout (to some calculated level) prior to casing insertion; 3) after the casing has been inserted into the borehole and the grout has cured, the plug can then be drilled out and the borehole advanced. Sonic drilling or a downhole air-hammer will be used to complete the pilot boreholes for the deep wells.

- **Borehole Geophysics:** Prior to well construction borehole geophysical logging in the three open bedrock holes will be completed by a subcontractor. The logs will include: borehole caliper, fluid conductivity, natural gamma, electromagnetic-induction, groundwater temperature, heat pulse flow meter, borehole direction/deviation, optical televiewer, and acoustic televiewer.

- **Well Installation:** After the drilling is completed, the pilot boreholes will be converted into monitor wells. Four-inch inner diameter (ID), Schedule 80 PVC casing and 10-slot well screen will be installed at each location. Screen lengths will be 30 feet for the bedrock wells and 15 feet for the overburden wells. A filter pack consisting of 10/20 sieve-size silica sand will be placed around each well screen. The filter pack will be emplaced in lifts as the override casing is removed from the boreholes at the shallow well locations. A hydrated bentonite seal will be placed above the filter pack at each well. The remainder of the annular space will be backfilled with cement-bentonite grout using a tremie pipe. A flush-mounted vault or monument cover encased in a concrete apron will be installed over the wellhead at each location.

- **Well Development**: The completed monitor wells will be developed using a combination of air lifting, surging, and pumping in accordance with SERAS SOP #2044, *Well Development*. The open bedrock interval for the three deep wells will be developed prior to installation of the well materials. The shallow wells will be developed no sooner than 48 hours after installation.

- **Slug Testing:** Slug tests, to estimate horizontal hydraulic conductivities, will be performed in accordance with SERAS SOP #2046, *Slug Tests*, on a subset of the new wells at a minimum following installation. The tests will be performed by monitoring the changes in water level in a well after the instantaneous addition/removal (slug in and slug out) of a 5 foot long, 3 inch diameter PVC slug. Water levels will be measured on a logarithmic scale during the tests, using an electronic pressure transducer with onboard data-logger (Level Troll® 700). Up to three slugin-slugout tests will be performed at each well to ensure precision. Slug test data will be processed using AQTESOLV™ Pro (ver. 4.0) or similar software and analyzed using the appropriate aquifer solution for each well.

4.14 Groundwater Sampling: New and Existing Wells

Objectives:

1. Further evaluate contaminant distributions in groundwater area wide.

2. Develop a detailed knowledge of the groundwater chemistry for assessing the chemical signatures of the groundwater and understanding the chemical reactions that are occurring along the groundwater flow paths.

- Two rounds of groundwater sampling and water level measurements will be conducted at the three new MTP wells, and the 11 new and 11 existing area-wide wells (Figure 8). Prior to placement of the pump, precise and accurate static water levels will be measured in the wells using an electronic indicator in conformance with SERAS SOP #2043, *Water Level Measurement*. The wells will be purged and sampled using a Grundfos Rediflo3 submersible pump in accordance with SERAS SOP #2007, *Groundwater Well Sampling*. Indicator parameters will be monitored in the field during well purging. The indicator parameters are pH, Eh (also known as oxidation/reduction potential [ORP]), dissolved oxygen, specific conductivity, temperature, turbidity, and ferrous iron (Fe^{2+}). All of the indicator parameters, except for Fe^{2+}, will be measured using a Horiba U-52 with flow chamber. Calibration procedures recommended by the manufacturer for the Horiba meter will be followed and documented in the project field logbook including calibration solutions used, expiration date(s), lot numbers, and calibration results. Ferrous iron will be measured by the 1,10-phenanthrolene method using a Hach test kit.

4.15 Biological Survey

Objective: Assess riparian corridors and upland areas within the site boundaries that would provide suitable habitat for wildlife.

- A reconnaissance-level survey of the plants and wildlife in upland habitats and riparian corridors will be performed at each sampling location, as outlined in the subsequent Bioassessment Sampling section. Additional locations within the area of concern may be selected in the field based on unique habitats or data gaps. At each location, sufficient time will be spent quietly at the sampling location to allow local fauna to return to normal behavior and activity and therefore become visible. Completion of appropriate EPA Checklists (EPA, 1997) will occur at each sampling location as well as any relevant observations in the surrounding area. The local habitat at each sampling location will be photo-documented. Plant species, vegetation type, and vegetative coverage will be photographed and recorded. Representative voucher specimens of plants will be collected for record and for later taxonomic identification and verification. In addition, any incidental wildlife observed while traveling from one area to another will be carefully recorded. All observations during field and laboratory efforts will be documented in accordance with SERAS SOP #4001, *Logbook Documentation* and SERAS SOP #2002, *Sample Documentation*.

Additional analysis for benthic community observations and fish observations may be recorded within the streams and corridors at each of the sampling locations, as outlined in the Bioassessment Sampling section below. The details have yet to be determined. The physical characteristics association with each area will also be carefully recorded (e.g. water depth, presence of vegetation or boulders, etc.).

4.16 Bioassessment Sampling

Objective: Estimate bioaccessibility for ecological risk assessment.

- A bioassessment sampling effort will occur at the Site in order to generate data that may be used in an Ecological Risk Assessment. Pre-selected locations for analysis will be sampled during the field effort. Plant material, soil, sediment, and surface water will be collected and analyzed for TAL Metals. Select sediment samples from the Agua Fria River will also be analyzed for dioxin/furans and total organic carbon (TOC). Selected water samples from the Agua Fria River will be analyzed for the water quality parameters as outlined in Table 3.

  Plant material and soil will be collected as part of the bioassessment sampling effort. Ten sampling points will be randomly generated within the designated areas of interest (Figure 9). Artificial structures and unvegetated areas will be eliminated prior to selection of the actual locations. If a sampling point falls within an area void of vegetation it may be moved to include the nearest area with vegetative cover. Each sampling point will be centered at a 1.0 meter (m) by 1.0 m square. The square will be divided into four quadrants. Plant density (number of plants per unit area), plant community (species), and soil coverage by vegetation will be evaluated for each quadrant independently according to SERAS SOP #2037, *Terrestrial Plant Community Sampling*. The mean of the parameters calculated for each quadrant will represent the vegetative coverage at that sampling point.

  After completion of the site vegetation assessment, one or two quadrants of the above ground biomass (SERAS SOP #2034, *Plant Biomass Determination*) within the 1.0 m by 1.0 m square will be collected depending on the plant density. The plants will be cut at 1.0 centimeter (cm) above the soil surface and, if necessary, washed with deionized (DI) water and blotted dry with paper towels. The fresh weight of the plant samples will be determined in the field or as soon as possible after sample collection. Samples will be placed in Ziploc bags and preserved at 4 degrees Celsius.

Soil sampling will begin after the vegetation assessment is completed. For each sampling point, a composite of four surface soil samples will be collected from the quadrants of the same square as the vegetation sampling (co-located). Each composite soil sample will be mixed thoroughly before being placed into a 4-ounce glass jar. Samples will be shipped to predetermined laboratories for chemical analysis. All samples will be collected in accordance with SERAS SOP #2012, *Soil Sampling*.

Sediment and sediment/surface water pairs will be collected at the 24 approximate sampling locations indicated in Figure 9 and outlined in Table 3. Locations on the figure are generalized and actual locations will be recorded by a handheld GPS in the field at the time of sampling. Sediment will be collected according to SERAS SOP# 2016 *Sediment Sampling* and SERAS SOP # 2013 *Surface Water Sampling*. Sediment and water samples will be analyzed for TAL metals. A select group of subsamples from the Agua Fria will also be subject to additional analysis (Table 3). All observations during field and laboratory efforts will be documented in accordance with SERAS SOP #4001, *Logbook Documentation* and SERAS SOP #2002, *Sample Documentation*.

4.17 Sampling Downstream of Dam

Overview and Objectives:

1. Groundwater Seeps: Groundwater seeps will be sampled at the base of the dam to determine if the seeps contain AMD.

2. Sediment Sampling: Sediment samples will be collected in Chaparral Gulch (over a distance of approximately 1,600 feet) to determine (1) sediment depth to bedrock; (2) lead and arsenic concentration levels in sediment; and (3) compare sediment concentration levels to existing data.

- **Groundwater Seeps:** A weighted tape will be used to determine the total depth of the water column at the base of the dam, which will be noted in a field logbook. Based on the depth of the water column, a minimum of two water samples will be collected using a subsurface grab sampling device or peristaltic pump. A water quality meter will be used measure water quality parameters (pH, specific conductivity, dissolved oxygen, Eh, temperature, turbidity) with depth. Water samples will be sent under chain-of-custody to the EPA Region 9 Laboratory for analysis of TAL metals. Additional samples will be sent under chain-of-custody to an outside, subcontracted laboratory for the following analyses: alkalinity, chloride, fluoride, nitrate, phosphate, silica, sulfate, DOC, and TDS.

- **Sediment Sampling:** Beginning at the base of the dam and at 200-foot intervals downstream, a hand auger (or tile probe) will be advanced through the sediment down to bedrock. The depth to bedrock at each location will be noted in a field logbook. A handheld GPS will be used to record the horizontal coordinates of each location. A minimum of two sediment samples (surface and total depth) will be collected at each location for XRF analysis of lead and arsenic concentrations.

Five percent of these samples will be sent for laboratory confirmatory analysis. Sediment samples will be collected in accordance with SERAS SOP #2016, *Sediment Sampling*.

4.18 Hydrologic Monitoring and Surface Water Sampling

Objective: To assess the impact of site sources on surface water quality in the Chaparral Gulch and the Agua Fria River, particularly during flow from seasonal storm events

- Surface water monitoring and sampling will be conducted in Chaparral Gulch downstream of the dam and in the Agua Fria River (both upstream and downstream of the confluence with the Chaparral Gulch) over a one-year period. A total of four monitoring and sampling stations will be placed along these waterways: two within the Chaparral Gulch (one at the base of the dam and the other immediately upstream of the Agua Fria River confluence) and two within the Agua Fria River (one upstream of the confluence with the Chaparral Gulch and the other downstream of the confluence). Each station will be equipped to continuously monitor basic water quality and flow parameters: hydraulic head, pH, turbidity, and specific conductivity. From the turbidity measurements, the suspended sediment load will be estimated based on a site-specific turbidity-suspended sediment concentration (SSC) calibration curve.

  At each monitoring location, the stream cross section, as a function of depth, will be measured. Using the wetted cross-sectional area (based on the hydraulic head measurements), estimated channel slope (from topographic data) and estimated channel roughness (i.e., Manning's n), variable flows at the four monitoring locations will be estimated over time. Estimated channel flows will be compared to flows at a U.S. Geological Survey (USGS) gauging station along the Agua Fria River, located downstream of the proposed new stations.

  A USGS-developed automated water sampler will also be deployed at each station. The automatic samplers will collect discrete, flow-triggered water samples during base flow, but more so during seasonal storm flow conditions when sediment loads are high. Surface water samples will retrieved periodically and analyzed for total and dissolved lead and arsenic, and sediment load. ERT will contract with the USGS, through an Inter-Agency Agreement (IAG), to deploy the samplers.

  Two rain gauges will also be deployed: one at one of the four stations and the other within upper Chaparral Gulch, located west of Highway 69. To enable real-time data transmission from the four monitoring stations and the upper Chaparral Gulch rain gauge, five Mini-SAT™ satellite-receiving units will be interfaced to the monitoring devices (excluding the USGS samplers) for real-time uploading of data to an internet server site. This data can be accessed routinely and any problems with data acquisition can be identified for subsequent corrective actions.

  Additional tasks that will be performed in support of a conceptual design of stormwater control and management include: gathering local historical precipitation records; delineation of sub-basin areas within and surrounding the Site area for estimating runoff contribution; determining rainfall-runoff relationships base on topography and surface runoff coefficients; estimating 100-year storm runoff; and constructing a hydrograph for the Agua Fria River based on flow conditions at the nearby USGS gauging station.

4.19 Site Dust Control: Smelter Dross Area

Objectives: Temporarily suppress the dust that is periodically generated during high wind events.

- A subcontractor will be retained to apply a soil stabilization and dust suppression agent over the entire Dross Area (approximately 15 acres) at the Humboldt Smelter. An environmentally safe and biodegradable liquid copolymer will be uniformly sprayed on the area. Once cured, the product will form a transparent, wind resistant, and flexible surface. An application rate will be selected to provide up to two years of dust suppression in the area. It is anticipated that this work will be scheduled for April 2014.

4.20 Residential Property Sampling

- The residential sampling objectives and approach that were developed by the Region (Attachments section) will be followed.

5.0 GENERAL SITE ASSESSMENT METHODS

5.1 Sample Collection, Handling and Shipment

- **Soil and Sediment Samples:** Soil and sediment samples will be collected in accordance with SERAS SOP #2012, *Soil Sampling* and SERAS SOP #2016, *Sediment Sampling*. Samples will be collected over discrete sampling intervals: surface samples will be collected from the top two inches of soil; one foot depth samples will be collected from 10 to 12 inches below grade; two foot depth samples from 22 to 24 inches; and so on. Organic surface layers, where present - such as wood chips, dead leaves, roots and sticks - will be removed to expose surface mineral soil for sampling. QA/QC field duplicate samples will be collected at a minimum rate of 5%.

  Soil samples will be transferred directly into strong, zip-lock plastic baggies having an average size of 6 to 8 square inches. Excess stones, rocks, and other debris will be removed from the samples. Each baggie will be labeled, at a minimum, with a unique sample number, date, time, and sampling team. A field log with observations and notations will be prepared for each sample.

  A minimum of 10 percent of the samples will be sent to a fixed laboratory for confirmation of the XRF results. SERAS personnel will manage and ship samples in accordance with SERAS SOP #2003, *Sample Storage, Preservation and Handling* and SERAS SOP #2004, *Sample Packing and Shipment*.

Leftover samples after XRF analysis and confirmation sample selection will be shipped to a location specified by the Region for storage.

- **Surface Water Samples:** Surface water samples will be collected in accordance with SERAS SOP #2013, *Surface Water Samples*. Prior to sample collection, indicator parameters will be measured in the field using a calibrated Horiba U-52 water quality monitoring instrument. Indicator parameters will include pH, Eh, dissolved oxygen, specific conductivity, temperature, and turbidity. Field measurements will be documented in a field logbook. Water samples will be sent under chain-of-custody to the EPA Region 9 Laboratory for TAL metals analysis. Additional samples will be sent under chain-of-custody to an outside, subcontracted laboratory for the following analyses: alkalinity, chloride, fluoride, nitrate, phosphate, silica, sulfate, dissolved organic carbon (DOC), and total dissolved solids (TDS). QA/QC field duplicate samples will be collected at a minimum rate of 5%.

- **Groundwater Samples:** Groundwater samples for TAL metals analysis will be sent under chain-of-custody to the EPA Region 9 Laboratory. Groundwater samples will be sent under chain-of-custody to an outside, subcontracted laboratory for the following analyses: alkalinity, chloride, fluoride, nitrate, phosphate, silica, sulfate, dissolved organic carbon (DOC), and total dissolved solids (TDS). QA/QC field duplicate samples will be collected at a minimum rate of 5%.

5.2 Sampling Equipment Decontamination

Sampling and drilling equipment will be decontaminated prior to use at each location in accordance with SERAS SOP #2006, *Sampling Equipment Decontamination*. All drilling equipment and sampling tools will be cleaned with high-pressure hot water before work begins, between borehole locations, and between individual sample locations. When appropriate, equipment shall be cleaned at each location using the following procedure: 1) physical removal of soil/debris using potable water and a scrub brush; 2) powered-rinsed with clean, hot water; 3) air dry. Water used for cleaning will be discharged directly to the ground surface at each drilling or sampling location.

5.3 Sample Identification

Each sample collected for during the field investigation will be assigned a unique alphanumeric code which will identify, at a minimum, the area from which it was collected (main tailings pile, smelter plateau area, Agua Fria River, etc.), the sample matrix/type (soil boring, surface soil, sediment, surface water, etc.), and sample collection depth if applicable (collected at a depth >0.2 feet). Field duplicates will be identified by adding an “A” to the end of the sample identification code. The sample identification scheme for this project is outlined in Table 4. Some examples of sample identification are:

- A sample collected at a depth of 5 feet from the second soil boring (SB) advanced in the Main Tailings Pile (MTP) would receive the following sample identification code: MTP-SB2-5’.

- The third slag sample collected at the surface from the Smelter Plateau Area (SL) would be identified as: SL-03. A field duplicate collected from the same location would be identified as SL-03A.
- The second pair of co-located sediment and surface water samples collected along the Agua Fria River would be identified as AG-SED-2 and AG-SW-2.
- CHF-IVBA-04 would represent the fourth soil sample collected from the Chaparral Gulch Floodplain for IVBA testing.

Because of the expansive scope of this project and the adaptive nature of some of the sampling (i.e., establishing boundaries of contamination through a step-out sampling process), additional sample areas and/or types may be added by the EPA during the implementation of the FWP. Table 4 will be updated periodically to accommodate these additions.

Sample codes will be recorded in field logbooks, on sample bags/containers, and on chain-of-custody (COC) forms. The field team leader will be responsible for maintaining a master database or spreadsheet of samples to be collected and samples obtained to ensure that all planned samples are collected during the field investigation, sample designation codes are not used twice for different locations, and the correct analytical parameters or geotechnical tests are identified on laboratory documentation.

5.4 XRF Field Analysis

All samples for XRF screening will be brought to an on-site laboratory. Samples will be analyzed for Pb and As using a NITON XRF in accordance with SERAS Standard Operating Procedure (SOP) #1720, *Operation of the NITON XLt792YW Field Portable X-Ray Fluorescence Unit*. The XRF will be calibrated against standards for lead and arsenic according to SOP #1720. The NITON XLt792YW XRF (XRF) measurement times (instrument live-time) are 120 seconds for measurement condition 1 (Filt1 for lead, arsenic) and 30 seconds for measurement condition 2 (Filt2). Sample preparation, analysis, and quality assurance/quality control (QA/QC) procedures for this instrument are also outlined in SOP #1720.

Only air dry samples will be analyzed. Therefore, moist or wet samples will be removed from the sample bags and air dried at room temperature or in an oven at 60 degrees Celsius overnight. The dried samples will then be transferred back to the original bag. Each bag will be homogenized by shaking the sample prior to analysis. The bag will be squeezed repeatedly between thumb and forefinger to break up any colloidal or semi-consolidated materials. Cohesive materials will be crushed, smeared, crumbled, and tumbled again within the bag to achieve as much mixing as is practicable. Each sample, including the plastic baggie, will be placed in the NITON portable test stand above the analyzer, the safety shield will be closed, and the analysis initiated with the measurement times previously noted. Each bag will be analyzed twice by the XRF: front (reading A) and back (reading B) of the sample bag. Both the “A” and “B” readings for each sample ID will be recorded into the sample database and field logbook. The arithmetic average of both readings will be reported. For measurements below the RL, the RL will be used to calculate the average. QA/QC replicate samples will be run at a minimum rate of 5%

After the samples are analyzed by XRF, a minimum of 10 % the samples will be selected for confirmation analysis at a fixed laboratory. These samples will be transferred to 8-ounce glass jars and then will be sent to the laboratory for TAL metals analyses.

XRF results will be evaluated by a SERAS statistician on a routine basis to confirm there is an ongoing and consistent correlation between the XRF results and the confirmation samples results. Confirmation samples will be analyzed at a rate of 5% for non-residential areas and 10% for residential properties. A classical OLS regression analysis will be used to assess the XRF data and the resulting coefficient of determination (R^2) must be ≥ 0.70, as specified in SERAS SOP #1720, for the XRF data to be considered valid. If the data fails to achieve this criterion, changes in XRF methodology and/or analyses types and methodologies will be evaluated in conjunction with EPA personnel.

5.5 Material Boundary and Volume Estimates

This approach pertains to the following areas:

- Waste rock area, west of MTP (Waste Rock)
- Lower bench area of the MTP - below blowout area (tailings)
- Galena Gulch (a small tailings pile)
- Smelter plateau area (dross material)
- Smelter tailings swale
- Chaparral Gulch floodplain and behind the Dam (tailings)

To the extent possible, the lateral (areal) and vertical extents of mine tailings, dross material, and impacted native materials will be determined by visual observations and XRF field analysis. The areal extent of the waste rock will be solely determined by visual observations and mapped out using a handheld GPS. Visual observations will include changes in material color and composition; absence of ground cover; type, quantity, and diversity of plant species; edges of the floodplain (Chaparral Gulch); and erosion features.

Step-out sample borings (both deep and hand-augered) will be used to define the three-dimensional extents of visibly impacted soil and/or until XRF lead and arsenic concentrations are below site action levels. Locations and spacing of step-out samples will require adjustment in the field based on visual observations of both surface and subsurface samples. The horizontal spacing of step-out sampling locations may range from 5 to 20 feet. Where subsurface samples indicate impact from tailings (based on XRF field screening), deeper samples will be collected to define the extent of contamination. Borehole depths will be confirmed or deepened (in 5 foot increments) according to contamination levels recorded with the portable XRF. Final boring depths will be recorded in a field logbook in accordance with SERAS SOP #4001, *Logbook Documentation*. Step-out sampling will continue both laterally and vertically until mine wastes and contaminated native materials are not encountered. Hand augers will be used to collect samples around or near perceived boundaries or where the mine wastes are thought to be less than four feet in thickness. Horizontal coordinates for all borings will be obtained with handheld GPS device.

Volume determination of the waste rock was previously discussed under the Site-Specific Tasks (IKM Main Tailings Pile). It is anticipated that this method will be used to estimate the volume of a small tailings pile along Galena Gulch and for a number of randomly scattered piles throughout the dross material area (refer to the Smelter Plateau section under Site-Specific Tasks).

XRF lead and arsenic concentrations will be used to define source-impacted extents and volumes. For other areas, including major portions of the dross material, the horizontal coordinates and contamination depth information for each boring will be imported into ArcGIS. Both *Spatial & 3D Analyst* tools within the software will be used to interpolate and contour the data, delineate source impacts in both two and three dimensions (2D/3D), and estimate material volumes. For each source, the impacted three-dimensional extents will be defined as the larger of the two extents with concentrations above the lead or arsenic cut-off contour (i.e., 400 and 200 mg/kg for lead and arsenic, respectively). The volume within the source-impacted extent is the source-impacted volume. Both 2D and 3D kriging will be used as the primary interpolation methods. Kriging uses an interpolation algorithm based on the geospatial distribution and variance of the data points. It produces best linear, unbiased estimates with a minimization of estimation error.

5.6 Surveying and Station Positioning

Horizontal coordinates of all tailings/waste rock field delineation locations, sample locations, and monitor wells will be surveyed using a mapping-grade GPS device. Coordinates of a number planned sample locations will be determined prior to mobilization and programmed into the GPS units as waypoints to facilitate the navigation to all planned sample locations. Coordinates will be recorded using a Trimble GeoXT or GeoXH series or equivalent handheld GPS device. Anticipated horizontal accuracy will be contingent on conditions encountered in the field. GPS data will be differentially corrected as necessary to maximize accuracy. Post-processing of coordinate data may allow sub-meter horizontal accuracy to be achieved.

A subcontracted Arizona-registered land surveyor will survey the vertical coordinates of newly installed monitor wells. Well elevations will be surveyed to less than 0.1 foot accuracy. The land surveyor will also survey the physical dimensions of the dam (and ultimately provide a scaled, construction detail in digital format), locations of major cracks in the slag material (linear transects), and positions of monitoring pins in the slag (both horizontal coordinates and vertical elevations of ground surface and top of pins).

5.7 Deviations from the Field Work Plan

Deviations from the FWP are inevitable. Deviations may arise from changed field conditions, adjustment of sampling methods, inability to obtain samples from a planned location, and other circumstances. All deviations to the FWP will be carefully documented by the field team leader using the SERAS Work Assignment Field Change Form (Attachments section), which will document the nature and reason(s) for specific deviations.

6.0 DATA MANAGEMENT & COMMUNICATION

Documentation of environmental sampling and monitoring performed for this project will be provided in an electronic data deliverable (EDD) form, compatible with Scribe™.

Scribe™ is a software tool developed by the ERT to assist in the process of managing environmental data. Scribe™ captures sampling, observational, and monitoring field data. Examples of Scribe™ field tasks include soil sampling, water sampling, and biota sampling. Scribe™ can import electronic data deliverable (EDD) files including analytical lab result EDD files and sampling location EDD data files. Scribe outputs include labels for collected samples, chain-of-custody generation, and analytical lab result data reports. Scribe™ provides a flexible user interface to manage, query, and view all this information. Scribe™ supports exporting electronic data for user services such as geographic information system (GIS) tools and spreadsheets so sampling data may be further analyzed and incorporated into report writing and deliverables.

All deliverables and other relevant project information will be uploaded in electronic format to the site-specific folder on the ERT-Information Management System (IMS) website. The Region's personnel will have access to the ERT-IMS site-specific folder.

Field notes and data for this project will be recorded in accordance with SERAS SOP #4001, *Logbook Documentation*. Site logbooks and other sampling related worksheets will be electronically scanned on a periodic basis and additionally posted to the site-specific folder on the ERT-IMS website.

7.0 PROJECT DELIVERABLES

The following deliverables will be provided as Technical Memorandums:

- GPS coordinates for all sampling locations (including ground elevations estimated from 2-foot topographic contour data)
- Borehole logs showing coordinates, estimated elevations (from contour data), drilling and sampling methods, drill rig model/type, etc.
- Borehole geophysical logs and construction details for the new monitor wells
- Top of casing and ground surface elevations for the new wells (as provided by a professional surveyor)
- Laboratory and other data/results (as delivered by subcontracted geotechnical and analytical labs)
- Sampling summary matrix tables showing sample number (location/depth) vs. analyses performed - sorted by area
- A list of local suppliers of raw construction materials (riprap, sand, gravel, etc.)
- As-built construction detail of the on-site dam (as provided by a professional surveyor)
- Horizontal coordinates and elevations of the slag pins, and transect data for major cracks within the slag (as provided by a professional surveyor)
- Results from the surface geophysical investigation and hydrologic monitoring

- Volume estimates of mine-related wastes and impacted materials for various areas of the site
- Results from the biological survey, surface and borehole geophysical surveys, and the hydrologic monitoring study.

A Scribe data file will additionally be created and maintained throughout all phases of this project. Upon completion the file will be posted to the ERT-IMS website.

8.0 PROJECT SCHEDULE

A tentative project schedule is attached to this plan (generated with Microsoft© Project software, 2010).

9.0 PROJECT ASSUMPTIONS

Revisions to the approach and schedule proposed in this Site-Specific Work Plan may result from the acquisition of new or additional information and data, additional tasks requested by ERT and the Region, and other circumstances that may arise that are outside or beyond SERAS program control. Changes in the project schedule, SERAS project priorities, and resource availability may affect the specific details of the proposed scope of work. Also, the total estimated cost to complete this project (including but not limited to, labor, travel and materials) may change as the project evolves.

A number of SERAS staff (geologists, geophysicists, hydrogeologists, chemists, environmental scientists, and environmental technicians) will travel to the site on multiple occasions with extended stays. At present, it is anticipated that the majority of field activities will occur from early December 2013 through mid May 2014.

10.0 REFERENCES

CH2M Hill, 2013. *Data Gap Analysis Report (draft): Iron King Mine – Humboldt Smelter Superfund Site, Dewey-Humboldt, Yavapai County, Arizona*. Prepared for the U.S. Environmental Protection Agency, Region 9. April 2013.

Environmental Protection Agency (EPA), 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. Office of Solid Waste and Emergency Response. EPA/540-R-97-006. June 1997.

TABLES (4 Tables)
FIGURES (9 Figures)

Attachments

Project Schedule
EPA Region 9 Sampling Procedure for Residential Properties
SERAS Work Assignment Field Change Form

TABLE 1
Iron King Mine Site
Sample Matrix: Geotechnical Laboratory Testing

TASK (ASTM method)	Spl. depths (ft)	Grain Size (D422)	Moisture (D2216)	A-L (D4318)	M-D (u) (D2937)	SG (D854)	HC (u) (D5084)	Consol (u) (D2435)	Shear (u) (D3080)	CU (u) (D4767)	SWCC (D6836)	Slake (D4644)
IKM Main Tailings Pile (MTP)												
3 deep borings/wells on MTP: 2 in Upper MTP up to 110 ft.; 1 in Lower MTP up to 50 ft.	Up to 110 ft./ 50 ft.	20		20	24	6	6	3	3	3	3	
Waste rock characterization	Surface											5
Smelter Plateau Area (dross/slag material)												
15 boings in plateau soils up to 6 ft	Up to 6 ft	6	6	6								
Slag material	Surface					3						
Smelter Tailings Swale (above tailings floodplain)												
40 shallow borings up to 25 ft	Up to 25 ft	2	2	2								
Chaparral Gulch Floodplain												
50 borings up to 25 ft	2 to 4 ft	10	10	10								
Dam & Area Behind Dam												
6 borings up to 25 ft (3 borings/2 depths)	Up to 25 ft	6	6	6								
Chaparral Gulch												
Upper section: 15 borings up to 15 ft	2 to 4 ft	6	6	6								
Lower section: 23 borings up to 8 ft	2 to 4 ft	6	6	6								
Totals		56	36	56	24	9	6	3	3	3	3	5

Grain size: w/sieve & hydrometer
Moisture: natural moisture content
A-L: Atterberg limits
M-D (u): in-place moisture-density
SG: specific gravity
HC (u): hydraulic conductivity (permeability)
Consol (u): 1-D consolidation
Shear (u): direct shear test
CU (u): consolidated-undrained triaxial shear test w/pore pressure measurments
SWCC: soil-water characteristic curves
Slake: slake durability (rock samples)
(u): undistrubed sample

TABLE 2
Iron King Mine Site
Sample Matrix: Analytical Laboratory Testing

TASK	Sampling Depths (ft)	XRF-field	TAL Metals*	SPLP Metals	IVBA	Hex Cr	ABA	Dioxins/furans	WQ
IKM Main Tailings Pile (MTP)									
3 deep borings/wells on MTP: 2 in Upper MTP up to 110 ft.; 1 in Lower MTP up to 50 ft.	Up to 110 ft/ 50 ft		12	12		12	12		
10 surface samples from MTP (IVBA testing)	Surface				10				
Waste rock characterization (5 samples)	Surface		5	5			5		
IKM Peripheral Areas									
XRF delineation (130 hand borings; 2-3 depths)	0 to 3 ft	285	15						
Minimum of 11 hand borings in 2 areas	5 to 20 ft	22	2						
5 surface samples from Galena Gulch (IVBA testing)	Surface				5				
Galena Gulch area (XRF field recon,12+ hand borings)	Surface & 1 ft.	24	2						
Undeveloped Areas									
4 hand borings in barren-undeveloped areas west of Waste Rock Area	Surface & 1 ft.	8	1						
11 hand borings in area south of Galena Gulch	Surface & 1 ft.	22	2						
11 hand borings in Legion Field	Surface & 1 ft.	22	2						
8 to 10 hand borings north of the IKM and Smelter Area	Surface & 1 ft.	20	1						
4 hand borings in area east of Chaparral Gulch and Agua Fria	Surface & 1 ft.	8	1						
Smelter Plateau Area (dross/slag material)									
~200 borings in dross material, ~ 4.5 ft	top/bottom of dross	400	20	4			4	2	
15 borings in plateau soils up to 6 ft	0, 2, 6 ft	45	3						
Slag sampling (3 samples)	Surface		3	3			3		
Smelter Tailings Swale (above tailings floodplain)									
~40 borings up to 25 ft	0, 5, 10, 15, 20, 25 ft	120	6	4		4	4		
Chapparal Gulch Floodplain									
~50 borings up to 25 ft	Surface & 5 ft intervals to bottom	150	8	8		8	8		
5 surface samples (IVBA testing)	Surface				5				
Dam & Area Behind Dam									
6 borings up to 25 ft	Up to 25 ft	30	8	6			6		
Chaparral Gulch									
Upper section: ~ 15 borings; ~ 5 to 15 ft	Up to 15 ft	45	3						
Lower section: ~ 23 borings; ~ 5 to 15 ft	Up to 8 ft	69	4						
3 surface sample (IVBA testing)	Surface				3				
Downstream of Dam									
Groundwater seeps	Subsurface		2						2
200 ft interval sediment sampling	Surface & total depth	18	1						

TABLE 2
Iron King Mine Site
Sample Matrix: Analytical Laboratory Testing

TASK	Sampling Depths (ft)	XRF-field	TAL Metals*	SPLP Metals	IVBA	Hex Cr	ABA	Dioxins/furans	WQ
Monitor Wells									
11 Existing Wells			22						22
11 New Wells			22						22
Residential Properties: Screening	Surface	150	15						
Residential Properties: Full Analysis (~ 200 properties)	Surface; 1 ft	2,200	220		10				
Totals		3,638	380	42	33	24	42	2	46

XRF - X-ray fluorescence
TAL - Target Analyte List: 23 metals (EPA Region 9 lab)
SPLP - Synthetic Precipitation Leaching Procedure: Analyze for RCRA metals plus Al, Cu, Fe, Mn and Zn (EPA Region 9 lab)
IVBA - *In Vitro* Bioaccessibility Testing: lead and arsenic (EPA Region 9 lab)
Hex Cr - hexavalent chromium
TBD - To be determined; periodic sampling
*Includes XRF confirmation samples

WQ - water quality parameters, which include the following:
Field measurments (pH, Eh, Fe^{2+}, specific conductivity, temperature, dissolved oxygen, turbidity)
Lab analysis (alkalinity, chloride, fluoride, nitrate, sulfate, phosphate, silica, dissolved organic carbon, total dissolved solids)

ABA - Acid Base Accounting (includes the following)
Moisture, Total (ASTM D2974-07a)
Neutralization Potential (Sobek 3.2.3)
Preparation air dry, crush and pulverize to < 60 mesh (Sobek 3.1.2 – grind)
Saturated Paste pH (Sobek 3.2.2)
Sulfur forms (includes Total S) (Sobek 3.2.4 & 3.2.6, ASTM E1915-09)
Acid Potential and Acid-Base Accounting reported from calculations (Sobek 1.3.1)

TABLE 3
Iron King Mine Site
Sample Matrix: Bioassessment Sampling

TASK	TAL Metals	Dioxins/furans	TOC	WQ
Bioaccumulation Study				
Plant matter (seeds/grasses)	10			
Soil (0 - 2 feet)	10			
Agua Fria River Sampling (downstream of dam)				
Sediment samples	12	5	5	
Surface water samples (see Note 1)	12			3
Upper Chaparral Gulch Sampling				
Sediment samples	3			
Middle Chaparral Gulch Sampling				
Sediment samples	5			
Lower Chaparral Gulch Sampling				
Sediment samples	2			
Lower Chaparral Gulch/Dam Confluence Sampling				
Sediment samples	2			
Surface water samples	2			
Totals	58	5	5	3

NOTE 1: Obtain instantaneous discharge measurements at WQ sampling locations using velocity-area method

TAL - Target Analyte List: 23 metals (EPA Region 9 lab)
dioxins/furans - 17 congeners
TOC - total organic carbon
WQ - water quality parameters, which include the following:
Field measurments (pH, Eh, specific conductivity, temperature, dissolved oxygen, turbidity)
Lab analysis (alkalinity, chloride, fluoride, nitrate, sulfate, phosphate, silica, dissolved organic carbon, total dissolved solids)

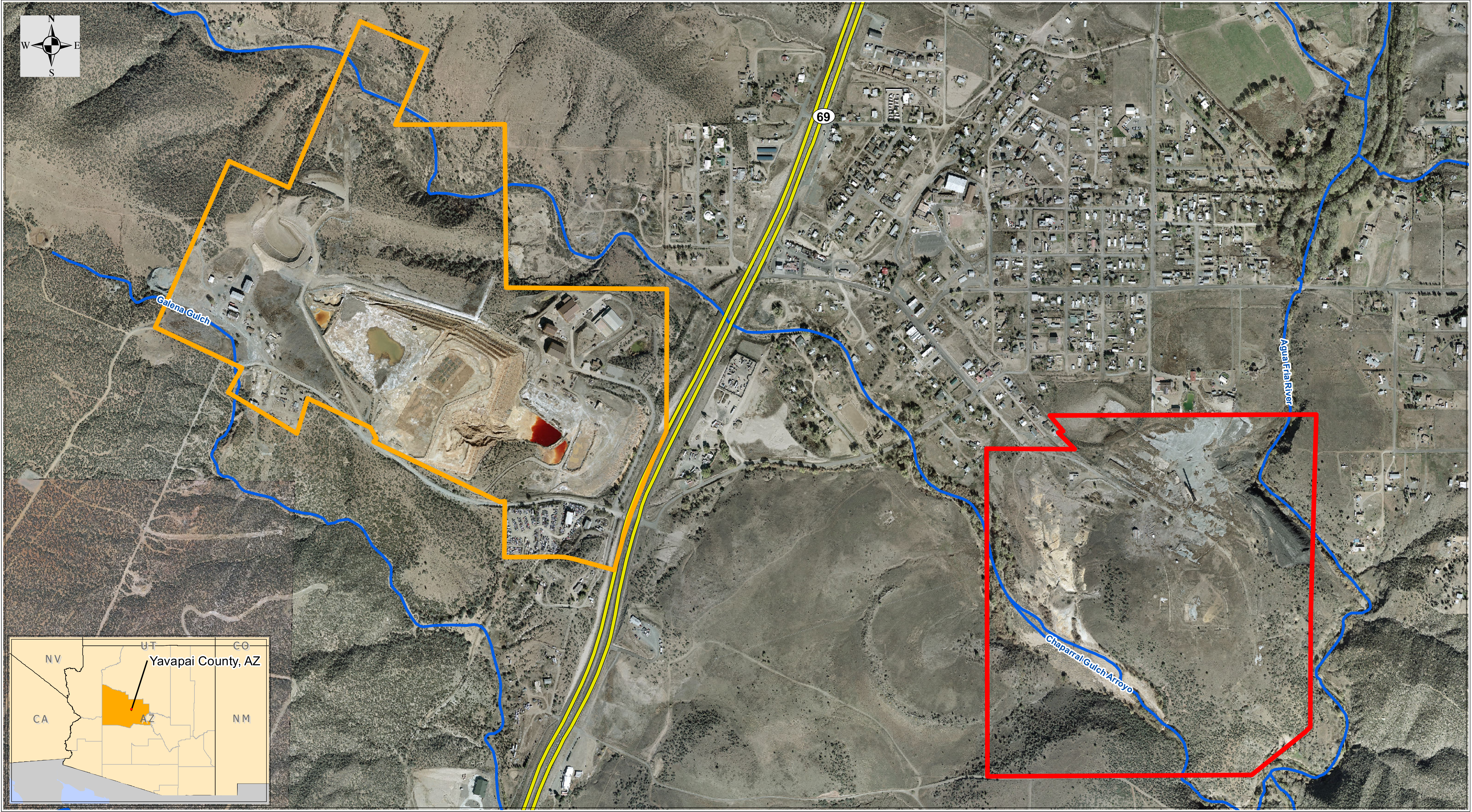
TABLE 4
Iron King Mine Site
Sample Identification Key

Area	**Symbol**
Residential: Risk Assessment (RA) Screening	RS*
Residential: Full RA Characterization	RA*
IKM Main Tailings Pile	MTP
Waste rock	WR
IKM Peripheral Areas	IKM
Galena Gulch	GAL
Undeveloped Areas	UND*
Smelter Plateau Area	(see below)
Dross material	ASH
Slag	SL
Plateau soils	PS
Smelter Tailings Swale	STS
Chaparral Gulch (upstream of floodplain)	CH
Chaparral Gulch Floodplain	CHF
Dam/Area behind the Dam	DAM
Chaparral Gulch (downstream of dam)	CHD
Agua Fria River	AG
Monitor Wells (groundwater samples)	MW
Sample type	
Soil - Surface/Near Surface (provide approx. depth if > 0.2 ft)	SS
Soil - Borings (provide approx. depth or depth interval)	SB
Sediment	SED
Surface Water	SW
Plant Matter	PL
Bioaccessibility Samples, Soil	IVBA
Bioaessessment Samples, Soil	BIOSS
Bioaessessment Samples, Sediment	BIOSED
Bioaessessment Samples, Plant	BIOPL
Bioaessessment Samples, Invertebrate	BIOINV
Sample location or boring number	#

* Symbol will additionally include a unique number or letter for each specific area

Example Sample
MTP-SB1-10' - Sample taken at 10 feet from boring No. 1 on the Main Tailings Pile

MTB-SSB-009



Base map created using 2010 orthoimagery,
proposed sampling plan areas by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_Site_Investigation_Area_f1

Legend

Area of Interest
- Iron King Mine
- Humboldt Smelter

0 750 1,500
Feet

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 1
Site Investigation Area
Iron King Mine Site
Dewey-Humboldt, Arizona

Base map created using 2010 orthoimagery, proposed sample location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_MTP_AdjacentArea_Proposed_Boring_f2

Legend

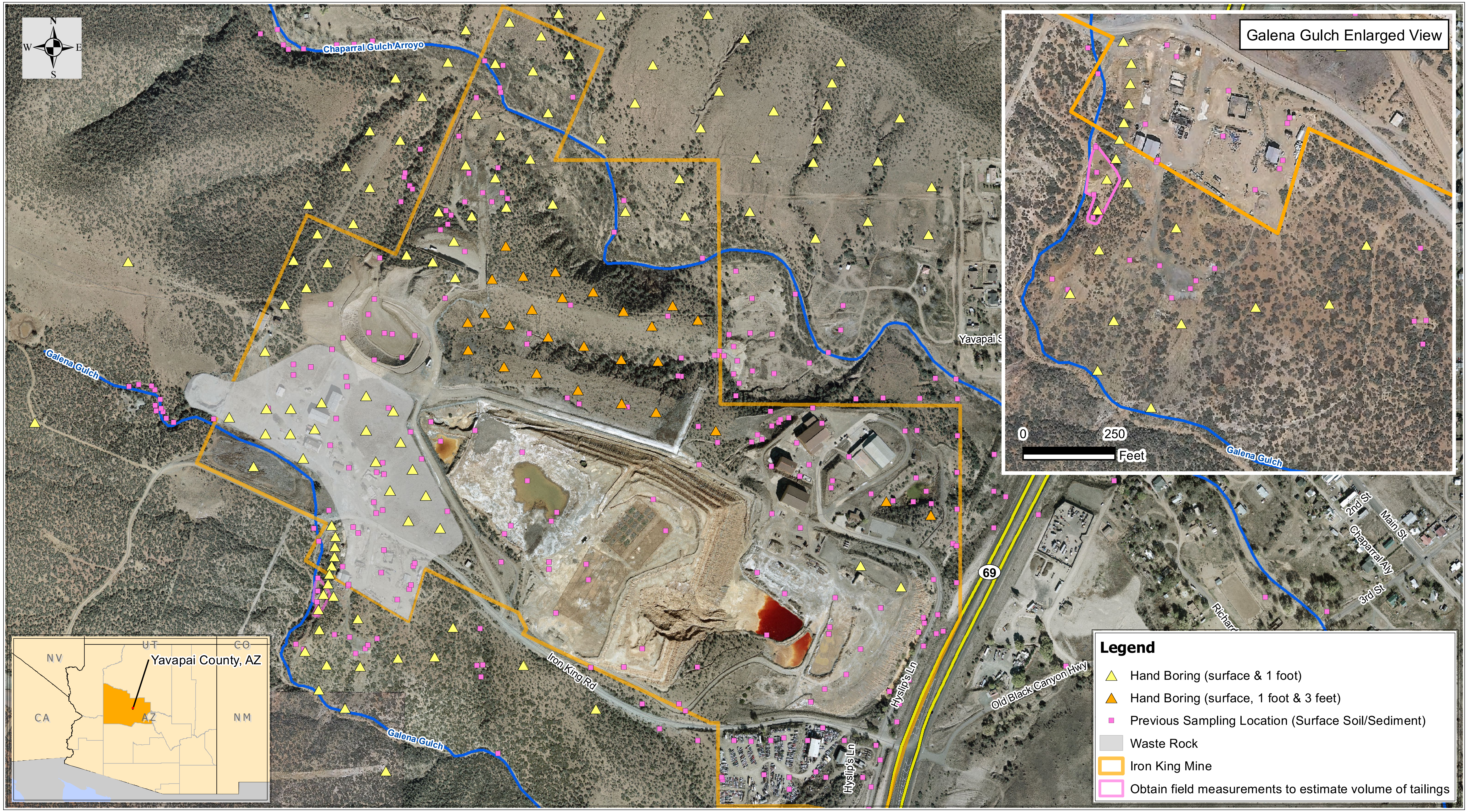
▲ Proposed deep boring & 2-inch well location

● Proposed shallow boring (approx. 20 ft or less)

0 250 500
Feet

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 2
Main Tailings Pile and Adjacent Areas
Proposed Borings
Iron King Mine Site
Dewey-Humboldt, Arizona



Base map created using 2010 orthoimagery, proposed sample location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

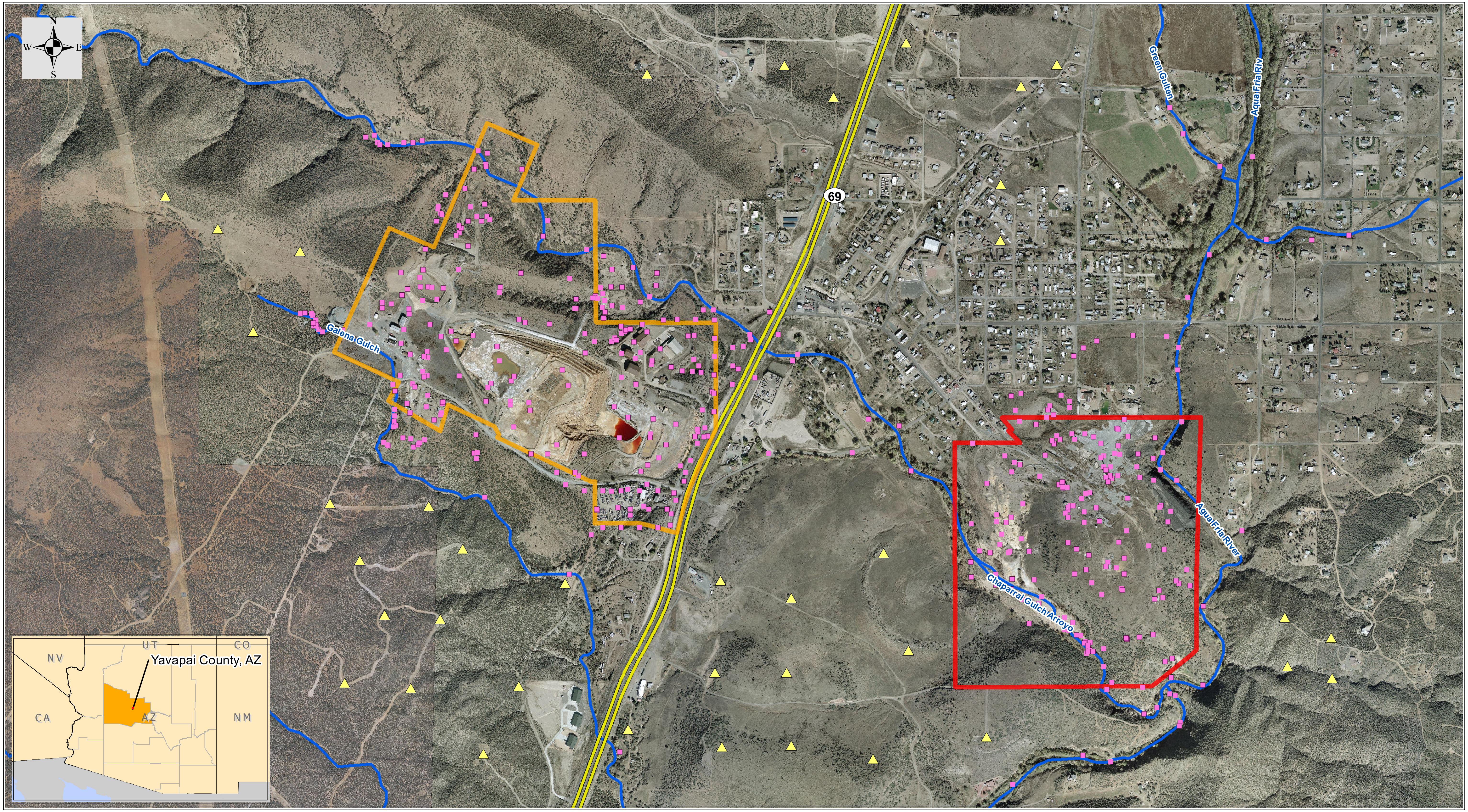
Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_Peripheral_Areas_MTP_Proposed_Surface_Sample_f3

0 500 1,000 Feet

Note:
XRF field analysis of all samples for As and Pb

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 3
Peripheral Areas Beyond Main Tailings Pile
Proposed Surface/Near Surface Samples
Iron King Mine Site
Dewey-Humboldt, Arizona



Base map created using 2010 orthoimagery,
proposed sampling plan areas by digitizing.

Map Creation Date: 06 November 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan
\146_PLAN_Undeveloped_Areas_Proposed_Surface_Sample_f4

Legend

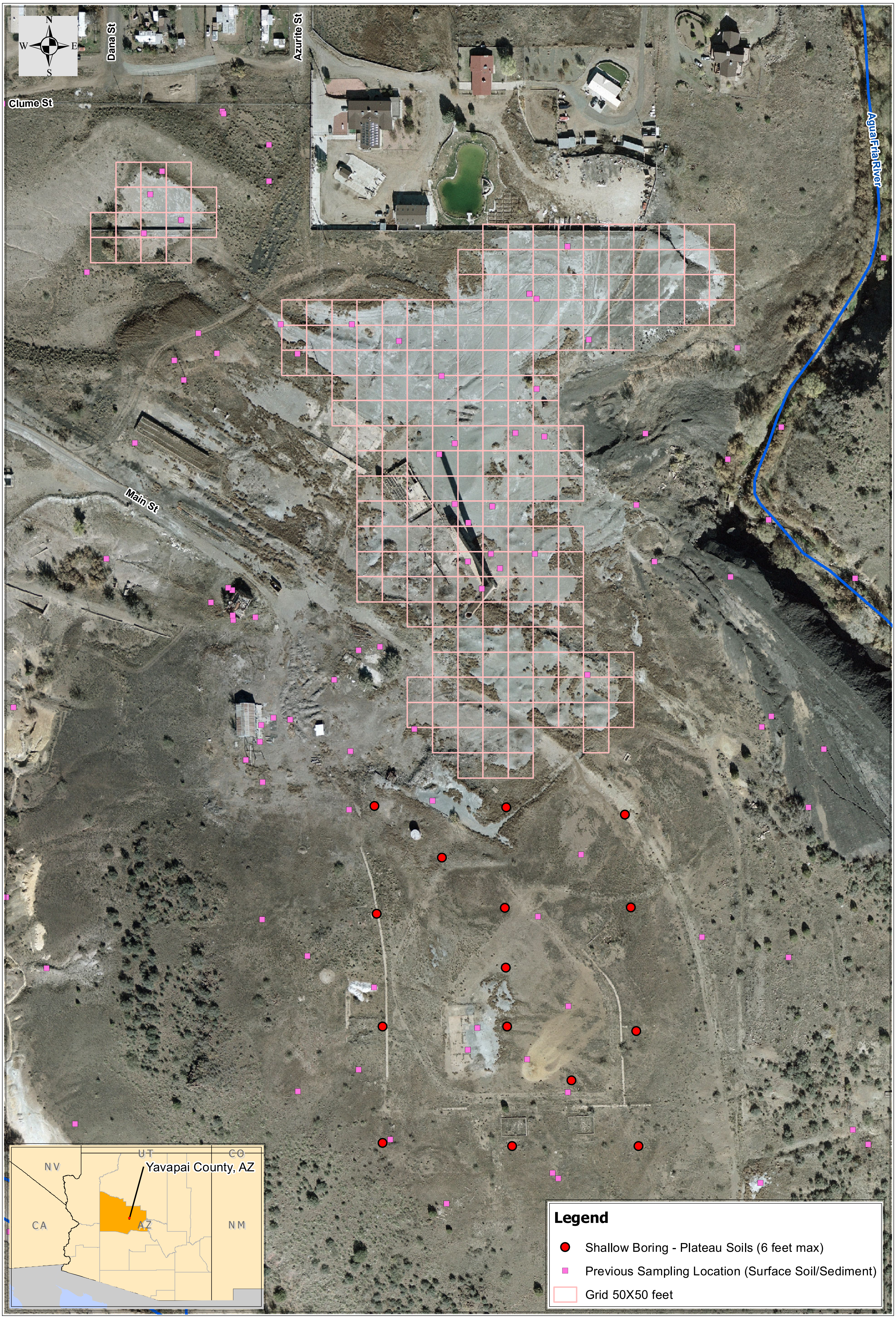
- Hand Boring (Surface & 1 foot)
- Previous Sampling Location (Surface Soil/Sediment)

Area of Interest
- Iron King Mine
- Humboldt Smelter

0 1,000 2,000 Feet

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 4
Undeveloped Areas
Proposed Surface/Near Surface Samples
Iron King Mine Site
Dewey-Humboldt, Arizona



Base map created using 2009 orthoimagery, proposed sample location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

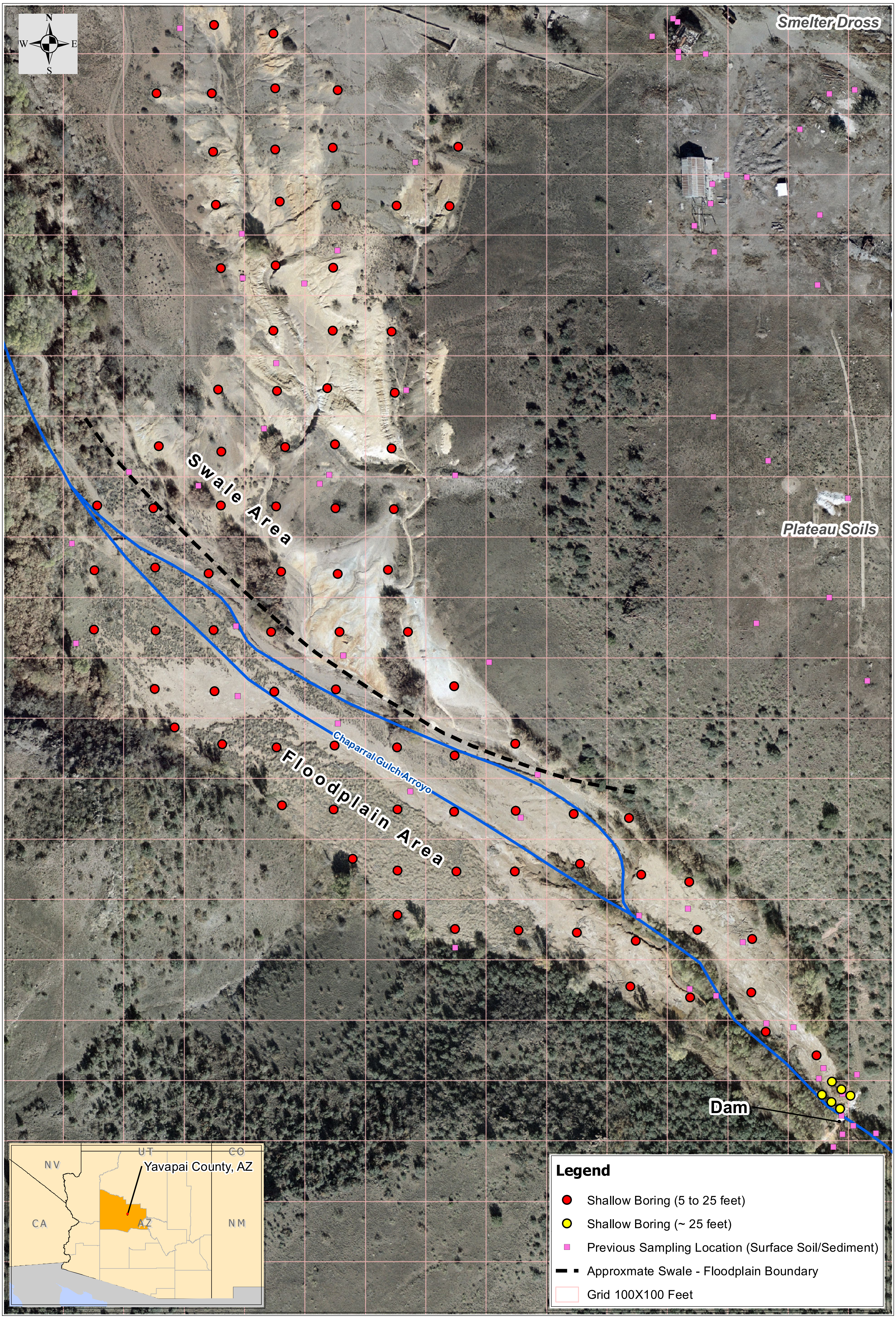
0 180 360 Feet

Note:
XRF field analysis of surface/subsurface sample - As and Pb

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_SmelterDross_PlateauSoil_Proposed_Boring_Location_f5

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 5
Smelter Dross and Plateau Soils
Proposed Boring/Sampling Locations
Iron King Mine Site
Dewey-Humboldt, Arizona



Base map created using 2009 orthoimagery, proposed sample location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

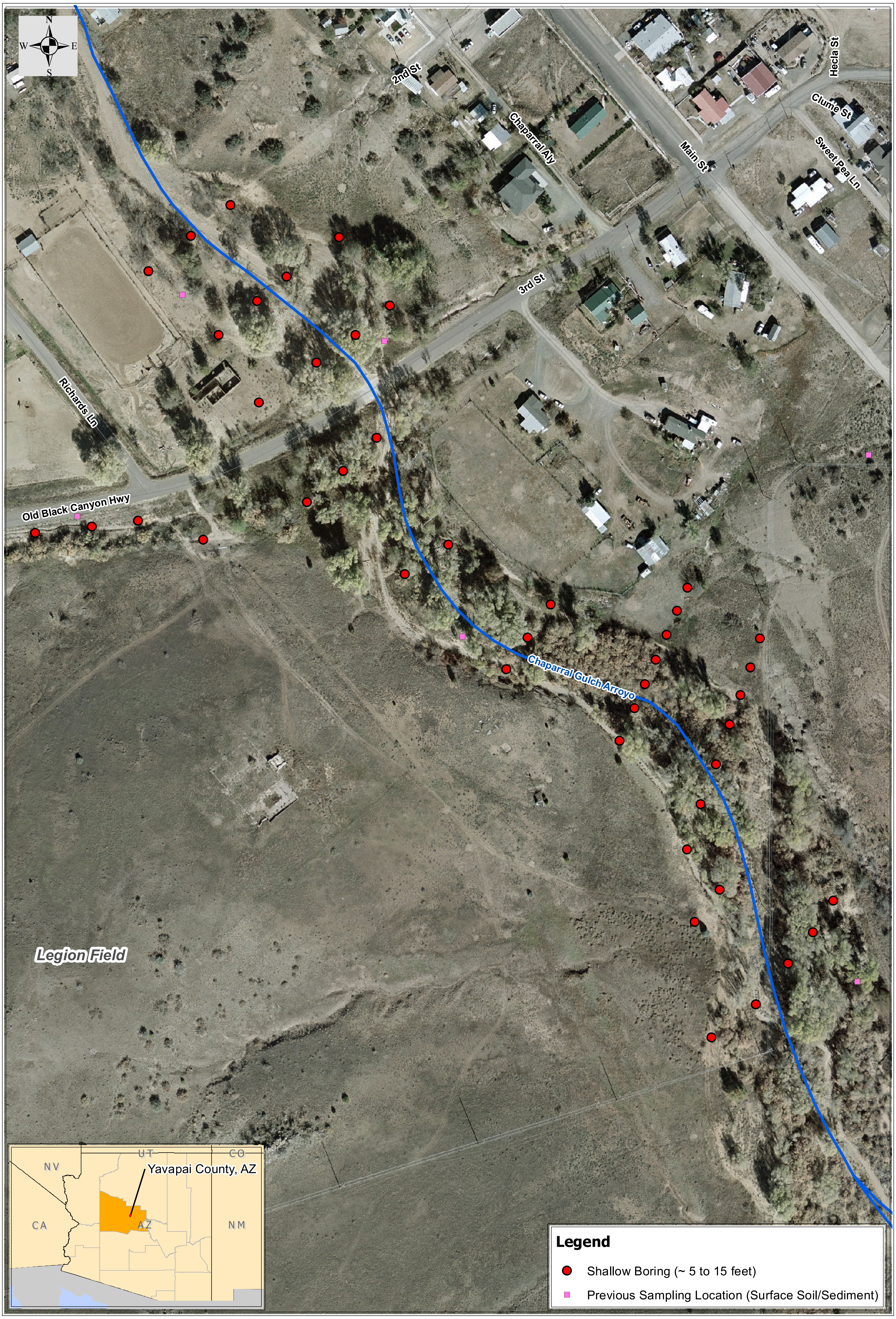
0 150 300 Feet

Note:
XRF field analysis of surface/subsurface sample - As and Pb

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 6
Smelter Tailings (Swale/Floodplain/behind Dam)
Proposed Boring/Sampling Locations
Iron King Mine Site
Dewey-Humboldt, Arizona

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_SmelterTailing_Proposed_Boring_Location_f6



Base map created using 2009 orthoimagery,
proposed sample location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

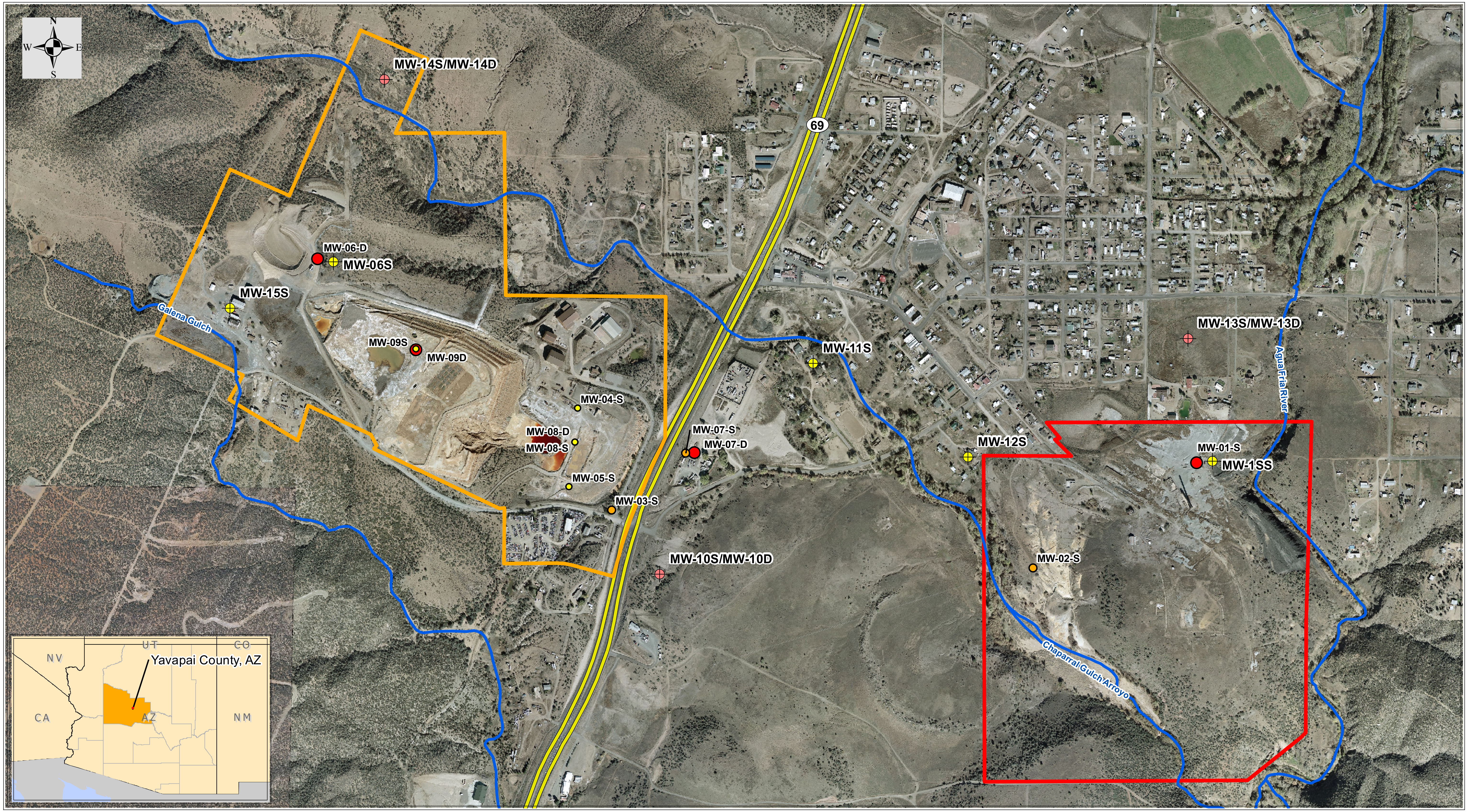
0 150 300 Feet

Note:
XRF field analysis of surface/subsurface sample

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_ChaparralGulch_Proposed_Boring_Location_f7

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 7
Chaparral Gulch
Proposed Boring/Sampling Locations
Iron King Mine Site
Dewey-Humboldt, Arizona



Base map created using 2010 orthoimagery,
Proposed Sample Location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_Proposed_WaterTable_Bedrock_MW_f8

Legend

Proposed New Wells
- Water Table Well
- Water Table and Bedrock Well Couplet

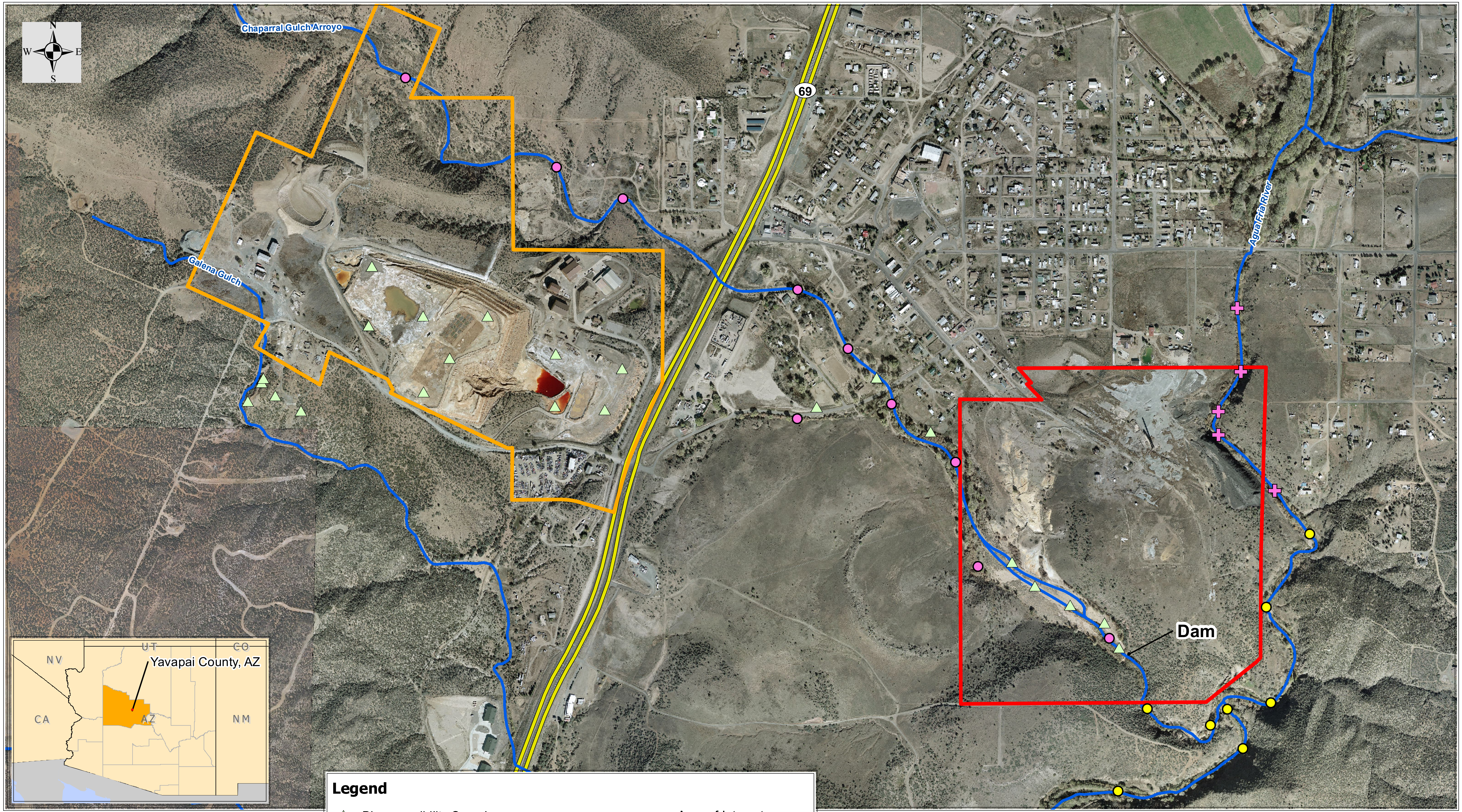
Existing Wells (Screened Unit)
- Tailings
- Alluvium
- Bedrock

Area of Interest
- Iron King Mine
- Humboldt Smelter

0 750 1,500
Feet

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 8
Proposed Water Table and Bedrock Monitoring Wells
Iron King Mine Site
Dewey-Humboldt, Arizona



Legend

- △ Bioaccessibility Samples

Bioassessment Samples

- Sediment
- Sediment/surface water pairs
- Sediment/surface water pairs (Sediments to be analyzed for dioxins/furans)

Area of Interest

- Iron King Mine
- Humboldt Smelter

0 800 1,600 Feet

Base map created using 2010 orthoimagery,
Proposed Sample Location by digitizing.

Map Creation Date: 28 August 2013

Coordinate system: Arizona State Plane Central
FIPS: 0202
Datum: NAD83
Units: Feet

Data: g:\arcviewprojects\SERAS01\00-146
MXD file: g:\arcinfoprojects\SERAS01\SER00146_IronKingMineSite\Sampling_Plan\146_PLAN_Bioaccessibility_BioAssmt_Proposed_Sampling_Location_f9

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-146

Figure 9
Bioaccessibility and Bioassessment
Proposed Sampling Locations
Iron King Mine Site
Dewey-Humboldt, Arizona

ATTACHMENT 2
Residential Sampling Approach
Iron King Mine Site UFP-QAPP
December 2013

Scope and Field Approach for Residential Risk-Based Sampling
Planned 2013/2014 Field Event
Iron King/Humboldt Smelter Superfund Site

Written by Region 9 and Intended for ERT as Fieldwork Agent

The *prime objective* of the residential investigation to obtain sufficient data for EPA to calculate either an *area-based* or a *yard-specific* risk due to site-related contamination in yards *located within the area of potential site impact*, or APSI. The APSI is a physical boundary outside which we do not need to collect further residential investigation.

Based on RI work to date, yards outside the APSI do not need sampling for risk purposes because the IKHS Site has not affected those areas –even though natural levels of arsenic, in particular, can be elevated in those areas. The APSI has been determined independently and prior to this field effort. Yards located *inside* the APSI do *not* necessarily contain contamination above background levels, or levels that would pose a health risk. Rather will be necessary to collect partial or full additional information about those yards before a decision on cleanup can be made. The APSI is marked on the attached map.

Secondary objectives include:

1. Identifying and characterizing "hot spots" that may be due to imported fill material rather than aerial dispersion from the site sources (see next section), and

2. Collecting a statistically-defensible number of soil samples for laboratory in-vitro analysis, which determines the bioaccessibility related to the metals in the soils.

USING MAP TO TARGET PARCELS; "AREA SCREENING" versus "YARD-SPECIFIC RISK CHARACTERIZATION"

Yards targeted on the attached map will be subjected to either: (1) yard-specific risk characterization automatically; *or* (1) an area-based risk screening, which could possibly followed by full yard-specific risk characterization after a real-time decision is made based on the screening information. Specifically to note:

- Yard-specific characterization will collect a population of soils data that will allow us to evaluate an upper-confidence limit (UCL) and in turn the risk that is posed by *that yard.* This population will usually be 10 surface samples and 1 deep (1 ft) sample within each yard subject to yard-specific characterization. Yards can be one parcel, but can also encompass more than one parcel. Particularly large yards may require more than 10 samples in order to obtain sufficient coverage. The question for these yards is what would a person living in *that yard* be exposed to if living there for 30 years.

- Area-based risk screening will collect a population of soils data that will allow us to evaluate an upper-confidence limit (UCL) for a defined *area* that is many yards in size (10-40 yards). The samples will be collected from a subset of yards within the defined area. If the UCL (risk) for the area is low, then the area will be screened out - meaning any yards not sampled yet in the area will not need to be sampled; and the yards that were sampled will not need to be further sampled. Subsequently, yard-specific risks will not be calculated for defined areas screened out.

- If an area has a UCL high enough that it cannot be screened out, then field crews will return to that area and sample the yards that were not previously sampled during the screening step to achieve full yard-specific characterization, *and* also collect *more* samples in yards that were previously sampled during the screening step so as to achieve full yard-specific characterization.

- The decision as to whether an area is screened in- or out- will be made in close to real time by region 9. While field crews move to screen the next area, the data from the last area will be evaluated. It will be essential that data from the yard are passed along in an electronic format that will allow the region and its contractor to perform statistics on the area as well as plot results to observe visual trends so that this evaluation can be timely.

- In 2009/2010, EPA collected yard-specific risk characterization in about 200 yards mainly in the core center of "town." These yards/parcels are *not* targeted for more sampling in this effort unless, on a case-by-case basis, a need for re-sampling is shown to be indicated.

On the Map – Tan Parcels: YARD-SPECIFIC

On the map provided, parcels marked in TAN color are designated to be subject to ***yard-specific risk characterization*** (as defined above) automatically (i.e. they will not first be subject to area-specific screening but go straight to yard-specific characterization). The TAN areas generally "fill in" the parcels that were not sampled previously in the 2009/2010 sampling, and/or are close enough to the sources that area-based screening is not considered appropriate.

On the Map – Blue Parcels with Intermittent Purple Shading: SCREENING

On the map provided, parcels marked in BLUE color (with intermittent purple shading) are designated to be subject to ***area-based risk screening***, as defined above. Each area is designated by a letter A-J. The focus of the screening sampling will be to determine a risk for the parcels within the area marked by a given letter. The screening areas are typically on the periphery of the APSI – where, while the area is within the APSI and therefore potentially site-affected, the site-specific risk may not be sufficient to warrant sampling every single yard with 10 samples.

The purple-shaded parcels are the subset of parcels in the area as marked that are targeted for sampling initially. The number shown on the parcel is the number of samples that should be collected on that particular parcel to serve the area-specific screening purpose. ***If no number appears, the number of samples is two (2).***

The blue-shaded parcels are available for sampling in the event that access cannot be obtained on one or more of the purple-shaded parcels. However, samples may only be transferred to any blue parcel up to a certain maximum number on that parcel. That maximum number is shown on each blue parcel. ***If no number appears the maximum number of samples for that blue parcel is two (2).***

As an example, if a access cannot be obtained for a purple parcel on which 6 samples are identified, the same 6 samples could be collected from adjacent blue parcels where access *can* be obtained. However, if the surrounding blue parcels have "3" and "3" respectively marked, then the 6 samples from the purple parcel could be relocated to *both* neighboring parcels – 3 on one and 3 on the other. It would *not* be acceptable, however, to put all 6 samples on just on one of the blue neighboring parcels.

These are the bases on which the sample parcels and locations were based. If field adjustments are needed, these should be borne in mind:

- Samples should obtain good aerial coverage throughout the area being characterized;
- Too many samples should not be collected from any one property in case something unexpected/unknown applies to that property that is not representative of the rest of the area – in which case placing a large percentage of area samples on that one parcel would skew the statistics;
- Up to a reasonable maximum, placing multiple samples on one property when appropriate will reduce the number of access agreements that must be obtain to complete the screening assessment.
- The number of samples collected for an area should allow for statistical significance.

Planning

ERT should plan first to access the targeted purple parcels, as well as all the tan parcels. If access cannot be obtained at some of the purple parcels, or there is an issue at a purple parcel property making sampling difficult, there is flexibility and an alternate parcel can be chosen provided that the number of samples transferred to any given parcel does not exceed its maximum.

It is assumed that it may be best to conduct the screening sampling first; this way the total number of yards undergoing full yard-specific characterization can be known before that work begins. However, other approaches can be considered if appropriate.

Modes of Potential Contamination; Variability and "Hot Spots"

This risk-based sampling scheme is specific to an assumed fate/transport mechanism of ***historical aerial deposition*** of wind-blown particulates from one of the site-related sources, among which are tailings piles, dross piles, and smelter stack emissions. However, there are phenomena *other than aerial deposition* that, at any given location, could have resulted in localized areas with higher contamination. We will not necessarily find all such occurrences, but they may come up during the effort. If they do, we will need to be able to adjust our sampling to ensure that the risk due to aerial dispersion can be calculated, separately from risk due to these other causes. These causes of "hot spots" could be:

1. Import of material not native to the yard, which could include imported landscaping or grading material. This material may have come from a quarry or borrow source nearby, but also can actually consist of imported tailings from one of the smelting or mining sources (tailings can be acquired very cheaply).

2. Deposition of material due to operations along rail lines, loading areas, transport pathways, or other small operations in town in the days of the smelter (1900-1937) of which knowledge may have been lost or is no longer available.

The levels of metals found in yards may be quite variable as there have been many decades since site operations within which soil may have been moved, mixed, regarded, blended with imported material, cut-filled, etc.

Hot spots from these phenomena do exist and have been identified in the neighborhood before. Therefore, the field crew will need to be aware of any signs or indications that buried or imported material is present. ***If a hotspot is identified, it will be necessary to shift focus and take additional samples to identify its localized extent.***

Need for Statistically-Based Sample Sets

The samples collected in each yard will be used in a statistical analysis to determine the exposure point concentration for a hypothetical receptor in the yard. *At least 10 surface soil samples and one one-foot sample are needed in each risk management area (RMA) for this purpose*. In most cases, the yard itself will be the RMA; however, there can be more than one RMA in a yard and the need for this can be determined in the field. *EACH RMA must have a statistically-based number of samples to allow for risk calculation for that RMA.*

Approach Steps for Each Yard

1. **Learn from Owner**. If possible, the owner should be approached and asked whether he has brought any fill material into the property, and what its depth is, and what its source was. Also, whether there has been construction or grading anywhere. *All information gleaned should be logged*.
2. **Reconnaissance.** A short reconnaissance of the yard should be performed. Driveways, depressions, differences in the color of soils, vegetation, staining, indications of fill, indications of renovations and house additions, etc. should be noted.
3. **Identify the Risk Management Area**. In yards without suspected or actual hot spots (e.g. imported contaminated material such as fill), an effort should be made to identify the area of the yard that covers where someone living at the address may routinely spend their time over the course of many years. In most cases, the samples will be taken throughout the active yard area. *If there are play areas for children*, ensure that these areas are adequately covered by samples. If necessary, increase the number of samples to ensure this coverage.
4. It may be appropriate to increase the density of samples somewhat in the areas most likely to be occupied by people over many years.
5. **Consider Whether to Split Risk Management Area**. If a yard is particularly large, it may be that more than one RMA should be calculated. For instance, the area around the house with a play area and fence may be far more likely to have human occupancy over the years than an area 50 years away in the far rear of the yard that is covered with briars and bushes. *Make sure that there are 10 samples taken in each area which may ultimately become a risk management area*. It may also be appropriate to split a risk management area if there is a localized hot spot in the yard (see below).
6. **Avoid Certain Materials**. Fresh potting soil or mulch in flower beds, gravel, locations under concrete, sand bedding under driveways, or soils immediately adjacent to a house foundation

probably should in most cases be avoided as sample targets as they may be biased low. Native soil below potting soil or gravel may be appropriate as a target, especially if the cover could be easily removed.

7. **Check Visually for Tailings**. Prior to laying out sample locations, an examination should be made for any material that has a yellowish or orangish cast as this may contain tailings (although many native soils do display high iron content and can mimic tailings appearance). If this material is identified, it should be investigated by digging carefully into it to see whether further tailings become more apparent. At least one deeper sample should be collected in any such material as well as at least one surface sample initially.
8. **Check for Suspected Hot Spots**. A hot spot means a location where imported contaminated material may have been placed. A suspected hot spot should be identified if:
    a. There is bright yellowish or orangish material, or a fine, flat silvery gray material, --either with a uniform particle size –or dark red/orange staining;
    b. A single sample point exceeds 200 mg/kg for arsenic or 400 mg/kg for lead;
    c. Direct information from an owner or neighbor suggests that affected fill or a former operation may be there.
9. At the location of a suspected hot spot, additional samples should be placed at somewhat higher density in the area of suspected hot spots to confirm whether they are actual hot spots; if high concentrations are repeated, the extent of the hot spot should be identified through a strategic spatial approach.
10. If the hot spot is relatively small with marked boundaries and does not cover much of the yard, it may be appropriate to consider it as its own risk management area, as otherwise it may skew the variability and data distribution that is used to calculate risk for the entire yard. *In such cases, make sure that there are at least 10 samples in the portion of the yard that is* **not** *within the hot spot*. This will allow the risk assessor to split the RMA later if it is appropriate.

Sampling, Logging

1. Part of every sample identifier will be a unique number that is specific to (can be cross-referenced one-to-one to) its GPS location. If more than one sample is collected from the same GPS location (such as at a different depth) then it should be identified by the same number with a dash or decimal extension, or similar approach. For example, sample 433.1 and 433.2 would be at the same GPS location but at different depths. A consistent approach to numbering should be taken throughout the program.
2. Calibrated GPS coordinates will be read and recorded for every sample location.
3. Unless otherwise specified, surface samples shall be collected from the top 2 inches of soil. If there is gravel, peat, cover bark, needles, detritus, sticks, or some other such material on top of where a sample must be collected, the top 2 inches of actual *soil* will be targeted.
4. When samples are collected targeting depths greater than 2 inches, a consistent method will be used to prevent surface cross-contamination into the hole. This may involve a coring device. ***If*** a shovel is used:

a. The shovel should be slowly and carefully advanced slightly below to the desired sampling depth. As much surface soil should be removed from the hole as practicable.

b. The shovel should then be advanced in a downward slicing motion *along one side of the hole and not lifted back up* such that the shovel is still in the hole, and native material at the desired depth is exposed at the bottom of the hole on one side of the shovel blade.

c. If any surface material falls into the hole, the shovel should be lifted very slightly, placed *over and in front of* the surface material (the surface material will be behind the shovel compared to the material to be sampled) and then placed back down so that again the material at the desired depth is exposed and adjacent to the shovel.

d. While keeping the tip of the shovel fixed in position at the bottom of the hole, the shovel head should then be tilted back away from the exposed face to make room for a sampling scoop.

e. The sampling scoop should be decontaminated if used in prior holes. This can be accomplished by wiping with a cloth soaked in distilled water and then dried.

f. The scoop should then be used to scrape material off the side of hole at the desired depth. It should be transferred directly into a strong zip-lock baggie or jar. If some material falls into the hole, as long it is on top of the shovel blade, it can be retrieved. The baggie or jar should be immediately sealed.

g. The hole should be refilled with the removed soil and any sod, cover, or plant material put back in place.

5. Care should be taken not to include stones, rocks, sticks, leaves or large colloids in samples.
6. Each baggie shall be labeled, at a minimum, with the sample number, yard number, address if available, date, time, and sampling team.
7. A separate field log with observations and notations for all samples (standard ERT software acceptable)

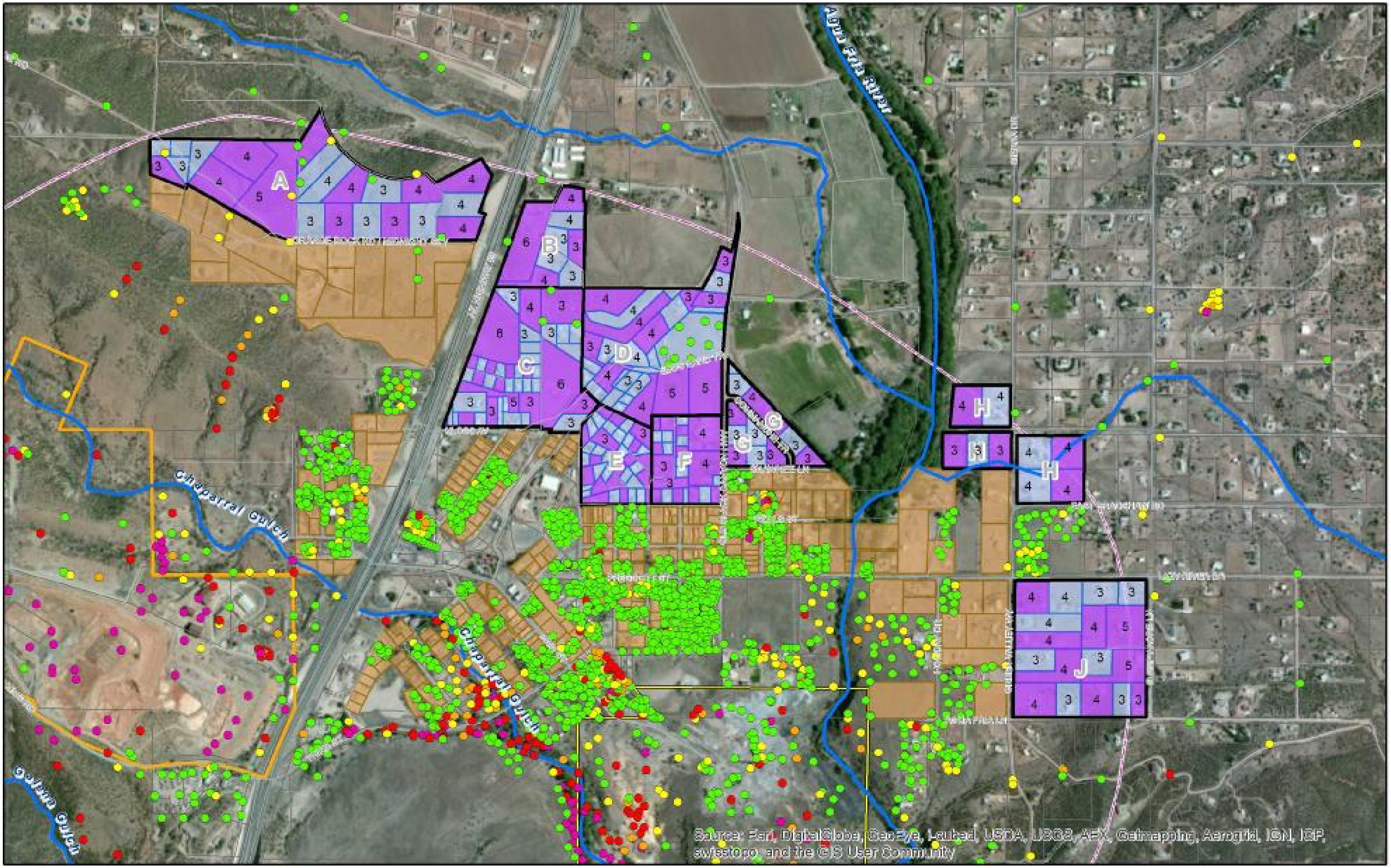
Sample Preparation and Analysis

1. All baggies shall be evaluated by XRF in the field for metals.
2. 20% of baggies will be analyzed by the laboratory for metals.
3. Ideally, 100% of baggies will be shipped to storage during or at the conclusion of the study. The availability of this needs to be checked and discussed.
4. The XRF will be calibrated against standards for all metals of interest according to appropriate SOPs.
5. Each baggie will be prepared prior to XRF analysis to homogenize the sample.

   a. The sample will be thoroughly shaken/mixed back and forth while in the baggie for 15-30 seconds.

   b. The baggie will be squeezed repeatedly between thumb and forefinger to break up any colloidal or semi-condolidated materials. Clays will be crushed, smeared, crumbled, and tumbled again within the bag to achieve as much mixing as is practicable.

6. Each baggie will be analyzed twice by the XRF. An "A" reading and a "B" reading for each sample ID will be recorded into the database and field notes. Each "shot", or analysis, will be taken from a different side or end of the bag.
7. The baggie will be pressed firmly and flat against the XRF window, completely covering the window, and held stationary during the entire analysis time.



Area of Potential Site Impact (APSI)

Dewey Humboldt Parcel

Iron King Mine

Humboldt Smelter

Streams

Targeted Parcels for Risk Assessment Screening

Alternate parcels for Risk Screening

Areas Committed to Risk Assessment

Arsenic Concentration in Shallow Soil Samples

- <= 61 mg/kg
- >61 and <=112 mg/kg
- >112 and <=145 mg/kg
- >145 and <=400 mg/kg
- >400 mg/kg

0 1,200

Feet

Proposed Risk Screening

Iron King Mine - Humboldt Smelter Superfund Site
Dewey-Humboldt, Yavapai County, Arizona

CH2MHILL.
CRITIGEN

Notes:
1. If access is unavailable to some targeted parcels alternate parcels will be selected.
2. Values in each parcel indicate number of samples to be collected.
Parcels with no number shown indicate 2 samples are to be collected.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 1/9/2014	**Time:** 11:30	**Location:** job trailer / Chapparel

Work Assignment #: 146	**Person Initiating Change:** Don Bussy / Terrence Johnson

Work Assignment Title:
Iron King Mine Site

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):
Electrical Resistivity over smelter tailings swale

Changed Scope (e.g., WAM requests 30 samples):
Add Electrical Resistivity over Chaparral Gulch Arroyo for bedrock sounding

~~Task Leader~~ Signature/Date:
Geophysicist [signature] 1/9/2014

Work Assignment Manager Signature/Date:
[signature] 1/9/2014

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Dennis Miller, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 01/23/2014	Time: 10:00	Location: Iron King Mine

Work Assignment #:
0-146

Person Initiating Change:
S. Richards/D. Newell

Work Assignment Title:
Iron King Mine

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

Samples being shipped to the CLP Lab for TAL Metals analysis will be shipped in an 8 oz. clear glass jar.

Changed Scope (e.g., WAM requests 30 samples):

Samples being shipped to the CLP Lab for TAL Metals analysis will be shipped in plastic Ziploc type bags.

SubTask Leader Signature/Date:
[signature] 1/23/14

Work Assignment Manager Signature/Date:
[signature] 1/23/14

Other Applicable Signature(s)/Date:
Sandra Richards 01/23/2014

cc: EPA Work Assignment Manager
Dennis Miller, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 01/29/14	**Time: 19:05**	**Location: IKM Site**
Work Assignment #: SERAS-146		**Person Initiating Change: Deborah Killeen, Duane Newell and Scott Grossman**

Work Assignment Title:
Iron King Mine Site

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

Amendment 3 of the UFP-QAPP for the Iron King Mine Site (document #SERAS-146-DQAPPA3-12/23/13) states that the RL for XRF analysis will be calculated using 1-5 times the MDL. Due to the need to be consistent with past XRF measurements performed by EPA Region 9 who used the MDL as the RL, SERAS and ERT personnel agreed to reevaluate the current RLs being used based on the 120sec/30 sec measurement times.

Changed Scope (e.g., WAM requests 30 samples):

The Pb MDL of 14 mg/kg and the RL of 50 mg/kg will be changed to 10 mg/kg for the MDL and 16 mg/kg for the RL.
The As MDL of 10 mg/kg and the RL of 40 mg/kg will be changed to 11 mg/kg for the MDL and 22 mg/kg for the RL.

In addition, the following metals (Zn, Cu, Fe, Mn and Cr) will be added to the residential sampling. MDLs/RLs are as follows: Zn = 27/81 mg/kg, Cu = 13/39 mg/kg, Fe = 50/150 mg/kg, Mn = 177/531 mg/kg and Cr = 114/228 mg/kg.

Data reported above the MDL and less than the RL will be flagged as estimated "J".

Task Leader Signature/Date:

1/29/14

Work Assignment Manager Signature/Date:

Duane Newell 1/29/14

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Dennis Miller, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 02/06/2014	**Time:** 16:00	**Location:** IKM
Work Assignment #: SERAS-146		**Person Initiating Change:** Duane Newell and Deborah Killeen

Work Assignment Title:
Iron King Mine Site

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

Residential confirmation samples were to be analyzed by SOW ISM01.3 by ICP-AES for TAL metals excluding mercury.

Changed Scope (e.g., WAM requests 30 samples):

Due to excessive dilutions required by the samples, the EPA Region 9 laboratory requested that the samples be analyzed for manganese using ICP-AES. Since the benchmarks for manganese currently are 180 mg/kg for human health and 220 mg/kg for ecological risk, the CRQL for manganese of 1.5 mg/kg without any solids correction or dilution factors applied is still reasonably below these benchmarks. The EPA Region 9 lab will run those samples that are non-detect by ICP-AES by ICP-MS.

Task Leader Signature/Date:
[signature] 2/11/14

Work Assignment Manager Signature/Date:
Duane Newell 2/11/14

Other Applicable Signature(s)/Date:
Sandra L Archards 02/11/2014

cc: EPA Work Assignment Manager Dennis Miller, SERAS Program Manager Deborah Killeen, SERAS QA/QC Officer Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: **02/11/14**	**Time:** **10:00**	**Location:** IKM Site
Work Assignment #: SERAS-146		**Person Initiating Change:** Terrence Johnson & Deborah Killeen
Work Assignment Title: Iron King Mine Site		
Original Scope Being Changed (e.g., Work Assignment requests 5 samples): **XRF analysis for only lead and arsenic was to be measured on the dross material.**		
Changed Scope (e.g., WAM requests 30 samples): **For the dross material, XRF measurements will be recorded for arsenic, lead, zinc, copper, iron, manganese and chromium (the same analytes as reported for the residential samples). The measurement times will remain at 120/30 sec. The same RLs used for the residential samples will be used for the dross material along with the same reporting guidelines (Refer to SERAS Work Assignment Field Change Form dated 1/29/14).** 2/12/14		
Task Leader Signature/Date: 2/12/14		
Work Assignment Manager Signature/Date: 2/12/14.		
Other Applicable Signature(s)/Date:		
cc: EPA Work Assignment Manager Dennis Miller, SERAS Program Manager Deborah Killeen, SERAS QA/QC Officer Richard Leuser, Deputy Program Manager		

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

Iron King Mine (0-146)
Field Changes to Original Work Scope

1. **Added**: (Monitoring Wells) - At the request of Region 9, five (5) shallow monitoring wells were installed at four locations: 3 in the Chaparral Gulch floodplain and one couplet (2 wells) in the lower section of Smelter Tailings Swale. Total footage ~ 92 feet

2. Added: (Archiving Soil Core Samples) - At the request of Region 9, soil core samples were collected and archived in wooden core boxes from 5 shallow borehole locations (approximately 19 core boxes)

3. Added: (Additional Boreholes) - At the request of Region 9, an additional borehole transect was added in the lower portion of Chaparral Gulch, which consisted of 3 shallow borings along with sample collection for field XRF analysis

4. Added: (Drilling Depths) - Most borings along Chaparral Gulch and within the floodplain with drilled to greater depths in order to better define the subsurface geology and depth to bedrock (or weathered bedrock)

5. Added: (Dross Area Borings) - At the request of the WAM, 10 shallow borings were drilled at seven (7) locations using a track-mounted sonic drilling rig to depths beyond what could be reached with hand augers. A number of samples were collected for field XRF analysis

6. Added: (Number of Field XRF Samples) - Additional field XRF samples were collected at many shallow boring locations in order to provide better definition of changes in contaminant concentrations with depth

7. Added: (Preliminary Assessment of Borehole Field XRF Data) - At the request of the WAM, a SERAS staff member assessed the borehole field XRF data to ensure that arsenic and lead concentrations in the deepest sample from each location were less than the site action limits

1. **Change**: (Dross Area – Number of Hand Borings and Field XRF Samples) - A total of 65 locations were hand-augered (the grid spacing was approximately 100 feet). Approximately 110 samples were collected for field XRF analysis

2. Change: (Number of Borings in Smelter Tailings Swale) - Because a surface geophysical survey was previously conducted in this area (by SERAS staff in January 2014), the WAM and Region 9 instructed SERAS to reduce the number of borings from 40 (originally planned) down to 15

3. Change: (Number of Borings in the Plateau Soils) - To save time, Region 9 suggested reducing the number of borings from 15 (originally planned) down to 5

4. Change: (Sample Naming) - 15 shallow borings within the upper section of Chaparral Gulch were labeled CHU (i.e., for upper Chaparral Gulch) instead of CH. Table 4 of the Field Investigation WP will need to be modified

[signature] 3/11/14
David Aloysius (TL – SERAS) date

[signature] 3/17/14
Don Bussey (WAM – EPA/ERT) date