Summer 6-2024

Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan 2024 Update, Revision 1

Pioneer Technical Services, Inc.

Atlantic Richfield Company

317 Anaconda Road
Butte, MT 59701
Main: (406) 782-9964

September 9, 2024

EMAIL

Mr. Jason Rappe, Remedial Project Manager
US EPA Region 8 Montana Office
Federal Office Building, Suite 3200
10 West 15th Street
Helena, Montana 59626

EMAIL

Mr. Daryl Reed, State Project Officer
Mine Flooding CERCLA Site
Montana Department of Environmental Quality
Remediation Division
P.O. Box 200901
Helena, Montana 59620-0901

Re: Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan, 2024 Update, Revision 1, Signed

Dear Mr. Rappe and Mr. Reed:

Atlantic Richfield Company (Atlantic Richfield), on behalf of the Settling Defendants (SDs) for the Butte Mine Flooding Operable Unit (BMFOU), is distributing the signed *Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan, 2024 Update, Revision 1* (Downstream FSP) to the U.S. Environmental Protection Agency and Montana Department of Environmental Quality (Agencies). The Downstream FSP is being distributed with the completed signature page, the Agencies' approval letter dated September 4, 2024, and the EPA Region 8 QA Document Review Crosswalk that was updated following review from the Agencies.

On behalf of the Settling Defendants,

Dave Griffis
Liability Manager
Atlantic Richfield Company

cc: Carolina Balliew, EPA
Will Lindsey, Esq., EPA
Katherine Jenkins, EPA
Mackenzie Meter, EPA
Charles Van-Otten, EPA
John Sither, DOJ-EES
Jonathan Morgan, Esq., DEQ
Katie Garcin-Forba, DEQ
Kevin Stone, DEQ
Garrett Smith, DEQ
Chapin Storrar, CDM Smith
Trisha Robertson, CDM Smith
Rebecca Summerville, Esq., MR
Mark Thompson, MR
Jeremy Fleege, MR
Irene Montero, Atlantic Richfield
Jean Martin, Atlantic Richfield
Loren Burmeister, Atlantic Richfield
Adam Cohen, Davis Graham & Stubbs LLP
Terence E. Duaime, MBMG
Gary Icopini, MBMG
Adam Logar, Pioneer Technical
Todd Church, Pioneer Technical
Rich Keeland, Aspect Engineering and Project Management
Jim Jonas, Life Cycle Geo
Heather Boese, Trihydro
Marc Dionne, WSP
Helen Joyce, Rampart Solutions
David Gratson, Environmental Standards
Eric Hassler, Butte-Silver Bow
Abigail Peltomaa, Butte-Silver Bow
Brandon Warner, Butte-Silver Bow
Joe Griffin, CTEC
Kristi Carroll, Montana Tech Library

File: RMO – upload

Attachments:

Response to Comment Table

EPA Region 8 QA Document Review Crosswalk for the Pilot Project Downstream Field Sampling Plan

Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan, 2024 Update, Revision 1

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE MINE FLOODING OPERABLE UNIT

Berkeley Pit and Discharge Pilot Project
Downstream Field Sampling Plan
2024 Update, Revision 1

Atlantic Richfield Company

June 2024

REGION 8
DENVER, CO 80202

September 4, 2024

Mark Thompson
Vice President of Environmental Affairs
Montana Resources LLC
600 Shields Avenue
Butte, MT 59701

Dave Griffis
Liability Manager
Atlantic Richfield Company
317 Anaconda Road
Butte, MT 59701

Re: Approval of: *Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan 2024 Update, Revision 1,* dated July 1, 2024.

Dear Mark and Dave:

The U.S. Environmental Protection Agency (EPA), in consultation with the Department of Environmental Quality (DEQ), approves the above-described document from Montana Resources LLC and the Atlantic Richfield Company. The completed QA document review crosswalk and signed signature page are attached. Please insert the crosswalk and signature page into a final PDF document and distribute the final copy to the distribution list.

If you have any questions or concerns, please call me at (406) 849-9245.

Sincerely,

Jason Rappe
Remedial Project Manager

cc:
Carolina Balliew, EPA
Will Lindsey, Esq., EPA
Katherine Jenkins, EPA
Mackenzie Meter, EPA
Charles Van-Otten, EPA
John Sither, DOJ-EES
Jonathan Morgan, Esq., DEQ

Katie Garcin-Forba, DEQ
Kevin Stone, DEQ
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Chapin Storrar, CDM Smith
Trisha Robertson, CDM Smith
Rebecca Summerville, Esq., MR
Mark Thompson, MR
Jeremy Fleege, MR
Irene Montero, Atlantic Richfield
Jean Martin, Atlantic Richfield
Loren Burmeister, Atlantic Richfield
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Todd Church, Pioneer Technical
Rich Keeland, Aspect Engineering and Project Management
Jim Jonas, Life Cycle Geo
Heather Boese, Alloy
Marc Dionne, WSP
Helen Joyce, Rampart Solutions
David Gratson, Environmental Standards
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Abigail Peltomaa, Butte-Silver Bow
Brandon Warner, Butte-Silver Bow
Joe Griffin, CTEC
Kristi Carroll, Montana Tech Library
File: RMO

EPA REGION 8 QA DOCUMENT REVIEW CROSSWALK

QAPP/FSP/SAP for: *(check appropriate box)*		**Entity** *(grantee, contract, EPA AO, EPA Program, Other)*	**Regulatory Authority and/or Funding Mechanism**	**___ 2 CFR 1500 for Grantee/Cooperative Agreements ___ 48 CFR 46 for Contracts ___ Interagency Agreement (FFA, USGS,) ___ EPA/Court Order ___ EPA Program Funding ___ EPA Program Regulation ___ EPA CIO 2105**
	GRANTEE	Settling Defendants		
	CONTRACTOR			
	EPA			
X	**Other**			
Document Title *[Note: Title will be repeated in Header]*		Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan 2024 Update, Revision 1		
QAPP/FSP/SAP Preparer		Pioneer Technical Services, Inc. Alloy Group		
Period of Performance *(of QAPP/FSP/SAP)*		Duration of the Pilot Project, or as specified in the FSP	**Date Submitted for Review**	3/28/2024 (2024 Update) 7/1/2024 (2024 Update, Revision 1)
EPA Project Officer EPA Project Manager		Jason Rappe	**PO Phone # PM Phone #**	(406) 457 5024
QA Program Reviewer or Approving Official		Jason Rappe	**Date of Review**	7/15/24

Documents Submitted for QAPP Review **(QA Reviewer must complete)*:***

1. QA Document(s) submitted for review:

QA Document	Document Date	Document Stand-alone	Document with QAPP
QAPP		Yes / No	
FSP		Yes / **No**	**Yes** / No
SAP		Yes / No	Yes / No
SOP(s)			Yes / No

2. WP/SOW/TO/PP/RP Date _____
WP/SOW/TO/RP Performance Period _____

3. QA document consistent with the:
WP/SOW/PP for grants? Yes / No
SOW/TO for contracts? Yes / No

4. QARF signed by R8 QAM Yes / No / NA
Funding Mechanism IA / contract / grant / NA
Amount _____

Notes for Document Submittals:

1. A QAPP written by a Grantee, EPA, or Federal Partner must include for review: Work Plan (WP) / Statement of Work (SOW) / Program Plan (PP) / Research Proposal (RP) and funding mechanism

2. A QAPP written by Contractor must include for review:
- **a)** Copy of Task Order Work Assignment/SOW
- **b)** Reference to a hard or electronic copy of the contractor's approved QMP
- **c)** Copy of Contract SOW if no QMP has been approved
- **d)** Copy of EPA/Court Order, if applicable
- **e)** The QA Review must determine (with the EPA CO or PO) if a QARF was completed for the environmental data activity described in the QAPP.

3. a. Field Sampling Plan (FSP) and/or Sampling & Analyses Plan (SAP) must include the Project QAPP ***or*** must be a stand-alone QA document that contain all QAPP required elements (Project Management, Data Generation/Acquisition, Assessment and Oversight, and Data Validation and Usability).

b. SOPs must be submitted with a QA document that contains all QAPP required elements.

Summary of Comments *(highlight significant concerns/issues)*:

1.) No major QA issues were identified during review of this FSP. However, if an issue or a detail not addressed is discovered during implementation of the FSP, it is EPA's expectation that any problems will be corrected in the annual document update and by the corrective action process, if necessary. (4/24/24)

Element	Acceptable *Yes/No/NA*	Page/ Section	Comments
A. Project Management			
A1. Title and Approval Sheet			
a. Contains project title	Yes	Cover pages	EPA: No comments. (4/24/24)
b. Date and revision number line (for when needed)	Yes	Cover pages, Section 1.4	EPA: No comments. (4/24/24)
c. Indicates organization's name	Yes	Cover pages	EPA: No comments. (4/24/24)
d. Date and signature line for organization's project manager	Yes	Page i	EPA: No comments. (4/24/24)
e. Date and signature line for organization's QA manager	Yes	Page i	EPA: No comments. (4/24/24)
f. Other date and signatures lines, as needed	Yes	Page i	EPA: No comments. (4/24/24)
A2. Table of Contents			
a. Lists QA Project Plan information sections	Yes	Page ii	EPA: No comments. (4/24/24)
b. Document control information indicated	Yes	Section 1.4 Exhibit A – Section 1.5	EPA: No comments. (4/24/24)
A3. Distribution List			
Includes all individuals who are to receive a copy of the QA Project Plan and identifies their organization	Yes	Cover letter	EPA: No comments. (8/22/23) EPA: The cover letter does not include several individuals that would need to receive a copy of the FSP, including the CPM and FTL. This could be shown in Figure 1 by identifying individuals that will receive the FSP with an asterisk or footnote. (4/24/24) Atlantic Richfield: Sections 1.4 and 2.0 were revised to provide additional clarification on distribution of this FSP and project Quality Assurance Project Plan (QAPP). Additional clarification was added in these sections describing that the Downstream Coordinator will ensure the most recent version of this FSP and QAPP are distributed to the Contractor Project Manager (CPM) and project team. The FSP cover letter includes the Downstream Coordinator and CPM in the distribution list. (6/17/24). EPA: No comments (7/15/24)

A4. Project/Task Organization			
a. Identifies key individuals involved in all major aspects of the project, including contractors	Yes	Section 2.0, Figure 1	EPA: No comments. (8/22/23) EPA: Please update EPA Project Manager in Figure 1 to Jason Rappe (4/24/24) Atlantic Richfield: The EPA Remedial Project Manager in Figure 1 was updated to Jason Rappe. Additionally, descriptions of Agency roles were added to Section 2.0, as requested in other Pilot Project FSP comments. (6/17/24). EPA: No comments (7/15/24)
b. Discusses their responsibilities	Yes	Section 2.0 Exhibit A – Section 1.4	EPA: No comments. (4/24/24)
c. Project QA Manager position indicates independence from unit generating data	Yes	Section 2.0	EPA: No comments. (4/24/24)
d. Identifies individual responsible for maintaining the official, approved QA Project Plan	Yes	Section 2.0	EPA: No comments. (4/24/24)
e. Organizational chart shows lines of authority and reporting responsibilities	Yes	Figure 1	EPA: No comments. (4/24/24)
A5. Problem Definition/Background			
a. States decision(s) to be made, actions to be taken, or outcomes expected from the information to be obtained	Yes	Section 3.1, Section 3.2 Table 1 Exhibit A – Table 1	EPA: No comments. (4/24/24)
b. Clearly explains the reason (site background or historical context) for initiating this project	Yes	Section 1.2 Exhibit A – Section 1.2	EPA: No comments. (4/24/24)
c. Identifies regulatory information, applicable criteria, action limits, etc. necessary to the project	Yes	Section 3.1, Section 3.2	EPA: No comments. (4/24/24)
A6. Project/Task Description			
a. Summarizes work to be performed, for example, measurements to be made, data files to be obtained, etc., that support the project's goals	Yes	Section 3.1, Section 3.2 Exhibit A – Section 2, Section 3	EPA: No comments. (4/24/24)
b. Provides work schedule indicating critical project points, e.g., start and completion dates for activities such as sampling, analysis, data or file reviews, and assessments	Yes	Section 3.2.3, Section 6.0 Exhibit A – Section 2.1.3, Section 3.1.2, Section 7.2, Tables 2 through 4	EPA: No comments. (4/24/24)
c. Details geographical locations to be studied, including maps where possible	Yes	Figure 2 Exhibit A – Figure 1 through Figure 6	EPA: No comments. (4/24/24)

d. Discusses resource and time constraints, if applicable	N/A	Not Applicable.	N/A
A7. Quality Objectives and Criteria			
a. Identifies - performance/measurement criteria for all information to be collected and acceptance criteria for information obtained from previous studies, - including project action limits and laboratory detection limits and - range of anticipated concentrations of each parameter of interest	Yes	Table 1 2023 Pilot Project QAPP: Section 2.4, Section 3.5, Section 4.1, Section 5 Exhibit A – Table 1	EPA: No comments. (4/24/24)
b. Discusses precision	Yes	Pilot Project QAPP – Section 2.4.2.1	EPA: No comments. (4/24/24)
c. Addresses bias	Yes	Pilot Project QAPP – Section 2.4.2.2	EPA: No comments. (4/24/24)
d. Discusses representativeness	Yes	Pilot Project QAPP – Section 2.4.2.3	EPA: No comments. (4/24/24)
e. Identifies the need for completeness	Yes	Pilot Project QAPP – Section 2.4.2.4	EPA: No comments. (4/24/24)
f. Describes the need for comparability	Yes	Pilot Project QAPP – Section 2.4.2.5	EPA: No comments. (4/24/24)
g. Discusses desired method sensitivity	Yes	Section 3.1, Section 3.2 Pilot Project QAPP – Section 2.4.2.6	EPA: No comments. (4/24/24)
A8. Special Training/Certifications			
a. Identifies any project personnel specialized training or certifications	Yes	Pilot Project QAPP – Section 2.5 Exhibit A – Appendix A	EPA: No comments. (4/24/24)

b. Discusses how this training will be provided	Yes	Pilot Project QAPP – Section 2.5 Exhibit A – Appendix A	EPA: No comments. (4/24/24)
c. Indicates personnel responsible for assuring training/certifications are satisfied	Yes	Pilot Project QAPP – Section 2.5	EPA: No comments. (4/24/24)
d. Identifies where this information is documented	Yes	Pilot Project QAPP – Section 2.5	EPA: No comments. (4/24/24)
A9. Documentation and Records			
a. Identifies report format and summarizes all data report package information	Yes	Section 6.0, Pilot Project QAPP – Section 2.6, Section 3.4.6, Section 5.1.2.2 Exhibit A – Section 7.0	EPA: No comments. (4/24/24)
b. Lists all other project documents, records, and electronic files that will be produced	Yes	Section 4.0 Exhibit A – Section 5.0	EPA: No comments. (4/24/24)
c. Identifies where project information should be kept and for how long	Yes	Section 4.0	EPA: No comments. (4/24/24)
d. Discusses back up plans for records stored electronically	Yes	Section 4.2.5	EPA: No comments. (4/24/24)
e. States how individuals identified in A3 will receive the most current copy of the approved QA Project Plan, identifying the individual responsible for this	Yes	Section 1.4, Section 2.0	EPA: No comments. (8/22/23) EPA: Please identify how the FSP is distributed to the appropriate people (e.g., via email) and the person for document distribution (e.g., CPM or FTL) (4/24/24) Atlantic Richfield: Sections 1.4 and 2.0 were revised to clarify that the Downstream Coordinator will ensure the most recent version of this FSP is distributed to the CPM and project team. The FSP cover letter includes the Downstream Coordinator and CPM in the distribution list. Additionally, an electronic version of this FSP will be maintained in the project files and made available to the CPM and project team. (6/17/24). EPA: No comments (7/15/24)

B. Data Generation/Acquisition			
B1. Sampling Process Design (Experimental Design)			
a. Describes and justifies design strategy, indicating size of the area, volume, or time period to be represented by a sample	Yes	Section 3.2 Exhibit A – Section 2, Section 3, Appendix A	EPA: No comments. (4/24/24)
b. Details the type and total number of sample types/matrix or test runs/trials expected and needed	Yes	Section 3.2 Exhibit A – Section 2, Section 3, Appendix A	EPA: No comments. (4/24/24)
c. Indicates where samples should be taken, how sites will be identified/located	Yes	Section 3.2 Exhibit A – Section 2, Section 3, Appendix A	EPA: No comments. (4/24/24)
d. Discusses what to do if sampling sites become inaccessible	Yes	Exhibit A –Section 6	EPA: No comments. (4/24/24)
e. Identifies project activity schedules such as each sampling event, times samples should be sent to the laboratory, etc.	Yes	Section 3.2.3 Exhibit A – Section 2.1.3, Section 3.1.2	EPA: No comments. (4/24/24)
f. Specifies what information is critical and what is for informational purposes only	Yes	Section 3.1, Section 3.2 Exhibit A – Section 2.0, Section 3.0	EPA: No comments. (4/24/24)
g. Identifies sources of variability and how this variability should be reconciled with project information	Yes	Section 3.2.2 Exhibit A - Section 4.1, Section 4.2	EPA: No comments. (4/24/24)
B2. Sampling Methods			
a. Identifies all sampling SOPs by number, date, and regulatory citation, indicating sampling options or modifications to be taken	Yes	Exhibit A – Appendix A	EPA: No comments. (4/24/24)
b. Indicates how each sample/matrix type should be collected	Yes	Section 3, Exhibit A – Section 2, Section 3, Appendix A	EPA: No comments. (4/24/24)
c. If in situ monitoring, indicates how instruments should be deployed and operated to avoid contamination and ensure maintenance of proper data	Yes	Section 3.2.3 Exhibit A – Section 4.1.1, Section 4.1.3	EPA: No comments. (4/24/24)
d. If continuous monitoring, indicates averaging time and how instruments should store and maintain raw data, or data averages	Yes	Table 2 Exhibit A – Table 4, Table 5	EPA: No comments. (4/24/24)
e. Indicates how samples are to be homogenized, composited, split, or filtered, if needed	N/A	NA	N/A

f. Indicates what sample containers and sample volumes should be used	N/A	NA	N/A
g. Identifies whether samples should be preserved and indicates methods that should be followed	N/A	NA	N/A
h. Indicates whether sampling equipment and samplers should be cleaned and/or decontaminated, identifying how this should be done and by-products disposed of	Yes	Exhibit A – Appendix A	EPA: No comments. (4/1//24)
i. Identifies any equipment and support facilities needed	Yes	Table 2 Exhibit A – Appendix A	EPA: No comments. (4/24/24)
j. Addresses actions to be taken when problems occur, identifying individual(s) responsible for corrective action and how this should be documented	Yes	Section 5.1 Pilot Project QAPP – Section 4.2 Exhibit A – Section 5.1	EPA: No comments. (4/24/24)
B3. Sample Handling and Custody			
a. States maximum holding times allowed from sample collection to extraction and/or analysis for each sample type and, for in-situ or continuous monitoring, the maximum time before retrieval of information	Yes	Exhibit A – Table 6	EPA: No comments. (4/24/24)
b. Identifies how samples or information should be physically handled, transported, and then received and held in the laboratory or office (including temperature upon receipt)	N/A	NA	N/A
c. Indicates how sample or information handling and custody information should be documented, such as in field notebooks and forms, identifying individual responsible	N/A	NA	N/A
d. Discusses system for identifying samples, for example, numbering system, sample tags and labels, and attaches forms to the plan	N/A	NA	N/A
e. Identifies chain-of-custody procedures and includes form to track custody	N/A	NA	N/A
B4. Analytical Methods			
a. Identifies all analytical SOPs (field, laboratory and/or office) that should be followed by number, date, and regulatory citation, indicating options or modifications to be taken, such as sub-sampling and extraction procedures	Yes	Exhibit A – Appendix A	EPA: No comments. (4/24/24)

b. Identifies equipment or instrumentation needed	Yes	Table 2 Exhibit A – Appendix A	EPA: No comments. (4/24/24)
c. Specifies any specific method performance criteria	Yes	Pilot Project QAPP – Section 4.1	EPA: No comments. (4/24/24)
d. Identifies procedures to follow when failures occur, identifying individual responsible for corrective action and appropriate documentation	Yes	Pilot Project QAPP – Section 4.2	EPA: No comments. (4/24/24)
e. Identifies sample disposal procedures	N/A	NA	N/A
f. Specifies laboratory turnaround times needed	N/A	NA	N/A
g. Provides method validation information and SOPs for nonstandard methods	Yes	Pilot Project QAPP – Section 3.5.2	EPA: No comments. (4/24/24)
B5. Quality Control			
a. For each type of sampling, analysis, or measurement technique, identifies QC activities which should be used, for example, blanks, spikes, duplicates, etc., and at what frequency	Yes	Exhibit A – Section 4 NA	EPA: No comments. (4/24/24)
b. Details what should be done when control limits are exceeded, and how effectiveness of control actions will be determined and documented	NA	NA	NA
c. Identifies procedures and formulas for calculating applicable QC statistics, for example, for precision, bias, outliers and missing data	Yes	Pilot Project QAPP – Section 2.4.2	EPA: No comments. (4/24/24)
B6. Instrument/Equipment Testing, Inspection, and Maintenance			
a. Identifies field and laboratory equipment needing periodic maintenance, and the schedule for this	Yes	Exhibit A – Section 4.1.1, Section 4.1.3	EPA: No comments. (4/24/24)
b. Identifies testing criteria	Yes	Section 3.2.3 Exhibit A – Appendix A	EPA: No comments. (4/24/24)
c. Notes availability and location of spare parts	Yes	Pilot Project QAPP – Section 3.6	EPA: No comments. (4/24/24)
d. Indicates procedures in place for inspecting equipment before usage	Yes	Section 3.2.3 Exhibit A – Appendix A	EPA: No comments. (4/24/24)
e. Identifies individual(s) responsible for testing, inspection and maintenance	Yes	Section 2.0 Exhibit A - Section 1.4.2	EPA: No comments. (4/24/24)
f. Indicates how deficiencies found should be resolved, re-inspections performed, and effectiveness of corrective action determined and documented	Yes	Pilot Project QAPP – Section 3.6	EPA: No comments. (4/24/24)
B7. Instrument/Equipment Calibration and Frequency			

a. Identifies equipment, tools, and instruments that should be calibrated and the frequency for this calibration	Yes	Section 3.2.3 Exhibit A – Appendix A	EPA: The previous version of this FSP had the following comments and responses: *EPA: Given the importance of the absolute accuracy needed for the temperature portion of the study, a section or SOP detailing the calibration of the temperature sensors listed in Table 2 is needed (1/20/20).* *Atlantic Richfield: Temperature measurement equipment absolute accuracy and potential calibration shall be per manufacturer recommendations and will be addressed in the appropriate Operation & Maintenance (O&M) manuals and specifically in the SOPs within the O&M manuals (04/19/2021)* *EPA: Comment resolved. In the O&M plan, EPA will expect a description of how temperature sensors will be periodically calibrated and/or verified, how this will be documented, and the frequency of calibration and/or verification (e.g., quarterly, bi-annually, annually). (11/5/21)* However, after review of the *Discharge System Operations & Maintenance Manual, Revision 1* (and SOPs), dated July 1, 2022, no further information about calibration of temperature sensors was found. Nor was there any manufacturer information about calibration of the identified temperature sensors. EPA expects a description of how temperature sensors will be periodically calibrated and/or verified, how this will be documented, and the frequency of calibration and/or verification (e.g., quarterly, bi-annually, annually). Please revise to include this information (8/28/23). Atlantic Richfield: Manufacturer recommendations for evaluation of temperature measurement accuracy include comparison to a reference measurement; temperature calibration is performed by the manufacturer. Additional discussion was added to Section 3.2.3 and Section 5.1 of this FSP to address the Agency comment, and a reference to this information will be included in the Discharge System Operations Assurance Plan. The Pilot Project instream temperature measured at monitoring location SS-04 and SS-05A will be verified with a field instrument measurement annually prior to peak instream temperatures and documented in a logbook. If the field verification

			results in a temperature difference greater than 1 degree Celsius, appropriate corrective actions will be taken, including flagging the data and replacing or maintaining the temperature sensor. (3/28/2024). EPA: No comments (4/24/24)
b. Describes how calibrations should be performed and documented, indicating test criteria and standards or certified equipment	Yes	Exhibit A – Appendix A	EPA: No comments. (4/24/24)
c. Identifies how deficiencies should be resolved and documented	Yes	Pilot Project QAPP – Section 3.6	EPA: No comments. (4/24/24)
B8. Inspection/Acceptance for Supplies and Consumables			
a. Identifies critical supplies and consumables for field and laboratory, noting supply source, acceptance criteria, and procedures for tracking, storing and retrieving these materials	Yes	Pilot Project QAPP – Section 3.7	EPA: No comments. (4/24/24)
b. Identifies the individual(s) responsible for this	Yes	NA	EPA: No comments. (4/24/24)
B9. Use of Existing Data (Non-direct Measurements)			
a. Identifies data sources, for example, computer databases or literature files, or models that should be accessed and used	Yes	Section 3.0, Table 2 Exhibit A – Section 2, Section 3	EPA: No comments. (4/24/24)
b. Describes the intended use of this information and the rationale for their selection, i.e., its relevance to project	Yes	Table 1 Exhibit A – Table 1	EPA: No comments. (4/24/24)
c. Indicates the acceptance criteria for these data sources and/or models	Yes	Section 4.2.3.3, Pilot Project QAPP – Section 3.8	EPA: No comments. (4/24/24)
d. Identifies key resources/support facilities needed	Yes	Section 3.0 Exhibit A – Section 2, Section 3	EPA: No comments. (4/24/24)
e. Describes how limits to validity and operating conditions should be determined, for example, internal checks of the program and Beta testing	N/A	N/A	NA
B10. Data Management			
a. Describes data management scheme from field to final use and storage	Yes	Section 4.0, Figure 3	EPA: No comments. (4/24/24)
b. Discusses standard record-keeping and tracking practices, and the document control system or cites other written documentation such as SOPs	Yes	Section 4.0	EPA: No comments. (4/24/24)

c. Identifies data handling equipment/procedures that should be used to process, compile, analyze, and transmit data reliably and accurately	Yes	Section 4.0	EPA: No comments. (4/24/24)
d. Identifies individual(s) responsible for this	Yes	Section 2.0	EPA: No comments. (4/24/24)
e. Describes the process for data archival and retrieval	Yes	Section 4.2.5, Section 4.2.6	EPA: No comments. (4/24/24)
f. Describes procedures to demonstrate acceptability of hardware and software configurations	Yes	Section 4.2.1	EPA: No comments. (4/24/24)
g. Attaches checklists and forms that should be used	Yes	Section 4.2.4 Exhibit A – Appendix A	EPA: No comments. (4/24/24)
C. Assessment and Oversight			
C1. Assessments and Response Actions			
a. Lists the number, frequency, and type of assessment activities that should be conducted, with the approximate dates	Yes	Pilot Project QAPP – Section 4.1	EPA: No comments. (4/24/24)
b. Identifies individual(s) responsible for conducting assessments, indicating their authority to issue stop work orders, and any other possible participants in the assessment process	Yes	Pilot Project QAPP – Section 4.1	EPA: No comments. (4/24/24)
c. Describes how and to whom assessment information should be reported	Yes	Pilot Project QAPP – Section 4.1	EPA: No comments. (4/24/24)
d. Identifies how corrective actions should be addressed and by whom, and how they should be verified and documented	Yes	Pilot Project QAPP – Section 4.2	EPA: No comments. (4/24/24)
C2. Reports to Management			
a. Identifies what project QA status reports are needed and how frequently	Yes	Section 6.0 Pilot Project QAPP – Section 2.3, Section 4	EPA: No comments. (4/24/24)
b. Identifies who should write these reports and who should receive this information	Yes	Section 2.0 Pilot Project QAPP – Section 2.3, Section 4	EPA: No comments. (4/24/24)

D. Data Validation and Usability			
D1. Data Review, Verification, and Validation			
Describes criteria that should be used for accepting, rejecting, or qualifying project data	Yes	Section 5.1 Pilot Project QAPP – Section 4, Section 5	EPA: No comments. (4/24/24)
D2. Verification and Validation Methods			
a. Describes process for data verification and validation, providing SOPs and indicating what data validation software should be used, if any	Yes	Section 5.1 Pilot Project QAPP – Section 4, Section 5	EPA: No comments. (4/24/24)
b. Identifies who is responsible for verifying and validating different components of the project data/information, for example, chain-of-custody forms, receipt logs, calibration information, etc.	Yes	Section 2.0, Section 5.1 Pilot Project QAPP – Section 2.3, Section 3, Section 4, and Section 5	EPA: No comments. (4/24/24)
c. Identifies issue resolution process, and method and individual responsible for conveying these results to data users	Yes	Pilot Project QAPP – Section 4, Section 5	EPA: No comments. (4/24/24)
d. Attaches checklists, forms, and calculations	Yes	Pilot Project QAPP – Section 4, Section 5	EPA: No comments. (4/24/24)
D3. Reconciliation with User Requirements			
a. Describes procedures to evaluate the uncertainty of the validated data	Yes	Pilot Project QAPP – Section 5.2	EPA: No comments. (4/24/24)
b. Describes how limitations on data use should be reported to the data users	Yes	Pilot Project QAPP – Section 5.2	EPA: No comments. (4/24/24)

Response to Agency comments in letter *Re: Comments on Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan, 2023 Update, dated, August 3, 2023.*
Agency comment letter dated September 11, 2023.

Agency Comment	Location Agency Comment Addressed		Response
	Document	Specific Location	
1. Please address, and respond to, all comments in the QA document review crosswalk.	Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan (Downstream FSP), 2024 Update	Quality Assurance (QA) Document Review Crosswalk	All Agency review comments contained in the QA document review crosswalk have been addressed, and individual comment responses are provided.
2. Table 2: The data quality objectives related to mixing zone and backwater effects assessments should be removed since those monitoring efforts are no longer included in the field sampling plan. Please ensure that if Table 2 is removed that other tables are renumbered accordingly and references in the document and the QA crosswalk are revised as necessary.	Downstream FSP, 2024 Update	Response to Comment Table 2	As suggested by the Agencies, data quality objectives will be removed from Field Sampling Plans (FSPs) as sufficient data are collected during the Berkeley Pit and Discharge Pilot Project (Pilot Project) and the monitoring requirements are removed. Table 2 has been removed in the revised Downstream FSP. Other tables in the Downstream FSP have been renumbered, and QA references have been updated accordingly.

Response to Agency comments in letter *Re: Comments on: Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan, 2024 Update, dated March 29, 2024.*
Agency comment letter dated May 16, 2024.

Agency Comment	Location Agency Comment Addressed		Response
	Document	Specific Location	
1. Please address the comments in the QA document review crosswalk.	Downstream FSP, 2024 Update, Revision 1	QA Document Review Crosswalk	All Agency review comments contained in the QA document review crosswalk have been addressed, and individual comment responses are provided.
2. Please change the EPA remedial project manager name to Jason Rappe on the signature page and Figure 1.	Downstream FSP, 2024 Update, Revision 1	Signature Page Figure 1	The EPA remedial project manager's name was revised to Jason Rappe on the approval page and Figure 1.

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE MINE FLOODING OPERABLE UNIT

Berkeley Pit and Discharge Pilot Project
Downstream Field Sampling Plan
2024 Update, Revision 1

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
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Prepared by:

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June 2024

APPROVAL PAGE

Silver Bow Creek/Butte Area NPL Site
Butte Mine Flooding Operable Unit
Pilot Project Downstream Field Sampling Plan 2024 Update, Revision 1

Approved: _____ Date: 9/4/2024

Jason Rappe, Remedial Project Manager
Environmental Protection Agency, Region 8

Approved: _____ Date: 9/4/2024

Daryl Reed, State Project Officer
Montana Department of Environmental Quality

Approved: _____ Date: 6/17/2024

Dave Griffis, Liability Manager
Atlantic Richfield Company

Approved: _____ Date: 6/17/2024

David Gratson, Quality Assurance Manager
Environmental Standards, Inc. (for Atlantic Richfield Company)

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REVISION SUMMARY

Revision No.	Author	Description	Date
0	Pioneer Technical Services, Inc.	Final Downstream SAP Addendum	04/19/2021
0	Pioneer Technical Services, Inc.	Retitled Pilot Project Downstream Field Sampling Plan	02/08/2022
2023 Update	Pioneer Technical Services, Inc.	Pilot Project Downstream Field Sampling Plan 2023 Update	08/03/2023
2024 Update	Pioneer Technical Services, Inc.	Revised title to 2024 Update and revised document to address the Agency comments as described in Response to Comment (RTC) table and QA Crosswalk. 2024 updates are described in Section 1.4.	03/28/2024
2024 Update, Revision 1	Pioneer Technical Services, Inc.	Revised organizational chart and approval page for Agency RPM change. Addressed crosswalk comments to clarify distribution procedures.	06/17/2024

ACRONYMS AND ABBREVIATIONS

Agencies	EPA and Montana DEQ
Alloy Group	Alloy Group (formerly Copper Environmental Consulting [CEC])
Atlantic Richfield	Atlantic Richfield Company
BMFOU	Butte Mine Flooding Operable Unit
BPSOU	Butte Priority Soils Operable Unit
BTC	Blacktail Creek
°C	degrees Celsius
CPM	Contractor Project Manager
DEQ	Department of Environmental Quality
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
FTL	Field Team Leader
HBEL	Horseshoe Bend Effluent Line
HDPE	high-density polyethylene
HsB	Horseshoe Bend
HSSE	Health, Safety, Security, and Environment
IM	Integrity Management
MR	Montana Resources, LLC
OAP	Operations Assurance Plan
Pilot Project	Berkeley Pit and Discharge Pilot Project
Pioneer	Pioneer Technical Services, Inc.
POC	point of compliance
QA	quality assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
RFC	Request for Change
SAP	Sampling and Analysis Plan
SBC	Silver Bow Creek
SDs	Settling Defendants
SLW	Silver Lake Water
SOP	standard operating procedure
USGS	U.S. Geological Survey
WSP	WSP Environment & Infrastructure Inc. (formerly Wood Environment and Infrastructure Solutions, Inc.)
W&C	Woodard & Curran (formerly TREC, Inc.)
YDTI	Yankee Doodle Tailings Impoundment

1.0 INTRODUCTION

This Pilot Project Downstream Field Sampling Plan (Downstream FSP) is Attachment D.2 to the *Final Berkeley Pit and Discharge Pilot Project Work Plan* (Pilot Project Work Plan; Atlantic Richfield Company and MR, 2023). This Downstream FSP describes downstream monitoring and sampling for the Berkeley Pit and Discharge Pilot Project (Pilot Project) of the Butte Mine Flooding Operable Unit (BMFOU) in Butte, Montana.

For the context of the project, *downstream* refers to areas of interest for the Pilot Project in the receiving waters of Silver Bow Creek (SBC) and Blacktail Creek (BTC). The majority of the receiving water flows in SBC originate from BTC and the Pilot Project discharge point is just above the confluence of BTC and SBC.

This Downstream FSP was prepared under the *Pilot Project Quality Assurance Project Plan, 2024 Update*, (Pilot Project QAPP; Atlantic Richfield Company and MR, 2024a) which provides the site-specific quality assurance/quality control (QA/QC) standards and procedures. This FSP builds on the Pilot Project QAPP and contains no substantive changes to that document. Additional data collection under the Pilot Project QAPP is described in two additional Field Sampling Plans:

- *Discharge System Field Sampling Plan, 2024 Update, Revision 1* (Discharge System FSP; Atlantic Richfield Company and MR, 2024b).
- *On-Site Water Management Field Sampling Plan, 2023 Update* (On-Site Water Management FSP; MR, 2023).

Additionally, this Downstream FSP includes activities performed in conjunction with the Butte Priority Soils Operable Unit (BPSOU) Interim Site-Wide Surface Water Monitoring Quality Assurance Project Plan (BPSOU Surface Water Monitoring QAPP; Atlantic Richfield Company, 2023a). Water quality data collected for this effort are managed by Woodard and Curran (W&C; formerly TREC, Inc.).

1.1 Data Quality Objectives

In addition to the data quality objectives (DQOs) described in the Pilot Project QAPP, the specific objectives of this Downstream FSP are to summarize monitoring and sampling activities to be performed that are associated with areas of interests for the Pilot Project in the receiving waters of SBC and BTC. The data quality objectives are included in Table 1 and the *Calcite Scale Formation Assessment Sampling and Analysis Plan* (Scale Assessment SAP; Exhibit A) and include the following Downstream FSP objectives:

- Scale monitoring in the receiving water.
- Temperature evaluation of the receiving water with the addition of Pilot Project discharge.

Sufficient data have been collected as part of the Pilot Project for the following Downstream FSP objectives, thereby satisfying the data quality objective obligations. The following monitoring and sampling activities were removed from the Downstream FSP as approved in Request for Change (RFC)-Downstream FSP-2022-2 (Atlantic Richfield Company, 2022a).

- Pilot Project effluent mixing with receiving waters.
- Backwater effect to BTC due to Pilot Project effluent.

1.2 Background

Montana Resources, LLC (MR) and Atlantic Richfield Company (Atlantic Richfield), jointly on behalf of the Settling Defendants (SDs) for the BMFOU, are conducting the Pilot Project work as outlined in the Pilot Project Work Plan. The Pilot Project is being completed under approval from U.S. Environmental Protection Agency (EPA) and Montana Department of Environmental Quality (DEQ) (Agencies).

The Pilot Project is a temporary, multi-year pilot project that seeks to evaluate a system to control the rise of water levels in the Berkeley Pit and East Camp points of compliance (POCs). The Pilot Project will also test additional methods of treating water from Horseshoe Bend (HsB) seeps, Berkeley Pit water, and other on-site sources of water, such that discharge of treated water to SBC meets all required water quality standards. Information developed during the Pilot Project will be used to evaluate potential improvements that may be necessary to implement with the final BMFOU remedy. This Downstream FSP details monitoring of Pilot Project effects on the receiving waters of SBC and BTC.

1.3 Problem Definition

This Downstream FSP uses the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). The EPA DQO process consists of seven steps to define the criteria used to design data collection efforts which result in data of sufficient quality and quantity to achieve goals of a study and support defensible project decisions. Step 1 of the DQO process lists the problem definition for each monitoring task. A DQO summary for the temperature assessment is presented in Table 1. A DQO summary table for the potential scaling is provided in the Scale Assessment SAP in Exhibit A.

1.4 Document Distribution and Revision

This Downstream FSP is a controlled document. Controlled distribution will be implemented so that only the most current approved version is used. A sequential revision numbering system will be used to identify changes in the controlled versions of this Downstream FSP. Updates or revisions to this FSP will be prepared as necessary (e.g., if guidelines, procedures, regulatory documents, or standard operating procedures [SOPs] are revised, or when task objectives, scope, or activities change). At a minimum, this document will be reviewed and, if appropriate, revised annually. The Downstream Coordinator will ensure the most recent version of this FSP and the Pilot Project QAPP are distributed to the Contractor Project Manager (CPM) and project team.

An electronic version of this FSP will be maintained in the project files and made available to the CPM and project team.

The 2024 revision of the Downstream FSP reflects developments in the Pilot Project and organizational changes that have occurred since the Pilot Project began. The updates specifically include the following:

- Section 2.0 Project Organization and Responsibilities was updated to reflect changes to project team roles, changes in the downstream monitoring and assessment, and added data management content.
- The Pilot Project effluent mixing zone and BTC backwater assessments were removed from this Discharge System FSP in accordance with RFC Downstream FSP-2022-2 (Atlantic Richfield Company, 2022a).
- The Downstream Data Management Plan content approved in RFC Downstream FSP-2022-3 (Atlantic Richfield Company, 2022b) was incorporated in Sections 2.0, 4.0, and 5.0.
- The temperature monitoring and assessment period was reduced to focus on the warmer months (June through September) for consistency with the On-Site Water Management FSP (MR, 2023).
- The Silver Lake Water (SLW) temperature monitoring locations were removed from this FSP. The use of SLW effluent flow augmentation expired at the end of the Pilot Project one-year shakedown period on September 30, 2020, and will not be used unless approved by the Agencies.
- Temperature monitoring stations described in Table 2. Temperature Monitoring Points were updated to match current Pilot Project infrastructure. The revisions include:
    - Continuous temperature monitoring was installed at the Polishing Facility influent in October 2020.
    - Temperature instrumentation for the Return Water Line was initially installed at one of the Yankee Doodle Tailings Impoundment (YDTI) barges. As described in the *Berkeley Pit and Discharge Pilot Project 2020 and 2021 Temperature Evaluation, Revision 1* (Atlantic Richfield Company and MR, 2022a), temperature instrumentation was installed on the Return Water Line junction box in 2021 to accurately characterize the Pilot Project flows entering the Return Water Line.
- The Scale Assessment SAP (Exhibit A) was updated with the following revisions:
    - Calcite scale monitoring frequency and procedures were revised based on scale monitoring activities completed through 2021 as described in RFC Downstream FSP-2022-1 (Atlantic Richfield Company, 2022c).
    - The QC reporting requirements of field water quality data was reduced from “Level II” to “Level I.”
    - The reporting requirements were reduced; the requirement to report the annual results of scale assessment activities in a technical memorandum was removed as recommended in *2022 Update to Assessment of Potential Calcite Scale Formation in Blacktail Creek and Silver Bow Creek* (Atlantic Richfield Company, 2023b).

- This FSP was revised to address Agency comments received in their letter dated September 11, 2023, and renamed the 2024 Update for consistency with the Pilot Project FSPs submitted in early 2024.
- This FSP was revised to address Agency comments received in their letter dated May 16, 2024. The revisions include:
  - The EPA Remedial Project Manager on Figure 1 and the approval page were updated.
  - Additional clarification on distribution of this FSP was added to Section 1.4 and 2.0.
  - Descriptions of EPA's and DEQ's roles were added to Section 2.0.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project team organizational chart is presented as Figure 1. Specific project roles and responsibilities of the project team are described in this section and in the Scale Assessment SAP (Exhibit A).

EPA Remedial Project Manager (RPM)

The EPA RPM is responsible for communicating and coordinating EPA requirements with the Liability Manager, such that Agency requirements are met. The EPA RPM must also coordinate with the DEQ State Project Officer to ensure that the state's concerns and requirements are addressed. The EPA RPM has authority to approve the FSP.

Montana DEQ State Project Officer

The DEQ State Project Officer is responsible for communicating and coordinating with the Liability Manager and the EPA Remedial Project Manager such that the state's requirements are addressed.

Atlantic Richfield Liability Manager

The Atlantic Richfield Liability Manager communicates directly to the Agencies on project matters, monitors the performance of the contractor(s), consults with the Downstream Coordinator and CPM on deficiencies and helps finalize resolution actions.

Atlantic Richfield Quality Assurance Manager (QAM)

The Atlantic Richfield QAM interfaces with the Atlantic Richfield Liability Manager on company policies regarding quality. The QAM is independent from the unit generating data and has the authority and responsibility to approve specific QA documents, including this Downstream FSP, as well as reviewing documents using data collected under this addendum.

Downstream Coordinator

Pioneer Technical Services Inc. (Pioneer) is the contractor responsible for maintaining the Downstream FSP, coordinating collection, management, and reporting of data under the direction of Atlantic Richfield on behalf of the SDs. The Downstream Coordinator ensures that the Downstream FSP and Pilot Project QAPP are distributed to the CPM and project team.

Additionally, the Downstream Coordinator will maintain an electronic version of this FSP and Pilot Project QAPP in the project files.

Contractors
Alloy Group (formerly Copper Environmental Consulting) and W&C are the contractors responsible for collection, management, and reporting of data under the direction of Atlantic Richfield on behalf of the SDs.

Contractor Project Manager (CPM)
The CPM ensures that the Downstream FSP and Pilot Project QAPP are available to the Field Team Lead (FTL) and project team. The CPM is responsible for scheduling all sampling work to be completed and ensuring that the work is performed in accordance with the requirements contained herein. The CPM, or designated alternate, is also responsible for coordinating data management and consulting with the specific project QA personnel regarding any deficiencies and finalizing resolution actions and verifying effective implementation of its requirements and procedures. CPM responsibilities also include reviewing field and laboratory data and evaluating data quality.

Contractor Field Team Leader (FTL)
The FTL ensures that the Downstream FSP has been reviewed by all members of the field team and its procedures are properly followed during field activities. The FTL conducts daily safety meetings, assists in field activities, and documents activities in the field logbook. The FTL is responsible for facilitating field activities and managing equipment, problem solving, and decision making in the field. The FTL is also responsible for technical aspects of the project and providing "on-the-ground" overviews of project implementation by observing site activities to ensure compliance with technical project requirements and the respective contractor's Health and Safety Plan. The FTL is responsible for verifying recommended maintenance and calibration procedures for the installed equipment and identifies potential Integrity Management (IM) issues during field activities and reports any issues to the CPM.

Contractor Quality Assurance Officer (QAO)
The QAO verifies effective implementation of QAPP and FSP requirements and procedures, including reviewing field and laboratory data and evaluating data quality. Specifically, the QAO will:

- Review data packages from the laboratory to ensure information is consistent with the chain of custody and with data/QC reporting requirements.
- Conduct on-site reviews (i.e., field audits to ensure the integrity of field measurements, sample collection, and documentation) and prepare site review reports for the QAM.
- Communicate directly with the QAM and CPM to ensure issues related to project QA are resolved.
- Stop work if, in the judgment of that individual, the work is performed contrary to or in the absence of prescribed quality controls or approved methods, and further work would make it difficult or impossible to obtain acceptable results.

Database Coordinator
The database coordinator is responsible for developing, operating, and maintaining the databases. The database coordinator takes the raw data from data collectors and data producers and, when necessary, transforms the data into a usable form. The database coordinator uses various software, hardware, and other tools necessary to make the data from data collectors available in a form that is useful for project managers and supported by the database. Once the data have been produced, they are transferred into an internal database for storage and access. The database coordinator employs various software and hardware equipment to store and access produced data from the database for data users.

Server Administrator
The database server administrator ensures that the database is properly established, developed, and maintained to house all data associated with the Downstream FSP. The database must undergo updates, protection, encryption, and other services to ensure continued storage and access to data. The server administrator configures all hardware and software applications and ensures appropriate connections and backup(s) are in place. The server administrator also determines database user access and user group definitions.

3.0 DOWNSTREAM MONITORING AND ASSESSMENT

The data collected as part of this Downstream FSP will provide information to support the evaluation of the Pilot Project as identified in the DQOs presented in Table 1 and Exhibit A.

3.1 Calcite Scale Formation Monitoring and Assessment

A scaling evaluation in the receiving waters from the Pilot Project discharge was included in the *Final Scale Formation Technical Memorandum Berkeley Pit and Discharge Pilot Project* (Atlantic Richfield Company, 2020a). The calcite scale formation assessment and substrate monitoring in receiving waters described in this Downstream FSP were developed based on this evaluation and addressing of Agency comments.

The *Discharge System Operations Assurance Plan (OAP) Berkeley Pit and Discharge Pilot Project, 2024 Update, Revision 1* (Discharge System OAP; MR and Atlantic Richfield Company, 2024) describes the scale compliance management tool. Data and observations from the calcite scale formation assessment and substrate monitoring will be used to assess this scale compliance management tool described in the Discharge System OAP.

Additional information on the calcite scale assessment and substrate monitoring is provided in the Scale Assessment SAP in Exhibit A.

3.2 Temperature Monitoring and Assessment

Agency comments provided in a letter dated February 27, 2018, cited potential adverse effects on aquatic life exposed to water temperatures greater than 20 degrees Celsius (°C) and requested information on the SDs' plan "*for monitoring and controlling the water temperature*." Potential temperature impacts from the Pilot Project to the receiving waters were evaluated and

documented in the *Final Technical Evaluation of Temperature Impacts to Discharge from the Berkeley Pit and Discharge Pilot Project* (Atlantic Richfield Company, 2020b). The temperature monitoring and assessment to receiving waters described in this Downstream FSP were originally developed based on the draft evaluation and addressing of Agency comments and have been revised based on Pilot Project temperature data collected and changes to the Discharge System OAP interim temperature management plan.

3.2.1 Background

Polishing Facility influent is sourced from the YDTI. Consideration of Pilot Project discharge temperature effects on the receiving water and potential mitigation methods necessitates an evaluation of the conveyance system and source water temperature characteristics.

Influent from the YDTI travels through approximately 31,000 feet of mostly above-ground black high-density polyethylene (HDPE) pipe to the Polishing Facility. The buried Horseshoe Bend Effluent Line (HBEL) conveys water from the Polishing Facility approximately 8,000 feet to the Discharge Structure. This Downstream FSP is intended to monitor the water temperature throughout the treatment process and collect information that may allow a better understanding of the system's thermodynamics.

3.2.2 Temperature Monitoring Description

To support the evaluation of temperature effects on the receiving waters, continuous measurement of water temperatures from source to discharge will be implemented at six locations along the Return Water Line, Pilot Project conveyances, and within the receiving waters (see Figure 2 and Table 2). Direct measurement of temperature along the conveyance system will provide temperature data to verify and/or calibrate the preliminary modeling estimates presented in the *Evaluation of Temperature Impacts to Discharge from the Berkeley Pit and Discharge Pilot Project* (Atlantic Richfield Company, 2020b).

The temperature monitoring program is designed to address the following issues identified in the temperature evaluation:

1. The addition of effluent from the Polishing Facility could impact the receiving stream temperature which already can approach 20 °C during short periods in the summer.
2. Limited temperature data are available from YDTI, the source of the Polishing Facility influent. Temperature data are needed from the Return Water Line near the Return Barge intake to characterize the changes in the pond temperature before flowing through the Return Water Line.
3. Temperature impacts from the conveyance system may influence the final effluent temperature. Temperature data along the conveyance system may be needed to inform potential modifications to the conveyance system.
4. Thermal heat transfer may increase due to the Polishing Facility operations, although the extent of the increase is uncertain and dependent on the operating mode of the facility.

Temperature monitoring DQOs are provided in Table 1. Where possible, naturally occurring temperature fluctuations, including anomalous data, will be annotated and addressed to distinguish operational patterns from natural temperature variability.

3.2.3 Monitoring Locations and Frequencies

This Downstream FSP describes water temperature measurements at several points from the Return Water Line near YDTI (Return Water Line), through the treatment and conveyance system, and to the receiving waters. The temperature data collection will occur during warmer months (June through September) to determine how the temperature of the source water and piping delivery system to the Polishing Facility may ultimately be influencing discharge water temperature. The six monitoring point locations are shown on Figure 2 and listed in Table 2. Although temperature measurements at the Return Water Line are collected as part of the On-Site Water Management FSP (MR, 2023), this location is included in the Downstream FSP to support the temperature DQOs.

Manufacturer recommended maintenance procedures will be followed for the installed equipment. Manufacturer recommendations for evaluation of temperature measurement accuracy include comparison to a reference measurement; temperature calibration is performed by the manufacturer. The Pilot Project instream temperature measured at monitoring location SS-04 and SS-05A will be verified with a field instrument measurement annually prior to peak instream temperatures and documented in a logbook. If the field verification results in a temperature difference greater than 1 °C, appropriate corrective actions will be taken, including flagging the data and replacing or maintaining the temperature sensor. Additional description of the field data review is provided in Section 5.1.

Temperature monitoring will continue for the duration of the Pilot Project or until operational modifications necessitate a change in the type or extent of monitoring. Monitoring will be conducted pursuant to the Health, Safety, Security, and Environment (HSSE) considerations in the applicable SOP (Exhibit A).

3.2.4 Temperature Assessment

Temperature data collected under this Downstream FSP will be used to evaluate temperature changes along the Polishing Facility conveyance and treatment process by segments. For this effort, segments are defined as lengths of pipe, the treatment system, and receiving waters between monitoring points. Temperature evaluation segments are shown on Figure 2 and described in Table 3. These data will be assessed to isolate segments where heat transfer is occurring and provide information whether additional monitoring is needed, or if potential temperature control measures need to be further considered and evaluated. Temperature data in the receiving water will be assessed to identify potential changes the Pilot Project discharge has on receiving water temperatures.

4.0 DATA MANAGEMENT

The *Final Butte Mine Flooding Operable Unit Data Management Plan* (BMFOU DMP; MR and Atlantic Richfield Company, 2022) provides a framework of the data management structure for the BMFOU. The following sections provide detailed information about the management and storage of data collected as part of downstream monitoring efforts as described in this Downstream FSP. Field and laboratory water quality data collection activities performed under the BPSOU Surface Water Monitoring QAPP follow data management procedures outlined in the *BPSOU Final Data Management Plan* (Atlantic Richfield Company, 2022d) and the management of that data is not described in this document.

4.1 Data Acquisition, Types, and Sources

Data collected under this Downstream FSP include field water quality information, field observations, photographs, and spatial data collected for Calcite Scale Formation Monitoring and Assessment (Section 3.1) and receiving water temperature data collected for Temperature Monitoring and Assessment (Section 3.2). Data acquisition varies according to the category and type of data to be acquired. Storage and access to data also varies by data type and category. The following sections describe the acquisition, type, and sources of data collected from each downstream monitoring and assessment component.

4.1.1 Data Acquisition

An overview of the data categories, types, and guiding documents for the Downstream FSP monitoring is presented on Figure 3.

4.1.2 Data Categories and Types

The different data components of this Downstream FSP involve collecting different categories and types of data and the methods of collection, storage, and management vary according to the category and type of data. The Downstream FSP data descriptions, categories, types, source, and storage details are listed in Table 4. The following sections provide additional description of the categories and types of data associated with the Downstream FSP monitoring efforts.

4.1.2.1 Field Data

Field data are generated by field team members and include measurements and observation made during sampling events. The following field data types are collected under the Downstream FSP:

- Field Observations (field notes/logbooks, photographs).
- Spatial (station location).

4.1.3 Component Databases and Data Sources

This section details component databases for data collected under the Downstream FSP. The Downstream FSP includes the following components:

- Calcite scale formation monitoring and assessment.
- Temperature monitoring and assessment.

The effluent mixing zone monitoring and assessment and BTC backwater monitoring and assessment components were removed from the Downstream FSP scope as described in RFC-Downstream FSP-2022-2 (Atlantic Richfield Company, 2022a).

4.1.3.1 Calcite Scale Formation Monitoring and Assessment

Calcite scale assessment data are collected along BTC and SBC under the Scale Assessment SAP (Exhibit A). The data managed under this document include scale deposition bed monitoring at two locations and substrate monitoring along six reaches (see Scale Assessment SAP Figure 1). Field data collected and managed under the Scale Assessment SAP include field notes, photographs, and spatial data. Field data recorded by field team members are compiled and stored on project cloud servers and subjected to quality assurance review prior to upload and storage on the component database. Acquisition and storage of calcite scale formation data follow the path outlined on Figure 3 and data descriptions, categories, types, source, and storage details are in Table 4.

4.1.3.2 Temperature Monitoring and Assessment

Water temperature data are collected at six locations as described in Table 2. Temperature data are acquired by continuous (automated) measurement at all monitoring locations. Collection of temperature data is managed by several different entities and organizations, including MR, WSP, W&C, and Fairweather IT on behalf of the SDs and by the U.S. Geological Survey (USGS) as part of publicly available data. Acquisition and storage of temperature data follows the path outlined on Figure 3 and data descriptions, categories, types, source, and storage details are found in Table 4. Temperature is recorded and stored on the Polishing Facility Human Machine Interface computer prior to distribution to the SDs and contractors and uploaded into the relevant component database.

Temperature data collection activities performed under the Discharge System FSP and On-Site Water Management FSP follow data management prescribed in those reference documents and the management of these data are not described in this document.

4.2 Data Storage and Management

This section details the data management system for data collected under the Downstream FSP. For the overarching project data structure, reporting, and integration, refer to the BMFOU DMP (MR and Atlantic Richfield Company, 2022).

4.2.1 Computer Hardware and Software

Component database management will occur using domain-controlled networked computers. Computer hardware will include the necessary storage and speed to access, process, and maintain data consistent with industry standards. Computer hardware also includes the logging and sampling equipment listed in Table 4.

Computer software includes various programs for database operators and users, including:

- Microsoft Access™
- Microsoft Excel™
- ESRI ArcMap™
- ArcGIS Survey123
- Google Earth™
- Google Chrome™/Microsoft Edge™

4.2.2 Data and Database Access and Security

Procedures for access to and security of the component databases are in place to ensure the protection of data and that data are not lost or modified without proper authority. Access to the data and component databases will be controlled by the database coordinator. Import and export of data will only occur through the database coordinator. Access to the databases will be controlled by domain-enforced user access with password protection. The appropriate manager, in conjunction with the database coordinator, will grant access to the database to authorized users.

4.2.3 Data Imports and Storage

When possible, data will be imported directly into the database through appropriate software with minimal handling and transcription by data collectors. The database coordinator will communicate the appropriate data format to data collectors and producers to minimize any required data transformation or manipulation. For some collected data, pre-processing or conversion may be required prior to database entry. The specific protocol for data conversion and import will depend on the type and category of data to be entered and should follow the procedures described in this FSP.

Once data have been collected and converted as necessary, they will be reviewed for QA/QC and completeness prior to entry into the database. If any errors, incomplete, or suspect data are received, project managers will work with data collectors and database coordinators to resolve

the issue prior to database entry. Database coordinators will then enter the data and confirm that the data were successfully imported into the database.

4.2.3.1 Calcite Scale Formation Monitoring and Assessment

Calcite scale assessment field notes, photographs, and spatial data are recorded and uploaded to the project folder on the project cloud server. Handwritten notes will be scanned into the appropriate format prior to upload. The data are subjected to internal QA review before being uploaded into the Contractor project database.

4.2.3.2 Temperature Monitoring and Assessment

Continuous temperature data are recorded for receiving water locations as part of the temperature assessment described in this FSP. Temperature data are managed and acquired by WSP as part of the Polishing Facility system operation as described in the Discharge System FSP (Atlantic Richfield Company and MR, 2024b) and by MR as part of the On-Site Water Management FSP (MR, 2023). Ambient air temperature and other weather parameters are recorded continuously at the Kelley Mine weather station, and data are managed by Fairweather IT and are not managed under this Downstream FSP.

4.2.3.3 Existing Data

Water quality data for Blacktail Creek and Silver Bow Creek obtained under the BPSOU Surface Water Monitoring QAPP are used for calculation of the Langlier Saturation Index, as described in Section 3.0 of Exhibit A.

Additional existing and publicly available data may be used as part of the Downstream FSP monitoring, will be identified when used, and may include:

- Weather information from public and private weather stations.
- Data from previous investigations and other projects that have undergone appropriate QA/QC and Agency review.
- Publicly available spatial or imagery data, e.g., the U.S. Department of Agriculture National Agriculture Imagery Program.

Prior to use, data quality will be assessed and evaluated to ensure they meet established data quality objectives of this FSP (Section 1.1) and the requirements described in Section 3.8 Data Requirements for Non-Direct Measurements of the Pilot Project QAPP.

4.2.4 Metadata

Metadata include data that describe the subject data of interest. For example, data collectors may annotate the location, time, and instrument used to collect field water quality parameters. Metadata are useful to contextualize and link together disparate data sets such as analytical water quality and stage data to calculate a load or flux. In general, relevant metadata received from data collectors will be saved and clearly linked to the related subject data. Field forms, field logbooks,

calibration records, location maps, and other metadata will be clearly organized and stored on the project cloud server. When appropriate, metadata files may be uploaded and linked to subject data stored in a database.

4.2.5 Data Redundancy and Backup

To protect against loss of data, databases will be regularly backed up and scheduled for preventative maintenance. Database administrators will ensure that server databases have appropriate safeguards to ensure multiple storage locations of database data. Redundancy of stored data ensures continued access and use of collected data. Data from this Downstream FSP uploaded to Contractor project database and cloud servers undergo routine replication and back-up. As the Pilot Project progresses, data from this Downstream FSP may be archived in a permanent storage location. Project managers will work with database coordinators to ensure continued access to relevant data and appropriate archival timelines.

4.2.6 Data Exports and Reports

Data collected as part of this Downstream FSP sampling, analysis, and monitoring will be reported to the Agencies on a quarterly basis in the Pilot Project quarterly report as described in Section 6.0 and the BMFOU DMP (MR and Atlantic Richfield Company, 2022). Field data generated as part of the calcite scale formation monitoring and assessment, such as field notes, photographs, and spatial data, will be provided upon request. Operational data generated as part of the temperature monitoring and assessment will be provided as described in the On-Site Water Management FSP and Discharge System FSP (MR, 2023 and Atlantic Richfield Company and MR, 2024b, respectively).

5.0 DATA REVIEW AND VALIDATION

Data review and validation procedures are described in the following section. Additional information and requirements are described in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2024a). Field and laboratory water quality data collection activities performed under the BPSOU Surface Water Monitoring QAPP follow data review and validation procedures outlined therein and are not described in this document.

5.1 Field Data Review

Raw field data will be recorded on project field forms and reviewed for accuracy and completeness by the FTL and/or the QAO in accordance with the Pilot Project QAPP (Atlantic Richfield Company and MR, 2024a). Field data review will include verification of instrument calibration logs, legibility and content of field notes, and comparability to present and past data collected. The review will confirm that these elements are documented properly on project field forms and/or electronic forms and that necessary appropriate corrective actions were implemented and recorded. The Pilot Project instream temperature monitoring measurement accuracy will be verified annually with a field instrument measurement prior to peak instream temperatures as described in Section 3.2.3. This field verification will be documented in a logbook. If the field verification results in a temperature difference greater than 1 °C, appropriate

corrective actions will be taken, including flagging the data and replacing or maintaining the temperature sensor.

If field documentation errors occur, the results will be legibly crossed out, initialed and dated by the field team member, and corrected in a space adjacent to the original entry. For electronic form errors, the original form and output file will be preserved, and a revised output file created. Corrected data in the replacement file will be entered into the database. Data entries to the project database will be reviewed for accuracy and completeness, prior to submittal to the database manager. Electronic files of field measurement data will be maintained as part of the project's quality records. Any data points suspected to be in error by the database manager or user will be investigated and corrected in the database, if warranted. The database manager will be responsible for any necessary notifications of the data revision or redistribution of the data.

5.2 Reconciliation with User Requirements

Field data collected for this Downstream FSP will be considered Level I (minimal or "results only") and categorized as Screening Quality. No data validation reports will be prepared. Additional information regarding data useability is described in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2024a).

6.0 REPORTING

Data collected and generated as part of any sampling, analysis, monitoring or otherwise described in this Downstream FSP will be reported to the Agencies on a quarterly basis in the Pilot Project quarterly report. Any assessment, interpretation, data trending, or evaluation will be provided in the Pilot Project quarterly report and/or other communications.

All data will be recorded, stored and accessed in accordance with Section 4.2, the applicable SOPs or the Pilot Project QAPP (Atlantic Richfield Company and MR, 2024a).

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FIGURES

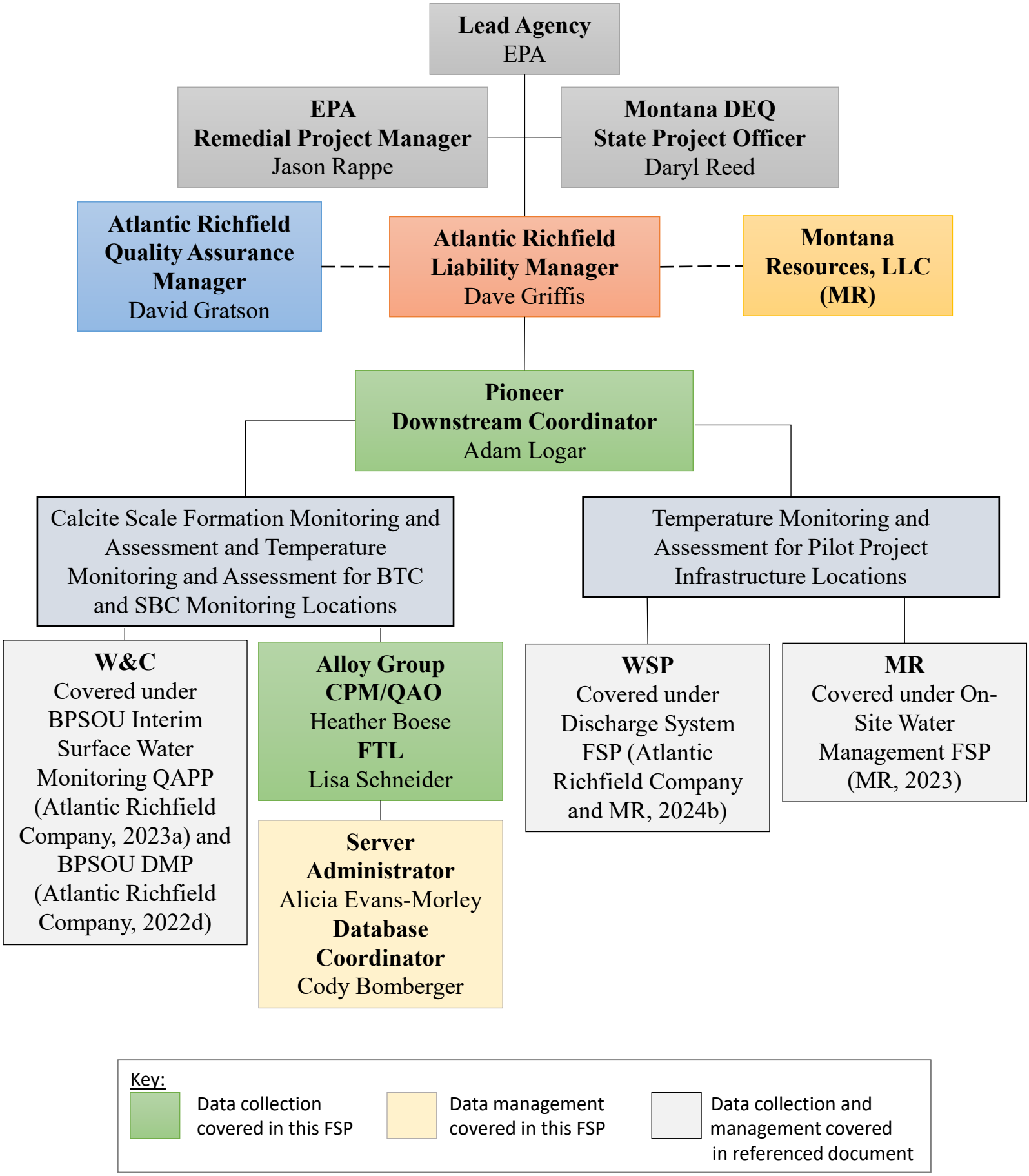
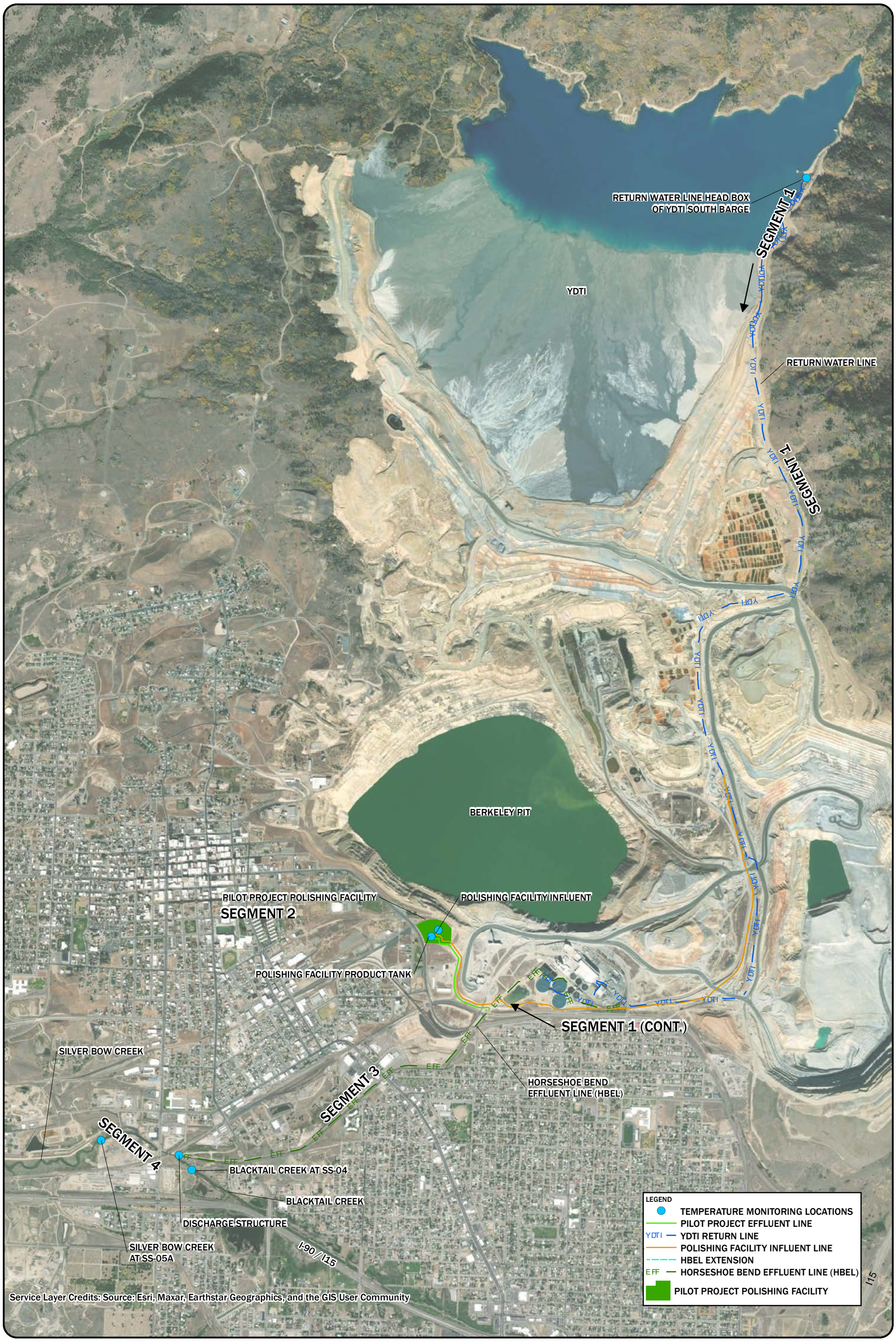


Figure 1. Project Roles and Responsibilities

PIONEER TECHNICAL SERVICES



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DATUM: NAD 83
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FIGURE 2

TEMPERATURE MONITORING LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 6/16/2023

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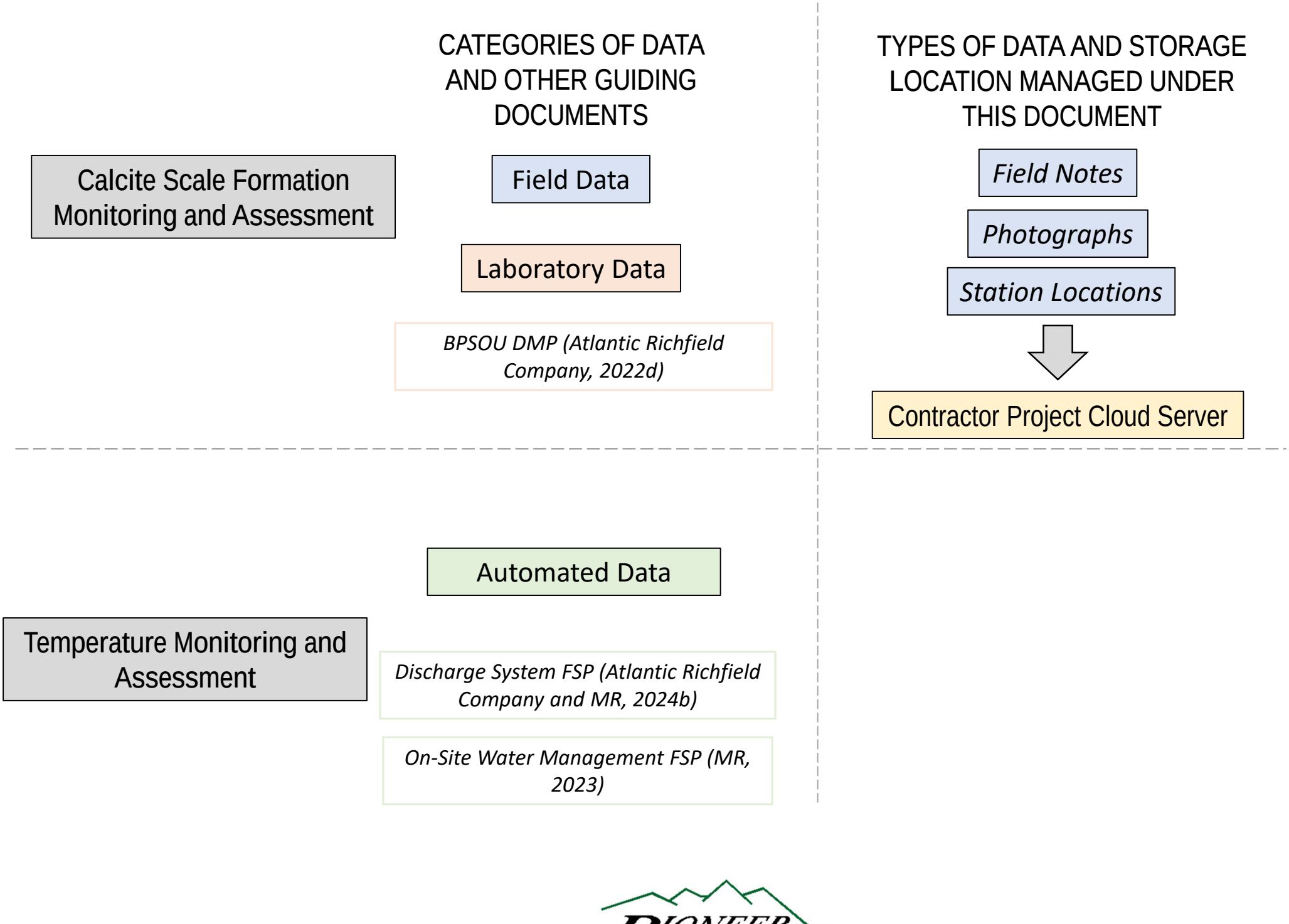

Figure 3. Data Management Structure

TABLES

Table 1. Data Quality Objective Summary: Temperature Assessment

TASK	STATE THE PROBLEM (STEP 1)	STUDY OBJECTIVE (STEP 2)	INFORMATION INPUTS (STEP 3)	STUDY BOUNDARIES (STEP 4)	ANALYTICAL APPROACH (STEP 5)	PERFORMANCE ACCEPTANCE CRITERIA (STEP 6)	DEVELOP A PLAN FOR OBTAINING THE DATA (STEP 7)
Temperature Assessment DQO 1	The addition of Pilot Project discharge could impact the receiving stream temperature conditions which already can approach 20° C during short periods in the summer.	Monitor temperature impacts to the receiving waters from the Pilot Project.	Continual temperature monitoring of Pilot Project discharge at the Discharge Structure, receiving water temperatures above the discharge in BTC at monitoring station SS-04, and downstream of the Discharge Structure in SBC at SS-05 and SS-05A.	The Pilot Project discharge at the Discharge Structure and receiving waters above and below the discharge point (monitoring station SS-04 to SS-05A).	Water temperatures and fluctuations from the receiving waters above and below the Pilot Project discharge point will be compared to one another and the discharge temperature to determine the temperature impact of the discharge.	Logger data are reviewed for inconsistencies and errors and assessed for continuity with upstream and downstream measurements. Stream temperature measurements should also be collected from similar depths in the receiving waters.	Stream temperature at SS-04 and SS-05A is not currently collected but will be collected using devices connected for remote monitoring and will be addressed in a pending RFC to the BPSOU monitoring program. Data from these new instruments will be continuously available for download and review from the Polishing Facility.
Temperature Assessment DQO 2	Limited temperature data are available from the source of the Polishing Facility effluent, the YDTI.	Document seasonal temperature trends and note maximum water temperatures.	Included in the On-Site Water Management FSP (MR, 2023).	Included in the On-Site Water Management FSP.	Included in the On-Site Water Management FSP.	Included in the On-Site Water Management FSP.	1. Water temperature data will be collected per the On-Site Water Management FSP. 2. Weather data are currently collected from the Kelley Mine Weather Station.

TASK	STATE THE PROBLEM (STEP 1)	STUDY OBJECTIVE (STEP 2)	INFORMATION INPUTS (STEP 3)	STUDY BOUNDARIES (STEP 4)	ANALYTICAL APPROACH (STEP 5)	PERFORMANCE ACCEPTANCE CRITERIA (STEP 6)	DEVELOP A PLAN FOR OBTAINING THE DATA (STEP 7)
Temperature Assessment DQO 3	Temperature impacts from the Pilot Project conveyance system may impact the Pilot Project discharge temperature.	1. Monitor heat impacts related to the conveyance system. Specifically, from the YDTI to the Polishing Facility and below the Polishing Facility to the Discharge Structure to identify the impacts of the conveyance infrastructure and identify mitigation opportunities if necessary. 2. Monitor impacts of SLW[1] addition to the discharge temperature to identify mitigation opportunities if necessary.	1. Continual temperature monitoring of the Return Water Line, Polishing Facility effluent, SLW[1], and Discharge Structure. 2. Ambient air temperature and solar radiation data collected continuously at the Kelley Mine (Atlantic Richfield Office) weather station. 3. Flow rates from Return Water Line, SLW[1] Line Takeoff, and Discharge Structure.	YDTI at the Return Water Line, along the conveyance system to the Polishing Facility, to the Discharge Structure at SBC.	1. Changes in water temperature will be compared along the conveyance system between the upstream and downstream locations. 2. Changes in temperature will also be compared to ambient air temperature, solar radiation and flow rates to understand how these factors impact heat exchange along the system.	Logger data are reviewed for errors by searching for abrupt changes in the time series at individual sites and assessing continuity of trends relative to downstream measurements.	1. Temperature data are currently collected continuously at the Polishing Facility product tank and Discharge Structure as described in the Pilot Project QAPP and FSPs. 2. Continuous temperature monitoring will be collected as described in the Pilot Project QAPP and FSPs. 3. Temperature will be continuously collected at the Return Water Line per the On-Site Water Management FSP. 4. Flow rate is collected at the Discharge Structure and Silver Lake Takeoff[1] using devices connected for remote monitoring and is collected as described in the Pilot Project QAPP and FSPs. 5. Weather data are collected from the Kelley Mine Weather Station. 6. Daily pumping data from the Return Water barges is described in the On-Site Water Management FSP.
Temperature Assessment DQO 4	Thermal heat transfer may be impacted by the Polishing Facility operations, although the extent of the increase is uncertain and dependent on the operating mode and flow rate of the facility.	Monitor the temperature impacts of the Polishing Facility at different operating modes to identify how the Polishing Facility impacts the final effluent temperature.	1. Daily temperature measurements from the influent to the Polishing Facility. 2. Continuous temperature measurements from the product tank at the Polishing Facility. 3. Continuous flow rate measurements from the Polishing Facility influent and effluent. 4. Polishing Facility operating configuration.	The Polishing Facility influent line where it enters the building through the treatment process to the Polishing Facility product tank. The study boundaries do not include the Pilot Project conveyance infrastructure.	Water temperatures measured at the Polishing Facility influent will be compared to the corresponding temperature measured at the Polishing Facility product tank to understand how it impacts the final effluent temperature during different operating modes.	Temperature data will be reviewed for inconsistencies and errors and assessed for continuity with upstream and downstream measurements.	1. Continuous temperature is collected at the product tank as described in the Pilot Project QAPP and FSPs. 2. The Polishing Facility influent temperature is currently recorded as part of the Polishing Facility operator log as described in the Pilot Project QAPP and FSPs. 3. The Polishing Facility operating configuration is recorded in the Polishing Facility operations reports.

[1] The use of effluent flow augmentation was limited to the one-year shakedown period which expired on September 30, 2020, and will not be used unless approved by the Agencies.

Table 2. Temperature Monitoring Points

MONITORING STATION	LOCATION DESCRIPTION	INSTRUMENTATION AND STORAGE	COLLECTION INTERVAL
Return Water Line	Water temperature in the Return Water Line is measured at the head box of the YDTI South Barge to characterize temperature at the source for the influent and before it is potentially impacted travelling through the Return Line to the Polishing Facility. Temperature measurements at the Return Water Line are collected as part of the On-Site Water Management FSP (MR, 2023), but also included in the Downstream FSP to support the temperature DQOs.	Instrumentation is as described in the *Discharge System Operations and Maintenance Manual, 2024 Update* (Discharge System O&M Manual; Atlantic Richfield Company, 2024). Temperature data are continuously collected and automatically transmitted to the Polishing Facility data historian as described in the On-Site Water Management FSP.	10-minute
Polishing Facility Influent	Continuous temperature from the Polishing Facility Influent Line is measured at the Polishing Facility influent line before it is treated. Temperature measurements from Discharge System components are described in the Discharge System FSP (Atlantic Richfield Company and MR, 2024b), but also included in the Downstream FSP to support the temperature DQOs.	Instrumentation is as described in the Discharge System O&M Manual. Temperature data are continuously collected and automatically transmitted to the Polishing Facility data historian as described in the Discharge System FSP.	10-minute
Polishing Facility Product Tank	Prior to discharging to the HBEL, continuous temperature in the Product Tank is measured. Temperature measurements from Discharge System components are described in the Discharge System FSP, but also included in the Downstream FSP to support the temperature DQOs.	Instrumentation is as described in the Discharge System O&M Manual. Temperature data are continuously collected and transmitted to the Polishing Facility data historian as described in the Discharge System FSP.	10-minute

MONITORING STATION	LOCATION DESCRIPTION	INSTRUMENTATION AND STORAGE	COLLECTION INTERVAL
Discharge Structure	Prior to discharging to SBC, continuous temperature at the Pilot Project Discharge Structure is measured. Temperature measurements from Discharge System components are described in the Discharge System FSP, but also included in the Downstream FSP to support the temperature DQOs.	Instrumentation is as described in the Discharge System O&M Manual. Temperature data are continuously collected and transmitted to the Polishing Facility data historian as described in the Discharge System FSP.	10-minute
Blacktail Creek	Continuous measurement of instream temperature upstream of the Pilot Project discharge is collected in BTC at the SS-04 monitoring station above the Discharge Structure. This location is maintained by W&C.	Temperature data are recorded using an ISCO Signature Flow Meter and TIENet 301 pH/temperature sensor. Data are continuously collected and transmitted to the Polishing Facility data historian.	10-minute
Silver Bow Creek	Continuous measurement of instream temperature is collected in SBC at the SS-05a monitoring station below the Discharge Structure. This location is maintained by W&C.	Temperature data are recorded using an ISCO Signature Flow Meter and TIENet 301 pH/temperature sensor. Data are continuously collected and transmitted to the Polishing Facility data historian.	10-minute

Table 3. Temperature Evaluation Segments

SEGMENT NUMBER		DESCRIPTION
1	Return Water Line from the South Return Water Barge to the Polishing Facility Influent	Segment 1 compares water traveling from the Return Water Line to the Polishing Facility Influent, which includes approximately 30,000 feet of above ground piping.
2	Polishing Facility Influent to the Polishing Facility Product Tank	Segment 2 evaluates the temperature change during treatment at the Polishing Facility, as measured by comparing the Polishing Facility Influent and Product Tank temperatures.
3	Polishing Facility Product Tank to Discharge Structure	Segment 3 observations include a comparison of temperatures measured from the Polishing Facility Product Tank to the Discharge Structure, which includes approximately 8,000 feet of buried pipe.
4	SS-04 to SS-05A	Segment 4 observations include evaluation of the receiving waters of Blacktail Creek measured at SS-04 and Silver Bow Creek measured at SS-05A, upstream and downstream of the Polishing Facility, respectively.

Table 4. Downstream FSP Data Description, Categories, Types, Sources, and Storage

Data Description	Data Category	Data Type	Data Source	Storage and Access Location
Calcite Scale Formation Monitoring and Assessment				
Field notes	Field	Field Observation	Field Team Notebook and/or Field Tablet	Contractor Project Cloud Server
Photographs	Field	Field Observation	Digital Camera or Field Tablet	Contractor Project Cloud Server
Station Locations	Field	Spatial	Field Tablet	Contractor Project Cloud Server
Temperature Monitoring and Assessment[1]				
Field Parameters	Operational	Water Quality	Water Quality Instrumentation	Polishing Facility Human Machine Interface Computer and Relevant Component Databases

[1] Information on the data associated with the temperature assessment is included in the Discharge System FSP (Atlantic Richfield Company and MR, 2024b) or the On-Site Water Management FSP (MR, 2023).

Exhibit A
Calcite Scale Formation Assessment
Sampling and Analysis Plan

CALCITE SCALE FORMATION ASSESSMENT SAMPLING AND ANALYSIS PLAN 2023 UPDATE

Butte Mine Flooding Operable Unit
Butte, Montana

Prepared for:

Atlantic Richfield Company
and
Montana Resources, LLC

Prepared by:

Alloy Group
406 East Park Avenue, Suite 2
Anaconda, Montana 59711
Phone: (406) 563-2700

August 2023

APPROVAL PAGE AND REVISION SUMMARY
Calcite Scale Formation Assessment Sampling and Analysis Plan 2023 Update
Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan 2023 Update
Butte Mine Flooding Operable Unit, Butte, Montana
July 2023

Kelly Benton, Project Manager / Field Team Leader
Alloy Group

Date 7/26/2023

Christa Whitmore, Quality Assurance Officer
Alloy Group

Date 7/26/2023

Scott Bradshaw, Project Manager
Woodard & Curran

Date 08-02-23

Paddy Stoy, Field Team Leader
Woodard & Curran

Date 7/27/23

Tina Donovan, Quality Assurance Officer
Woodard & Curran

Date 7/27/23

REVISION SUMMARY

Revision No.	Author	Description	Date
0	Copper Environmental Consulting	Final Calcite Scale Formation Assessment SAP	4/01/2021
1	Alloy Group (formerly Copper Environmental)	Update methods and references per RFC-Downstream SAP-1 and describe 2022 monitoring activities.	1/24/2022
2023	Alloy Group	Updated per RFC-Downstream FSP-2022-1, updated title to reflect update year, changed Level 2 review / reporting for water quality to Level 1, changed reporting to specify quarterly reports only.	8/2/2023

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LIST OF ACRONYMS AND ABBREVIATIONS

Agencies	U.S. EPA and Montana DEQ
BMFOU	Butte Mine Flooding Operable Unit
BPSOU	Butte Priority Soils Operable Unit
BTC	Blacktail Creek
BTL	Butte Treatment Lagoons
CD	Consent Decree
CFRSSI	Clark Fork River Superfund Site Investigations
cfs	cubic feet per second
CLP	Contract Laboratory Program
COC	chain of custody
CPM	Contractor Project Manager
DEQ	Montana Department of Environmental Quality
DQO	Data Quality Objective
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
ft	feet
FTL	field team leader
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HCl	hydrochloric acid
LaMP	Laboratory Management Program
LAP	Laboratory Analytical Protocol
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LSI	Langelier Saturation Index
MS	matrix spike
MSD	matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
OAP	Operation Assurance Plan
Pilot Project	Berkeley Pit and Discharge Pilot Project
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QAM	quality assurance manager
QAO	quality assurance officer
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
RL	reporting limit
SAP	Sampling and Analysis Plan
SBC	Silver Bow Creek
SI	saturation index
SOP	Standard Operating Procedure
TDS	total dissolved solids
TRA	task risk assessment
U.S.	United States
USGS	U.S. Geological Survey

1. INTRODUCTION

This *Calcite Scale Formation Assessment Sampling and Analysis Plan* (Scale Assessment SAP) has been prepared as Exhibit A to the *Berkeley Pit and Discharge Pilot Project Downstream Field Sampling Plan, 2023 Update* (Downstream FSP; Atlantic Richfield Company, 2023b), which is Attachment D.2 to the *Draft Final Berkeley Pit and Discharge Pilot Project Work Plan* (Pilot Project Work Plan; Atlantic Richfield Company and Montana Resources, LLC [MR], 2020). This SAP discusses details of the calcite scale formation assessment program as well as quality assurance/quality control (QA/QC) activities specific to this program. Additional details regarding QA/QC and data management are contained in the *Final Pilot Project Quality Assurance Project Plan, Revision #1* (Pilot Project QAPP; Atlantic Richfield Company and MR, 2022a) and the *Final Butte Mine Flooding Operable Unit Data Management Plan* (BMFOU DMP; MR and Atlantic Richfield Company, 2022a), respectively. This SAP has been updated in accordance with RFC-Downstream FSP-2022-1, approved on April 14, 2022.

1.1 Objectives

The objectives of this Scale Assessment SAP include:

- Describing the purpose of the calcite scale formation assessment activities.
- Presenting the scope and project organization of the in-stream calcite scale formation assessment activities, including monitoring substrate, water quality collection and analysis in relation to in-stream Langelier Saturation Index (LSI) and monitoring scale depositions beds.
- Describing the locations, frequency, and analytes of surface water quality sampling being performed for correlation of in-stream LSI with substrate monitoring observations.
- Describing the locations and frequency of substrate monitoring and circumstances that may require the collection of substrate samples.
- Providing details of the scale deposition bed structure, location, and frequency of examination.
- Describing how the data collected and calculated will be used to validate the impact of controlling discharge LSI on potential in-stream calcite scale formation.
- Specifying quality control (QC) measures related to calcite scale formation assessment activities.
- Outlining health and safety measures related to calcite scale formation assessment activities.
- Describing the reporting and documentation associated with calcite scale formation assessment activities.

1.2 Background

This SAP has been prepared to address monitoring of calcite scale formation in Silver Bow Creek (SBC) and Blacktail Creek (BTC) as recommended in the *Final Scale Formation Technical Memorandum Berkeley Pit and Discharge Pilot Project* (*Final Scale Formation Memorandum*; Atlantic Richfield Company, 2020). These monitoring activities are intended to assure that offsite discharge associated with the Berkeley Pit and Discharge Pilot Project (Pilot Project) is compliant with the Discharge Standards for point-source discharges released from the Butte Mine Flooding Operable Unit (BMFOU) as defined in the *Consent Decree* (CD) *for the Butte Mine Flooding Site*; (United States [U.S.] Environmental Protection Agency [EPA], 2002).

The *Final Scale Formation Memorandum* (Atlantic Richfield Company, 2020) recommended using a scale compliance management tool to calculate LSI, a widely used indicator of calcite scale potential, for the Pilot Project discharge. The discharge LSI is calculated from water quality parameters measured in Pilot Project discharge as described in the *Discharge System Operations Assurance Plan Revision 1.3* (Discharge System OAP; MR and Atlantic Richfield Company, 2022b). Scale coupons in the Polishing Facility Product Tank and Discharge Structure are used to correlate discharge LSI with physical calcite precipitation or lack thereof from the Pilot Project discharge (MR and Atlantic Richfield Company, 2022b).

To evaluate the effectiveness of controlling the discharge LSI on the potential for formation of new calcite scale in SBC, the *Final Scale Formation Memorandum* (Atlantic Richfield Company, 2020) recommended several validation activities, which are presented in this Scale Assessment SAP.

The *Draft Assessment of Potential Calcite Scale Formation in Blacktail Creek and Silver Bow Creek through 2020 Technical Memorandum* (Alloy Group, 2021) summarized data collected under Revision 0 (April 2021) of this SAP and recommended modifications to scale monitoring based on scale monitoring activities completed through 2020. RFC-Downstream SAP-1 was submitted to propose these recommendations to EPA and Montana Department of Environmental Quality (DEQ) and was approved on November 22, 2021. Revision 1 (January 2022) of this SAP included the approved modifications to scale monitoring. Major modifications included a reduction in the types of data collected during substrate monitoring, a reduction of analytes in associated water quality sampling, and a reduction in the types of saturation indices calculated.

The *Draft 2021 Update to Assessment of Potential Calcite Scale Formation in Blacktail Creek and Silver Bow Creek Technical Memorandum* (Alloy Group, 2022) summarized data collected through the end of 2021 and recommended modifications to scale monitoring based on scale monitoring activities completed through 2021. RFC-Downstream FSP-2022-1 was submitted to propose these recommendations to EPA and DEQ and was approved on April 14, 2022. This revised SAP includes the approved modifications to scale monitoring. Major modifications include reducing the frequency of monitoring activities (substrate monitoring, associated water quality monitoring, and scale deposition bed monitoring) and simplifying the scale deposition bed monitoring procedure.

In addition, revisions in this SAP include reducing the quality control (QC) reporting requirements of water quality data from "Level II" to "Level I" (Section 5.3) and, as recommended in the *2022 Update to Assessment of Potential Calcite Scale Formation in Blacktail Creek and Silver Bow Creek Technical Memorandum* (Alloy Group, 2023), limiting reporting of results to discussion in Pilot Project quarterly reports rather than preparation of an annual technical memorandum as has been done in the past. Finally, the title of the SAP was revised to reflect the current year for consistency with other Pilot Project documents.

The modified monitoring procedures described in this revised SAP assume that in-stream conditions remain similar to what has been observed during previous substrate monitoring. If changes in the nature or extent of scale are observed, procedures will be reevaluated and may revert to those described in previous versions of this SAP, pending discussion.

1.3 Problem Definition

This Scale Assessment SAP uses the EPA Data Quality Objective (DQO) process (EPA, 2006) to define criteria used to design data collection efforts which result in data of sufficient quality and quantity to achieve goals of a study and support project decisions. The DQOs for this Scale Assessment SAP are summarized in Table 1.

1.4 Project Organization and Responsibilities

The calcite scale formation assessment activities described in this SAP are part of a larger monitoring effort. The assessment of calcite scale formation in SBC and BTC are part of the Downstream FSP (Atlantic Richfield Company, 2023b). Key personnel and management structures for these programs, including calcite scale formation activities, are included in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a). Key team member responsibilities are described below.

1.4.1 Contractor Project Manager

The Contractor Project Managers (CPMs) are Kelly Benton (Alloy Group) and Scott Bradshaw (Woodard & Curran). The CPM is responsible for leading the technical direction of the project, including ensuring that work is performed in accordance with requirement contained in this SAP and the Pilot Project QAPP

(Atlantic Richfield Company and MR, 2022a). The following duties will be performed by the CPM or their designee:

- Manage overall workflow and project organization.
- Resolve technical details related to sampling, analysis, data interpretation, and overall conclusions of work.
- Interface with the Agencies as necessary.
- Maintain communication with the appropriate Project Manager and Quality Assurance Manager regarding project activities, deadlines, results, and data quality.
- Communicate with Contractor Quality Assurance Officer (QAO) to manage overall QA/QC of the relevant portions of site activities.
- Verify that corrective actions are taken for deficiencies cited during reviews of relevant site activities.

1.4.2 Field Team Leader

The Field Team Leaders (FTLs) are Kelly Benton (Alloy Group) and Paddy Stoy (Woodard & Curran). The FTL will manage field activities and personnel and ensure that field activities are performed in accordance with this QAPP as well as the relevant SAP and Standard Operating Procedures (SOPs). Responsibilities and duties of the FTL or their designee include:

- Ensure that the SAP and QAPP have been reviewed by all members of the field team and are properly followed when implementing field activities.
- Coordinate monitoring schedules with other Atlantic Richfield Company entities that perform monitoring tasks within Blacktail Creek, Silver Bow Creek, and creek tributaries.
- Ensure field procedures associated with the investigations are performed as set forth in the SAP.
- Ensure field analyses are performed and QA/QC samples are collected as specified in the SAP and QAPP.
- Ensure field equipment is calibrated, operated, and maintained as specified in instrument manuals and SOPs.
- Review field instrumentation, maintenance, and calibration to meet quality objectives.
- Organize field data.
- Ensure sample custody is maintained.
- Ensure field records and logs are properly recorded and maintained.
- Identify potential data quality issues during field activities and prepare appropriate documentation and/or report any issues to the Contractor QAO.

1.4.3 Contractor Quality Assurance Officer

The Contractor QAOs are Christa Whitmore (Alloy Group) and Tina Donovan (Woodard & Curran). The QAO verifies effective implementation of QAPP requirements and procedures, including reviewing field and laboratory data and evaluating data quality. Specifically, the QAO or their designee will:

- Perform overall QA/QC of site activities.
- Coordinate field QA/QC procedures with CPMs, concentrating on field analytical measurements and practices to meet DQOs.
- Review data packages from the laboratory to ensure information is consistent with the chain of custody (COC) and with data/QC reporting requirements.
- Conduct on-site reviews (i.e., field audits to ensure the integrity of field measurements, sample collection, and documentation) and prepare site review reports for the Quality Assurance Manager (QAM; as defined in the Pilot Project QAPP).
- Communicate directly with the QAM and CPM to ensure issues related to project quality assurance are resolved.
- Interface with the analytical laboratory regarding data quality.

- Stop work if, in the judgment of that individual, the work is performed contrary to or in the absence of prescribed quality controls or approved methods and further work would make it difficult or impossible to obtain acceptable results.
- Oversee data validation activities.
- Evaluate usability of data and flag in accordance with the QAPP and SAP.
- Prepare a QA/QC report in accordance with the QAPP and EPA guidelines, including an evaluation of laboratory data and data usability reports.

1.4.4 Contract Laboratory

The primary contract laboratory for surface water monitoring will be NELAP and state of Montana certified for applicable analyses, and the laboratory must be approved by Atlantic Richfield Company's LaMP (Atlantic Richfield Company, 2017). Additional details for the contract laboratory and its responsibilities are contained in the 2022 Final Butte Priority Soils Operable Unit Interim Site-Wide Surface Water Monitoring QAPP (2023 BPSOU SW QAPP; Atlantic Richfield Company, 2023a).

1.5 Revision Log

Revisions to this SAP will be prepared as necessary (e.g., if guidelines, procedures, regulatory documents, or SOPs are revised or when task objectives, scope, or activities change). At a minimum, this SAP will be reviewed annually and revised if needed. This SAP is a controlled document and distribution will be managed so the most current approved version is used for all work described herein. The most recent and approved version of this document will be followed. A revision log is included in the front matter of this document.

2. IN-STREAM CALCITE MONITORING

Monitoring of BTC and SBC provides in-stream observations of calcite presence and assessment of the potential for calcite scale formation. These monitoring activities include:

- Analyzing water chemistry of surface water samples, which will be used to calculate the LSI at locations corresponding to the substrate monitoring locations.
- Monitoring substrate for calcite scale.
- Monitoring scale deposition beds, which provide a platform to capture newly formed calcite scale upstream and downstream of the discharge point.

These activities will be conducted under the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a).

2.1 Substrate Monitoring

The following subsections provide details of the substrate monitoring, which is a visual assessment of substrate upstream and downstream of where the Pilot Project discharge enters SBC.

2.1.1 Substrate Monitoring Overview

The objective of the substrate monitoring is to systematically assess substrate particles along several transects (cross-sections) determined for a reach of stream. The procedure for systemically monitoring substrate is based on the *Environmental Monitoring and Assessment Program – Surface Waters: Field Operations and Methods for Measuring the Ecological Conditions of Wadeable Streams (EMAP – Surface Waters, Wadeable Streams;* EPA, 1998) but adds an assessment for calcite scale for each substrate particle. The calcite scale assessment includes a visual inspection for calcite scale and a test for effervescence by applying drops of 10% hydrochloric acid (HCl). If visual scale is observed or if the effervescence test is positive, the item will be categorized according to *EMAP – Surface Waters, Wadeable Streams* (EPA, 1998) and a photograph will be taken. Complete details are provided in the Substrate Monitoring SOP (SOP-SM-01 Rev. 2; Attachment A).

2.1.2 Substrate Monitoring Locations

The stream beds of BTC and SBC will be monitored along transects established across six reaches. Substrate monitoring observations will be compared with the in-stream LSI, which is calculated from water quality data (Section 3.2.1). Surface water quality sample locations previously established under the BPSOU are also used for water quality monitoring locations for LSI calculations; therefore, each substrate monitoring reach overlaps with or is near an existing BPSOU surface water monitoring station:

- Reach 1 – SBC, downstream of SS-07, Butte-Silver Bow Wastewater Treatment Plant discharge, and Pilot Project discharge.
- Reach 2 – SBC, near SS-06G, starts at SS-06F (which is not a regularly monitored BPSOU surface water station), upstream and downstream of Butte Treatment Lagoon (BTL) discharge, downstream of Pilot Project discharge.
- Reach 2.5 – SBC, overlaps with SS-05A, downstream of Slag Canyon and Pilot Project discharge.
- Reach 3 – SBC, overlaps with SS-05, downstream of Pilot Project discharge.
- Reach 4 – BTC, overlaps with SS-04, upstream of Pilot Project discharge.
- Reach 5 – BTC, overlaps with SS-01, upstream of Pilot Project discharge.

The exact locations of the reaches (Figure 1) were determined by 2019 in-field constraints and may be revised as stream conditions change.

Reach 1 was established downstream of BPSOU surface water monitoring station SS-07 to monitor the stream bed after Butte-Silver Bow Wastewater Treatment Plant discharge enters SBC. There was construction of the I-90/15W bridge near SS-07 when monitoring was conducted in 2019. Therefore, Reach 1 was designed to end just upstream of the I-90/15E bridge (Figure 2).

Reach 2 was selected to be near BPSOU surface water monitoring station SS-06G, due to the slightly higher baseline potential for calcite scale formation near that location (Atlantic Richfield Company, 2020). Like Reach 1, the exact location of Reach 2 was located to avoid road construction activities on I-90/15W. Therefore, Reach 2 begins just upstream of SS-06G at station SS-06F. Station SS-06F is not regularly monitored. The BTL discharge enters SBC within Reach 2 (Figure 3).

Reach 2.5 was established after the first round of pre-discharge monitoring in 2019 and after examples of calcite scale were found in Reaches 2 and 3. This reach was established as an intermediate reach to be able to monitor SBC between Reaches 2 and 3, after the creek has passed through most of Slag Canyon. Reach 2.5 overlaps with BPSOU surface water monitoring station SS-05A (Figure 4).

The upstream end of Reach 3 is located just downstream of where the Pilot Project discharge enters SBC. The downstream half of Reach 3 includes a portion of SBC bordered by one tall slag wall and one short slag wall. Reach 3 overlaps with BPSOU surface water monitoring station SS-05 (Figure 5).

Reach 4 was established to represent a section of BTC upstream of the Pilot Project discharge. The downstream end of Reach 4 begins in BTC just upstream of where the Pilot Project discharge enters SBC. Reach 4 continues upstream and overlaps with BPSOU surface water monitoring station SS-04 (Figure 5).

Reach 5 begins in BTC near BPSOU surface water monitoring station SS-01, which is just upstream of the intersection of Harrison Avenue with BTC, and from there Reach 5 continues upstream (Figure 6). Reach 5 was established to represent a section of BTC upstream of the Pilot Project discharge near SS-01, which historically has a low potential for baseline calcite formation through all seasons (LSI is almost always less than zero), unlike Reach 4 near SS-04 (Atlantic Richfield Company, 2020). Because Reaches 4 and 5 are upstream of the Pilot Project discharge, they will be instrumental to establishing a long-term understanding between LSI values calculated from water quality data and substrate observations in the creek unimpacted by Pilot Project discharge.

2.1.3 Substrate Monitoring Frequencies

Per RFC-Downstream FSP-2022-1, the substrate monitoring frequency will be once per month June through September, starting in June 2022. No monitoring is scheduled from October through May. This schedule may be modified based on monitoring observations. Any changes will be discussed with the

Agencies prior to initiation. A summary of the substrate monitoring locations and schedule is provided in Table 2.

2.1.4 Substrate Collection

The Substrate Monitoring SOP (Attachment A) does not include collecting examined substrate and/or calcite unless circumstances deem necessary. Post-discharge substrate samples may be collected if substantial calcite scale in SBC is observed that requires further analysis to differentiate it from pre-discharge calcite.

Each item collected would be placed in a Ziploc® bag labeled with the location and date of collection. After fieldwork, each collected item would be air-dried at ambient indoor conditions and then stored in a clean, dry Ziploc® bag labeled with the field collection date and location.

The collected items will be stored for a minimum of one year, during which time they may be analyzed if circumstances arise that support further analysis. If any collected item warrants analysis, then the method(s) of analysis will be discussed and determined with the Agencies. If the collected items do not warrant analysis within one year, then the need for continued storage of the samples will be evaluated.

2.2 Scale Deposition Bed Monitoring

Scale deposition beds were installed in SBC and BTC in January 2020 to supplement the substrate monitoring and help differentiate pre-existing calcite scale in the creek from any calcite scale that might form after discharge. Scale deposition beds are at the following locations:

- SS-04 in BTC (Figure 5), just upstream of discharge.
- SS-05A in SBC (Figure 4), downstream of discharge in an area that is fully mixed.

The downstream location was confirmed to be in a fully mixed location in the *Assessment of Berkeley Pit and BMFOU Discharge Effluent Mixing Zone and Blacktail Creek Backwater Monitoring Data*, Attachment C to the *Berkeley Pit and Discharge Pilot Project Quarterly Pilot Project Report Fourth Quarter 2021* (Atlantic Richfield Company and MR, 2022b).

Each scale deposition bed consists of a 2-inch diameter slotted polyvinyl chloride (PVC) pipe with 0.020-inch slots. The pipe was filled to half capacity with material from the stream bed and capped on both ends with a #20 mesh screen. The material was collected from the stream near the locations where the scale deposition beds were installed, removing any material too large to fit in the pipe. The remaining material was dried and then screened to remove the fine particles that are smaller than the #20 mesh screen size (<0.033 inches). The remaining material consists of sand, fine gravel, and coarse gravel. The material was then washed with dilute HCl (3 to 10%) to remove any existing scale. The PVC pipes were installed in the stream approximately horizontal, parallel to flow, at a depth where they would be submerged in low flow conditions, and near a bank in an area with relatively low turbulence. Two deposition beds were installed as a pair at each location (SS-04 and SS-05A).

Per RFC-Downstream FSP-2022-1, scale deposition beds will be monitored four times per year, in May, July, September, and November, starting in May 2022. Table 3 summarizes the scale deposition bed locations and schedule.

The presence of calcite scale will be determined both visually and by applying drops of 10% HCl to the material to test for effervescence. After inspection, the material from one bed of the installed pair will be acid washed to remove any calcite scale and enable tracking of potential short-term calcite scale formation. Per RFC-Downstream FSP-2022-1, the scale deposition bed casing will no longer be acid washed with the sediment of the acid-washed bed, starting in May 2022. The other bed of the pair (sediment and casing) will not be acid washed in order to track potential longer-term accumulation of calcite scale. The Scale Deposition Bed Monitoring SOP (SOP-SM-02 Rev. 1) is included in Attachment A and includes steps for retrieving, screening, examining, acid-washing, and replacing the beds.

3. LSI CALCULATION AND VALIDATION

As discussed in the *Final Scale Formation Memorandum* (Atlantic Richfield Company, 2020), managing the LSI of the Pilot Project discharge was proposed as a tool to monitor and control the scaling potential of the Pilot Project discharge entering SBC. In-stream LSI calculations from locations upstream and downstream of the Pilot Project discharge monitor potential impact that the Pilot Project discharge has on the in-stream scaling potential.

Calculations are based on water chemistry such as major ion concentrations, pH, and water temperature. Major ion and other concentrations may be obtained by laboratory or field analysis of water quality samples. Water quality parameters are measured in-situ at the time of sample collection. Methods for sample collection and analyses are discussed in Section 3.1; calculations of LSI are discussed in Section 3.2.

To validate whether controlling the discharge LSI is sufficient to prevent new calcite scale formation in SBC, comparisons will be made between physical observations and calculated saturation indices for the Pilot Project discharge, BTC, and SBC. These comparisons are discussed in Section 3.3

3.1 Water Quality Monitoring of Blacktail and Silver Bow Creeks

Data used to calculate LSI are obtained from surface water samples collected during normal flow surface water monitoring performed under the 2023 BPSOU SW QAPP (Atlantic Richfield Company, 2023a). Monitoring frequency and parameters will be, at a minimum, sufficient for calculations as described in Subsections 3.1.1 – 3.1.5, below.

3.1.1 Surface Water Monitoring Locations

BPSOU surface water monitoring stations SS-07, SS-06G, SS-05A, SS-05, SS-04, and SS-01 are correlated with substrate monitoring locations as shown in Figure 1.

3.1.2 Surface Water Monitoring Frequency

Surface water samples will be collected once per month January through December as part of the existing BPSOU surface water quality monitoring, and LSI will be calculated from each set of these samples. Substrate monitoring activities will be coordinated with BPSOU normal flow surface water sampling in June through September. Surface water monitoring events and substrate monitoring events will be coordinated as closely as possible and will occur during Polishing Facility off-site discharge, if possible. Substrate monitoring is a longer process than surface water monitoring, and other in-stream activities or weather events may interrupt the substrate monitoring and / or surface water sampling schedule. Sampling locations and frequencies are summarized in Table 4.

3.1.3 Surface Water Analytes and Field Parameters

Each water quality sample will be analyzed at a minimum for dissolved calcium, total alkalinity, sulfate[1], and total dissolved solids (TDS).Temperature and pH will also be monitored by recording field measurements when the water quality samples are collected. At SS-04 and SS-05A, pH and temperature will be continuously monitored, instantaneously recorded every 15 minutes, and transmitted to the Polishing Facility for monitoring and storage. Table 5 summarizes the field parameters and methods as well as instrument accuracy and resolution. Table 6 lists laboratory analyses, associated analytical methods, approximate method detection limits, reporting limits, and holding times. Table 7 provides the bottle count and required preservation.

3.1.4 Surface Water Sampling Methods

Surface water samples collected for correlation with substrate monitoring are collected in accordance with the methods in the 2023 BPSOU SW QAPP (Atlantic Richfield Company, 2023a), Pilot Project QAPP

[1] Sulfate is only required for geochemical modeling of monohydrocalcite and calcite saturation indices, not LSI calculations. These saturation indices may be calculated, if warranted, as described in Section 1.2.

(Atlantic Richfield Company and MR, 2022a), Clark Fork River Superfund Site Investigations (CFRSSI) SOPs (Atlantic Richfield Company, 1992a), or approved contractor SOPs. Full texts of the CFRSSI SOPs and approved contractor SOPs are available in the 2023 BPSOU SW QAPP (Atlantic Richfield Company, 2023a). All sampling equipment will be consistent with CFRSSI SOPs, unless updated equipment has been made available, in which case updated equipment may be used.

The intent of the surface water monitoring as it relates to this Scale Assessment SAP is to monitor the effect of the BMFOU Pilot Project discharge on surface water chemistry. Therefore, it is important to perform the monitoring while the Pilot Project is discharging. Monitoring should be coordinated with the Polishing Facility to ensure that no interruptions or changes to flow rate are anticipated. The monitoring team should request notification in the event that flow rates do change. The surface water monitoring team shall record the Pilot Project effluent flow in their logbook at the beginning of each day during the sampling event and confirm that the flow rate did not change by contacting the Polishing Facility operations team at the end of each day. If flows change significantly during the course of the sampling day, Woodard & Curran and Alloy Group will discuss and devise an appropriate resolution.

3.1.5 Sample Handling and Custody

All surface water samples collected will have a unique sample ID placed on each sample bottle and will exactly match the sample ID on the field form and on the COC.

During sampling activities, a "paper trail" of sample custody must be maintained from the time the samples are collected until laboratory data are issued. Information on the custody, transfer, handling, and shipping of samples will be recorded by the sampling personnel on a COC form. A copy of each COC form will be retained in the project files. COC forms will include at a minimum:

- Date and time of collection,
- Sample identification number,
- Analyses requested,
- Sampling personnel's signature,
- Signatures of persons relinquishing custody, dates, and times, and
- Signatures of persons accepting custody, dates, and times.

3.2 Calculation of In-stream LSI

In-stream LSI values for SBC and BTC will be calculated from monthly water quality data collected at locations correlated with substrate monitoring reaches (SS-01, SS-04, SS-05, SS-05A, SS-06G, and SS-07). In-stream LSI will be calculated using laboratory-analyzed total alkalinity, dissolved calcium, and TDS as well as field pH and field temperature using the same equations used to calculate the LSI of the discharge as described in the Discharge System OAP (MR and Atlantic Richfield Company, 2022b).

3.3 Data Comparison and Analysis

To validate whether controlling the discharge LSI is sufficient to prevent new calcite scale formation in SBC, comparisons will be made between the following data:

- Substrate monitoring observations
- Scale deposition bed monitoring observations
- Scale coupon monitoring results
- In-stream and discharge saturation indices

Substrate monitoring and scale deposition bed monitoring observations will be compared temporally and spatially to evaluate if potential new calcite scale formation is related to the Pilot Project discharge. Substrate monitoring and scale deposition bed monitoring observations will be compared with in-stream saturation indices from the coordinated water quality samples to better understand what the numerical values of the calculations physically represent in SBC and BTC. Similarly, the discharge saturation indices will be compared with the physical results of the scale coupon monitoring. Finally, discharge saturation indices will be compared with in-stream saturation indices from the nearest collection dates to better understand the impact that the discharge has on potential calcite formation in SBC.

4. QUALITY CONTROL

This section describes the QA/QC methods to be followed to ensure that data collected are of sufficient technical quality to meet the DQOs presented in Table 1 for the calcite scale formation assessment activities executed under this Scale Assessment SAP.

4.1 Surface Water Monitoring

Variability in surface water quality is expected considering the range of monitoring conditions which may occur. Some of the potential sources of natural variability include baseline creek flow rate, surface water runoff and other discharges to the creek, ambient temperature, and biological factors. Variability of surface water quality data can also be introduced through sampling and analysis methods. This introduced variability will be controlled through use of consistent methods and adherence to applicable SOPs (Attachment A).Water quality data will be compared with recent historic data and extreme outliers will be investigated. Unexpected analytical results will be verified by reviewing calibration records and QC samples and / or by contacting the laboratory and requesting a data review. QC samples and procedures are summarized in the following sections. Details are described in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a).

4.1.1 Field Equipment Testing, Inspection, and Maintenance

Field multi-meters will be calibrated in accordance with applicable SOPs in Attachment A and the 2023 BPSOU SW QAPP (Atlantic Richfield Company, 2023a). Calibration methods will follow manufacturer's instructions. Calibration logs will be recorded, stored in the instrument, or both; the storage method is at the discretion of individual contractors. Calibration failures will result in meters being immediately removed from service. Once repaired, and successfully calibrated, meters will be returned to service.

4.1.2 Field Quality Control

Water quality measurements and sample collection procedures will be assessed by the QAM/QAO based on the results of field QC samples and field documentation. The following sections describe field QA/QC procedures and sample requirements.

4.1.2.1 Field Duplicate

A field duplicate is a second sample collected from the same location at the same time as the primary sample, using identical techniques. Analysis will be identical for the primary and duplicate sample. The analytical results of the duplicate sample will be compared to determine sampling precision. Field duplicates will be collected at a frequency of a minimum of 1 per 20 primary samples collected or 1 per sampling event, whichever is more frequent.

4.1.2.2 Field Blank

Field blanks will be used to help identify possible contamination from the sampling environment, from sampling equipment, or from sample handling. For samples aliquots requiring filtration, the source water will be poured into a single-use plastic container and triple rinsed. The container will then be filled with the source water, and sample aliquots requiring filtration will be pumped from this container. Sample aliquots which do not require filtration will be poured from the source water container directly into the sample bottle. The FB sample will be given its own sample identification, but will be sealed, handled, shipped, and analyzed in the same manner as the primary sample. Analysis will be identical to the primary samples. Field blanks will be collected at a frequency of a minimum of 1 per 20 primary samples collected or 1 per sampling event, whichever is more frequent.

4.1.3 Laboratory Equipment Testing, Inspection, and Maintenance

All analytical measurement instruments and equipment used by the laboratories will be controlled by a formal calibration and preventive maintenance program and be consistent with the CFRSSI Laboratory Analytical Protocol (LAP; Atlantic Richfield Company, 1992b). At a minimum, each laboratory will require that equipment be of the proper type, range, accuracy, and precision to provide data compatible

with specified requirements. All instruments and equipment that measure a quantity or whose performance is expected at a stated level are subject to calibration. Additional requirements are specified in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a).

4.1.4 Laboratory Quality Control and Calibration Samples

Laboratory QC samples are introduced into the measurement process to evaluate laboratory performance and sample measurement bias. Internal laboratory checks will be used to monitor data integrity in accordance with the CFRSSI LAP (Atlantic Richfield Company, 1992b). Laboratory QC samples may be prepared from environmental samples or generated from standard materials in the laboratory. Required QC samples are specified by analytical methods. Where applicable, laboratory control charts will be used to determine long-term instrument trends. Typical laboratory QC/calibration samples with associated control limits and corrective actions for control limit failures are outlined in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a).

4.1.4.1 Method Blank

The method blank is laboratory deionized water which has gone through the applicable sample preparation and analysis procedure. Control limits are typically < ½ reporting limit (RL).

4.1.4.2 Laboratory Control Sample

A laboratory control sample (LCS) consists of a laboratory blank sample with a known concentration of the target analyte. The LCS sample is prepared and analyzed in the same manner as field samples. Percent recovery of the target analytes in the LCS helps determine whether the laboratory's methodology is accurate.

4.1.4.3 Matrix Spike

Matrix spike (MS) samples evaluate the effect of the sample matrix on sample preparation and measurement methodology.

4.1.4.4 Laboratory Duplicates

Laboratory duplicate (LD) samples test laboratory precision; samples which are known to be field blanks cannot be used for LD samples. A laboratory control sample duplicate (LCSD) is a duplicate of the LCS. The LCSD tests laboratory reproducibility.

A matrix spike duplicate (MSD) is a duplicate of the matrix spike (MS). The MSD is used to determine analytical precision and bias of a method in a sample matrix.

4.1.4.5 Laboratory Calibration Samples

Physical and chemical calibrations will be performed within each laboratory as described in the governing methods, laboratory SOPs, and Atlantic Richfield Company's LaMP (Atlantic Richfield Company, 2017). As required by the CD, all analytical laboratories used for compliance monitoring must participate in an EPA or EPA-equivalent QA/QC program. Additional requirements for laboratory calibration procedures are described in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a).

4.2 Substrate Monitoring

Variability in calcite scale formation is not fully understood and the monitoring procedures are intended to evaluate variability by performing the monitoring once per month from June through September, performing the monitoring at multiple reaches upstream and downstream of the discharge, utilizing 11 transects per reach, utilizing five locations along each transect, and by monitoring the scale deposition beds in addition to the substrate monitoring. To limit variability due to execution of the monitoring, consistent methods will be used in accordance with the applicable SOPs. Field personnel for substrate monitoring will be trained in and adhere to this Scale Assessment SAP, the Substrate Monitoring and Scale Deposition Bed Monitoring SOPs (Attachment A) and the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a). Additionally, the following QA/QC measures will be implemented:

- Personnel will be trained by previous field crews as necessary to ensure consistency of the monitoring.
- Field personnel will review field notes to ensure completion and accuracy of the field forms before signing each field form.
- Field forms and photos will be uploaded to an internal digital platform, to which field team members will have access.
- Field documentation will be completed for all activities related to calcite scale formation assessment.

5. DATA REVIEW AND VALIDATION

Data review and validation procedures are described in the following sections. Additional information and requirements are described in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a) and 2023 BPSOU SW QAPP (Atlantic Richfield Company, 2023a).

5.1 Field Data Review

Raw field data shall be entered in field logbooks or on electronic field forms, which shall be reviewed for accuracy and completeness by the FTL, or their designee, before those records are considered final. The overall quality of the field data from any given sampling round shall be further evaluated during the process of data reduction and reporting.

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Field data review will include verification that any QC checks and calibrations, if necessary, are recorded properly in the field logbooks and/or on electronic forms and that any necessary and appropriate corrective actions were implemented and recorded. QC checks, calibrations, and any corrective actions will be written into field logbooks and/or recorded on electronic forms immediately after they occur. If errors are made in logbooks, results will be legibly crossed out, initialed and dated by the field team member, and corrected in a space adjacent to the original (erroneous) entry. If mistakes are made in electronic forms, a revised form is submitted, and the change is recorded. In a reasonable timeframe, the FTL will proof the field logbooks and electronic field forms to determine whether any transcription errors have been made by the field crew. If transcription errors have been made, the FTL and field crew will address the errors to provide resolution.

Appropriate field measurement data will be uploaded from electronic field forms for project database entry. Data entries will be made directly from electronic field forms which have been reviewed for accuracy and completeness, prior to submittal to the database manager. Electronic files of field measurement data will be maintained as part of the project's quality records.

Should the database manager, or a data user, find suspect data, the suspect data point will be investigated. If the data point is found to be in error, it will be corrected in the database, and the database manager will be responsible for any necessary notifications of the data revision or redistributions of the data.

5.2 Laboratory Data Review

Internal laboratory data reduction procedures will be according to the laboratory's Quality Management Plan. At a minimum, records shall be maintained by the analysts to document sample identification number with sample results and other details. These records shall be signed and dated by the analyst. Secondary review of these records by the Laboratory Supervisor (or designee) shall take place prior to final data reporting to Atlantic Richfield Company. The laboratory shall appropriately flag unacceptable data in the data package. Shall any deficiencies with the potential to change analytical results be found during laboratory review of previously reported data, Atlantic Richfield Company, or their representative, will be immediately notified, and a revised report and EDD will be issued.

5.3 Reconciliation with User Requirements

The *CFRSSI Data Management/Data Validation Plan* (AR, 1992b) identified three data categories for determination of data usability: Enforcement Quality (Unrestricted Use), Screening Quality (Restricted

Use), and Unusable Data. These data utilization categories are loosely related to the analytical support levels described in EPA's *Data Quality Objectives for Remedial Response Activities,* (EPA 1987). For example, Level IV data (contract laboratory program [CLP] data) typically would be categorized as enforcement quality data provided other assessment criteria are met, while Level III and Level II data (laboratory analyses using other methods than the CLP routine analytical services analyses or field analyses, respectively) typically would be categorized as screening quality data. Level I reporting is used for analyses that, due either to their nature (i.e., field monitoring or specialty analyses that do not follow EPA reporting protocols) or the intended data use (i.e., preliminary screening or other measurements not critical to project DQOs), do not generate or require extensive supporting documentation.

Data collected for this SAP will typically be considered "Screening Quality" and will be reported as Level I (minimal or "results only"). The data may be subject to informal QC review or validation but a full QC review and data validation reporting will not be required. Additional information regarding these categories and data useability are described in the Pilot Project QAPP (Atlantic Richfield Company and MR, 2022a).

6. HEALTH AND SAFETY

Important safety information for field work is recorded in the relevant Health and Safety Plans (HASPs) and in task risk assessments (TRAs). Field authorization forms will be completed each field day. Personal protective equipment (PPE) required for the various aspects of the SOPs are described in the HASPs and TRAs, and lists of required PPE for performing the work are included in the SOPs. All personnel performing field work will have completed all training required by the associated HASP.

Conducting the surface water monitoring, substrate monitoring, and scale deposition bed monitoring must be frequently coordinated with other in-stream sampling/monitoring events, nearby construction sites, and storm events/periods of high stream flow to ensure continued safety. Some of the monitoring and sampling locations require crossing BTL property, which requires coordination with BTL personnel. If, for any reason, the field work cannot be conducted safely, it will be postponed until safe monitoring can resume. In general, work that requires entering the stream will not be performed on days when stream flow is above 70 cubic feet per second (cfs) or water depth is greater than 3 feet (ft) or deeper than the worker's waist. If stream flow is between 40 cfs and 70 cfs, then work may still need to be postponed, as determined by judgment of the field crew on the day of scheduled monitoring. Stream flow will be checked at the U.S. Geological Survey (USGS) gage station 12323250 near SS-07 and any other gage stations available within the field area, and stream depth will be checked in the field using a staff gage, wading staff, or similar. If field work cannot be conducted due to high flows or other issues, then it will be rescheduled as soon as possible. There may be times, such as spring runoff, when field work will be cancelled instead of postponed because it cannot be safely completed during the scheduled time period.

7. REPORTING

7.1 Records and Electronic Files

The BMFOU DMP (MR and Atlantic Richfield Company, 2022a), RFC Downstream FSP-2022-3 (approved on January 9, 2023), and the Downstream FSP (Atlantic Richfield Company, 2023b) describe data sharing and the reporting framework as well as distribution and retention of data, reports, and electronic files.

7.2 Project Documents

A summary of observations from the substrate monitoring, associated LSI calculations from the correlated water quality data, and scale deposition bed monitoring will be included in the BMFOU Berkeley Pit and Discharge Pilot Project Quarterly report. Any significant changes in scale formation will be discussed with the Agencies on an on-going basis.

8. REFERENCES

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Tables

Table 1. Data Quality Objectives Summary

STATE THE PROBLEM (STEP 1)	STUDY OBJECTIVE (STEP 2)	INFORMATION INPUTS (STEP 3)	STUDY BOUNDARIES (STEP 4)	ANALYTICAL APPROACH (STEP 5)	PERFORMANCE ACCEPTANCE CRITERIA (STEP 6)	DEVELOP A PLAN FOR OBTAINING THE DATA (STEP 7)
The CD (EPA, 2002) requires that there be no increase in naturally occurring turbidity in Silver Bow Creek that is likely to render the waters detrimental to fish or other wildlife. Evaluation of the existing stream shows that there is a potential for calcite scale formation without discharge. Introduction of the discharge from the Polishing Facility can further promote calcite scale formation.	Does calcite scale form in Blacktail and Silver Bow Creeks prior to discharge? Does discharge from the Pilot Project create calcite scale in Silver Bow Creek? If so, can Pilot Project operating parameters be adjusted to stop scale formation and reverse it? Can a saturation index be used to determine when scale formation will occur?	Types and sources of information needed: • Qualitative observations of stream substrate prior to and after discharge. • Qualitative observations of stream substrate upstream and downstream of discharge. • Qualitative observations of scale deposition beds in receiving stream upstream and downstream of discharge. • Water quality data, notably including pH, alkalinity, temperature, calcium, and TDS, from discharge structure and points along the stream corresponding to stream substrate observations. • Scale coupons in product tank and discharge structure.	The study area will be Reach 1 (in Silver Bow Creek) through Reach 5 (in Blacktail Creek).	**Population parameters for making decisions:** Valid water sample results and field measurements collected from points along the stream corresponding to stream substrate observations will be used to calculate LSI. Calcite scale prior to discharge will be compared against scale after discharge at the same reaches in the stream. Reaches upstream of the discharge point will be used to determine the amount of natural variability with time. Scale coupons will be visually checked and weighed monthly for indication of scale formation. Scale deposition beds will be visually inspected for calcite scale. Calculated indices will be compared with calcite monitoring observations. **Action Levels** Observable increase in calcite scale in the stream over the same reach.	In-stream water quality data that meet all conditions specified in this SAP and the Draft Pilot Project QAPP. Substrate monitoring and scale deposition bed monitoring will be performed as outlined in SOP-SM-01 and SOP-SM-02, respectively.	1. In-stream water quality samples and field measurements are collected, analyzed, and recorded in accordance with this SAP and the Draft Pilot Project QAPP. 2. Substrate monitoring began in 2019 and will continue in 2022. All observations will be recorded according to SOP-SM-01. 3. Scale deposition bed monitoring began in 2020 and will continue in 2022. All observations will be recorded according to SOP-SM-02.

Abbreviations:
BPSOU = Butte Priority Soils Operable Unit
CD = Consent Decree
EPA = United States Environmental Protection Agency
LSI = Langelier Saturation Index
QAPP = Quality Assurance Project Plan
SAP = Sampling and Analysis Plan
TDS = total dissolved solids

Table 2. Summary of Substrate Monitoring Locations and Frequency

Substrate Monitoring Location	Schedule	Rationale	Analysis
Reach 1 (Figure 2)	Once per month June through September	Reach 1 was established downstream of BPSOU surface water monitoring station SS-07 to monitor the stream bed after Butte-Silver Bow Wastewater Treatment Plant discharge enters SBC.	• Visual inspection of substrate for calcite • HCl effervescence test
Reach 2 (Figure 3)	Once per month June through September	Reach 2 was selected to be near BPSOU surface water monitoring station SS-06G, due to the slightly higher baseline potential for calcite scale formation near that location.	• Visual inspection of substrate for calcite • HCl effervescence test
Reach 2.5 (Figure 4)	Once per month June through September	Reach 2.5 was established after the first round of pre-discharge monitoring in 2019 and after examples of calcite scale were found in Reaches 2 and 3. This reach was established as an intermediate reach to be able to monitor SBC between Reaches 2 and 3, after the creek has passed through most of Slag Canyon. Reach 2.5 overlaps with BPSOU surface water monitoring station SS-05A.	• Visual inspection of substrate for calcite • HCl effervescence test
Reach 3 (Figure 5)	Once per month June through September	The upstream end of Reach 3 is located just downstream of where the Pilot Project discharge enters SBC. Reach 3 overlaps with BPSOU surface water monitoring station SS-05.	• Visual inspection of substrate for calcite • HCl effervescence test
Reach 4 (Figure 5)	Once per month June through September	Reach 4 was established to represent a section of BTC upstream of the Pilot Project discharge. The downstream end of Reach 4 begins in BTC just upstream of where the Pilot Project discharge enters SBC. Reach 4 continues upstream and overlaps with BPSOU surface water monitoring station SS-04.	• Visual inspection of substrate for calcite • HCl effervescence test
Reach 5 (Figure 6)	Once per month June through September	Reach 5 was established to represent a section of BTC upstream of the Pilot Project discharge near SS-01, which historically has a low potential for baseline calcite formation through all seasons.	• Visual inspection of substrate for calcite • HCl effervescence test

Table 3. Summary of Scale Deposition Bed Monitoring Locations and Frequency

Scale Deposition Bed Location	Schedule	Rationale	Analysis
SS-04 (Figure 5)	May, July, September, November	This location is near the first BPSOU sampling station located upstream of the Pilot Project discharge (SS-04) and can be used to evaluate the scaling potential in water unimpacted by discharge. The scale deposition bed is located near SS-04 to evaluate water chemistry in conjunction with the scale deposition bed.	• Visual inspection of substrate for calcite • HCl effervescence test • Two beds installed at each location. The contents of one will be acid washed after inspection and the other will not be washed.
SS-05A (Figure 4)	May, July, September, November	This location is near a BPSOU sampling station located downstream of the Pilot Project discharge in a fully mixed section of the creek (SS-05A). The scale deposition bed is located near SS-05A to evaluate water chemistry in conjunction with the scale deposition bed.	• Visual inspection of substrate for calcite • HCl effervescence test • Two beds installed at each location. The contents of one will be acid washed after inspection and the other will not be washed.

Table 4. Blacktail Creek and Silver Bow Creek Surface Water Quality Monitoring Locations and Schedule

Sites	Coordinates		Sampling Schedule	Location/Rationale
	Latitude	Longitude		
SS-01	45.985271	-112.507762	Manual sampling once per month and coordinated with substrate monitoring in June through September.	Upstream of discharge location where historical LSI values have been relatively low.
SS-04	45.994635	-112.536114	Manual sampling once per month and coordinated with substrate monitoring in June through September. Instantaneous pH and temperature readings recorded every 15 minutes.	Immediately upstream of discharge location. Sample location captures stream conditions unimpacted by Polishing Facility effluent.
SS-05	45.995769	-112.539176	Manual sampling once per month and coordinated with substrate monitoring in June through September.	Immediately downstream of discharge location to capture impacts of Polishing Facility effluent.
SS-05A	45.996215	-112.544249	Manual sampling once per month and coordinated with substrate monitoring in June through September. Instantaneous pH and temperature readings recorded every 15 minutes.	Downstream of discharge where stream is completely mixed with Polishing Facility effluent.
SS-06G	45.996413	-112.562797	Manual sampling once per month and coordinated with substrate monitoring in June through September.	Downstream of discharge where historical LSI values have been the highest to evaluate if Polishing Facility effluent further increases these values.
SS-07	45.996626	-112.563646	Manual sampling once per month and coordinated with substrate monitoring in June through September.	Downstream of SS-06G which has the highest historical LSI values. Sample location will determine if LSI values drop in this location as they have historically.

Table 5. Surface Water Monitoring Field Parameter Specifications

Parameter	Method	Accuracy	Resolution
Parameters Measured During Sampling Events			
pH (SU)	YSI Professional Plus or similar	± 0.2	0.01 SU
Temperature (˚C)	YSI Professional Plus or similar	0.2 ˚C	0.1 ˚C
Parameters Measured Continuously			
pH (SU)	TIENet 301/ISCO Signature	± 0.1 SU	0.01 SU
Temperature (˚C)	TIENet 301/ISCO Signature	± 1	Not available

Table 6. Surface Water Monitoring Parameter List and Associated Analytical Methods, Approximate Method Detection Limits, Reporting Limits, and Holding Times

Analyte	Method	Method Detection Limit[1] (mg/L)	Reporting Limit (mg/L)	Holding Time (days)
Constituents Analyzed during Each Sampling Event				
Dissolved Calcium	EPA 200.8	0.018	0.04	180
Sulfate	EPA 300.0	0.34	1.2	28
Total Alkalinity (as $CaCO_3$)	SM 2320B	1.8	5	14
Total Dissolved Solids	SM 2540C	5	10	7

Notes: [1] The method detection limits presented represent 2021 (most recent) values. The detection and reporting limits are determined on an annual basis; thus, they will fluctuate and will be updated in annual revisions as necessary. The desired analytical sensitivity are method detection limits less than the applicable water quality standards specified in Montana Circular DEQ-7, Montana Numeric Water Quality Standards.

Table 7. Surface Water Monitoring Analytical Bottle Count and Preservative Addition

Analytes	Sampling Container	Preservative	Filter
General Laboratory			
Total Alkalinity (as $CaCO_3$)	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None
Sulfate	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None
Total Dissolved Solids	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None
Metals			
Dissolved Calcium	Polyethylene, 1 x 250 mL	pH<2 nitric acid, refrigerate 0°C-6°C	0.45-micron filter

Figures

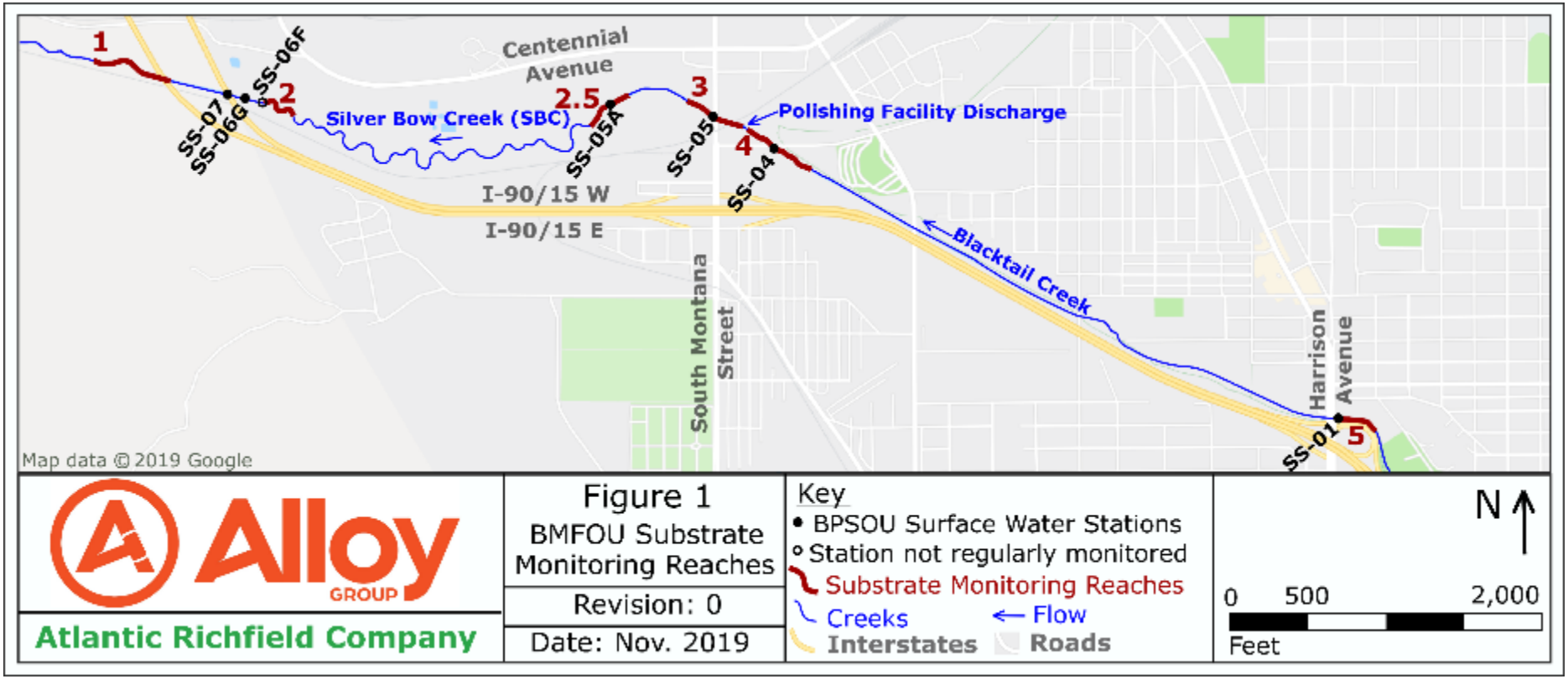

Figure 1. Substrate Monitoring Reaches and Correlated BPSOU Surface Water Monitoring Stations along Silver Bow Creek and Blacktail Creek

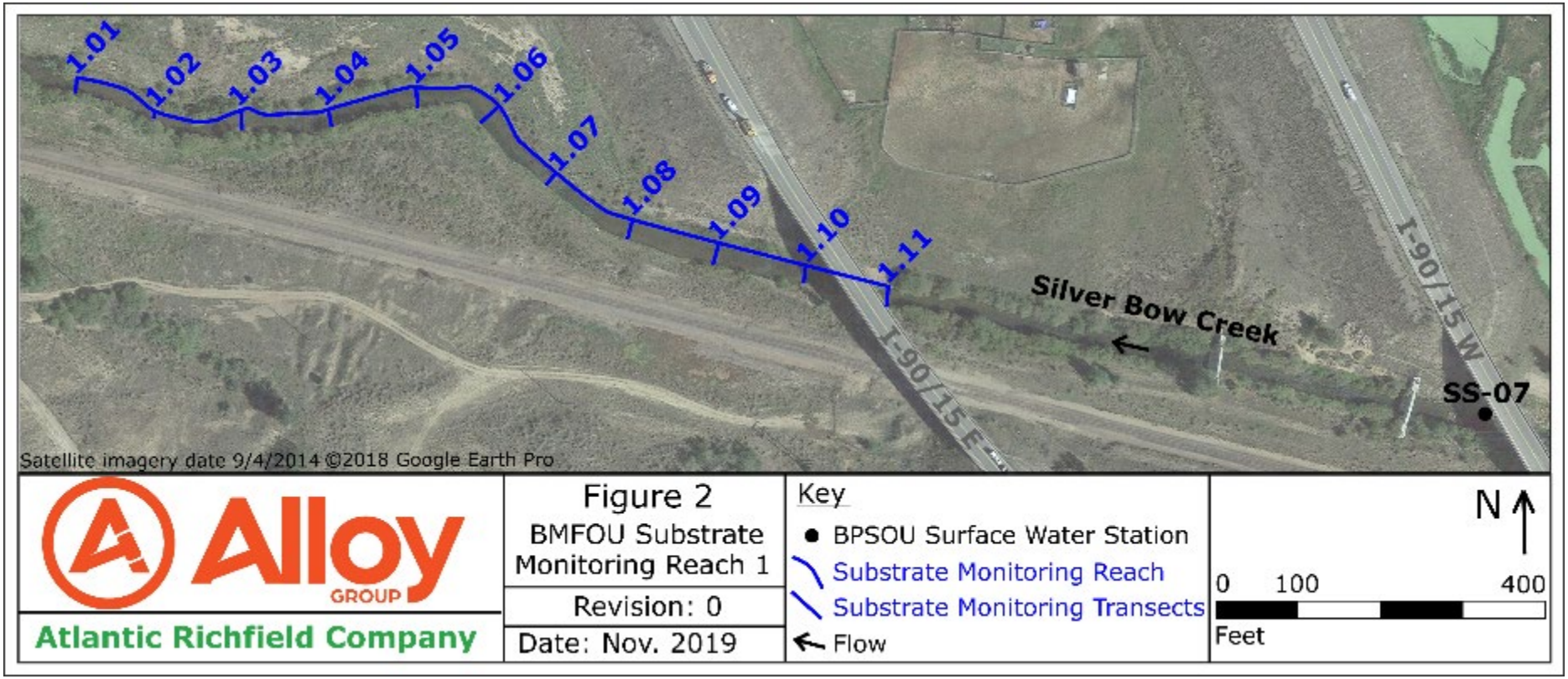

Figure 2. Reach 1 with Transects 1.01 to 1.11

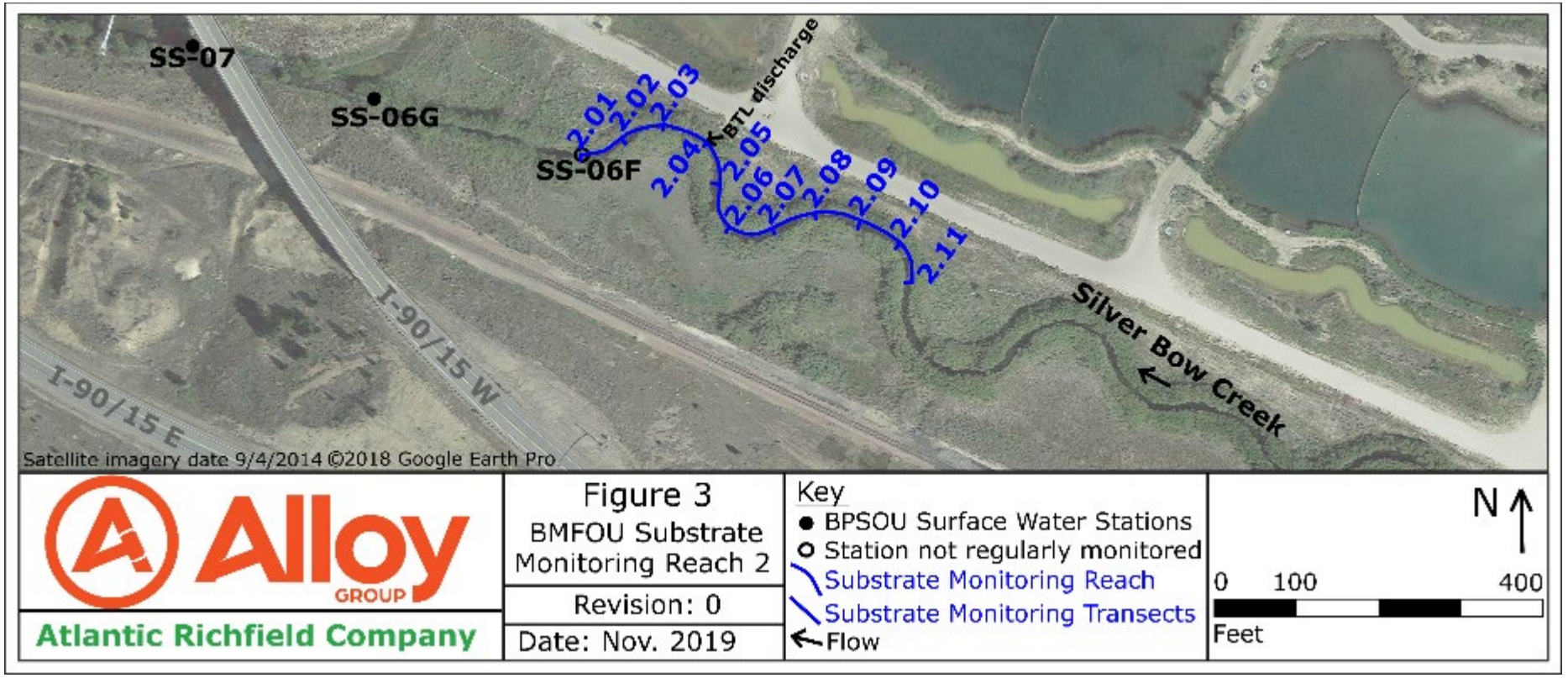

Figure 3. Reach 2 with Transects 2.01 to 2.11

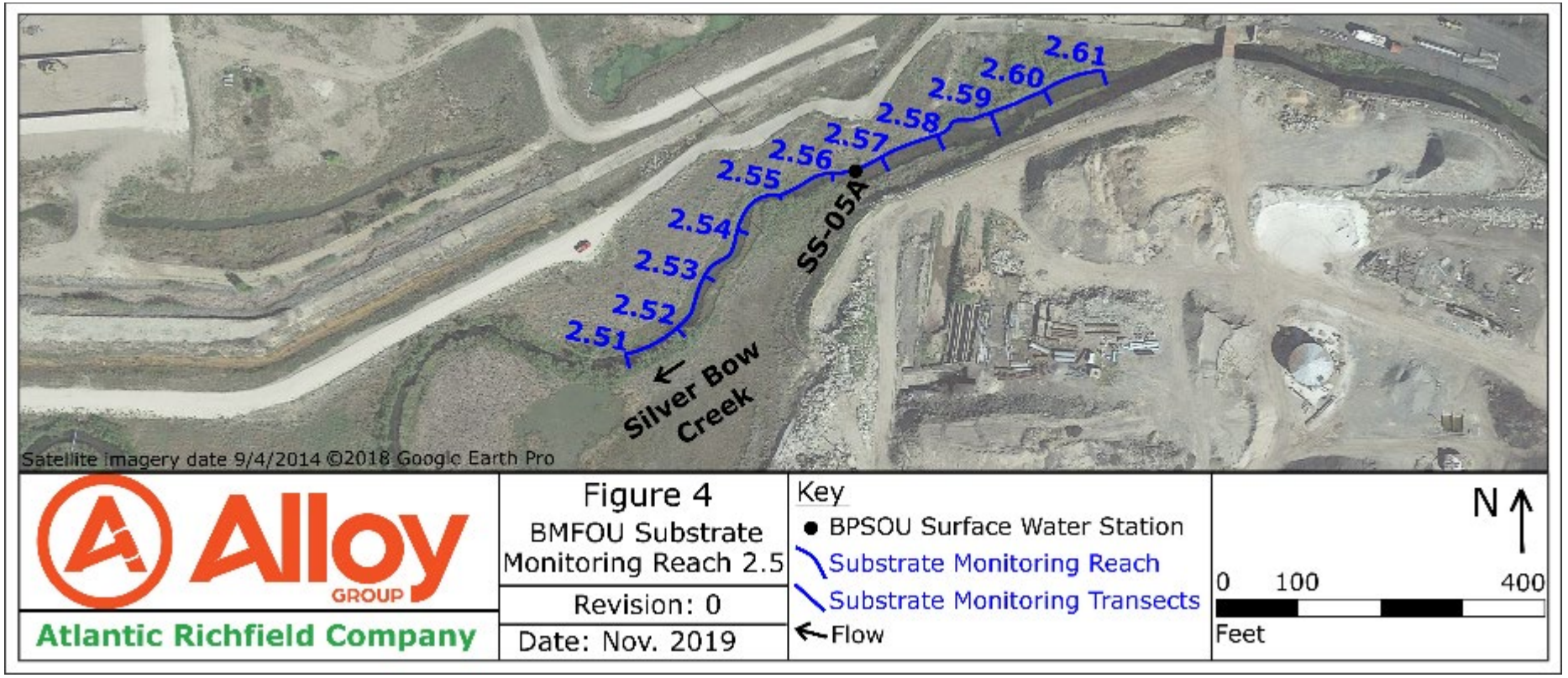

Figure 4. Reach 2.5 with Transects 2.51 to 2.61

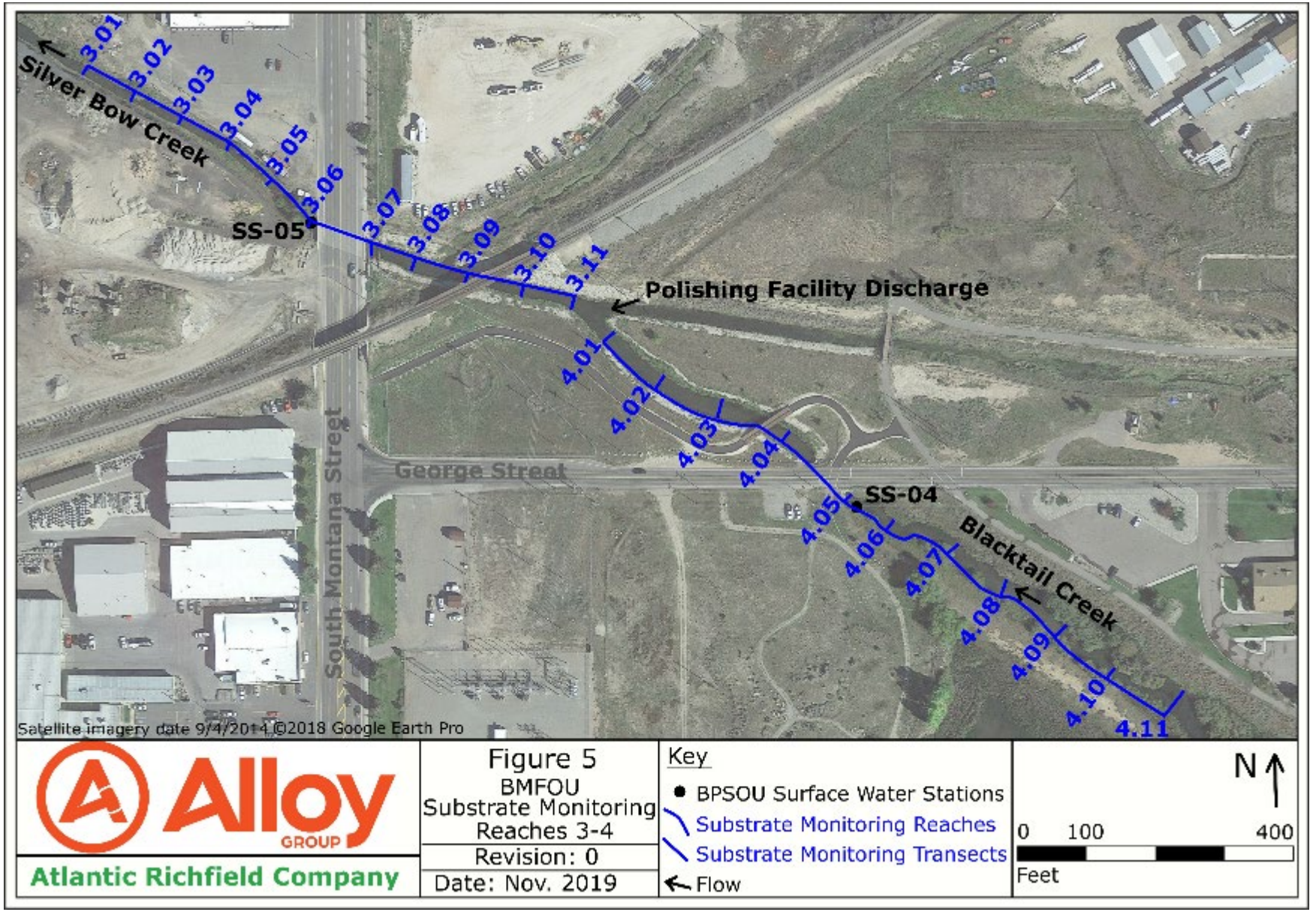

Figure 5. Reaches 3 with Transects 3.01 to 3.11 and Reach 4 with Transects 4.01 to 4.11

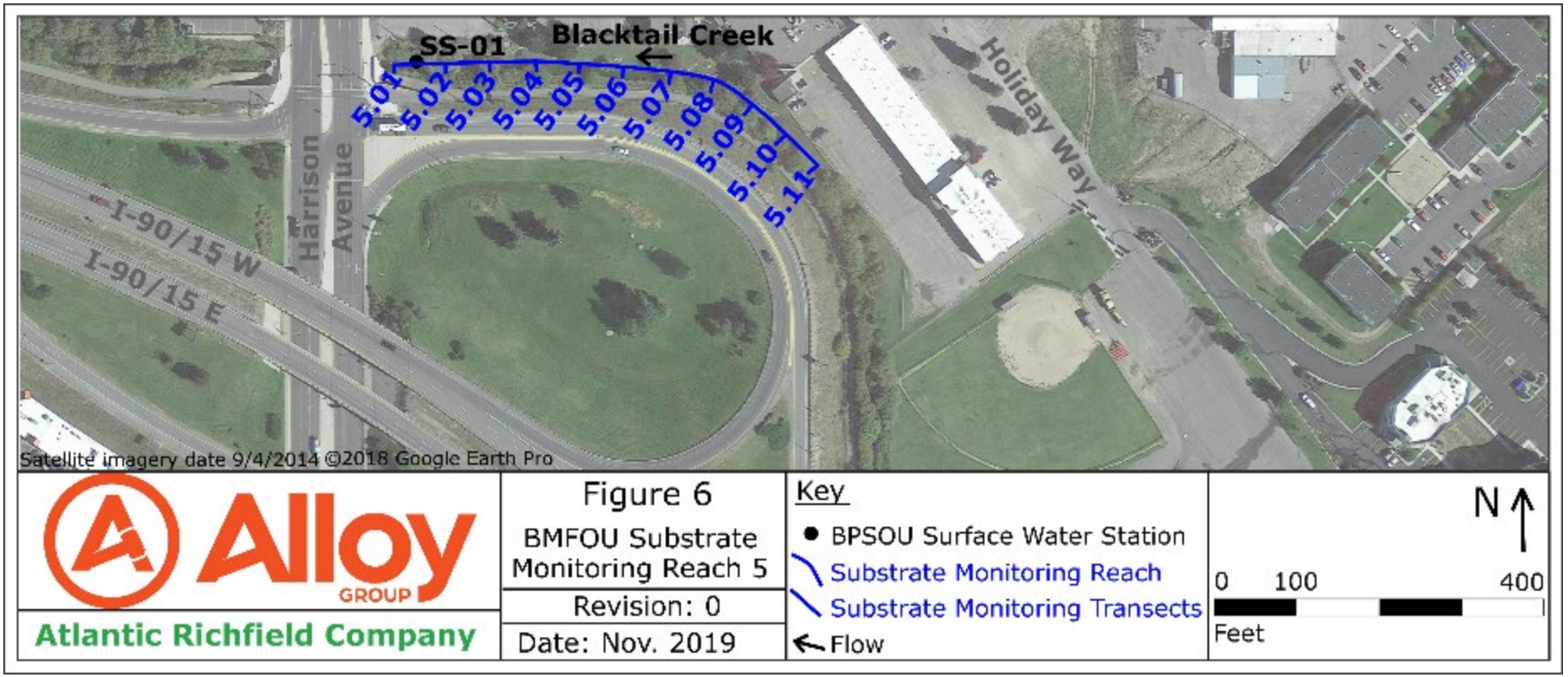

Figure 6. Reach 5 with Transects 5.01 to 5.11

Appendix A– In-Stream Calcite Monitoring Standard Operating Procedures

SOP – SM – 01
Substrate Monitoring

Project Name: Butte Mine Flooding Operable Unit | **Date:** 05/23/2022

1. INTRODUCTION

1.1. Purpose

This document presents a Standard Operating Procedure (SOP) for evaluating calcite scale formation in Silver Bow Creek (SBC) and Blacktail Creek (BTC) during active discharge from the Butte Mine Flooding Operable Unit (BMFOU) Polishing Facility to SBC.

1.2. Scope

This procedure has been prepared for the Alloy Group (formerly Copper Environmental Consulting) workforce and applies to work carried out by and on behalf of Alloy Group. All members of the Alloy Group workforce who conduct the work shall be trained and competent in the work described below.

2. REVISION LOG

The Substrate Monitoring SOP is subject to continued review and revision based on the data collected, changes in safe conditions, and/or changes in objective.

Revision #	Description	Author	Date
0	Original	CEC	7/01/2020
1	Update methods and references per RFC No. DS SAP 1 and to describe 2022 monitoring activities.	Alloy Group (formerly CEC)	12/22/2021
2	Added Data Management Section	Alloy Group	05/23/2022

3. SAFETY DOCUMENTATION

3.1. Relevant and Reviewed Task Risk Assessments

- Driving Site Access
- Substrate Monitoring

3.2. Safety Data Sheets

- Hydrochloric Acid (HCl) (3%-10%)

3.3. Other Safety Documents

- BMFOU Task Specific Health and Safety Plan
- Field authorization forms

4. EQUIPMENT LISTS

Provided below are lists of the personal protective equipment (PPE) and materials required to perform the work described in this SOP.

4.1. PPE Required

All personnel require items 1-8, and personnel working in the stream additionally require items 9 and 10.

1. Safety glasses
2. High visibility vest
3. Long-sleeved shirt
4. Long trousers

5. Weather appropriate attire
6. Work gloves
7. Steel-toed boots (if working on Butte Treatment Lagoon property and not in the creek)
8. Hard hat (if working on Butte Treatment Lagoon property, near slag canyon, or in a construction zone)
9. Nitrile gloves
10. Waders and wading boots

4.2. Materials Required

1. Substrate Monitoring Field Form – Blacktail Creek and Silver Bow Creek (Attachment 1)
2. Dedicated field notebook
3. Indelible ink pens
4. Staff gage with 0.02-foot increments
5. Vibrant flagging
6. Water-resistant permanent marker
7. Sampling dipper (3 feet)
8. Plastic cup
9. Hand-held ruler with 1-millimeter increments
10. Calculator
11. Hand lens (10x magnification)
12. Dropper bottle with dilute HCl (10%)
13. Specimen containers and scraper
14. Backpack
15. Camera

5. SUBSTRATE MONITORING PROCEDURE

To monitor the substrate of BTC and SBC for scale related to the Polishing Facility Discharge, follow the listed steps:

1. Monitor each transect at Reaches 1, 2, 2.5, 3, 4, and 5 previously established under the *Final Calcite Scale Formation Assessment Sampling and Analysis Plan* (Alloy Group, 2021). Begin at the furthest downstream reach and the furthest downstream established transect location, when possible.
2. Beginning at the left bank (when facing downstream), walk towards the right bank and perform the following at approximately 0%, 25%, 50%, 75%, and 100% of the distance along the cross-sectional transect:
    a. Measure the water depth using a staff gage. If water depth is greater than three feet, proceed to the next transect; otherwise proceed to step b.
    b. Touch the stream bed, without looking down to minimize bias, with either a hand or short sampling dipper, depending upon water depth, and pick up the first item touched. If the item is obtained with the sampling dipper, then reach into the scoop (without looking) and choose the first item touched. If the items are too small to easily pick up one item, then pick up a pinch.
    c. Follow steps d and e below for both the first item touched and a rock underneath, if the first item touched is not a rock.
    d. Visually assess the item(s) for calcite scale.

e. If the item(s) observed include(s) a macrophyte, periphyton, or non-aquatic plant material that are not visibly scaled with calcite, then they do not need to be tested with 10% HCl for effervescence. Otherwise, apply 10% HCl to the item(s) and observe for effervescence. If there is visible calcite scale, then test both the calcite and parts of the item not scaled (as applicable) with 10% HCl.
f. If the item(s) did not have visible scale or effervescence, proceed to step g. If the item had visible scale or effervescence, follow steps a and b below before proceeding to step g.
    a. Categorize the item(s) according to Table 1 of Attachment 1, using the median value of the measured length, width, and depth of the item if it is a particle.
    b. Photograph the item(s).
g. Place the item back into the stream, unless the circumstances require collection of scale samples (i.e. if extensive calcite scale is found in SBC post-discharge and further analysis is necessary to differentiate it from pre-discharge calcite).

3. If there is something noteworthy along the streambed or stream bank, capture it in a photograph.
4. Repeat steps 2 and 3 for each transect along a reach, moving progressively upstream, when possible.
5. Repeat steps 2 through 4 for each reach monitored, moving progressively upstream, when possible.

6. DOCUMENTATION

Record all field observations and measurements on a paper or electronic form that covers, at a minimum, the information in the Substrate Monitoring Field Form – Blacktail Creek and Silver Bow Creek (Attachment 1).

1. Upon arriving at a given reach or transect, record the following information:
    - Date
    - Arrival time
    - Location (reach number)
    - Weather
    - In-stream participant name(s)
    - Ground-based participant name(s)
    - Other personnel/visitors
2. At each transect, record the following information:
    - Arrival time
    - Transect number
    - Additional photo number(s) (if applicable)
    - General observation(s) (if there is something noteworthy, such as visible calcite scale)
    - At approximately 0%, 25%, 50%, 75%, and 100% of the distance along each transect, record the following information for each item observed:
        - Approximate location along the transect (to the nearest 0%, 25%, 50%, 75%, or 100%)
        - Whether or not calcite scale is visible
        - Whether or not effervescence occurred and if it did, whether it was weak or strong
        - Stream bed class, using the codes provided in Table 1 of Attachment 1, only if scale or effervesence was observed

- Photo number, only if scale or effervescence was observed
- Any other comment

3. If filling out a reach-based field form, after monitoring an entire reach, record any additional notes, if applicable, in the "Other Notes" section of the field form, ensure each participant (in-stream and ground-based) signs in the approprate box, fill in the page numbers, and record the depature time. Or, if filling out a transect-based field form, after monitoring an entire transect, record any additional notes, if applicable, ensure the ground based participant verbally confirms data with the in-stream participant and records their consent, and record the departure time.

7. DATA MANAGEMENT AND QUALITY ASSURANCE/QUALITY CONTROL

At the end of each field event:

- Check the contents of the field forms for completeness and accuracy. Confirm that the forms have been checked by either signing the form or documenting electronic consent.
- Upload any photos from the field camera to Alloy Group BMFOU Sharepoint.
- If electronic forms were used, upload any remaining photographs to the form, when relevant. Ensure all completed electronic forms are submitted and the data are stored on the Alloy Group BMFOU Sharepoint.
- If notes were written on paper forms or in a notebook, scan all written notes or forms and upload the file of the scan to the Alloy Group BMFOU Sharepoint.

8. ATTACHMENTS

- Attachment 1 – Substrate Monitoring Field Form – Blacktail Creek and Silver Bow Creek

Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Date:	**Arrival Time:**	**Departure Time:**
Location:	**Weather:**	
In-stream participant name(s):	**In-stream participant signature(s):**	
Ground-based participant name(s):	**Ground-based participant signature(s):**	
Other personnel/visitors:		

Data/Observations			**0%**	**25%**	**50%**	**75%**	**100%**
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					

Field form format revised: 202211222

Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Data/Observations			0%	25%	50%	75%	100%
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
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		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					

0% is the left bank relative to facing downstream.

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Data/Observations			0%	25%	50%	75%	100%
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
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		Photograph Number					
		Comments					

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Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Data/Observations			0%	25%	50%	75%	100%
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
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		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
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		Table 1 Code					
		Photograph Number					
		Comments					
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		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					

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Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Data/Observations			0%	25%	50%	75%	100%
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					

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Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Data/Observations			0%	25%	50%	75%	100%
Transect _____; Start time _____ Additional photo number(s) _____	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
Transect _____; Start time _____ Additional photo number(s)	First item touched	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					
	Substrate under first item (if applicable)	Scale visible? (Y/N)					
		Effervescence? (NA/S/W/N)					
		Table 1 Code					
		Photograph Number					
		Comments					

0% is the left bank relative to facing downstream.

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

Substrate Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Table 1: Stream bed class definitions from *EMAP* (EPA, 1998) with the addition of periphyton, macrophyte, and non-aquatic plant and modification to the "wood" description.

Code	Class	Size Range (mm)	Description
RS	Bedrock (Smooth)	>4000	Smooth surface rock larger than a car
RR	Bedrock (Rough)	>4000	Rough surface rock larger than a car
HP	Hardpan	any	Firm, consolidated fine substrate or firm, precipitated surface
BL	Boulder	>250 to 4000	Basketball to car size
CB	Cobble	>64 to 250	Tennis ball to basketball size
GC	Gravel (Coarse)	>16 to 64	Marble to tennis ball size
GF	Gravel (Fine)	>2 to 16	Ladybug to marble size
SA	Sand	>0.06 to 2	Smaller than ladybug size, but visible as particles - gritty between fingers
FN	Fines	<0.06	Silt, clay, muck (not gritty between fingers)
PE	Periphyton	Regardless of Size	Freshwater organism attached to a submerged surface
MP	Macrophyte	Regardless of Size	Rooted aquatic plant visible with the naked eye
NP	Non-aquatic Plant	Regardless of Size	Land-based plant or plant parts like willow roots, dead grass, leaves, etc.
WD	Wood	Regardless of Size	Wood (logs, sticks, twigs, etc.)
OT	Other	Regardless of Size	Artificial inorganic items: slag, concrete, metal, tires, etc. (describe in comments)

Other Notes:

0% is the left bank relative to facing downstream.

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

SOP – SM - 02
Scale Deposition Bed Monitoring

Project Name: Butte Mine Flooding Operable Unit | **Date:** 05/24/2022

1. INTRODUCTION

1.1. Purpose

This document is meant to act as a Standard Operating Procedure (SOP) for monitoring the substrate in the scale deposition beds in Blacktail Creek (BTC) and Silver Bow Creek (SBC), which requires retrieval and return of the scale deposition beds and examination of the contained substrate.

1.2. Scope

This procedure has been prepared for the Alloy Group (formerly Copper Environmental Consulting) workforce and applies to work carried out by and on behalf of Alloy Group. All members of the Alloy Group workforce who conduct the work shall be trained and competent in the work described below.

2. REVISION LOG

The Scale Deposition Bed Monitoring SOP is subject to continued review and revision based on the data collected, changes in safe conditions, and/or changes in objective.

Revision	Description	Author	Date
0	Original	CEC	12/17/2020
1	Updated per RFC No. RFC-Downstream FSP-2022-1. Updated Documentation Section for electronic form option. Added Data Management Section.	Alloy Group (formerly CEC)	05/24/2022

3. SAFETY DOCUMENTATION

3.1. Relevant and Reviewed Task Risk Assessments

- Driving and Site Access
- Scale Deposition Bed Monitoring

3.2. Safety Data Sheets

- Hydrochloric Acid (HCl) (3%-10%)
- pH 4.00 Calibration Buffer Solution
- pH 6.86 Calibration Buffer Solution
- pH 9.18 Calibration Buffer Solution

3.3. Other Safety Documents

- BMFOU Task Specific Health and Safety Plan
- Field authorization forms

4. EQUIPMENT LISTS

Provided below are lists of the personal protective equipment (PPE) and materials required to perform the work described in this SOP.

4.1. Scale Deposition Bed Retrieval and Return

4.1.1. PPE Required

All personnel require items 1-8, and personnel working in the stream additionally require item 9.

1. Safety glasses

2. High visibility vest
3. Long-sleeved shirt
4. Long trousers
5. Weather appropriate attire
6. Gloves
7. Steel-toed boots (if working on Butte Treatment Lagoon property and not in the creek)
8. Hard hat (if working on Butte Treatment Lagoon property, near slag canyon, or in a construction zone)
9. Waders and wading boots

4.1.2. Materials Required

1. Scale Deposition Bed Monitoring Field Form – Blacktail Creek and Silver Bow Creek (Attachment 1)
2. Indelible ink pens

4.2. Scale Deposition Bed Substrate Examination

4.2.1. PPE Required

1. Nitrile gloves
2. Safety glasses with splash guards
3. Long-sleeved shirt
4. Long trousers
5. Close-toed shoes

4.2.2. Materials Required

1. #20 mesh screen
2. Buckets with lids
3. Long-handled spoon
4. Tongs
5. Funnel
6. Wide shallow polypropylene bins
7. 3%-10% HCl
8. 10% HCl in a dropper bottle
9. Water (tap and distilled)
10. pH test paper or probe
11. Scale Deposition Bed Monitoring Field Form – Blacktail Creek and Silver Bow Creek (Attachment 1)
12. Indelible ink pens
13. Camera

5. SCALE DEPOSITION BED MONITORING PROCEDURE

5.1. Scale Deposition Bed Retrieval

1. Go to the location of a set of scale deposition beds and measure the water depth by placing a staff gage adjacent to the stream side (furthest from the stream bank) scale deposition bed and parallel to the downstream T-post.
2. Record the turbulence of the stream near the scale deposition beds according to Table 1 of the Scale Deposition Bed Monitoring Field Form – Blacktail Creek and Silver Bow Creek.
3. Remove the scale deposition beds from the T-posts, and rinse each bed in the creek to remove the bulk of accumulated fines. Allow the water to drain from the beds when removing from the creek.

4. Repeat for all locations of scale deposition beds.

5.2. Substrate Examination

1. Allow the substrate to air dry for 12 hours or until thoroughly dry.
2. Check the substrate in a scale deposition bed for calcite scale by performing the following steps:
    a. Place a #20 mesh screen above a bucket and pour substrate from a scale deposition bed over the screen until the screen is full. Use a long-handled spoon to help move substrate as necessary.
    b. Shake the screen above the bucket to facilitate movement of smaller particles through the screen, until only the substrate sizes originally placed into the scale deposition bed are on top of the screen.
    c. Discard the smaller substrate that passed through the screen.
    d. Transfer the substrate from the #20 mesh screen into an appropriately sized bin.
    e. Repeat steps 2a-2d until all substrate from the scale deposition bed has been transferred.
    f. Visually observe the substrate in the bin for calcite scale.
    g. Photograph the substrate in the bin.
    h. Drop 10% HCl onto the substrate in the bin as necessary to check for effervescence.
3. If the scale deposition bed does not require acid washing (beds with names ending in "U"), then return the substrate to the original scale deposition bed. If the scale deposition bed requires acid washing, then perform the following steps:
    a. Add 3%-10% HCl to the bin until the substrate is completely submerged.
    b. Watch the substrate for effervescence. If there is no effervescence or once effervescence ceases, gently stir the substrate in the bin with a long-handled spoon to expose as much substrate surface area to the HCl as possible.
    c. If the HCl becomes too murky to observe the effervescence, carefully pour the contents of the bin over a #20 mesh screen above a different bucket to separate the substrate from the liquid.
    d. After the HCl has finished dripping from the #20 mesh screen, return the substrate from the screen to the same appropriately sized bin.
    e. Repeat steps 3a-3d until effervescence ceases.
    f. Pour the contents of the bin over a #20 mesh screen above a bucket to separate the substrate from the liquid and ensure all acid has drained from the screen before proceeding to the next step.
    g. Move the mesh screen holding the substrate over an empty bucket, and securely cover the acid-containing bucket.
    h. Rinse the substrate by pouring tap water over the substrate, catching the rinse water in the empty bucket below (not the bucket containing acid).
    i. Move the mesh holding the substrate above a new bucket and immediately rinse the substrate using distilled water. Check the pH of the final rinse water to ensure the pH is within half a standard pH unit (0.5 s.u.) of the pH of unused distilled water.
        i. If the pH is not within ± 0.5 s.u. of the unused distilled water, then repeat step 3i until the pH of the distilled rinse water is within ± 0.5 s.u. of unused distilled water.
        ii. If the pH is within ± 0.5 s.u. of unused distilled water, then perform step 3j.
    j. Return the acid-washed substrate to the corresponding scale deposition bed housing.
    k. Drain acid from bin into a container with a lid for transport.

l. If the pH of the HCl remains within zero ± 0.5 s.u., then the HCl can be reused. Otherwise, the used HCl and the used rinse water can be disposed in the off-spec vault in the Polishing Facility or other appropriate waste receptacle.

4. Repeat steps 1 through 3 for each scale deposition bed.

5.3. Scale Deposition Bed Return

1. Go to the location of a set of scale deposition beds and replace the scale deposition beds in the stream.
2. Repeat for each set of scale deposition beds.

6. DOCUMENTATION

Record all field observations and measurements on a paper or electronic form that includes the information in the Scale Deposition Bed Monitoring Field Form – Blacktail Creek and Silver Bow Creek (Attachment 1) and the information summarized below.

6.1. Scale Deposition Bed Retrieval

1. Upon arriving at a location, record the following information:
    - Date
    - Arrival time
    - Location
    - Weather
    - In-stream participant name(s)
    - Ground-based participant name(s)
    - Other personnel/visitors
2. At each location, record the following information:
    - Water depth (measured according to step 1 of section 5.1)
    - Stream turbulence (using the codes provided in Table 1 of the Scale Deposition Bed Monitoring Field Form – Blacktail Creek and Silver Bow Creek)
    - Scale deposition bed ID
    - Time each scale deposition bed is removed
    - Any other observations
3. Before moving to the next location, record the following information:
    - Departure time

6.2. Substrate Examination

For the substrate from each scale deposition bed examined, record the following information:

- Date
- Personnel performing the procedure
- Scale deposition bed ID
- Start and end times of drying
- Photo numbers
- Whether or not calcite scale is visible
- Whether or not effervescence occurred and if it did, whether it was weak or strong
- Acid washing details:
    - Scale deposition bed ID
    - Number of acid washes
    - Observations about effervescence

- The final pH of the rinse water
- Any other observations

- Any other observations

6.3. Scale Deposition Bed Return

- Upon arriving at a location, record the following information:
  - Date
  - Arrival time
  - Location
  - Weather
  - In-stream participant name(s)
  - Ground-based participant name(s)
  - Other personnel/visitors
- At each location, record the following information:
  - Scale deposition bed ID
  - Time each scale deposition bed is replaced
  - Any other observations
- Before moving to the next location, record the following information:
  - Departure time

7. DATA MANAGEMENT AND QUALITY ASSURANCE/QUALITY CONTROL

At the end of each field event:

- Check the contents of the field forms for completeness and accuracy. Confirm that the forms have been checked by either signing the form or documenting electronic consent.
- Upload any photographs from the field camera to Alloy Group BMFOU Sharepoint.
- If electronic forms were used, upload any remaining photographs to the form, when relevant. Ensure all completed electronic forms are submitted and the data are stored on the Alloy Group BMFOU Sharepoint.
- If notes were written on paper forms or in a notebook, scan all written notes or forms and upload the file of the scan to the Alloy Group BMFOU Sharepoint.

8. ATTACHMENTS

- Attachment 1 – Scale Deposition Bed Monitoring Field Form – Blacktail Creek and Silver Bow Creek

Scale Deposition Bed Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Scale Deposition Bed Retrieval:

Date:	**Locations:**	**Weather:**
In-stream participant name(s):		**In-stream participant signature(s):**
Ground-based participant name(s):		**Ground-based participant signature(s):**
Other personnel/visitors:		

Location	**Arrival Time**	**Departure Time**	**Water Depth (ft)**	**Table 1 Code**	**Scale Deposition Bed ID**	**Bed Removal Time**	**Other Comments**
Location	**Arrival Time**	**Departure Time**	**Water Depth (ft)**	**Table 1 Code**	**Scale Deposition Bed ID**	**Bed Removal Time**	**Other Comments**

<u>Other Comments:</u>

Field form format last updated: 20200402

Scale Deposition Bed Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Scale Deposition Bed Substrate Examination:

Date(s):	**Personnel:**	**Personnel Signatures:**

Substrate Examination

Scale Deposition Bed ID	**Drying Start Date/Time**	**Drying End Date/Time**	**Photo Number(s)**	**Calcite Scale Visible? (Y/N)**	**Effervescence? (S,W,N)**	**Other Comments**

Acid Washing

Scale Deposition Bed ID	**Number of Acid Washes**	**Effervescence? (S,W,N)**	**Final Rinse Water pH**	**Other Comments**

Other Comments:

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

Scale Deposition Bed Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Scale Deposition Bed Substrate Examination:

Date(s):	**Personnel:**	**Personnel Signatures:**

Substrate Examination

Scale Deposition Bed ID	**Drying Start Date/Time**	**Drying End Date/Time**	**Photo Number(s)**	**Calcite Scale Visible? (Y/N)**	**Effervescence? (S,W,N)**	**Other Comments**

Acid Washing

Scale Deposition Bed ID	**Number of Acid Washes**	**Effervescence? (S,W,N)**	**Final Rinse Water pH**	**Other Comments**

Other Comments:

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

Scale Deposition Bed Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Scale Deposition Bed Return:

Date:	**Locations:**	**Weather:**
In-stream participant name(s):		**In-stream participant signature(s):**
Ground-based participant name(s):		**Ground-based participant signature(s):**
Other personnel/visitors:		

Location	**Arrival Time**	**Departure Time**	**Scale Deposition Bed ID**	**Bed Return Time**	**Other Comments**
Location	**Arrival Time**	**Departure Time**	**Scale Deposition Bed ID**	**Bed Return Time**	**Other Comments**

Other Comments:

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak

Scale Deposition Bed Monitoring Field Form - Blacktail Creek and Silver Bow Creek page _____ of _____

Table 1: Channel unit habitat class definitions from *EMAP* (EPA, 1998) without subdivided pool types for use as stream turbulence descriptions.

Code	Class	Description
P	Pool	Still water, low velocity, smooth, glassy surface, usually deep compared to other parts of the channel.
GL	Glide	Water moving slowly, with a smooth, unbroken surface. Low turbulence.
RI	Riffle	Water moving, with small ripples, waves and eddies -- waves not breaking, surface tension not broken. Sound: "babbling", "gurgling".
RA	Rapid	Water movement rapid and turbulent, surface with intermittent whitewater with breaking waves. Sound: continuous rushing, but not as loud as cascade.
CA	Cascade	Water movement rapid and very turbulent over steep channel bottom. Most of the water surface is broken in short, irregular plunges, mostly whitewater. Sound: roaring.
FA	Falls	Free falling water over a vertical or near vertical drop into plunge, water turbulent and white over high falls. Sound: from splash to roar.
DR	Dry Channel	No water in the channel

Other Comments:

Key: Y = yes, N = none, NA = not applicable, S = strong, W = weak