Spring 5-13-2021

SILVER BOW CREEK/BUTTE AREA NPL SITE BUTTE PRIORITY SOILS OPERABLE UNIT

Atlantic Richfield Company

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Final

Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Remedial Design Work Plan

Atlantic Richfield Company

May 13, 2021

RESPONSE TO AGENCY COMMENTS
FOR THE
BUTTE PRIORITY SOILS OPERABLE UNIT (BPSOU) BUTTE REDUCTION WORKS (BRW) SMELTER AREA MINE WASTE REMEDIATION AND CONTAMINATED GROUNDWATER HYDRAULIC CONTROL SITE
REMEDIAL DESIGN WORK PLAN AND PRE-DESIGN INVESTIGATION WORK PLAN
DATED DECEMBER 23, 2020

General Document Comments

EPA General Comment 1: *Prior to submitting the 30% design, please make best efforts to address as many comments below. EPA and DEQ are asking for as much detail in the 30% design analysis as is available in anticipation of the development and success of the 60% design.*

a) *Determine excavation vertical surface and lateral limits – This has been addressed in the pre-design investigation evaluation report (PDIER), but revisions are expected based on any new information collected in Phase III.*
b) *Based on the selected repository, develop a conceptual excavation plan which considers transportation to the repository – A conceptual excavation plan is normally expected in the 30 percent design, but analysis of the alternatives should be discussed in a deliberative fashion to support the decisions made for the 30 percent design.*
c) *Present an analysis of alternatives for groundwater collection – Concepts have previously been touched on, but an analysis of collection alternatives has not been compiled into a report available to the Agencies. It is expected that this will require a groundwater model to evaluate the efficacy of various alternatives. This could be part of the PDI ER or a separate submittal.*
d) *A hydrology report presenting calculations to determine channel and flood plain characteristics – Although it is anticipated that this will be an attachment to the 30 percent design submittal, the design will have proceeded without Agency review and comment on the hydrology report. We believe it would be beneficial to have Agency input on the hydrology report prior to submitting the 30 percent design.*

Atlantic Richfield Company Response: Atlantic Richfield will provide available information on the above elements in either the Pre-Design Investigation Evaluation Report (PDI ER) or the Preliminary 30% Remedial Design (RD) Report. The PDI ER and the Preliminary 30% RD Report will follow the requirements within the *BPSOU Statement of Work* (BPSOU SOW [Appendix D to the BPSOU Consent Decree {CD}]) and generally contain the components listed in the *Remedial Design/Remedial Action Handbook*, EPA 540/R-95/059. A Draft Final of the PDI ER with data from the Phase I Site Investigation was submitted to Agencies. As further Site investigations are completed, the PDI ER will be revised and resubmitted to Agencies for review. Response to specific comments are below.

(a) Revisions to the excavation vertical surface and lateral limits will be incorporated into the PDI ER as the Phase II and III Site Investigations are completed, including the required data validation. As the design progresses, an updated PDI ER will be submitted to Agencies for review.
(b) A conceptual excavation plan will be included in the Preliminary 30% RD Report. The repository is a site-wide project applicable to all the Corridor Further Remedial Element (FRE) projects and will have its own submittals associated with it including a RD Work Plan, RD Report, Construction Drawings, and Haul Route Analysis.
(c) A preliminary alternatives analysis for the Butte Reduction Works (BRW) hydraulic control will be included in the Preliminary 30% RD Report. At the completion of the Phase II Site Investigation activities, the PDI ER will be revised to include a detailed comparative analysis of the BRW hydraulic control options as well as a groundwater conceptual model.
(d) A hydrology report and hydraulics modeling report will be included in the Preliminary 30% RD Report.

Specific Document Comments – Remedial Design Work Plan

EPA Specific Comment 1: *Section 1.1, Page 3, 2nd Bullet – Please update the reference for the Phase III quality assurance project plan (QAPP), as the final document was not completed in 2020.*

Atlantic Richfield Company Response: The reference has been updated and is now mentioned in Section 1.1.4.

EPA Specific Comment 2: *Section 1.3.5, Page 7, 1st Bullet – Please discuss the tailings left in place during the expedited removal action (ERA). Also, "water" should be replaced with "waste" in the first sentence.*

Atlantic Richfield Company Response: Additional detail on the excavation extents during the Lower Area One Expedited Response Action were added, and "water" was replaced with "waste."

EPA Specific Comment 3: *Section 1.3.5, Page 7, 4th Bullet – According to the capture study, some portions of Silver Bow Creek (SBC) in the lower slag canyon are still gaining, even after regrading of the BRW-00 pond. Please discuss.*

Atlantic Richfield Company Response: Per Agency comments received via email on November 5, 2020, Atlantic Richfield has removed any references to the Draft Final BRW Capture Effectiveness Monitoring Technical Memorandum (2016 BRW Capture Effectiveness Tech Memo) since it has not been approved by EPA. Atlantic Richfield intends to incorporate historical data along with newer data collected during the BRW Site Investigations into a loading analysis that will evaluate which reaches of Silver Bow Creek are gaining and losing. The results of this loading analysis will be incorporated into the PDI

ER as the Phase II and Phase III Site Investigations are completed, including the required data validation.

EPA Specific Comment 4: *Section 2.0, Page 8 – The text states this section covers EPA guidance items 5 through 10 listed in Section 1.0, however this section also covers items 2 through 4, and items 8 through 10 are covered in section 3. Please modify the text accordingly.*

Atlantic Richfield Company Response: Text has been updated as requested.

EPA Specific Comment 5: *Section 2.2, Data Gaps –*

a) *Data Gap 3*
   i) *Organic impacts that originate within the site are called out for investigation. Section 6 of Attachment C within Appendix D states that 'any' dissolved phase or free product organic contamination found in groundwater shall be properly addressed by the SDs. Please remove the word "originating" from the data gap text.*
   ii) *How will primary and secondary sources be differentiated on site? Please explain in a bullet.*
   iii) *The plan for treatment and disposal of organic contamination has not been discussed. Will this discussion be included in the repository remedial design workplan and the pre-design investigation work plan? Please indicate here.*

b) *Data Gap 7*
   i) *Please include successful examples of liners installed at other sites.*
   ii) *Will the data be used in a groundwater model? Please explain how the new data will be used.*

c) *Please add data gap bullets to include the characterization of the contaminated metals plume that is located onsite of the BRW and the contaminated plume that is entering the BRW project area.*

d) *Consent Decree, Appendix D, Attachment C Section 6 - Data Gaps {k} identifies need for a plan to deal with organic contamination in soils and groundwater as a data gap that must be filled. Section 3.0, conceptual remedial design (RD) item 2, includes the need to manage organic-impacted soil and groundwater at the site, however the data gaps presented in this RD does not identify the plan. PDI WP Table 2 lists Plan to Manage Organic-Impacted Soil and/or Groundwater. Please include a bullet here identifying this plan.*

Atlantic Richfield Company Response: The following edits have been made to the text:

(a)(i) "Originating" has been removed from the data gap text. Atlantic Richfield intends to manage groundwater and soil within the Site impacted by organic pollutants in a manner that is complementary with the remedy. Organic pollutants (petroleum-compounds, polychlorinated biphenyls [PCBs], pentachlorophenol [PCPs], and dioxins) are secondary concerns for the Site; therefore, soil and groundwater within the Site that have been impacted

by these pollutants to concentrations above Site-specific action levels will be properly addressed/managed as part of the remedy. However, additional remediation of the soil and groundwater impacted with organic pollutants (i.e., treatment of organic pollutant sources) is not required by the BPSOU CD.

(a)(ii) It is not necessary to differentiate the primary and secondary source areas to complete the remedial design for the Site; therefore, the text was deleted.

(a)(iii) A management plan for soil impacted with organic pollutants will be included with the Intermediate 60% RD Report. This clarification has been added to this data gap.

(b)(i) The data gap text has been edited to include "successful and unsuccessful examples of liners installed at other sites."

(b)(ii) Additional text has been added to clarify how the data will be used. The data collected will be used to create a groundwater conceptual model that will be used to evaluate the effectiveness of the hydraulic control and evaluate if the relocated Silver Bow Creek channel will require a liner.

(c) Data Gap #4 includes collecting data regarding the groundwater chemistry within the Site and from nearby sources. The BPSOU SOW requires that contaminant of concern (COC)-impacted groundwater within the Site be hydraulically controlled to limit the extent of COC-impacted groundwater discharge to surface water and sediments in BPSOU generally and in the Site specifically. There are no requirements within the BPSOU CD or pre-design objectives that require the delineation of the extents of COC-impacted groundwater, which are anticipated to extend beyond the boundary of the Site. However, Atlantic Richfield will delineate the extents of the COC-impacted groundwater within the Site as this information would be helpful to complete the BRW hydraulic control design.

(d) See response to (a)(iii) above.

EPA Specific Comment 6: *Section 2.3, Page 9, 1st paragraph - Please delete "originating." See Specific Comment 5ai.*

Atlantic Richfield Company Response: "Originating" has been removed from the text.

EPA Specific Comment 7: *Pg. 9, Section 2.3, 2nd paragraph, 1st sentence – Please delete "the intent of."*

Atlantic Richfield Company Response: Text has been edited as requested.

EPA Specific Comment 8: *Section 2.6, Schedule - Considering the Phase III QAPP is preceding the completion of Phase II, it is currently unclear if all data gaps will be filled with the current proposed Phase III work. Please provide text that describes uncertainty of additional data gaps and apotential need to extend the Phase III schedule.*

Atlantic Richfield Company Response: Additional text has been added.

EPA Specific Comment 9: *Section 3.0 - Please add a subsection here that lists the Remedial Action objectives and a statement that the construction of the prescribed remedy is expected to contribute to the achievement of the objectives.*

Atlantic Richfield Company Response: The Remedial Action Objectives have been added to the text.

EPA Specific Comment 10: *Section 3.0, Page 11, first numbered list*

a) *Bullet 2: Please remove the word 'originating' from the bullet text (see Specific Comment 5ai).*
b) *Bullet 3: The data required, and modeling needed for developing the 100-year floodplain for the new SBC channel are not discussed within the RDWP or PDI WP. CD, Appendix D, Attachment C, Section 6.4 Bullet 4 and 5 has specific requirements as to how the 100-year flow and the base flood elevation need to be determined. Please include this in the minimum elements of the RD later in this section.*
c) *Figure 3 includes a proposed area designated for end land use which is not represented in this section. Please include a bullet describing end land use as a component of the conceptual RD.*

Atlantic Richfield Company Response: The following edits have been made to the text:

(a) The word "originating" has been removed from the text.
(b) Additional text has been added to the minimal elements of the RD.
(c) Additional text has been added to describe the end land use.

EPA Specific Comment 11: *Section 3.0, Page 11-12, second numbered list*

a) *There is currently no mention of a repository as part of the minimum RD elements.Please include a bullet (Waste Disposal) that describes a waste repository with associated haul routes will be a part of the RD.*
b) *Bullet 5. There is no mention of the potential need for soft armoring of the bank. CD,Appendix D, Attachment C, Section 3.4, bullet 7 lists soft armoring of the bank basedon hydraulic modeling as an element that needs to be addressed in the RD. Please include this element here.*
c) *The minimum elements of the remedial design adequately lists components of end use specifics such as planting and vegetation, irrigation, and architecture, there is no mention of a master plan to facilitate coordination between remedial activities*

and land use development/end land use objectives as stipulated in the Appendix D, Attachment C, Section 3.4, bullet 12 of the consent decree. Please include a bullet describing this master plan.

Atlantic Richfield Company Response: The following edits have been made to the text:

(a) A "waste disposal" element has been added to the list.
(b) "Soft armoring" has been added to the text.
(c) A reference to the Silver Bow Creek Conservation Area Master Plan has been added to the list of conceptual remedial design elements (first bullet list) under Section 3.2 Remedial Design.

EPA Specific Comment 12: *Section 5.1, Page 16, Preliminary (30 percent) RD - While this list of minimum requirements is consistent with the SOW, it is suggested that this section focus on deliverables that meet these requirements in greater detail and include actual components that relate to the project. The following is a suggestion on how to summarize the deliverables expected to meet the preliminary design requirements in the SOW and be in accordance with the RD/RA handbook:*

a) Design Criteria Report that includes (but not limited to) project description, design requirements (such as principles greener cleanups, monitoring and control measures, etc.) preliminary PFDs, and preliminary operations and maintenance(O&M) provisions.Based on the size and complexity of the project, it is reasonable to include the Basis of Design into the Design Criteria Report. As such, the Design Criteria Report should additionally include (but not limited to) design assumptions (including transportation options, disposal locations, excavation calculations, dewatering assumptions, geotechnical interpretations and data, etc.), plans to address substantial requirements ofpermits, evaluation of how ARARs will be met, plan to minimize negative effects on the environment and community, easements/access agreements, and preliminary P&IDs.

b) Preliminary Drawings that includes (but not limited to) a complete list of drawings, final PFD and P&IDs (if applicable), and preliminary site layouts (existing site plan,utilities, and site preparation plans).

c) Preliminary Specifications that includes (but not limited to) an outline of general specifications, drawings (complete list, final PFD and P&IDs, and preliminary sitelayout, existing site plan, utilities, and site preparation plans).

Atlantic Richfield Company Response: The description for the Preliminary 30% RD Report has been updated to include greater detail on components that relate to the project. Specifications will be provided with the Remedial Action Work Plan (RAWP). The draft RAWP will be submitted near the submittal of the Intermediate 60% RD. Additional text has been added to this report to provide clarification.

EPA Specific Comment 13: *Section 5.1, Page 16, Intermediate (60 percent) RD - Similar to the comment on the Preliminary Design, the following is a suggestion on how to summarize*

the deliverablesexpected to meet the intermediate design requirements in the SOW and be in accordancewith the RD/RA handbook:

a) *Design Criteria Report/Basis of Design that includes revisions from EPA/State/Stakeholder comments, updates to components where lagging PDI data is incorporated, and any other changes as new information becomes available.*

b) *Intermediate Drawings that include all applicable drawings (in preliminary form) thatrelate to the entire work including plans, sections, schematics, and detail drawings.*

c) *Intermediate Specifications that include all applicable specifications (in preliminaryform) that relate to the entire work in CSI format.*

d) *Updated RA Schedule*

Atlantic Richfield Company Response: The description for the Intermediate 60% RD Report has been updated to include greater detail on components that relate to the project.

EPA Specific Comment 14: *Section 5.1, Page 16-17, Pre-Final (95 percent) RD - Should include a continuation of deliverables identified above, as well as a Draft Construction Quality Assurance Plan and Draft O&M Manual.*

Atlantic Richfield Company Response: The description for the Pre-Final (95%) RD Report has been updated to include greater detail on components that relate to the project. A Construction Quality Assurance Plan and O&M Manual will be provided with the RAWP. The draft RAWP will be submitted near the submittal of the Intermediate 60% RD. Additional text has been added to this report to provide clarification.

EPA Specific Comment 15: *Section 5.1 (Final (100 percent) RD) - Should include all deliverables from the 95 percent but finalized for construction.*

Atlantic Richfield Company Response: Text has been edited to include "finalized for construction."

Specific Document Comments – Preliminary Design Investigation Work Plan

EPA Specific Comment 1: *Section 2.0, Page 2, 2nd Paragraph – Please add "ore concentrate" and "baghouse dust" to the list of waste types.*

Atlantic Richfield Company Response: Text has been updated as requested.

EPA Specific Comment 2: *Section 3.0, Page 4, 2nd Bullet – Please add "Butte Priority Soils Operable Unit (BPSOU)Draft Final Butte Reduction Works (BRW) Capture Effectiveness Monitoring Technical Memorandum."*

Atlantic Richfield Company Response: Per Agency comments received via email on November 5, 2020, Atlantic Richfield has removed any references to the 2016 BRW Capture

Effectiveness Tech Memo since it has not been approved by EPA and instead included references to the individual investigations and reports that are summarized within the 2016 BRW Capture Effectiveness Tech Memo.

EPA Specific Comment 3: *Section 3.3 Blue Seep Investigation, Page 5, 2nd paragraph, 4th sentence – The idea that metals are mobilized by "reduced (i.e., low oxygen) conditions caused by the abandoned sanitary sewer lines" is not likely unless the tailings are highly oxidized (with metals present within iron oxyhydroxides). Metals within tailings are typically present as sulfides,which are more stable under anoxic conditions compared to oxic. Please correct.*

Atlantic Richfield Company Response: Since the condition of the tailings is unknown, "likely" was changed to "possible."

EPA Specific Comment 4: *Section 3.4.2, Page 6 - Some of the most important findings of the report, in terms of the BRW area, were omitted from the summary. The pore water study contained within the report identified areas which had both a positive head and elevated metals concentrations within the slag canyon pore water. Left bank sample PO205, with a zinc concentration of 26,700 µg/L was particularly important in that it showed that the tailings within the FP98-1 area were an important source of zinc loading to SBC. The right bank samples showed that the groundwater capture by the hydraulic control channel extension/BRW-00 pond is only partial (consistent with the findings of AR's 2016 BRW Capture Effectiveness Tech Memo).*

Atlantic Richfield Company Response: Atlantic Richfield intends to incorporate historical data along with newer data collected during the BRW Site Investigations into a loading analysis that will evaluate which reaches of Silver Bow Creek within and immediately adjacent to the Site are gaining and losing. The results of this loading analysis will be incorporated into the PDI ER as the data from the Phase II and Phase III Site Investigations have been properly validated. At that time, applicable additional details and conclusions from the 2017 Groundwater and Surface Water Interaction Report will be included in the PDI ER.

EPA Specific Comment 5: *Section 5.4, Page 14, Additional Groundwater Characterization – Please update this discussion to reflect recent input from DEQ about using MPTP wells to monitor their interaction between the BRW dewatering and the MPTP groundwater remedy.*

Atlantic Richfield Company Response: Additional text has been added to clarify that existing monitoring wells within and adjacent to the Montana Pole and Treating Plant (MPTP) Site will be included (due to additional text, Section 5.4 is now Section 5.5 in the updated document).

EPA Specific Comment 6: *Section 5.4, Page 14, Additional SBC Loading Analyses – Will radon be the only way in which groundwater loading to SBC is measured? Shouldn't this data be used in conjunction with measured flow and metals concentration data in SBC? Please discuss.*

Atlantic Richfield Company Response: Additional detail has been added to this section to clarify how groundwater loading to Silver Bow Creek will be measured (due to additional text, Section 5.4 is now Section 5.5 in the updated document).

EPA Specific Comment 7: *PDI WP, Table 2 – The objective status is difficult to understand. There are multiple rows with green checks, indicating the objective has been met, followed by white plus signs in subsequent phases, indicating that additional data gathering is occurring. Please update table to correspond with current objective status.*

Atlantic Richfield Company Response: The table has been updated to reflect the current objective status. The green check indicates that enough data have been collected to fulfill the objective and complete the design, and typically the information was included as Data Quality Objectives for the indicated Site investigation. However, additional data may be collected during subsequent investigations to help further refine the data interpretation. The plus signs indicate when the additional "opportunistic" data will be collected to provide additional data to refine a completed objective, but these data are not necessary to complete the design.

End Comments.

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Final

Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Remedial Design Work Plan

Prepared for:

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Prepared by:

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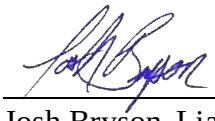
May 13, 2021

APPROVAL PAGE

Silver Bow Creek/Butte Area NPL Site
Butte Reduction Works Smelter Area
Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site
Remedial Design Work Plan

Approved: _____ Date: _____
Nikia Greene, Site Project Manager, EPA, Region 8

Approved: _____ Date: _____
Daryl Reed, Project Officer, Montana DEQ

Approved:  Date: 05/13/2021
Josh Bryson, Liability Manager
Atlantic Richfield Company

Approved:  Date: 05/13/2021
Don Booth, Quality Assurance Manager
Atlantic Richfield Company

Plan is effective on date of approval.

DOCUMENT REVISION TRACKING TABLE

Revision No.	Author	Version	Description	Date
Rev 0	Karen Helfrich	Final	Issued for Agency Approval	May 13, 2021

DISTRIBUTION LIST

Silver Bow Creek/Butte Area NPL Site
Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site
Remedial Design Work Plan

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ATTACHMENTS

ACRONYMS

Acronym	Description
ARARs	Applicable or Relevant and Appropriate Requirements
ARM	Administrative Rules of Montana
Atlantic Richfield	Atlantic Richfield Company
BNSF	Burlington Northern Santa Fe Railway
BPSOU	Butte Priority Soils Operable Unit
BRW	Butte Reduction Works
BSB	Butte-Silver Bow
BTL	Butte Treatment Lagoons
CCR	Construction Completion Report
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
DEQ	Montana Department of Environmental Quality
Domestic Manganese	Domestic Manganese and Development Company
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
FRE	Further Remedial Element
HCC	Hydraulic Control Channel
HSSE	Health, Safety, Security, and Environment
KRECCR	Key Remedial Elements Construction Completion Report
LAO	Lower Area One
LTTD	Low-temperature thermal desorption
MASW	Multichannel Analysis of Surface Waves
MBMG	Montana Bureau of Mining and Geology
MPTP	Montana Pole and Treating Plant
NPL	National Priorities List
NRDP	Natural Resource Damage Program
O&M	Operation and Maintenance
PCB	Polychlorinated Biphenyls
PCP	Pentachlorophenol
PDI	Pre-design Investigation
Pioneer	Pioneer Technical Services, Inc.
QA	Quality Assurance
QAO	Quality Assurance Officer
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RAO	Remedial Action Objectives
RBCA	Risk-Based Corrective Action
RD	Remedial Design
RAWP	Remedial Action Work Plan
RDWP	Remedial Design Work Plan
RFC	Request for Change
SBC	Silver Bow Creek
SSHASP	Site-Specific Health and Safety Plan
SD	Settling Defendants
TI	Technical Impracticability
USGS	U.S. Geological Survey
WP	Work Plan

1.0 INTRODUCTION

This Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Remedial Design (RD) Work Plan (WP) (referred to as the RDWP) provides the framework for developing design documents for the proposed remedy at the BRW Investigation Area (Site) shown in Figure 1. The proposed remedy involves removal of tailings, waste, impacted soils, and slag within the stream reconstruction corridor (referred to herein as the waste removal corridor) that fails the Waste Identification Screening Criteria (EPA, 2020) to a depth determined during the RD; construction of a hydraulic control system to manage groundwater impacted with contaminants of concern (COCs) (i.e., arsenic, cadmium, copper, mercury, lead, and zinc) to prevent exceedances of Performance Standards (EPA, 2020) under normal flow conditions in surface water and to limit loading of COCs from groundwater to sediments in Silver Bow Creek (SBC) within the Butte Priority Soils Operable Unit (BPSOU) generally and within the Site specifically; and reconstruction of SBC and the floodplain.

This RDWP has been developed consistent with applicable U.S. Environmental Protection Agency (EPA) guidance and decision documents, including the following:

- *Consent Decree* [CD] *for the Butte Priority Soils Operable Unit. Partial Remedial Design/Remedial Action and Operation and Maintenance* (BPSOU CD) (EPA, 2020), referred to herein as BPSOU CD.
- *Remedial Design/Remedial Action Handbook*, EPA 540/R- 95/059 (EPA, 1995).

This RDWP includes the following items:

1. Descriptions of any areas requiring clarification and/or anticipated problems (e.g., data gaps) (Section 2.2).
2. Description of the proposed Pre-Design Investigation (PDI) activities (Section 2.1).
3. A PDI Work Plan (WP) (Section 2.1 and Attachment 1).
4. Description of the high-level design data gaps and how the investigation activities detailed in the PDI WP will meet those data gaps (Section 2.2 and Attachment 1).
5. Description of the proposed treatability studies (Section 2.3).
6. Description of the applicable permitting requirements and other regulatory requirements (Section 2.4).
7. Description of the plans for obtaining access through property acquisition, leases, and/or easements (Section 2.5).
8. Plans for implementing all RD activities identified in the BPSOU CD for work that will be required to develop the RD (Section 3.0).
9. A description of the overall management strategy for performing the RD, including a proposal to conduct the design and construction activities in phases, if applicable (Section 3.0).

10. A description of the proposed general approach to contracting, construction, operation, maintenance, and monitoring of the Remedial Action (RA) as necessary to implement the RD (Section 3.0).
11. A description of the responsibility and authority of all the organizations and key personnel involved with the development of the RD (Section 4.0).
12. Appropriate reference to the following supporting deliverables: Site-Wide Health and Safety Plan; Site Wide Emergency Response Plan; and Quality Assurance Project Plans (QAPPs) (Sections 2.0 and 4.0).

1.1 Supporting Documents

This RDWP provides an overview of the RD work and is supported by the documents summarized in the following subsection.

1.1.1 BRW Phase I QAPP

The *Final Butte Reduction Works (BRW) Phase I Quality Assurance Project Plan (QAPP)* (Atlantic Richfield, 2021a) (BRW Phase I QAPP) describes the procedures and protocols necessary to collect and analyze data needed to further define the characterization of groundwater and solid materials within the Site. Additionally, the BRW Phase I QAPP lists the quality assurance/quality control (QA/QC) protocols to be followed during field data collection and laboratory analytical efforts. The BRW Phase I QAPP was initially approved by Agencies on August 31, 2018.

The BRW Phase I QAPP includes the Final BRW Phase I QAPP Request for Change (RFC) BRW-2019-01 (RFC BRW-2019-01) and the Final BRW Phase I QAPP RFC BRW-2019-03: Hydrocarbon Investigation (RFC BRW-2019-03).

- *RFC BRW-2019-01:* On October 11, 2019, Agencies approved RFC BRW-2019-01, which lists the procedures necessary to collect and analyze additional groundwater samples to further define the characterization of groundwater within the Site.
- *RFC BRW-2019-02:* The second RFC to the BRW Phase I QAPP (RFC BRW-2019-02) was revised and submitted as the BRW Phase II QAPP discussed below.
- *RFC BRW-2019-03:* On December 2, 2019, Agencies approved RFC BRW-2019-03, which provides details on the procedures and protocols necessary to conduct an investigation at the Site and define the characterization of groundwater and solid materials within the Site, especially with regard to the presence of petroleum-impacted soil and groundwater within the Site. Additional data quality objectives were developed to expand on those in the BRW Phase I QAPP to better define how to determine the nature and extent of petroleum-impacted materials within the Site.

1.1.2 BRW PDI Evaluation Report

Phase I Site Investigation activities began in August 2018 and were concluded in February 2020. The results and conclusions of the Phase I Site Investigation activities are summarized in the *Draft Final Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Evaluation Report* (BRW PDI Evaluation Report) (Atlantic Richfield, 2021b). Upon completion of subsequent Site investigation activities, the PDI Evaluation Report will be updated to include the new data and recommendations. The completed PDI Evaluation Report, evaluating the accumulated efforts of the Phase I, Phase II, and Phase III Site Investigations, will be submitted to the Agencies at the conclusion of the PDI field efforts and prior to submittal of the BRW Smelter Area Intermediate (60%) RD Report.

1.1.3 BRW Phase II QAPP

The *Final Revised Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Phase II Quality Assurance Project Plan (QAPP)* (Atlantic Richfield, 2021c) (BRW Phase II QAPP) describes the procedures and protocols necessary to fill the remaining data gaps related to the groundwater characterization and hydraulic control, the characterization of soil and groundwater impacted with organic pollutants (petroleum compounds, Polychlorinated Biphenyls [PCB], Pentachlorophenol [PCP], and dioxins) within the Site, the realignment of SBC, and provide additional details on the solid material characterization. Activities included conducting two pumping tests, pre- and post-pumping test groundwater sampling and analysis, a COC loading analysis for SBC, additional opportunistic solid material characterization, and an investigation of slag physical properties and demolition methods. The Phase II Site Investigation activities began in June 2020 and were concluded in April 2021.

The BRW Phase II QAPP includes the BRW Phase II QAPP RFC BRW-2021-01 (RFC BRW-2021-01) and the BRW Phase II QAPP RFC BRW-2021-02 (RFC BRW-2021-02).

- *RFC BRW-2021-01:* Prior to the approval of the BRW Phase III QAPP (Atlantic Richfield, 2021d) (BRW Phase III QAPP), Agencies approved RFC BRW-2021-01, which enabled a supplemental groundwater and surface water sampling event to occur during low-groundwater conditions and within the allotted timeframe of the Site Investigation schedule. The Data Quality Objectives for the supplemental sampling event are detailed in the BRW Phase III QAPP.

- *RFC BRW-2021-02:* This RFC adds monitoring well GW-13 to the sampling list included in RFC BRW-2021-01. It also provides the procedures and protocols necessary for Montana Department of Environmental Quality (DEQ) to sample monitoring wells GW-13 and GW-17 (originally included in RFC BRW-2021-01) on behalf of Atlantic Richfield Company as part of the supplemental groundwater and surface water sampling event included in RFC BRW-2021-01.

1.1.4 BRW Phase III QAPP

The *Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Phase III Quality Assurance Project Plan (QAPP)* (Atlantic Richfield, 2021d) (BRW Phase III QAPP) describes the investigation activities that will fill the remaining design-related data gaps. Additional data will be collected to fill the geotechnical considerations data gap and supplement the solid materials characterization, groundwater characterization, hydraulic control design, and design construction dewatering adjacent to the Montana Pole and Treating Plant (MPTP) Site. The Phase III Site Investigation will include installing additional soil borings to collect data to inform the hydraulic control design and determine the extent of waste removal within the waste removal corridor; conducting a geotechnical investigation to characterize the properties of subsurface materials to inform the end land use design features and the excavation surface; adding additional piezometers to the west of the Site; and conducting seasonal groundwater and surface water sampling events to provide the data necessary to optimize the SBC realignment design and BRW hydraulic control. The Phase III Site Investigation activities are anticipated to begin in May 2021, pending Agency approval.

1.1.5 BRW Smelter Area PDI WP (Attachment 1)

The PDI WP evaluates existing data and addresses data gaps that are necessary for completing the RD.

1.1.6 Remedial Design Reports

The BRW Smelter Area Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RD Reports are forthcoming and will provide an iterative approach to developing the final design. The Preliminary (30%) RD Report will focus on the Site excavation, backfill, and grading design along with the hydraulic modeling for the realigned SBC. Conceptual details on the BRW hydraulic control will be provided in the Preliminary (30%) RD Report, with a complete design of the BRW hydraulic control provided in the Intermediate (60%) RD Report after the PDI Evaluation Report is updated with results from the Phase II and Phase III Site Investigations. Additional design elements identified in Section 3.0 of this report will be presented initially in the Preliminary (30%) RD Report with additional detail provided in subsequent RD reports (i.e., 60% and 95%).

1.2 Site Description

The Site covers approximately 24 acres and is located in Butte, Montana, to the immediate west of Montana Street between SBC and the Burlington Northern Santa Fe Railway (BNSF) railroad line (Figure 1 and Figure 2). The Site is located in the west-central portion of the BPSOU (Figure 1) and within Lower Area One (LAO). The LAO is approximately 80 acres in size.

The BRW-00 Pond and the hydraulic control channel (HCC) function as a combined groundwater capture system within LAO. This system extends across LAO from the east boundary to the west boundary, having a combined length of over 1 mile. The Butte-Silver Bow

(BSB) municipal wastewater treatment plant bisects LAO, separating the Butte Treatment Lagoons (BTL) on the western half of LAO from the BRW Site on the eastern half of LAO (Figure 2).

The Site is located within an urban area and adjacent to other impacted areas. To the south and west of the Site, the MPTP Water Treatment Plant treats extracted groundwater impacted by nearly 40 years of uncontrolled releases of a solution of approximately 5% PCP mixed with a petroleum carrier oil that was used to preserve poles, posts, and bridge timbers from 1946 to 1984 (Figure 2) (EPA, 2017).

Historically, the BRW area included several different smelting configurations and was also used by the Domestic Manganese and Development Company (Domestic Manganese) (Sanborn, 1943). The operations left behind a complex distribution of materials (including slag, tailings, manganese waste, ore concentrate, baghouse dust, demolition debris, foundations, and other historic structures) as well as impacted soils and groundwater. Currently, the Site is used by BSB for construction aggregate and equipment storage.

1.2.1 Climate

The Butte area climate is characterized by short, cool, dry summers and long, cold winters. The annual precipitation in Butte generally varies from 8 to 20 inches per year, with an average of 13 inches. The greatest amount of precipitation, approximately one third, occurs during the months of May and June (obtained from the National Oceanic and Atmospheric Administration website at www.noaa.gov/climate.html for 1990 to 2019, excluding 2014 for which there was insufficient data).

1.2.2 Topography

While the native terrain underneath the Site is relatively flat, the current topography is complex. Multiple structures, piles of various materials from historic and recent industrial activities, and historic features are scattered throughout the Site. The north and west boundary of the Site is SBC, the south boundary is the BNSF railroad line, and the east boundary is Montana Street (Figure 2).

1.2.3 Geology

The Butte area lies within the Summit Valley of southwest Montana and is characterized by Quaternary alluvium surrounded by the Butte Granite of the Cretaceous Boulder Batholith (*Geologic Map of the Upper Clark Fork Valley, Southwestern Montana, Open File Report 506,* [MBMG, 2004]). The alluvial aquifer beneath the Site is relatively uniform in thickness (from 22 to 35 feet) with weathered and/or competent bedrock underneath. The top of alluvium may be marked by a layer of black organic silt on top and consists of alternating layers ranging from fine sand to medium gravel. Groundwater travels through alluvium and decomposed granite via the small, interconnected pore spaces, and travels through competent bedrock via fractures (Atlantic Richfield, 2021b).

1.2.4 Surface Water

As shown in Figure 2, SBC travels along the northern and western boundary of the Site. The current path of SBC along these boundaries is not the historical one, as operations at the BRW Smelter shifted the creek channel to the north. The relatively consistent depth to bedrock underneath the Site controls the surface water/groundwater interaction. This is in stark contrast to the upwelling groundwater located to the east of Montana Street, where a rapidly shallowing bedrock surface forces groundwater into Blacktail Creek and a series of natural groundwater-fed wetlands that exist between Lexington Avenue and Montana Street.

1.2.5 Groundwater

As groundwater enters the Site within the alluvial system, the flow direction is generally from southeast to northwest. The flow direction to the east of the Site generally mimics the lay of the land (i.e., topographic slope) and, due to the shallowing bedrock depth, historically flowed toward and into SBC and adjacent wetlands.

Currently, with the completion of the LAO expedited response action (ERA) (Atlantic Richfield, 2002) and the regrading of the BRW-00 Pond (Atlantic Richfield, 2012a), the area of lowest potential (i.e., water level elevation) in the vicinity of the Site is the BRW-00 Pond and the HCC. The groundwater beneath the Site is located within the alluvial aquifer Technical Impracticability (TI) Zone adopted by EPA in the 2006 Record of Decision (EPA, 2020) and incorporated into the BPSOU CD where cleanup standards are waived (Figure 1). Groundwater quality standards apply to groundwater at and beyond the edge of this boundary. The Site is also located within the Butte Alluvial and Bedrock Controlled Groundwater Area, which restricts and controls installation and use of private wells.

1.3 Background

Almost the entire footprint of the Site has been affected by multiple industrial operations from 1885 to the present day. This section outlines the history.

1.3.1 1883 (Approximately) to 1910: BRW Smelter

In 1885, the first smelting furnace was built at the Site with a capacity of about 45 tons per day. During its operation from 1885 to 1910, the BRW Smelter was continually expanded and the equipment was constantly modified, improved, or replaced. As a result, the plant's capacity increased to approximately 1,000 to 1,100 tons per day. In 1908, an experimental concentrator was constructed to evaluate techniques for concentrating zinc ores from the Elm Orlu mine (Quivik, 1998). In 1910, the BRW Smelter discontinued operations and shortly after most of the structures were demolished.

The concentration and smelting processes generated both tailings and slag. Tailings were mostly generated in the concentrator, while slag was generated in the furnaces. When the first concentrator was built, tailings were simply discharged into SBC. Around 1897, the BRW Smelter began building an open culvert or flume in the original bed of SBC to allow the creek to

flow through the tailings dump without eroding the tailings. This culvert was built of pilings and plank sidewalls. Later, a second culvert was built north of the first culvert. This culvert, initially built of pilings and plank sidewalls, was later built with concrete and reinforced slag, and was continuously expanded to keep up with the tailings dump (Quivik, 1998).

1.3.2 1927 to 1945: Manganese Plant and Stockpiling Ore

In 1927, a manganese plant was built with some of the structures existing on the Site. The plant was built to process manganese ore from the Emma mine into concentrated manganese nodules and went into operation in March 1928. The plant was operated by Domestic Manganese who leased the land from the Anaconda Copper Mining Company. Ultimately, the plant did not live up to its expectations as the Emma mine could not always produce the quality of ore needed by the plant. From 1927 to 1940, the plant sporadically processed ore (GCM Services, Inc., 1991).

As a result of World War II and the demand for manganese, Domestic Manganese, as an agent of the Metals Reserve Company, began treating manganese ores from mines in the Philipsburg area in 1944. The plant operated through 1945 when the war ended. During that time approximately 30,000 to 40,000 tons of ore were stockpiled at the Site. After the plant shut down, the General Services Administration, and then the Department of Defense, continued to stockpile ore on the Site (GCM Services, Inc., 1991).

1.3.3 Early 1960s: Phosphate Plant

During the early 1960s, Rocky Mountain Phosphates, Inc. leased the Domestic Manganese facilities on the Site for a phosphate plant operation. The plant operated from 1961 until it was shut down by a court injunction on May 2, 1963 (GCM Services, Inc., 1991).

1.3.4 Mid-1990s to Date: BSB Asphalt Plant

Since the mid-1990s, the Site has been used by BSB for construction aggregate mixing and storage and as an asphalt plant. The Site was used by BSB during the LAO ERA work (Atlantic Richfield, 2002). Currently, BSB is in the process of removing equipment and materials from the Site.

1.3.5 1992 to Date: Response Activities in and around the BRW Smelter Area

Response activities at the Site began with the removal of stockpiled manganese ore in 1992 (Helgen, Davis, and Nicholson, 2007). Response activities on other land in the LAO area, including the removal of approximately 1.2 million cubic yards of tailings and impacted soils, reconstruction of the SBC stream and floodplain, and other actions, began in 1994 and continued until about 2014 and are outlined below:

- *1994 to 1998 LAO ERA*: Approximately 1.25 million cubic yards of mine waste materials and tailings impacted soils were removed and disposed of from the LAO area west of the Site. On the east end of LAO ERA (west portion of the Site), there were some areas where the existing ground surface was below the required removal surface because the

computer-generated excavation surface was interpolated from the top of the slag wall. In these areas the surface was excavated to an appropriate depth determined during the construction to construct the flood channel. The area was backfilled, a diverse and natural vegetative cover was planted, and SBC and the floodplain along the south portion of the LAO area were reconstructed. Additional construction included the installation of the HCC and flow control structures (Atlantic Richfield, 2002).

- *Abandoned Aqueduct Head Gate Improvements*: In April 2011, improvements were made to the Abandoned Aqueduct head gate (located north of the Site) to reduce the interaction of SBC with the impacted materials contained within the Abandoned Aqueduct (Atlantic Richfield, 2011).
- *2011 to 2014 Upgrades to the BTL*: The BTL was upgraded to a full-scale permanent system. The West Camp Pump Station (WCP-1) was also upgraded at this time.
- *Regrading of BRW-00 Pond*: Completed in 2011, the regrading of BRW-00 Pond physically lowered the elevation at which local groundwater entered the BRW-00 Pond, increasing the groundwater gradient from SBC to the BRW-00 Pond (Atlantic Richfield, 2012a).
- *East End Culvert Removal*: In 2012, two culverts were removed from the eastern portion of LAO to lower the surface water elevation in SBC, upstream of the culverts, by approximately 1 foot (Atlantic Richfield, 2012b).

The BPSOU CD, which became effective on November 16, 2020, identified a number of further remedial elements required to complete the BPSOU remedy, one of which (the BRW Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control) addresses the Site. The BPSOU CD outlines the specific RD requirements and identifies several data gaps related to the BRW RA design. Site investigations are necessary to fill the data gaps outlined in the BPSOU CD (the investigations are detailed in the PDI WP in Attachment 1) and to characterize the Site in more detail to support future RA design activities.

1.4 Relevant Previous Investigations

Several previous investigations at the Site are relevant to the RD work. The PDI WP in Attachment 1 includes descriptions of these investigations.

2.0 DESIGN SUPPORT ACTIVITIES

This section describes the PDI activities and the data gaps, treatability, permitting, and access plans (EPA guidance items 1 through 7 listed in Section 1.0). Key points of the PDI are in this section and details are in the PDI WP (Attachment 1).

2.1 Pre-Design Investigation

The Site has been characterized to some degree by previous investigations; however, more detail is needed to guide the decision making for future response actions in the area. The PDI activities for the Site will be completed in multiple phases. Details on the Site investigations are provided in the PDI WP (Attachment 1).

2.2 Data Gaps

The data gaps needed to support RD for the Site have been identified by the design team after reviewing existing data and documents, as follows:

1. Define the lateral limits, thickness, and base of tailings, waste, COC-impacted soil, and slag in or adjacent to the waste removal corridor and estimate the total volumes of tailings, waste, COC-impacted soil, and slag.
2. Define the lateral limits, thickness, and base of potential fill materials and estimate the total volume of potential fill materials.
3. Define the nature and extent of organic-pollutant impacts within the Site and develop a plan to manage soil and groundwater impacted with organic pollutants (petroleum compounds, PCB, PCP, and dioxins) within the Site, including development of Site-specific action levels. Additional data needed may include thickness and transmissivity of impacted materials, aquifer characteristics, and soil quality data (natural organics and major cations such as iron and manganese). A management plan for soil and groundwater impacted with select organic pollutants (petroleum compounds, PCBs, PCP, and dioxins) above Site-specific action levels will be included with the Intermediate 60% RD Report. Atlantic Richfield intends to manage groundwater and soil within the Site impacted by organic pollutants in a manner that is complementary with the remedy. Organic pollutants are secondary concerns for the Site; therefore, soil and groundwater within the Site that have been impacted by these pollutants to concentrations above Site-specific action levels will be properly addressed/managed as part of the remedy. However, additional remediation of the soil and groundwater impacted with organic pollutants (i.e., treatment of organic pollutant sources) is not required by the BPSOU CD.
4. Refine data for groundwater characteristics to design a plan for construction dewatering and to aid in the design of the hydraulic control for COC-impacted groundwater to prevent exceedances of Performance Standards (EPA, 2020) under normal flow conditions in surface water and to limit loading of COCs from groundwater to sediments in SBC within the BPSOU generally and within the Site specifically. Data needed include groundwater chemistry and elevations within the Site, potentiometric surfaces (including seasonal changes), data collected via two aquifer tests (i.e., hydraulic conductivity, transmissivity, aquifer geometry, etc.), COC loading to SBC, and groundwater chemistry and elevations from nearby impacted sites. The data collected will be used to create a groundwater conceptual model that will help delineate the extents of COC-impacted groundwater within the Site and evaluate the impact of groundwater on SBC, which will be used to evaluate the options for construction dewatering and select the final hydraulic control remedy for the Site.

5. Determine geotechnical parameters that are related to the removal of durable materials (i.e., excavation or other removal methods for poured slag and other debris), construction of end land use features, and design of the excavation surface to ensure stable slopes.
6. Determine the SBC bottom invert at the upstream and downstream tie-in locations of the reconstructed stream.
7. Collect relevant data to determine if the relocated SBC channel will require a liner. Data needed may include groundwater elevations, groundwater chemistry adjacent to and upgradient of the proposed channel alignment, underlying soil chemistry and leachability of COCs, aquifer parameters, and successful and unsuccessful examples of liners installed at other sites. The data collected will be used to create a groundwater conceptual model that will be used to evaluate the effectiveness of the hydraulic control and evaluate if the relocated SBC channel will require a liner.
8. Define the property boundary for the BNSF railroad to the south and determine required setbacks for construction activities.
9. Inventory the locations and properties of utilities, infrastructure, and any historic or cultural sites that might be on or adjacent to the Site that will need to be avoided, removed, or replaced during construction.

The PDI WP (Attachment 1) addresses these data gaps and summarizes how each investigation phase will fill the data gaps.

2.3 Treatability Study for On-Site Organic Contamination

Solid material and groundwater within the Site may be impacted with hydraulic oils, crude oil, fuels, volatile organic compounds, and other non-hazardous organic and petroleum materials. Additional evaluation of the material impacted by organic pollutants is needed to refine the extent and nature of the impacted material within the Site and help develop a plan to manage impacted soil and groundwater within the Site.

Atlantic Richfield intends to manage groundwater and soil within the Site impacted by organic pollutants in a manner that is complementary with the remedy. Organic pollutants (petroleum-compounds, PCBs, PCPs, and dioxins) are secondary concerns for the site; therefore, soil and groundwater within the Site that have been impacted by these pollutants to concentrations above Site-specific action levels will be properly addressed/managed as part of the remedy. However, additional remediation of the soil and groundwater impacted with organic pollutants (i.e., treatment of organic pollutant sources) is not required by the BPSOU CD.

During the RD, an evaluation will be completed following the State of Montana Risk-Based Corrective Action (RBCA) procedures (DEQ, 2018). The RBCA evaluation will be submitted with the BRW PDI Evaluation Report and will outline the RBCA process and future site use(s) and identify a proposed management action to protect human health and environment. Due to the complexity of the Site, Atlantic Richfield intends to complete a Tier 3 evaluation and develop Site-specific action levels for soil and groundwater impacted with organic pollutants within the

Site. Once the Phase II and Phase III Site Investigations are completed, the RBCA evaluation will be finalized, including a Tier 3 evaluation and proposed site-specific action levels.

Multiple alternatives may be evaluated based on cost, performance, reliability, implementation, safety, and effects on public health and the environment. Options that may be evaluated include, but are not limited to, the following:

- No-Action Alternative (Monitoring Natural Attenuation).
- Soil Removal and Disposal.
- Treatment Technologies for Organic Contamination within the Site.

For the options above that include treatment, a study will be conducted to evaluate the management effectiveness. A management plan for soil impacted with select organic pollutants (petroleum compounds, PCBs, PCP, and dioxins), including Site-specific action levels, will be included with the Intermediate 60% RD Report.

2.4 Permitting/Regulatory Requirements

Only the substantive requirements (i.e., compliance with numerical standards, use of control/containment equipment, etc.) associated with Applicable or Relevant and Appropriate Requirements (ARARs) apply to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on-site activities. According to CERCLA Section 121[e][1], ARARs associated with administrative requirements, such as permitting, are not applicable to CERCLA on-site activities. The RD for the Site will incorporate the substantive environmental permitting/regulatory requirements; in particular, the action-specific ARARs identified in the BPSOU CD. The exact requirements will be detailed in the forthcoming design documents.

2.5 Access Plan

Atlantic Richfield owns the Site property. If Atlantic Richfield needs access to adjacent private property to complete the RA-related activities (including sampling and monitoring), Atlantic Richfield will request that all private property owners grant access to their properties for all RA-related activities. Atlantic Richfield and/or its representatives will maintain copies of completed agreements received from property owners. Completed agreements will be photocopied and scanned with the electronic version stored on a networked server.

2.6 Schedule

The proposed schedule for deliverables outlined in this RDWP is specified in Attachment 2; this includes the completed Phase I and Phase II Site Investigation activities and the proposed Phase III Site Investigation activities. The results and conclusions of the Phase I Site Investigation activities are summarized in the BRW PDI Evaluation Report (Atlantic Richfield 2021b). The PDI Evaluation Report follows the guidance provided by EPA in the BPSOU CD.

At the conclusion of each additional Site investigation phase (i.e., Phase II and Phase III), the BRW PDI Evaluation Report will be updated and re-submitted with data collected from that Site investigation phase along with updated recommendations and conclusions. Because the Phase III Site Investigation is preceding the submittal of the updated PDI Evaluation Report with the Phase II Site Investigation data, there is a possibility that additional data gaps will be identified by Agencies while reviewing the results from the Phase II Site Investigation. If additional data gaps are identified, this may potentially require additional work not captured in the current schedule. If additional work is required, an RFC to the applicable QAPP will be submitted for Agency review and approval prior to completing the additional work.

A Preliminary (30%) RD Report will be developed by Pioneer Technical Services, Inc. (Pioneer) and submitted to the Agencies in early 2021. Following submittal of the Preliminary (30%) RD Report, the Intermediate (60%), Pre-Final (95%), and Final (100%) RD reports will be completed and subsequently submitted for Agency review and approval. This iterative approach fosters collaboration between all parties involved.

The RA activities in the BPSOU are anticipated to be completed by the end of 2028 in accordance with the BPSOU CD. A final RA Construction Completion Report (CCR) will be submitted to the Agencies within 60 days of the final inspection of the Site.

Effective, open communications will be critical to achieving timely completion of the project. As such, periodic meetings between EPA and Atlantic Richfield will be scheduled to discuss the status of ongoing efforts, upcoming events, and deliverables and to resolve any issues that may arise. Because of the uncertainty associated with the schedule for several tasks that are out of Atlantic Richfield's control (e.g., seasonal constraints, EPA review periods, the need to fill data gaps, etc.), Attachment 2 lists important deliverables and design activities relative to key milestones and other conditions.

3.0 REMEDIAL DESIGN OVERVIEW

This section summarizes the RD and outlines the overall management strategy to perform the RD and the approach to contracting (as outlined in the BPSOU CD and Items 8 through 10 in Section 1.0).

3.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) are the media-specific statements regarding the objectives to be achieved by the RA. The RAOs for solid media (tailings, waste, impacted soil, and slag), surface water, and groundwater are outlined in Section 8 of the 2006 BPSOU ROD (Appendix A to the BPSOU CD) and are summarized in the sections below. The RD detailed in Section 3.2 is expected to contribute to the achievement of the RAOs.

3.1.1 Solid Media

The RAOs for solid media are outlined by EPA in Section 8 of the 2006 BPSOU ROD (Appendix A to the BPSOU CD), and are listed below.

- *"Prevent the ingestion of, direct contact with, and the inhalation of, contaminated soils, indoor dust, waste rock, and / or tailings or other process waste that would result in an unacceptable risk to human health assuming current or reasonably anticipated future land uses.*

- *Prevent releases of contaminated solid media to the extent that they will not result in an unacceptable risk to aquatic environmental receptors.*

- *Prevent releases of contaminated water from solids media that would result in exceedances of the Montana State Water Quality Standards for surface water.*

- *Prevent releases of contaminated water from solid media that would result in exceedances of the Montana State Water Quality Standards for groundwater, except where ARAR waivers are appropriate and other means to protect from associated risks are available.*

- *Remediate contaminated solid media to the extent that it will not result in an unacceptable risk to human health and/or aquatic environmental receptors.*

- *Prevent release of contaminated water from solid media that would result in degradation of surface water, in accordance with the surface water RGs."*

3.1.2 Surface Water

The RAOs listed in the 2006 BPSOU ROD for contaminated surface water remain unchanged for the 2020 ROD Amendment (BPSOU CD), except for the need to waive certain Circular DEQ-7 standards (DEQ, 2019), which will be replaced by federal water quality criteria. The surface water RAOs (from the BPSOU CD) are:

- *"Prevent ingestion or direct contact with contaminated surface water that would result in an unacceptable risk to human health.*

- *Return surface water to a quality that supports its beneficial uses.*

- *Prevent source areas from releasing contaminants to surface water that would cause the receiving water to violate surface water ARARs and remedial goals (or replacement standards for ARARS appropriately waived) for the BPSOU and prevent degradation of downstream surface water sources, including during storm events.*

- *Ensure that point source discharges from any water treatment facility (e.g., water treatment plant, wetland) meet ARARs.*

- *Prevent further degradation of surface water.*

- *Meet or appropriately waive and replace the more restrictive of chronic aquatic life or human health standards for surface water identified in Circular DEQ-7 through the application of B-1 class standards."* B-1 class standards are as defined by the Montana Clean Water Act.

3.1.3 Groundwater

The RAOs for groundwater are outlined by EPA in Section 8 of the 2006 BPSOU ROD (Appendix A to the BPSOU CD), and are listed below.

- *"Prevent ingestion or direct contact with contaminated groundwater that would result in an unacceptable risk to human health.*
- *Prevent groundwater discharge that would lead to violations of surface water ARARs and RGs for the BPSOU.*
- *Prevent degradation of groundwater that exceeds current standards."*

3.2 Remedial Design

The design will be detailed in the Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) documents. These design documents will be supported by the results of the PDI to fill data gaps. The design documents will include the design drawings and technical specifications. Because the RD construction design documents will be developed with input from EPA, DEQ, BSB, and the public through an iterative process, only a high-level overview is provided in this RDWP.

The conceptual RD is shown on Figure 3 and will include the following:

1. Remove waste (as defined by the BPSOU CD Waste Identification Screening Criteria [EPA, 2020]) from the Site in a corridor that will contain a new channel for SBC to a depth determined during the RD.
2. Manage soils and groundwater within the Site impacted by organic pollutants, as appropriate and in a manner that is complementary with the remedy. Organic pollutants (petroleum-compounds, PCBs, PCPs, and dioxins) are secondary concerns for the Site. Soil and groundwater within the Site that have been impacted by these pollutants to concentrations above Site-specific action levels will be properly addressed/managed as part of the remedy. However, additional remediation of the soil and groundwater impacted with organic pollutants (i.e., treatment of organic pollutant sources) is not required by the BPSOU CD.
3. Realign SBC and construct the bank-full channel and 100-year floodplain.
4. Regrade and construct caps over the tailings, waste, impacted soil, and slag left in place. Regrading will be conducted outside of the waste removal corridor to produce a land surface acceptable for future end land uses. The end land use design for the Site will be derived from concepts presented within the SBC Conservation Area Master Plan (LDI,

2020). The Site will be open area with trails, landscaping, an amphitheater[1], and the reconstructed portion of SBC.

5. Hydraulically manage COC-impacted groundwater from the Site to prevent exceedances of Performance Standards (EPA, 2020) under normal flow conditions in surface water and to limit loading of COCs from groundwater to sediments in SBC within the BPSOU generally and within the Site specifically.

The RD will include, at a minimum, the following elements:

1. Site Controls (plot plans, existing topography and survey control, construction fencing, temporary traffic control, construction staging and field office areas, construction stormwater management, etc.).
2. Site Excavation (horizontal and vertical extents, salvage and stockpile, laybacks, dewatering, etc.).
3. Waste Disposal (repository location and associated haul routes).
4. Site Backfill and Grading (Site backfill and reconstruction, general fill and subbase placement, and rough grading).
5. Engineered Covers (placement, grading, and amendment specific to zone).
6. SBC Stream (new stream alignment, hydraulic modeling and sediment transport modeling, stream bed materials, soft armoring, liner system [if necessary], etc.). The floodplain must be designed to convey a 100-year flow rate of 493 cubic feet per second, as determined in the CD. The 100-year flood elevation will be determined based on the calculated 100-year flow via appropriate hydraulic modeling methods. All connected areas below this elevation will be considered in the "100-year floodplain." The channel will be sized to convey a bankfull flow rate equivalent to the 1.5 year (or similar) recurrence and will be calculated through appropriate Bulletin 17B statistical analysis of data available from the U.S. Geological Survey (USGS) stream gage sites 12323240 on BTC and 12323250 on SBC.
7. Hydraulic Control System for COC-impacted groundwater (alignment, groundwater modeling, construction details, etc.). The groundwater modeling will be used to design the BRW hydraulic control to meet the defined objective, which is to prevent exceedances of Performance Standards (EPA, 2020) under normal flow conditions and to limit loading of COCs from groundwater to sediments within the BPSOU.
8. Instrumentation and Controls (piping and instrumentation, logic, controls, etc.), if necessary.
9. Civil Infrastructure (water, sanitary sewer, storm sewer, Site electrical and lighting, curb and gutter, parking lots, access roads, etc.).
10. Landscape (landscape grading/contouring, hardscapes, community spaces, education and interpretation, boardwalk and trails, wayfinding, etc.).

[1] Design, construction, and operation and maintenance of the amphitheater requires mutual agreement of Atlantic Richfield Company and Butte-Silver Bow, and identification and commitment of a third-party investor and operator.

11. Planting and Vegetation (wetland protection/mitigation requirements, wetland species placement, tree and shrub placement, manicured spaces, seeding and fertilizer, erosion, and depredation control).
12. Irrigation (initial establishment, interim maintenance, trees/shrubs, riparian corridor, manicured spaces).
13. Architectural (shelters and structures including mechanical, plumbing, and electrical where necessary).
14. Institutional and Engineered Controls (e.g., signage, fencing, and maintenance agreements).
15. Consideration of preservation, documentation, and/or mitigation activities for historical or cultural significant features, such as the slag walls.

3.3 Management Strategy

The general management strategy for the Site's RD is for Atlantic Richfield to manage the project design using one design engineer for the RD and one contractor for implementation of the RA. All design documents will be submitted to and reviewed and approved by EPA, in consultation with DEQ. Atlantic Richfield will implement the Site RD and RA as outlined in Section 2.6. Details on the organizational structure, roles, and responsibilities are provided in Section 4.0. Data management procedures are provided in the respective QAPPs listed in Section 1.1.

4.0 PROJECT ORGANIZATION

This section provides descriptions of the responsibility and authority of key organizations and personnel involved with the development of the RD (EPA Guidance Item 11 [Section 1.0]).

4.1 Key Organizations

The key organizations and their roles and responsibilities are listed below.

4.1.1 Environmental Protection Agency

EPA is the lead agency for RD/RA efforts by the Settling Defendants (SDs) (Atlantic Richfield and BSB) in the SBC/Butte Area National Priorities List (NPL) Site. EPA will lead communications with Atlantic Richfield, DEQ, and BSB. EPA will review and authorize this RDWP and the associated Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs and RA work plans (RAWPs). During construction, EPA may participate in pre-construction Site walks and pre-final and final inspections. EPA will attend the weekly progress meetings and review daily construction reports provided by Atlantic Richfield via email and will communicate any concerns or questions to Atlantic Richfield. EPA will also provide QA oversight to ensure the RD is being implemented as designed and approved. EPA will also review and approve the final project RA CCR.

4.1.2 Montana Department of Environmental Quality

The DEQ is the state agency for review of RD/RA efforts by the SDs in the SBC/Butte Area NPL Site. The DEQ will review and provide comments to EPA on the associated Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs and RAWPs. During construction, the DEQ may participate in technical meetings, pre-construction Site walks, and pre-final and final inspections. The DEQ will attend the weekly progress meetings and review daily construction reports provided by Atlantic Richfield via email and will communicate any concerns or questions to EPA.

4.1.3 Atlantic Richfield Company

Atlantic Richfield will manage the project RD and RA construction. Atlantic Richfield will administer the contract and monitor the overall progress of RD and RA activities conducted under the project and will be the primary authority regarding interpretation of the project requirements.

4.1.4 Butte-Silver Bow

BSB is the local agency for coordination and review of RD and RA efforts conducted in the SBC/Butte Area NPL Site. A BSB representative will review and provide comments to EPA on the associated Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs and RAWPs. Once reclamation is complete, long-term operation and maintenance activities will be turned over to BSB.

4.1.5 Pioneer Technical Services, Inc.

Pioneer is the Atlantic Richfield engineer for investigation and preliminary design activities at the Site. Pioneer will be responsible for administering subcontracts for the necessary remaining professional services including, but not limited to, landscape architecture and architectural design. Pioneer developed this RDWP and associated PDI WP in Attachment 1. Pioneer will also develop the associated Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs, the RAWP, and bid documents.

4.1.6 Construction Contractor

The selected contractor will be responsible for executing the project in strict compliance with the RD, RAWP, and technical specifications. The contractor will have primary responsibility for project safety, construction activities, subcontractor management, daily project documentation, and reporting, and the construction QC measures associated with implementing the RA. An independent QA contractor will be selected by Atlantic Richfield to oversee construction activities. Atlantic Richfield will select the contractor and inform EPA of its choice prior to starting the project.

The contractor will be responsible for attending weekly progress meetings, providing required status reports and two-week look-ahead schedules, and discussing any construction issues that occur or may occur.

4.1.7 Contract Laboratory

The Contract Laboratory will ensure that the laboratory QA personnel are familiar with the QAPPs (refer to Section 1.1) and any associated RFCs and are available to perform the work as specified. Contract Laboratory personnel will be responsible for reviewing final analytical reports produced by the laboratory, scheduling laboratory analyses, and supervising in-house chain of custody procedures.

4.2 Key Personnel

Key personnel and their roles and responsibilities for the Site are listed below. During construction activities, EPA, DEQ, Atlantic Richfield, and the contractor(s) will be coordinating or attending (as necessary) technical meetings, pre-construction Site walks, weekly progress meetings, and pre-final and final inspections.

4.2.1 EPA Remedial Project Manager

Mr. Nikia Greene is the EPA remedial project manager for this work. Mr. Greene is based in the EPA Region 8 office in Helena, Montana. He will be the primary contact for EPA and ensure that RDs and RAs comply with the Agency RD/RA Scope of Work. Mr. Greene will be responsible for review and approval of this RDWP and the Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs and RAWP. During construction Mr. Greene will be responsible for providing construction oversight on behalf of EPA.

4.2.2 DEQ Project Officer

Mr. Daryl Reed is the DEQ project officer for this work. Mr. Reed is based in the DEQ Remediation Division office located in Helena, Montana. He will be the primary contact for DEQ and ensure that RDs and RAs comply with the Agency RD/RA Scope of Work. Mr. Reed will be responsible for review and approval of this RDWP and the Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs and RAWP on behalf of the DEQ.

4.2.3 Atlantic Richfield Liability Manager

The Atlantic Richfield liability manager is Mr. Josh Bryson, who is responsible for overall programmatic planning for technical and administrative components of RD and RA work completed by Atlantic Richfield. Mr. Bryson will be the primary technical point of contact for EPA, DEQ, BSB, and the project engineer and contractor.

4.2.4 Atlantic Richfield Quality Assurance Manager

The Atlantic Richfield QA Manager (QAM) for the project is Mr. Don Booth. Mr. Booth will interface with the Atlantic Richfield liability manager on company policies regarding quality and has the authority and responsibility to approve QA documents specific to the project.

4.2.5 Pioneer Project Manager

Atlantic Richfield will contract directly with Pioneer who will serve as the Atlantic Richfield Representative for the investigation and pre-design phases of the project. Pioneer's project manager for Atlantic Richfield is Ms. Karen Helfrich, P.E. Ms. Helfrich will be responsible for ensuring the PDI WP (Attachment 1) is implemented and coordinate all project-specific assignments and provide overall project direction to the Pioneer team. Ms. Helfrich will be the primary contact for Atlantic Richfield. Responsible for developing this RDWP, she will also be responsible for the Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RDs and RAWP.

4.2.6 Field Team Leader

The Field Team Leader for the field investigations and pre-design activities is Ms. Kendra Jackson. Ms. Jackson will ensure that all members of the field team review and follow the BRW QAPPs and associated RFCs when implementing field activities. The Field Team Leader will also be responsible for maintaining any task-specific QAPPs. The Field Team Leader will conduct daily safety meetings, assist in field activities, and document activities in the logbook. The Field Team Leader will be responsible for equipment coordination, problem solving, and decision making in the field for technical aspects of the project. Additionally, the Field Team Leader will provide "on-the-ground" overviews of project implementation by observing Site activities to ensure compliance with technical project requirements; Health, Safety, Security, and Environment (HSSE) requirements; and the Site-Specific Health and Safety Plan (SSHASP). Finally, the Field Team Leader will identify potential integrity management issues, as appropriate, and prepare required project documentation.

4.2.7 Quality Assurance Officer

The QA Officer (QAO), Mr. Thomas Brown, P.E., from Pioneer, will be responsible for reviewing field and laboratory data and evaluating data quality during investigation and pre-design activities. He will also conduct on-site reviews and prepare Site review reports for the QAM.

4.2.8 Project Safety and Health Manager

The Project Safety and Health Manager, Tara Schleeman from Pioneer, will conduct the initial safety meeting prior to starting investigation fieldwork. Ms. Schleeman will ensure that work crews comply with all health and safety requirements and revise the BRW SSHASP, if necessary. In addition, she will be responsible for safety and health reviews during the Preliminary (30%) and Intermediate (60%) RD process to identify any potential safety concerns

associated with implementation and assure that HSSE requirements are met during the design process.

5.0 REMEDIAL DESIGN DELIVERABLES

This section describes the major reporting deliverables for the RD and construction (EPA Guidance Item 12 [Section 1.0]).

5.1 Remedial Design Documentation

Atlantic Richfield will submit a Preliminary (30%), Intermediate (60%), Pre-Final (95%), and Final (100%) RD for EPA's comment, in consultation with DEQ. Each RD document will contain the components listed in the BPSOU CD. The following sections detail what each of the RD documents will contain.

Preliminary (30%) RD. The Preliminary RD will include the following:

1. Design report with design criteria and basis of design included, as described in the Remedial Design/Remedial Action Handbook, EPA 540/R-95/059 (EPA, 1995). The RD report will include, but not be limited to, the following:
    a. Project description.
    b. Evaluation of how ARARs will be met.
    c. Design requirements including, but not limited to, BPSOU Statement of Work requirements (BPSOU CD), RAOs, and Remedial Action Levels.
    d. Design assumptions including, but not limited to, waste removal extents, utility construction/preservation, waste disposal methods and location, dewatering design, and end land use for the Site.
    e. Design approach including, but not limited to, excavation design, backfill and Site grading, SBC reconstruction, hydraulic control, haul road design, management of soil and groundwater impacted with organic pollutants above Site-specific action levels, cap and re-vegetation, and end land use design.
    f. Description of permit requirements, if applicable, and plans to address substantial requirements of permits.
    g. Easement/access agreements.
    h. Description of monitoring and control measures to protect human health and the environment, such as air monitoring and dust suppression, during the RA.
    i. Description of how the RA will be implemented in a manner that minimizes environmental impacts in accordance with *EPA's Principals for Greener Cleanups* (EPA, 2009).
2. Preliminary drawings, including but not limited to the following:
    a. Waste removal design in plan and cross-section view.
    b. Backfill/regrading design in plan and cross-section view.

c. SBC reconstruction in plan and profile view.
d. Plan view of other construction elements: existing conditions map, Site utilities, ownership, Site plan/conceptual end land use plan, etc.

3. Any proposed revisions to the RA schedule.
4. Updates of all supporting deliverables required to accompany the RDWP.

Intermediate (60%) RD. The Intermediate RD is a continuation and expansion of the Preliminary (30%) RD and will include the following:

1. Revised RD Report that include revisions from EPA / State / Stakeholder comments to the Preliminary (30%) RD and updates to components where additional data have been collected as part of the Site investigations.
2. Intermediate drawings, including, but not limited to the following:
   a. Updated/revised drawings from the Preliminary (30%) RD based on EPA / State / Stakeholder comments and updates to components where additional data have been collected as part of the Site investigations.
   b. Additional Site-wide plans including, but not limited to, traffic control, temporary fencing, staging and stockpile management, demolition, erosion control, utility plan and profiles, hardscape, Site lighting, architectural, planting, and irrigation.
   c. Draft or schematic details, where applicable. Structure detailing to be submitted with the Pre-Final (95%) RD.
3. Any proposed revisions to the RA schedule.

Pre-Final (95%) RD. The Pre-Final RD must be a continuation and expansion of the previous design submittal and address EPA's comments regarding the Intermediate (60%) RD. The Pre-Final RD will serve as the approved Final (100%) RD if EPA approves it without comments. The Pre-Final RD must include a continuation of deliverables identified above for the Intermediate (60%) RD in addition to the following:

1. A complete set of construction drawings and specifications that are (1) certified by a registered professional engineer; (2) suitable for procurement; and (3) follow the current Construction Specifications Institute's Master Format.
2. Additional Site-wide plans including, but not limited to, instrumentation and controls, performance monitoring, and electrical.
3. Additional detail including, but not limited to, structural, mechanical, electrical, Site lighting, architectural, planting, and irrigation.
4. Any proposed revisions to the RA schedule.

Final (100%) RD. Atlantic Richfield will submit the Final (100%) RD for EPA approval, in consultation with DEQ. The Final RD must address EPA and DEQ comments on the Pre-Final RD and must include final versions of all Pre-Final RD deliverables finalized for construction.

RAWP. Atlantic Richfield currently anticipates submittal of a RAWP specific to the Site. The following elements will be included in the RAWP:

1. Project Background.
2. Summary of Data Collected.
3. Team Organization.
4. Pre-Construction Activities.
5. Design Summary.
6. Construction Meeting Description and Procedures.
7. Design and Field Change Procedures.
8. Post Construction Activities Procedures.
9. Construction Quality Assurance.
10. Construction Monitoring and Associated QAPPs.
11. Construction Records and Reporting.
12. Health and Safety Requirements.
13. Construction Plans.
14. Haul Logistics Report.
15. Specifications.
16. Operation and Maintenance Manual.

Atlantic Richfield will submit the draft RAWP near the Intermediate (60%) design.

5.2 Construction Documentation and Records

5.2.1 Daily Contractor Quality Control Reports

The contractor will prepare daily contractor QC reports. The reports will list a description of the trades working on the project, the number of personnel working, weather conditions encountered, and any delays encountered. The reports will cover both conforming and deficient features and will include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The daily reports will include copies of test reports. The contractor must also take photographs documenting the day's major work activities and incorporate them into the reports. The Construction QC Manager must sign and date the reports.

The contractor will provide the reports to the independent QA contractor daily within 24 hours after the date covered by the report, with one exception: reports need not be submitted for days on which no work is performed.

5.2.2 Daily Construction Activity Report

An independent QA contractor will complete a daily construction activity report and submit it daily to Atlantic Richfield. The report will summarize the activities at the Site based on daily field notes. The report will address weather, contractor/subcontractor personnel that are at the Site, equipment used, construction activities performed, samples collected, field test results, and any issues encountered.

5.2.3 Material Receipt Inspections

All materials, equipment, and/or supplies that arrive at the Site will be inspected by the independent QA contractor to ensure that the products are as ordered or as specified; any deviations will be relayed to the contractor and Atlantic Richfield immediately. Receiving checklists for critical materials will be completed and recorded in a suitable location on the Site. These checklists will be included with other inspection documentation as part of the final CCR.

5.2.4 Inspections and Testing Records

All observations, field test results, and laboratory test results performed on the Site or off the Site will be recorded in a suitable manner. Recorded observations may take the form of notes, charts, sketches, photographs, or any combination of these. At a minimum, the inspection documentation will include the following information:

- Description or title of the inspection activity with the date activity was inspected.
- Location of the inspection activity or location from which the sample was obtained.
- Type of inspection activity and procedure used.
- Recorded observation or test data.
- Results of the inspection activity (e.g., pass/fail).
- Comparison with specification requirements.
- Personnel involved in the inspection besides the individual preparing the data sheet.
- Signature of the QAO accompanied by the date.

5.2.5 Photographic Documentation

Pioneer will obtain photographs that document existing Site conditions, progress activities, and completion conditions.

5.2.6 Record Field Data

The contractor will keep at the Site two complete sets of as-built field data, one for the contractor's use and one for Atlantic Richfield construction oversight personnel. The as-built field data will consist of full size, blackline prints of the Contract Drawings marked by the contractor to show all deviations in actual construction from the original Contract Drawings. These working-as-built drawings will be updated weekly.

5.2.7 Record Drawings

Pioneer will document the final Site construction through record drawings. The record drawings will be incorporated into the final RA CCR (Section 5.4).

5.3 Record Maintenance

The contractor will store and manage all project records and back up documents during construction activities. The contractor will maintain all current records and make those documents available at all times for inspection by the independent QA contractor. The contractor will submit all the deliverables to the independent QA contractor. The independent QA contractor will include these materials in the final RA CCR (Section 5.4).

5.4 Final Reporting

Atlantic Richfield expects to provide a RA CCR to EPA within 60 days of the successful completion of the final inspection. The RA CCR will contain all construction-related information and documented aspects of QA associated with the project. The RA CCR will include a summary of the project activities and document all aspects of the QA program performed during the project. In addition, a final O&M Plan and O&M Manual will be submitted to reflect any issues that may have been encountered during construction. In the report, the Design Engineer of record registered in the State of Montana will state that the project has been constructed consistent with the project Construction Drawings and Technical Specifications and that the discrete RD elements are complete. Content of the BRW RA CCR, in addition to RA CCRs from remaining key remedial element RA projects will be consolidated into a Key Remedial Elements CCR (KRECCR). The KRECCR will be submitted following the construction of all key remedial elements.

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FIGURES

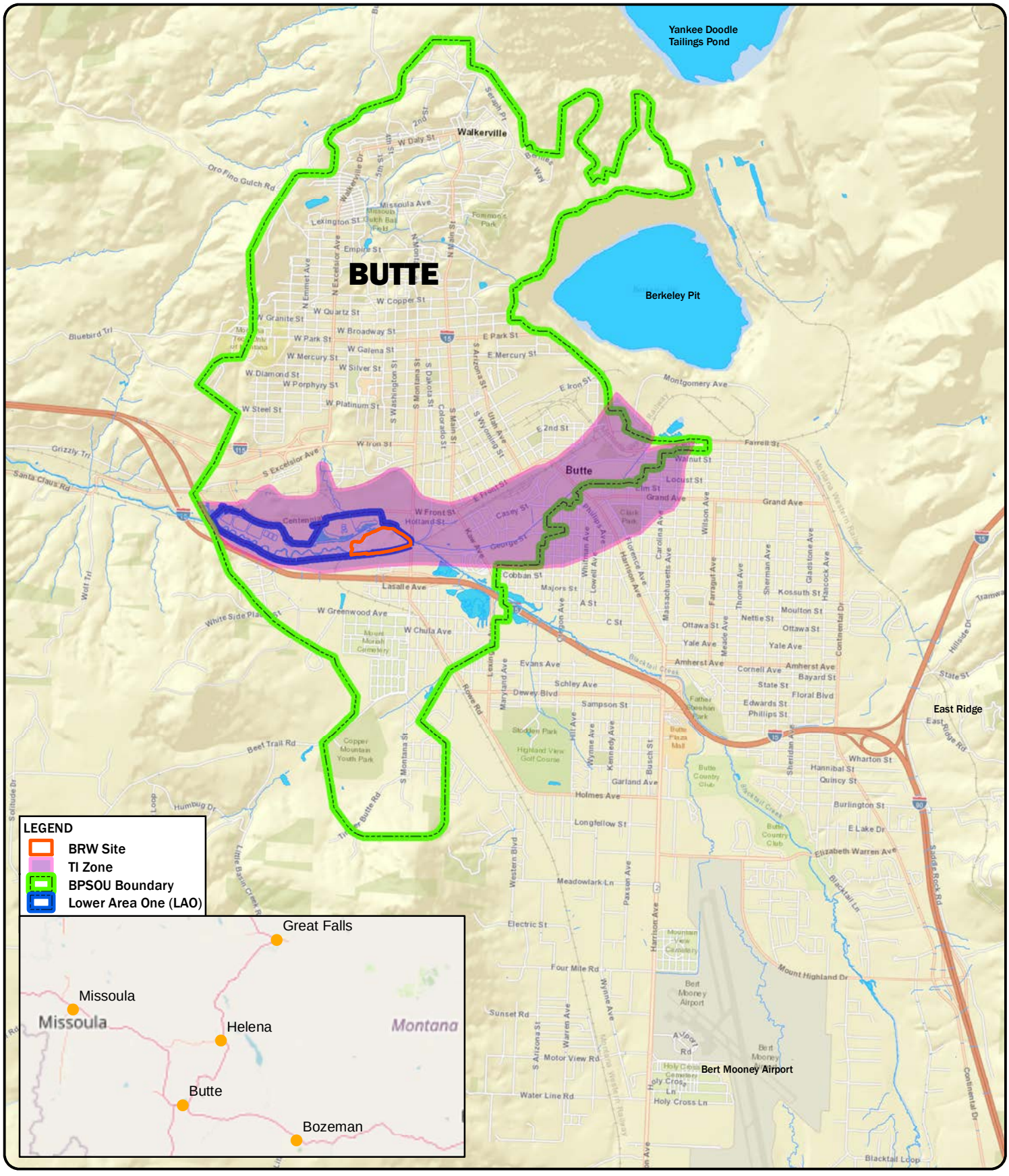

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FIGURE 1

BRW SMELTER AREA SITE LOCATION MAP

PIONEER TECHNICAL SERVICES, INC.

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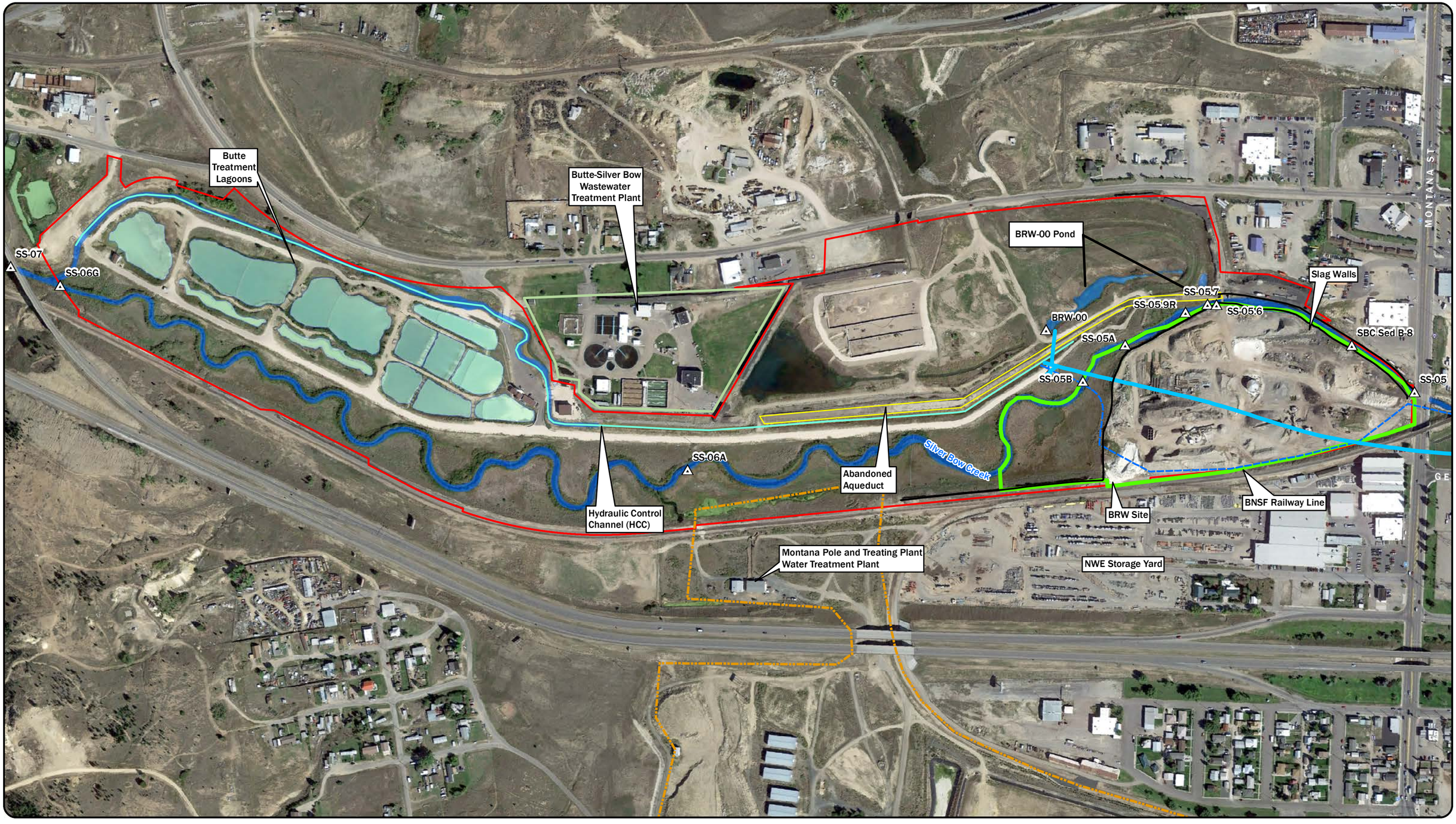

Surface Water Monitoring Points
BPSOU Subdrain Pump System Primary Force Main
BPSOU Subdrain Pump System Alternative Discharge Line
Hydraulic Control Channel
Slag Walls
BRW Site Boundary
BTL/LAO
LAO Boundary
Butte-Silver Bow Wastewater Treatment Plant Boundary
Abandoned Aqueduct
MPTP NPL Site

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FIGURE 2

LOWER AREA ONE AND BRW SMELTER AREA SITE MAP

PIONEER TECHNICAL SERVICES, INC.

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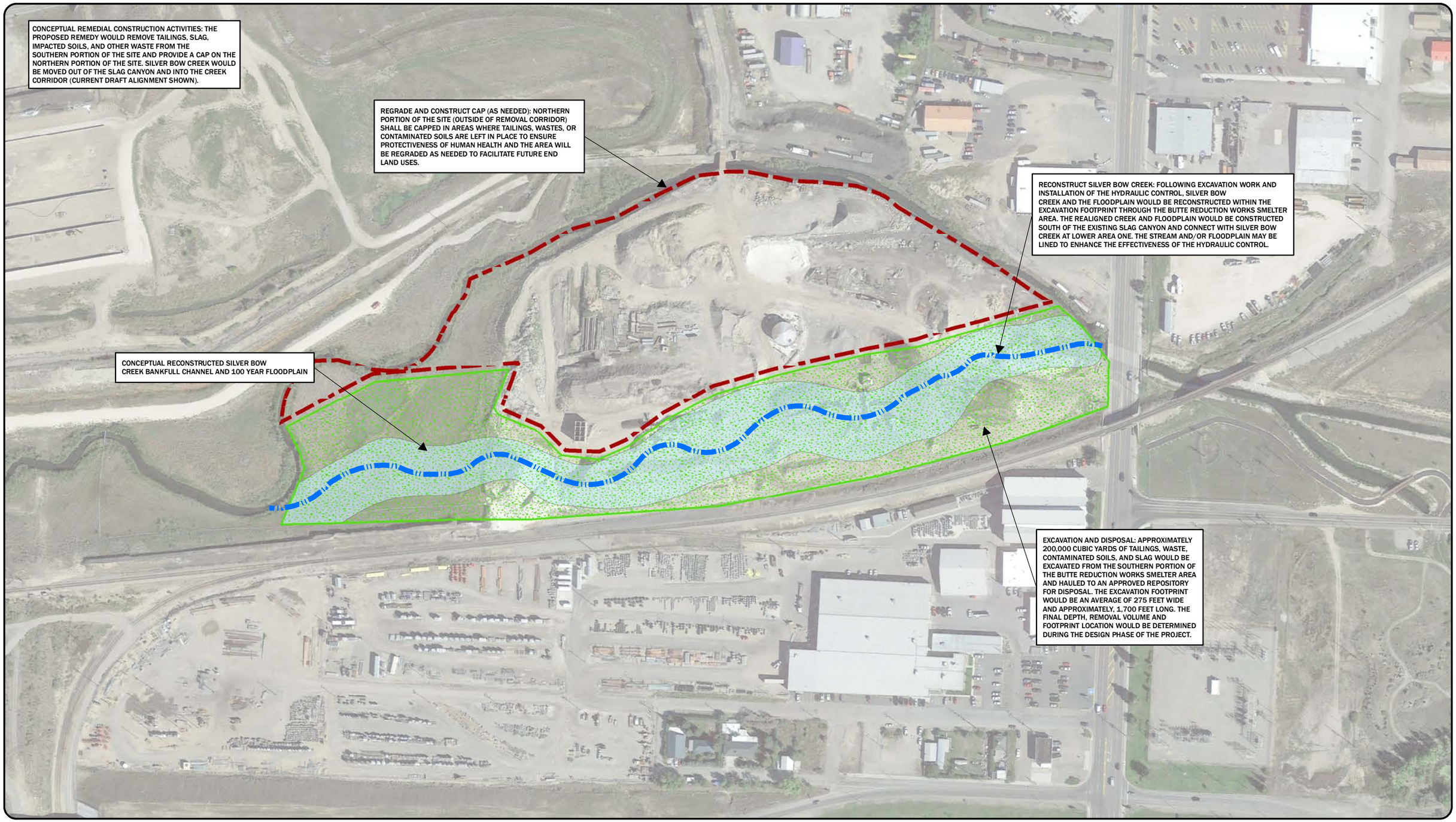

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FIGURE 3

PIONEER TECHNICAL SERVICES, INC.

BRW SMELTER AREA
CONCEPTUAL REMEDIAL ACTION PLAN

DATE: 5/3/2021

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Attachment 1
Butte Reduction Works Smelter Area Pre-Design Investigation Work Plan

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Final

Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Work Plan

Atlantic Richfield Company

May 13, 2021

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Final

Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Work Plan

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Prepared by:

Pioneer Technical Services, Inc.
1101 S. Montana Street
Butte, Montana 59701

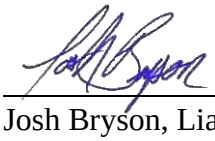
May 13, 2021

APPROVAL PAGE

Silver Bow Creek/Butte Area Butte Reduction Works Smelter Area
Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site
Pre-Design Investigation Work Plan

Approved: _____ Date: _____
Nikia Greene, Site Project Manager, EPA, Region 8

Approved: _____ Date: _____
Daryl Reed, Project Officer, Montana DEQ

Approved:  Date: 05/13/2021
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Silver Bow Creek/Butte Area NPL Site
BRW Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site
Pre-Design Investigation Work Plan

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ACRONYMS

Acronym	Description
µg/L	microgram per Liter
ABA	acid base accounting
Atlantic Richfield	Atlantic Richfield Company
BNSF	Burlington Northern Santa Fe Railway
BPSOU	Butte Priority Soils Operable Unit
BRW	Butte Reduction Works
BSB	Butte-Silver Bow
BTC	Blacktail Creek
BTL	Butte Treatment Lagoons
CD	Consent Decree
CECRA	Comprehensive Environmental Cleanup and Responsibility Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
DEQ	Montana Department of Environmental Quality
Domestic Manganese	Domestic Manganese and Development Company
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
HCC	Hydraulic Control Channel
LAO	Lower Area One
LNAPL	Light Non-Aqueous Phase Liquid
MASW	Multichannel Analysis of Surface Waves
MBMG	Montana Bureau of Mines and Geology
MPTP	Montana Pole and Treating Plant
MSD	Metro Storm Drain
NPL	National Priorities List
NRDP	Natural Resource Damage Program
NWE	NorthWestern Energy
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCP	Pentachlorophenol
PDI	Pre-Design Investigation
PID	photoionization detector
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RD	Remedial Design
RFC	Request for Change
SBC	Silver Bow Creek
SS	Sampling Station
SST	Streamside Tailings
SPLP	Synthetic Precipitation Leaching Procedure
s.u.	standard unit
TOC	total organic carbon
USGS	United States Geological Survey
VPH	volatile petroleum hydrocarbon
XRF	X-ray fluorescence

1.0 INTRODUCTION

This Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Work Plan (PDI Work Plan) has been developed consistent with the applicable U.S. Environmental Protection Agency (EPA) guidance and decision documents, including the following:

- *Consent Decree* (CD) *for the Butte Priority Soils Operable Unit. Partial Remedial Design/Remedial Action and Operation and Maintenance* (EPA, 2020), referred to herein as BPSOU CD.
- *Remedial Design/Remedial Action Handbook,* EPA 540/R- 95/059 (EPA, 1995).

The additional investigations at the BRW Smelter Area (or Site) are necessary to support the remedial design (RD) as required by EPA and Montana Department of Environmental Quality (DEQ). The proposed remedy involves removal of tailings, waste, impacted soil, and slag within the stream reconstruction corridor (referred to herein as the waste removal corridor) that fails the Waste Identification Screening Criteria (BPSOU CD) to a depth determined during the RD; construction of a hydraulic control system to capture groundwater impacted with contaminants of concern (COCs) (i.e., arsenic, cadmium, copper, mercury, lead, and zinc) to prevent exceedances of Performance Standards (BPSOU CD) under normal flow conditions in surface water and to limit loading of COCs from groundwater to sediments in Silver Bow Creek (SBC) within the Butte Priority Soils Operable Unit (BPSOU) generally and within the Site specifically; and reconstruction of SBC and the floodplain. This PDI Work Plan includes the following items:

- General information regarding the Site (Section 2.0).
- Existing data summaries (Section 3.0).
- Identified data gaps associated with the RD (Section 4.0).
- A summary of the sampling activities (Section 5.0).
- A summary of the Quality Assurance Project Plans (QAPPs), which outline the procedures and protocols necessary to collect and analyze data needed to refine the characterization of groundwater and solid materials at the Site (Section 6.0).
- Investigation schedule (Section 7.0).
- The proposed PDI Evaluation Report format (Section 8.0).

The investigation activities have been divided into three phases. The *Final Butte Reduction Works (BRW) Phase I Quality Assurance Project Plan (QAPP)* (BRW Phase I QAPP) (Atlantic Richfield, 2021a) describes the procedures to conduct the Phase I Site Investigation. The Phase I Site Investigation activities were reported in the *Draft Final Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Evaluation Report* (BRW PDI Evaluation Report) (Atlantic Richfield, 2021b). The Phase II Site Investigation activities are described in the *Final Revised Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Phase II Quality Assurance Project Plan (QAPP)* (BRW

Phase II QAPP) (Atlantic Richfield, 2021c). Finally, the Phase III Site Investigation activities are detailed in the *Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Phase III Quality Assurance Project Plan (QAPP)* (BRW Phase III QAPP) (Atlantic Richfield, 2021d).

2.0 BACKGROUND

The Site covers approximately 24 acres and is located in Butte, Montana, to the immediate west of Montana Street between SBC and the Burlington Northern Santa Fe Railway (BNSF) railroad line (Figure 1 and Figure 2). Currently, a portion of the Site is used by Butte-Silver Bow (BSB) for construction aggregate mixing and storage. A portion of the Site also includes the SBC floodplain to the west.

Historically, the Site included several different smelting configurations and was also used by the Domestic Manganese and Development Company (Domestic Manganese) (Sanborn, 1943). The operations left behind a complex distribution of materials including slag, tailings, manganese waste, ore concentrate, baghouse dust, demolition debris, foundations, and other historic structures as well as impacted soils and groundwater.

2.1 Site Location

The Site is located within Lower Area One (LAO), an area approximately 80 acres in size. The LAO in turn is located within the BPSOU of the SBC Butte Area National Priorities List (NPL) Site on the western edge of the city of Butte in Silver Bow County, Montana (Figure 1). The BSB municipal wastewater treatment plant bisects the LAO area, separating the Butte Treatment Lagoons (BTL) on the western half of LAO from the BRW Site on the eastern half of LAO (Figure 2). The BTL and hydraulic control channel (HCC) are key components of the selected remedy identified in the BPSOU CD, which is the capture and treatment of COC-impacted alluvial groundwater from LAO preventing discharge of COCs to SBC and includes the BPSOU subdrain (subdrain) pump system force main and alternative discharge line, both of which run under the Site (Figure 2 and Figure 3).

NorthWestern Energy (NWE) has a storage yard and operating center immediately south of the Site (Figure 2). The storage yard has been there since 1899 and is a Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) site. Underground storage tanks and on-site use or disposal of various substances such as paints, solvents, mercury, Fuller's earth, wood-treating compounds and transformer oil containing polychlorinated biphenyls (PCBs) have resulted in on-site soil contamination and possibly, localized groundwater contamination (DEQ, 2002).

To the southwest of the Site, another impacted area, the Montana Pole and Treating Plant (MPTP) Water Treatment Plant (Figure 2) treats extracted groundwater impacted by nearly 40 years of uncontrolled releases of a solution of approximately 5% pentachlorophenol (PCP) mixed with a petroleum carrier oil that was used to preserve poles, posts, and bridge timbers from 1946 to 1984 (EPA, 2017a). The MPTP Site is an EPA Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA) site and is within the BPSOU but is a separate site operated/managed according to a separate Record of Decision.

2.2 Site History

The Site has had multiple industrial operations resulting in a complex history. Industrial operations at the Site began in 1885 and continue to present day (GCM Services, Inc., 1991). A summary timeline of activities at the Site is below.

- 1868 to 1900 (approximately): Silver mill and mine operations near Missoula Gulch dispose of mine and mill wastes into the gulch. The wastes flow downhill onto the Site and into SBC.
- 1883 (approximately) to 1910: The BRW Smelter is constructed and operated by the Butte Smelting Co., Butte Reduction Co., William A. Clark, and/or Colusa Parrot Mining & Smelting Co., producing copper and copper tailings on the Site. A zinc concentrator is added in 1909. Additional waste from zinc mills and concentrators in Missoula Gulch is disposed of in the gulch, flowing downhill onto the Site and into SBC.
- 1910 to 1911: Atlantic Richfield Company's (Atlantic Richfield) predecessor purchases the BRW Smelter in 1910 and shuts down the copper smelter. The Site is leased back to Clark, who continues to process zinc ore on the Site until the zinc concentrator is destroyed in a fire in 1911.
- 1927 to 1945: Domestic Manganese processes and stores manganese on the Site. From 1943 to 1945, U.S. agencies (General Services Administration and Department of Defense-Defense Logistics Agency) construct a flotation mill, produce manganese, dispose of manganese tailings, and store manganese ore on the Site.
- 1945 to 1992: Continued stockpiling of manganese ore on the Site by the U.S. agencies.
- Early 1960s: Rocky Mountain Phosphates, Inc. phosphate plant becomes active.
- Mid-1990s to Date: BSB uses a portion of the Site to house an asphalt plant.

Based on historical research of photographs, plans, maps, historical surveys (etc.), and observations made during the Phase I Site Investigation, the footprint of these operations over the years resulted in almost every portion of the Site being used, as shown on Figure 4. Additional details on the infrastructure shown in Figure 4 are summarized in Table 1.

Response activities at the Site began with the removal of stockpiled manganese ore in 1992. Response activities on other land in the LAO area, including the removal of approximately 1.2 million cubic yards of tailings and impacted soils, reconstruction of the SBC stream and floodplain, and other actions, began in 1994 and continued until about 2014 (Atlantic Richfield, 2002). The projects that were completed had the overlying objective to remove tailings and to collect, manage, and treat COC-impacted groundwater. The BPSOU CD outlines the requirements for the completion of additional RD requirements and identifies several data gaps related to the design of the BRW remedial action (RA).

3.0 EXISTING DATA SUMMARY

The following is a list of the investigations conducted in the area of the Site. A brief summary of each, as they pertain to the Site is provided in the sections below.

- Cultural Resource Inventory:
    - *Cultural Resource Inventory of The Lower Area One Operable Unit of Silver Bow Creek/Butte Area NPL Site and the Montana Pole and Treating Plant NPL Site* (GCM Services, Inc., 1991).
- Abandoned Aqueduct Investigations:
    - *Draft 2009 Butte Reduction Works (BRW) Slag Tunnel Field Inspection Work Plan* (Atlantic Richfield, 2009a).
    - *Final 2009 Butte Reduction Works (BRW) Slag Tunnel Test Pit Results and Potential Remediation Actions* (Atlantic Richfield, 2009b).
- Blue Seep Investigations:
    - *Butte Reduction Works – Blue Water Seep Investigation Summary* (WET, 2010).
    - *Butte Reduction Works Seep Investigation Results During Base Flow: 2010 to 2011* (TREC, 2011).
- Evaluation of groundwater and surface water interaction investigations:
    - *Final Revised 2011 Blacktail Creek and Silver Bow Creek Radon Tracing and Thermal Imaging Survey Technical Memorandum* (Radon Thermal Technical Memorandum) (Atlantic Richfield, 2016).
    - *Groundwater and Surface Water Interaction* (EPA, 2017b).
- Monitoring well construction and data collection efforts:
    - *Draft Ground Water Monitoring Well Installation Plan* (Atlantic Richfield, 2011).
    - *Draft 2010 Butte Reduction Works (BRW) Effectiveness Monitoring Work Plan* (Atlantic Richfield, 2010a).
- Impacted Soil and Solid Materials Characterization:
    - *Butte Reduction Works Smelter Site Draft Test Pit Report* (NRDP, 2016).
    - *Data Gap Investigation – Silver Bow Creek and Blacktail Creek Corridors* (Tetra Tech, 2016).
- Adjacent sites:
    - *Fourth Five-Year Review Report for the Montana Pole and Treating Plant Site* (EPA, 2017a).
    - *Draft Report of Groundwater Sampling and Hydrogeologic Characterization at the Montana Power Company's Montana Street Center, Butte, Montana.* (MBMG, 1990).
    - NorthWestern Energy CECRA site information gathered from DEQ Geographic Information System Portal at https://gis.deq.mt.gov/portal/home/.

- Groundwater and Surface Water Monitoring Database:
    - Groundwater and surface water monitoring data collected as part of a series of groundwater and surface water monitoring programs (TREC, 2020).

3.1 Cultural Resource Inventory

In 1991, GCM Services, Inc. completed a cultural resource inventory within LAO (including the BRW Site) to locate, record, and evaluate the type and nature of the cultural resources (i.e., buildings, features, and artifacts). The cultural resource inventory included a basic literature and records review followed by a field investigation and survey of the project area in accordance with standard archaeological field techniques. The project area and all features were photographed, mapped, and evaluated. Of the features remaining on the Site, the most relevant features identified appeared to be the foundation of the Domestic Manganese plant, the BRW Smelter furnace remains, the aqueduct, various structural foundations, and manganese ore stockpiles. However, most of the remaining features identified were not sufficiently intact or extensive enough to be matched with specific components of the original plants (GCM Services, Inc., 1991).

3.2 Abandoned Aqueduct Investigations

A field inspection of the Abandoned Aqueduct was conducted on July 22, 2009, as described in the *2009 BRW Slag Tunnel Field Inspection Work Plan* (Atlantic Richfield, 2009a). The field inspection provided general characterizations of the Abandoned Aqueduct structural features and also provided observations of the water levels and sediments contained within the Abandoned Aqueduct.

Five test pits were excavated in the vicinity of the eastern portion of the Abandoned Aqueduct on September 9 and 10, 2009, as described in the *2009 BRW Slag Tunnel Test Pit Results and Potential Remediation Actions* (Atlantic Richfield, 2009b). The test pits were excavated to assist in defining the extent of the impacted materials that remained beneath the BRW-00 Pond and resulted in the removal of approximately 2,600 cubic yards of impacted material during the BRW east end grading work (Atlantic Richfield, 2010b).

3.3 Blue Seep Investigation

In 2010 and 2011, the BRW Seep (Blue Seep) Investigation was conducted to identify the nature of a small seep of impacted water near the east end of the Abandoned Aqueduct. This seep was associated with an increase in dissolved copper concentrations in SBC. Reports describing two direct investigations of the Blue Seep are the *Butte Reduction Works – Blue Water Seep Investigation Summary* (WET, 2010) and the *Butte Reduction Works Seep Investigation Results During Base Flow: 2010 to 2011* (TREC, 2011).

As part of these investigations, several sanitary sewer lines were evaluated and, in the process, an improperly abandoned sewer line was discovered that reported directly to SBC. As a result, two sewer lines extending towards the Abandoned Aqueduct head gate were plugged and abandoned, and one manhole connecting these two lines was filled with concrete. During the abandonment

of this infrastructure, samples were collected from tailings located adjacent to the sanitary sewer lines. It is possible that the reduced (i.e., low oxygen) conditions caused by the abandoned sanitary sewer lines caused mobilization of the metals within the adjacent tailings. The combined effort of the abandonment of the sanitary sewer lines and the regrading of the BRW-00 Pond has increased the effectiveness of groundwater capture in the vicinity of the blue seep (TREC, 2020).

3.4 Evaluation of Groundwater and Surface Water Interaction Investigations

3.4.1 Radon Thermal Technical Memorandum

During the spring and fall 2011 base flow sampling events, multiple flow measurement methodologies were used to identify areas of groundwater gains and associated load to Blacktail Creek (BTC) and SBC. Notable stream gains and associated load were used to identify stream reaches that typically receive upwelling groundwater. The information was compiled into the Radon Thermal Technical Memorandum (Atlantic Richfield, 2016). While notable stream gains and loading results within BTC and SBC were the crux of the Radon Thermal Technical Memorandum, other areas were investigated for upwelling groundwater, including the BRW-00 Pond. Thermal images taken of groundwater upwelling into the BRW-00 Pond are included in Figure 2-7 of Appendix A.

3.4.2 2017 Groundwater and Surface Water Interaction Report

In 2016, EPA conducted a pore water investigation along both banks of BTC and SBC from just upstream of the confluence with Grove Gulch to just downstream of sampling station (SS) SS-05B along SBC. As part of the investigation, EPA collected pore water samples along the left and right banks, finding that pore water concentrations for copper and zinc were elevated on both banks through the slag canyon and downstream of the Site. The location of the source for this impacted pore water was also evaluated using a weight-of-evidence approach for being a local or distant source; the analysis concluded that the source(s) of impacted pore water was local. EPA *Groundwater and Surface Water Interaction* (EPA, 2017b) includes figures and tables with results.

3.5 Monitoring Well Construction and Data Collection Efforts

In 1982, the Anaconda Mining Company monitoring wells were the first groundwater monitoring wells installed in the BPSOU. The expansion of the monitoring well network continued in a series of steps, with the most recent expansion completed in early 2012 (Atlantic Richfield, 2010a). Currently, the monitoring network includes semi-annual water quality sampling of 113 wells, 3 piezometers, and 5 subdrain manholes; monthly water level measurements at 176 wells, 5 manholes, and 44 surface water stations; and continuous water level recordings at 38 wells, 2 manholes, and 2 surface water stations throughout the BPSOU. Specific wells relevant to the Site are identified on Figure 5, including additional monitoring wells installed in 2011 and 2012.

In 2012, an initial monitoring effort was completed to evaluate the capture effectiveness of the BRW-00 Pond. The main objectives of the data collection and evaluation were to provide the

means to measure general water quality effects and monitor changes in gradient caused by the 2010 modifications (i.e., monitor the capture effectiveness of the BRW-00 Pond). The data monitoring specified in the *2010 BRW Effectiveness Monitoring Work Plan* (Atlantic Richfield, 2010a) included monitoring groundwater and surface water levels and collecting field parameters and laboratory samples. To conduct water level monitoring at certain locations on SBC, several staff gages were installed. At water level monitoring locations, manual water level measurements were conducted on a routine basis and transducers were installed for a subset of these locations. Specific wells relevant and/or proximal to the Site are identified on Figure 5.

3.6 Impacted Soil and Solid Materials Characterization

3.6.1 2016 BRW Smelter Site Test Pit Report

In 2016, Tetra Tech, Inc. conducted a test pit investigation and subsurface material sampling within the Site to characterize subsurface mine waste deposits, slag, impacted soil, and miscellaneous fill materials placed within the area. Thirty test pits were excavated, screened, and sampled (Figure 5). Multiple samples were collected from each test pit and screened with a portable X-ray fluorescence (XRF) device for arsenic, cadmium, copper, lead, mercury, and zinc. Based on the screening results, distribution of the samples, and their respective material types, specific samples were selected for laboratory analysis for total acid extractable metals (total metals), nitrogen as nitrate, total phosphorous, total organic carbon (TOC), pH, soil conductivity, etc. Approximately 20% of the samples submitted for total metals analysis were also analyzed for Synthetic Precipitation Leaching Procedure (SPLP) and acid base accounting (ABA) analysis.

Within the BRW Smelter Site Draft Test Pit Report, soil sample results were compared to Streamside Tailings (SST) Operable Unit (OU) field screening criteria. Soil samples exceeded the SST OU screening criteria for arsenic, cadmium, copper, lead, mercury, and zinc. Additionally, the SPLP leachate results were compared to Montana DEQ Circular DEQ-7 standards for groundwater (DEQ, 2012). The SPLP leachate results were above the DEQ-7 standards for arsenic, lead, and zinc. Lastly, subsurface impacts from hydrocarbons were noted in 10 of the 30 test pits.

To support the RD for the Site, the figures, tables, and test pit logs from the BRW Smelter Site Draft Test Pit Report (NRDP, 2016) is included in Appendix A. The figures include the Site location, test pit locations, concentration maps for overburden/construction debris, slag, and alluvium, and a slag thickness map. The tables include the sample summary, XRF soil screening results, test pit soils metals analytical results, test pit soil physical and chemical characteristics, nutrients, acid base accounting and SPLP analytical results, and the comparison of detectable total metals concentrations between natural and blind field duplicates. The Test Pit Logs include the lithology log from each test pit.

Additional information from the investigations, including photographic logs, field sampling notes, and laboratory reports are included in the appendices of the BRW Smelter Site Draft Test Pit Report (NRDP, 2016).

3.6.2 2016 Data Gap Site Investigation

In 2016, Natural Resource Damage Program (NRDP) conducted an investigation of soil, sediment, surface water, groundwater, and pore water along BTC and SBC corridors. Out of the 53 pore water samples, the investigation noted elevated pore water concentrations for arsenic, cadmium, copper, and zinc within and just downstream of the slag canyon reach. Figures and tables with results, photographic logs, field sampling notes, and laboratory reports are included in the appendices of the 2016 Data Gap Site Investigation (Tetra Tech, 2016).

3.7 Adjacent Sites

3.7.1 Montana Pole and Treating Plant

The RA activities at the MPTP Site include collecting groundwater from the area surrounding the MPTP Site and treating it to meet the water standards specified in the 1993 Record of Decision for the site. The primary constituent of concern is PCP. The MPTP Water Treatment Plant also treats the captured groundwater for chlorinated phenols, polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, and metals. Surface water and groundwater monitoring are an essential component of the remedy and the data are included in the five-year reviews, which include groundwater contours for the areas adjacent to the MPTP Site and the estimated extents of PCP impact to the groundwater in the area (EPA, 2017a). The data will be used to inform of any possible impacts to the design of the BRW hydraulic control and RA construction dewatering, as well as ensure that the construction dewatering does not notably expand the extent of PCP at the MPTP Site.

3.7.2 NorthWestern Energy Storage Yard

In 1990, the Montana Bureau of Mines and Geology (MBMG) conducted a groundwater sampling and hydrogeologic investigation at the NWE storage yard (Section 2.1) for the Montana Department of Health and Environmental Sciences (now DEQ). Results indicated that arsenic and other metals concentrations were elevated above typical values for the area (MBMG, 1990). The arsenic and metals anomaly appeared primarily around one monitoring well in the northeast portion of the site. MBMG continued to monitor groundwater until June 1994, when monitoring was discontinued. Based on DEQ's existing information, no additional investigations or cleanup work have occurred at the NWE CECRA site.

During two storm events in 2017, DEQ collected surface water samples upstream of the MPTP Site, adjacent to the NWE storage yard, as part of operations and maintenance activities of the adjacent MPTP Site. The results from the sampling events indicated exceedances of Montana DEQ Circular DEQ-7 aquatic life and human health standards (DEQ, 2017a). These results were provided to NWE in a letter from DEQ dated October 18, 2017 (DEQ, 2017b).

3.8 Groundwater and Surface Water Monitoring Database

Groundwater and surface water monitoring have been integral components of the BPSOU remedy work. Stakeholders have accumulated a large database of physical and chemical data on

SBC and the large network of groundwater monitoring wells and piezometers in the BPSOU. The database, kept by TREC, Inc. (TREC), has groundwater and surface water monitoring data from 1998 to the time of this report and includes data collected by TREC, Pioneer Technical Services, Inc., the MBMG, and the U.S. Geological Survey (USGS) (TREC, 2020). The database includes, but is not limited to, the following:

- Surface water chemistry, flow, and select physical parameters from discrete sampling events.
- Groundwater chemistry, depth to groundwater measurements, and select physical parameters from discrete sampling events.
- Continuous surface water flow and select physical parameters.
- Continuous groundwater depth to water measurements and select physical parameters.

The groundwater and surface water data in the database have been submitted as annual data summary reports to EPA and DEQ. These data will be used to supplement the data gathered during the investigations at the Site.

4.0 BRW REMEDIAL DESIGN DATA GAPS

The design team has reviewed the available data in the documents discussed in Section 3.0 and other associated documents currently available for the Site. The objective of the data review was to identify data that will be required to support the RD for the Site and identify any necessary additional data collection. A list of the initial data needs identified to support the development of the Site's RD is outlined in Section 2.2 of the BRW RD Work Plan (to which this report is an attachment). Table 2 shows a condensed, high-level list of these data gaps and how this wide range of data gathering will be filled by each of the investigations. The BRW Phase I, Phase II, and Phase III QAPPs (refer to Section 1.0) and any requests for change (RFCs) will provide up-to-date data gaps that include those objectives identified during finalization of the RD.

5.0 FIELD INVESTIGATIONS

To collect the necessary information required to support the RD for the Site, the field investigation work will be split into three phases.

5.1 Phase I Site Investigation

The Phase I Site Investigation was an initial data collection effort to help fill the data gaps identified in Section 4.0, summarized in Table 2, and listed below:

- Refine the lateral limits, thickness, and base of tailings, waste, COC-impacted soil, and slag in or adjacent to the waste removal corridor (Figure 6) (BPSOU CD) and estimate the total volumes of tailings, waste, COC-impacted soils, and slag.
- Refine data for groundwater characteristics to aid in the design of the hydraulic control for COC-impacted groundwater to prevent exceedances of Performance Standards (BPSOU CD) under normal flow conditions in surface water and to limit loading of

COCs from groundwater to sediments in SBC within the BPSOU generally and within the Site specifically.

- Define the nature and extent of the soil and groundwater impacted with organic pollutants (petroleum compounds and PCB) within the Site and begin to develop a management plan, including developing Site-specific action levels.
- Evaluate geotechnical concerns for constructability (i.e., excavation or other removal methods for poured slag and other debris).

The Phase I Site Investigation activities were conducted in three stages. Stage 1 included an initial data collection effort to help refine the characterization of solid materials and groundwater within the Site. The BRW Phase I QAPP RFC *BRW-2019-01* (RFC BRW-2019-01) described the Stage 2 activities, which included collecting additional groundwater samples to further refine the groundwater characterization of the Site. The Stage 3 activities, detailed in the BRW *Phase I QAPP RFC BRW-2019-03: Hydrocarbon Investigation* (RFC BRW-2019-03), included an investigation intended to further define the petroleum-impacted soil and groundwater within the Site and provide additional information on the solid materials and groundwater characterization. The results of the three stages of the Phase I Site Investigation were summarized in the BRW PDI Evaluation Report (Atlantic Richfield, 2021b).

5.1.1 Stage 1 – Initial Phase I Site Investigation

The initial Phase I Site Investigation took place in 2018 and 2019, and efforts conducted as part of the investigation included excavating test pits, drilling boreholes, collecting soil samples from test pits for laboratory analyses, and collecting and archiving core samples (with certain intervals being submitted for laboratory analysis). Efforts also included installing piezometers and collecting water levels and groundwater samples. The subsections below summarize the field activities conducted as part of the Phase I Site Investigation. The approved BRW Phase I QAPP (Atlantic Richfield, 2021a) and the BRW PDI Evaluation Report (Atlantic Richfield, 2021b) provide additional details for the Phase I Site Investigation.

Solid Materials Characterization

To help characterize the solid materials (slag, demolition debris, tailings, peat/alluvium, etc.) within the Site, 48 boreholes were drilled, and 12 test pits were excavated. The locations of the boreholes and test pits were selected to refine the lateral limits, thickness, base, and properties of solid materials; evaluate the presence of any organic pollutants; and evaluate any remaining manganese impacts. The general locations and quantities of solid materials were known from previous investigations, but additional quantification was necessary for the RD of the Site.

For all investigation points, the lithology was documented, soil samples were collected, and select samples were submitted to the laboratory for analyses to determine the properties of solid materials including the chemical stability/leachability of these solid materials. Additional details on the solid materials characterization are included in the BRW Phase I QAPP (Atlantic Richfield, 2021a) and the BRW PDI Evaluation Report (Atlantic Richfield, 2021b).

Groundwater Characterization
In 2007 and 2011, BPSOU site-wide monitoring well construction efforts installed several monitoring wells at various depths within the Site and surrounding area. To obtain additional information and fill design-specific data gaps, 24 additional piezometers were installed during the Phase I Site Investigation. Once the piezometers were complete and developed, groundwater samples were collected and submitted to the laboratory for specified analyses, including metals, arsenic speciation, and organic pollutants (petroleum compounds and PCB). Transducers were installed in select piezometers and monthly water levels have been collected since January 2019.

Data from the new piezometer locations will provide the best possible information to refine the estimates of groundwater chemistry, elevations, potentiometric surface (including seasonal changes), conductivity, transmissivity, and aquifer geometry. Additional details on the groundwater characterization are included in the BRW Phase I QAPP (Atlantic Richfield, 2021a) and the BRW PDI Evaluation Report (Atlantic Richfield, 2021b).

Hydrocarbon Screening
During the Phase I Site Investigation, soil samples and groundwater samples were collected from boreholes/piezometers that appeared to contain hydrocarbons in the soils and/or groundwater (via sight and/or smell or detection with a photoionization detector [PID]). The samples were analyzed for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbon (EPH) fractionation with PAH. Additionally, the Site was examined during the Phase I Site Investigation and any surface soils that appeared to contain hydrocarbons (via sight and/or smell or detection with a PID) were sampled and analyzed for VPH and EPH fractionation with PAH. Additional details on the hydrocarbon screening during the Phase I Site Investigation are included in the BRW Phase I QAPP (Atlantic Richfield, 2021a).

Geophysics Tasks and Quantification of Existing Durable Historic Infrastructure
The Phase I Field Investigation included efforts to identify any remaining historical infrastructure on the Site to help identify any geotechnical concerns for constructability (i.e., excavation or other removal methods for poured slag and other debris). To identify remaining historic infrastructure within the Site, 12 test pits were excavated, and measurements and photographs of historic infrastructure were collected.

Additionally, a geophysical Multichannel Analysis of Surface Waves (MASW) seismic survey was completed to locate subsurface flumes/culverts within the Site. In 1890 or 1891, water from Blacktail Creek was routed to the Site via an underground aqueduct. Portions of this aqueduct still exist on the Site.

Additional details on these tasks completed during the Phase I Site Investigation are included in the BRW Phase I QAPP (Atlantic Richfield, 2021a) and the BRW PDI Evaluation Report (Atlantic Richfield, 2021b).

5.1.2 Stage 2 – Additional Groundwater Sampling (RFC BRW-2019-01)

Additional Groundwater Characterization
In October and November 2019 additional groundwater samples were collected from the 24 piezometers installed during Stage 1 of the Phase I Site Investigation and from 4 monitoring wells located on NorthWestern Energy's property to the south of the Site. The samples were analyzed for COCs and organic pollutants (petroleum compounds and PCB) to further refine the characterization of groundwater within the Site. The 4 monitoring wells were also added to the list of wells from which monthly groundwater elevations are collected. The information gathered from this stage of the Phase I Site Investigation will be used to inform the hydraulic control design and to develop a plan to manage the groundwater impacted with organic pollutants (petroleum compounds, PCB, PCP, and dioxins) within the Site, including development of Site-specific action levels.

Details on the additional groundwater sampling activities are included in RFC BRW-2019-01 (Atlantic Richfield, 2021a) and the BRW PDI Evaluation Report (Atlantic Richfield, 2021b).

5.2 Phase I RFC BRW-2019-03

Hydrocarbon Investigation
Thirteen hydrocarbon monitoring piezometers were installed at the Site and additional groundwater samples were collected beginning in December 2019 and finishing in February 2020. The locations of the piezometers were selected to further refine the nature and extent of petroleum-impacted materials within the Site. Soil from a selection of the installed piezometers was screened with a PID, sampled, and analyzed for petroleum compounds, including VPH, EPH, and PAH concentrations. Additional data were also collected related to COC concentrations to supplement the solid material characterization at the Site. The 13 hydrocarbon monitoring piezometers were sampled, and the groundwater was analyzed for petroleum compounds and COCs. Six existing monitoring wells, that had previously shown detectible concentrations of petroleum compounds, were also sampled, and the groundwater was analyzed for petroleum compounds and COCs. The investigation activities characterized petroleum-impacted material, determined that no notable light non-aqueous phase liquid (LNAPL) was detected on the Site, and further refined the nature and extent of dissolved petroleum compounds in groundwater and petroleum-impacted soil exceeding risk-based screening levels (DEQ, 2018). The data collected from the investigation were used to inform the Phase II Site Investigation pumping test locations and will be used to inform a management strategy for the soil and groundwater impacted with organic pollutants (petroleum compounds, PCB, PCP, and dioxins) within the Site, including development of Site-specific action levels. The data from the COC analyses will be used to further refine the nature and extent of the presence of COCs within the Site, which will inform the hydraulic control design and assist in determining the extent of waste removal within the waste removal corridor.

Additional details on the investigation are included in RFC BRW-2019-03 (Atlantic Richfield, 2021a) and the BRW PDI Evaluation Report (Atlantic Richfield, 2021b).

5.3 Phase II Site Investigation

The Phase II Site Investigation had 4 objectives: conducting two pumping tests, a pre- and post-pumping test groundwater analysis, a COC-loading analysis on SBC, and a slag investigation. Field activities began in June 2019 and are expected to conclude in March 2021. The data collected from the investigation activities are expected to fill the data gaps related to the leachability of solid materials, groundwater characterization and hydraulic control design, characterization of soil and groundwater impacted with organic pollutants (petroleum compounds, PCB, PCP, and dioxins) within the Site, and SBC realignment design (Table 2).

Details of the investigation activities are outlined in the BRW Phase II QAPP (Atlantic Richfield, 2021c). Below is a summary of the investigation activities.

Pumping Tests

To prepare for the pumping tests, 26 piezometers were installed to increase the network of monitoring wells and piezometers used to monitor the progress of the pumping tests, and 2 pumping wells were installed at the site. The first pumping well, BRW-PW-01A, location was selected for several reasons: the aquifer thickness, relatively higher hydraulic conductivity of the alluvial aquifer, apparent location of secondary source, proximity to SBC, and because the area will likely be a principal focus area for the future hydraulic control as well as dewatering efforts during the construction phase of the RA. The second pumping well, BRW-PW-01B, location was selected because it was located within an area where the alluvial aquifer is relatively thicker than other parts of the Site, and data collected from this area could provide necessary information related to the central part of the removal area and central part of the upgradient impacted boundary area. Locations of the wells are in the BRW Phase II QAPP (Atlantic Richfield, 2021c). It is anticipated that the pumping tests will provide information on the aquifer parameter's transmissivity, hydraulic conductivity, and storativity as well as the presence of hydraulic barriers and/or sources of storage, preferential flow, anisotropy and heterogeneity of the aquifer, role of confining and/or less conductive units, well efficiency, specific yield, and quality and quantity of water.

The following work tasks were completed during each pumping test:

- Install and develop the pumping well.
- Install additional piezometers.
- Install pumping test systems.
- Monitor groundwater level trend.
- Complete step drawdown test.
- Set up long-term pumping test and associated monitoring.
- Complete recovery test.

In addition to the aquifer parameters, data were collected on the COC concentrations and leachability of solid materials by collecting soil samples during the installation of the piezometers. The information gathered during the preparation for and during the pumping tests will be used to inform the hydraulic control design and construction dewatering efforts as well as

aid in determining the volume of waste to be removed from the waste removal corridor (Figure 6).

Pre- and Post- Pumping Test Groundwater Analysis
Groundwater samples were collected from 27 piezometers and wells prior to the start of the pumping tests. After the pumping tests were concluded, an additional 31 piezometers and wells were sampled. The sampling results and groundwater elevations will be used to determine direction of groundwater flow, spatial variability of groundwater chemistry within the Site, and temporal geochemical changes during the pumping tests. These parameters will be used to inform the hydraulic control design and construction dewatering efforts.

SBC Loading Analysis
The loading analysis sought to determine the total groundwater discharged into a specific surface water reach. To achieve this objective, a selection of monitoring wells, piezometers, and surface sample locations were analyzed for COCs and radon. The unique properties of the radon will be used to trace where groundwater is discharging to SBC. This information will be used to inform the hydraulic control design and construction dewatering efforts.

Slag Investigation
The slag investigation included three phases: excavate test pits, collect slag core samples, and remove material by heavy equipment. A fourth phase, conduct a pilot test of expandable grout, was not completed based on the results from the first two phases (test pits and slag core sampling). The investigation locations were generally located in areas where slag is anticipated to be removed during remedial activities. The main objective of the slag investigation was to further delineate the extents (horizontal and vertical) of the slag within the Site and to collect appropriate information to inform the potential effectiveness of methods that may be employed to remove the slag.

5.4 Phase II RFC BRW-2021-01 and RFC BRW-2021-02

Prior to the approval of the BRW Phase III QAPP, Agencies approved RFC BRW-2021-01 and RFC BRW-2021-02 to the BRW Phase II QAPP (Atlantic Richfield, 2021c) which enabled a supplemental groundwater and surface water sampling event to occur during low-groundwater conditions and within the allotted timeframe of the Site Investigation schedule. The Data Quality Objectives for the supplemental sampling event are detailed in the BRW Phase III QAPP (Atlantic Richfield, 2021d).

5.5 Phase III Site Investigation

The Phase III Site Investigation aims to fill the remaining data gaps and conclude data collection so that the design team can finalize the Site characterization and proceed with the RD. Remaining design-related data gaps consist of solid material characterization, geotechnical considerations, groundwater water characterization, and COC loading to SBC (Table 2).

Details of the investigation activities are outlined in the BRW Phase III QAPP (Atlantic Richfield, 2021d). Below is a summary of the proposed investigation activities.

Additional Solid Material Characterization

Additional soil data will be collected to further define the nature and extent of the presence of COCs within the Site, which will inform the hydraulic control design and assist in determining the extent of waste removal within the waste removal corridor (using the waste identification criteria listed in Table 1 in Appendix 1 of Attachment C of Appendix D of the BPSOU CD). To meet this objective, a number of Waste Characterization Boreholes will be installed and their soils sampled and analyzed for COCs, petroleum compounds, and chemical stability/leachability.

Geotechnical Investigation

The geotechnical investigation will characterize the geotechnical properties of subsurface materials to remain in place in areas where structural features will potentially be constructed as part of the Site's end land use. The geotechnical investigation will also gather data to supplement the excavation surface design to ensure stable slopes adjacent to existing features on and off the Site. A series of boreholes will be installed along the waste removal corridor and within the anticipated end land use boundary. *In-situ* geotechnical evaluations will be conducted along with laboratory assessments of the geotechnical properties of the soil. Additional boreholes may be required once the Intermediate (60%) RD documents are reviewed by Agencies as the design will include details regarding the end land-use plan. If additional boreholes are required, an RFC to the BRW Phase III QAPP will be submitted for Agency review and approval prior to completing the additional boreholes.

Additional Groundwater Characterization

A primary goal of the Phase III Site Investigation is to assess the effect of seasonal changes in groundwater conditions on the chemical and spatial variability of groundwater within and upgradient of the Site. As part of that assessment, a number of piezometers will be installed between the MPTP Site and BRW Site. Data from these piezometers, along with existing monitoring wells within and adjacent to the MPTP Site, will be used to determine the baseline concentrations of PCP in the area between the two sites to avoid any potential impacts to the MPTP Site groundwater remedy by future remedial activities at the BRW Site, such as construction dewatering and hydraulic control. Groundwater samples will be collected from the newly installed piezometers as well as from a series of existing monitoring wells and piezometers within and adjacent to the Site. The samples will initially be collected during a representative range of seasonal groundwater and surface water conditions, such as low- and high-groundwater and surface water, and analyzed for COCs and organic pollutants.

Additional SBC Loading Analyses

In concert with the additional groundwater characterization activities, manual flow measurements along with groundwater and surface water samples will be collected twice during different times of the year to locate sub-reaches along SBC where COC-impacted groundwater is upwelling and quantify the load to SBC. Groundwater and surface water samples will be analyzed for metals, trace elements, and radon. Results from the radon analysis combined with surface water flow measurements will help define locations where groundwater is upwelling into surface water. Results from the metals and trace elements analyses combined with surface water flow measurements will help quantify the load to SBC. This information will be used to inform the hydraulic control design and construction dewatering efforts.

5.6 Additional Site Investigations

Additional data collection efforts may be necessary depending on the design-related data gaps remaining (or additional data gaps identified) during the Phase I, Phase II, and Phase III Site Investigation and development of the RD. Additional efforts may include another geotechnical investigation. Any additional investigation activities are anticipated to be submitted as RFCs to the appropriate QAPP.

6.0 QUALITY CONTROL

The BRW Phase I, Phase II, and Phase III QAPPs (refer to Section 1.0) contain information on the following:

- Quality assurance and quality control information, including laboratory quality control samples.
- Instrument/equipment testing, inspection, maintenance, and calibrations.
- Data management.
- Assessment and oversight.
- Data validation and usability.

Atlantic Richfield will provide the personnel to oversee all field investigation activities. If third parties want a representative on the Site, they will be required to check in and check out with the Field Team Leader daily. The Atlantic Richfield representative will be responsible for managing on-site activities.

7.0 SCHEDULE

Fieldwork for the Phase I Site Investigation was completed in February 2020, and fieldwork for the Phase II Site Investigation was completed in April 2021. The Phase III Site Investigation is expected to start in May 2021, pending agency approval, and conclude in summer or fall 2021, once all the seasonal groundwater and surface water data have been collected. Potential constraints that could delay fieldwork include adverse weather conditions, contractor availability, coordination with land managers/users, challenges with drilling and test pitting caused by site conditions, restrictions or personnel shortages related to COVID-19, or other unforeseen issues. Major project delays resulting from these constraints will be recorded in the field logbooks and reported to the Agencies. A detailed investigation schedule is in the main BRW Remedial Design Work Plan (to which this report is an Attachment). Note that this schedule will be updated periodically, as needed, and provided to Agencies independent of this report.

8.0 PDI EVALUATION REPORT

A PDI Evaluation Report was developed following the guidance provided in the BPSOU CD and submitted to Agencies (Atlantic Richfield, 2021b). Upon completion of the subsequent Site

investigation activities, the PDI Evaluation Report will be updated to include the new data and recommendations. The PDI Evaluation Report provides the following information:

1. Summary of the investigation performed.
2. Summary of investigation results.
3. Summary of validation data (i.e., tables and graphics).
4. Data validation reports and laboratory data reports.
5. Narrative interpretation of data and results.
6. Results of statistical and modeling analyses, if completed.
7. Photographs documenting the work conducted.
8. Conclusions and recommendations for RD, including design parameters and criteria.

The completed PDI Evaluation Report, evaluating the accumulated efforts of the Phase I, Phase II, and Phase III Site Investigations, will be submitted to the Agencies at the conclusion of the PDI field efforts and prior to submittal of the BRW Smelter Area Intermediate 60% RD Report.

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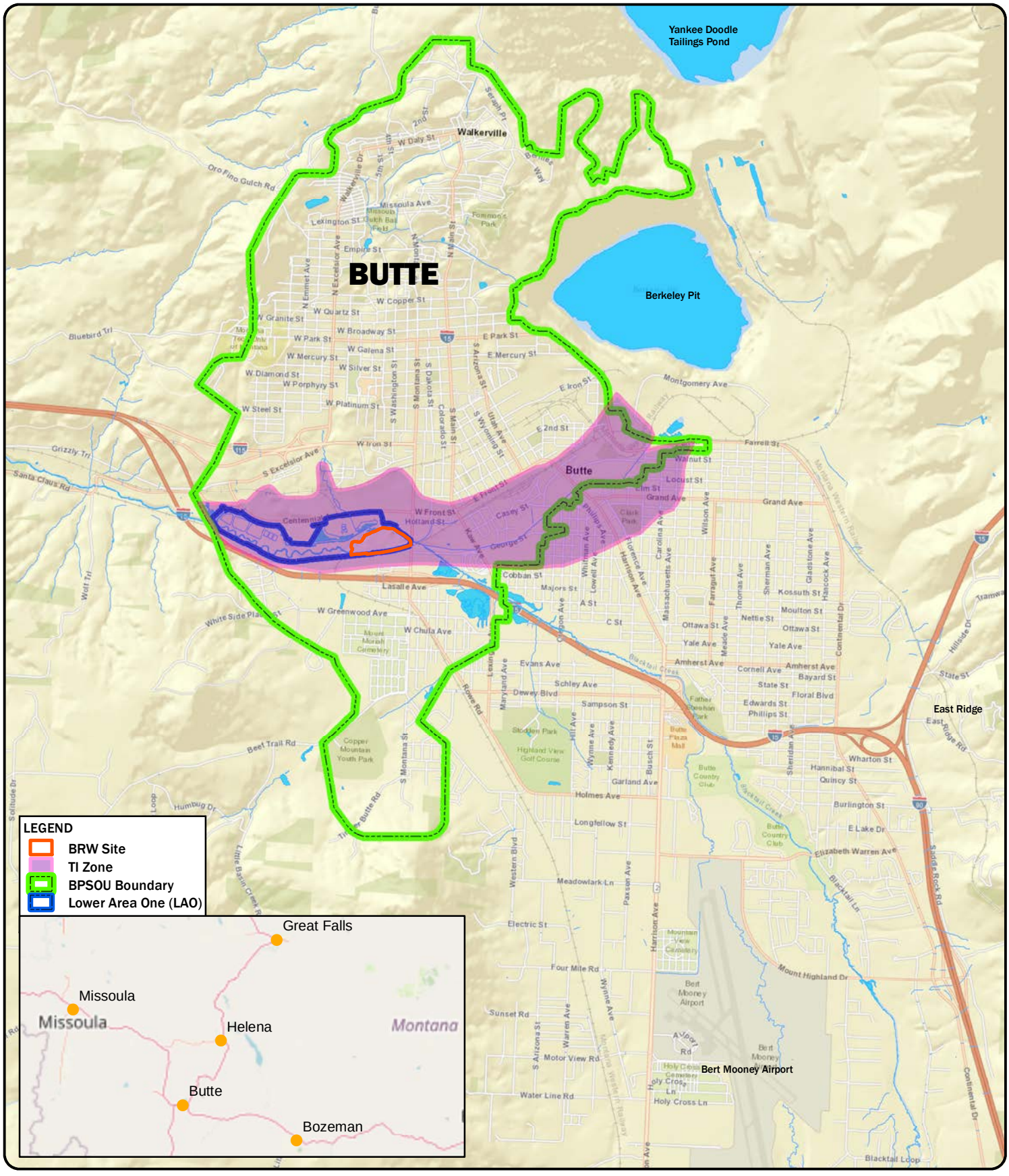
FIGURES



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SOURCE: PIONEER/ARCO/BSB

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Miles

FIGURE 1

BRW SMELTER AREA
SITE LOCATION MAP

PIONEER TECHNICAL SERVICES, INC.

Date: 5/3/2021

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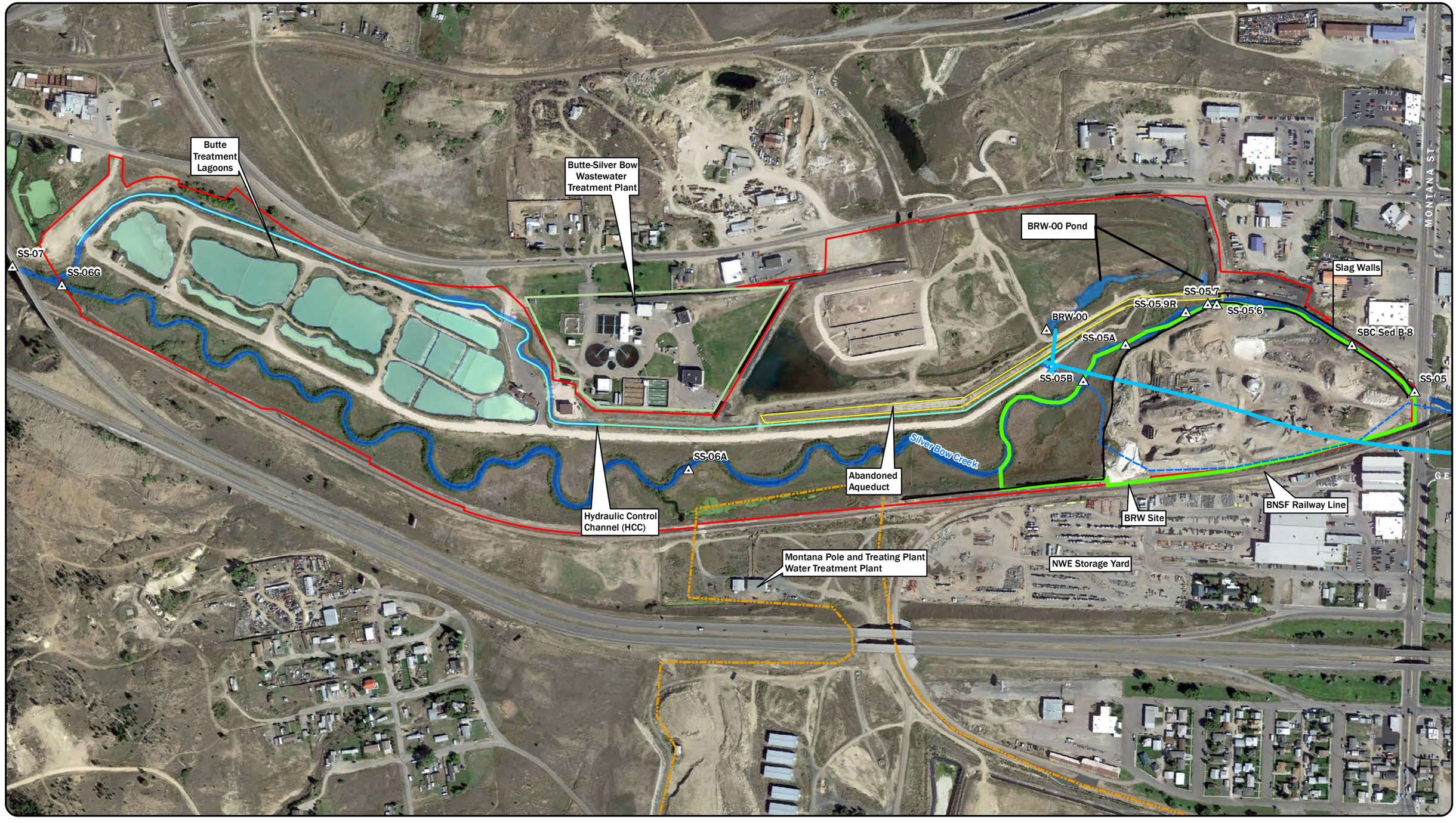

Surface Water Monitoring Points
BPSOU Subdrain Pump System Primary Force Main
BPSOU Subdrain Pump System Alternative Discharge Line
Hydraulic Control Channel
Slag Walls
BRW Site Boundary
BTL/LAO
LAO Boundary
Butte-Silver Bow Wastewater Treatment Plant Boundary
Abandoned Aqueduct
MPTP NPL Site

N

DISPLAYED AS:
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DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/TREC/GOOGLE

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Feet

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FIGURE 2

LOWER AREA ONE
SITE MAP

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/3/2021

BRW-00 Pond
GS-13B
GS-13A
BPS07-25
BPS11-07
BPS07-08A
BPS11-01
HOLLAND ST
SS-05.7
SS-05.9R
BRW18-PZ24
BPS07-14A
BRW-00
SS-05A
BPS07-15A
SBC Sed B-8
BPS11-02
BPSOU Subdrain Pump System Force Main
HCC
Slag Wall
BPS07-13B
BPS07-13A
BRW18-PZ09
BRW19-HCW31
FP98-2
BRW18-PZ08
BRW19-HCW32
BRW18-PZ16
Abandoned Aqueduct
SS-05B
BRW18-PZ23
BRW19-HCW33R
BRW19-PZ16S
FP98-01B
BRW19-HCW34
SMONTANA ST
BRW18-PZ25
BRW18-PZ06
FP98-1
BRW18-PZ22
BRW19-PZ19
SS-05
B-6
BPS11-06
BRW18-PZ05
BRW19-HCW39
BRW18-PZ18
BRW18-PZ17
BRW18-PZ04
BRW19-HCW30
BRW18-PZ15
BRW19-PZ05S
BRW19-HCW38
BRW19-HCW35
Stack Foundation
BRW19-PZ03D
BRW18-PZ03
BRW19-PZ42
BRW18-PZ20
FP98-5
Manganese Ore Bin
BRW18-PZ14
BRW19-PZ27
BRW19-PZ31
BRW19-PZ40
BRW18-PZ21
BRW19-PZ45
BPS11-05A1
BPS11-05A2
BRW19-PZ26
BRW18-PZ02
BRW19-HCW37
BRW19-HCW36
BRW19-HCW41
BRW19-PZ32R
BRW19-PZ28R
BRW19-PZ41
BRW19-PZ43
BRW19-HCW40
BRW19-PZ30
BRW19-PZ44
BRW19-PZ50
BRW18-PZ13
BRW19-PZ29
BRW18-PZ12
BRW19-PZ49
BPSOU Subdrain Pump System Alternate Discharge Line
BRW-SS01
BRW19-PZ11S
BRW19-PZ12D
GEORGE ST
BRW18-PZ01
BRW19-PZ01DR
BRW19-PZ47
FP98-3
MW-03-MPC
BRW19-PZ48
BRW18-PZ11
BRW19-HCW42
MW-03A-MPC
BRW19-PZ10D
BRW18-PZ10
Silver Bow Creek (SBC)
BRW19-PZ01S
BNSF Railroad
BRW19-PZ46
MW-02-MPC
MW-01-MPC

Notes:
1. Boundary and utility lines shown are approximate.

UTILITIES.dwg Polyline

Utilities

- GAS — Gas Line
- OE — Overhead Electric
- SS — Sewer Line
- SD — Storm Sewer Line
- UE — Underground Electric
- T EL — Underground Telephone Line
- WTR — Water Line

- Existing Monitoring Wells
- BRW Piezometers
- BRW Hydrocarbon Wells
- Staff Gages
- BPSOU Subdrain Pump System Force Main
- BPSOU Subdrain Pump System Alternate Discharge Line
- Hydraulic Control Channel (HCC)
- Current Railroads
- Proposed Waste Removal Corridor (Average 275' Width) and SBC Reconstruction Area
- Abandoned Aqueduct
- BRW-00 Pond
- BRW Smelter Area Site Boundary

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTN'L FT
SOURCE: PIONEER/CAD EARTH 2014

0 75 150 300
Feet

FIGURE 3
BUTTE REDUCTION WORKS
SMELTER AREA SITE MAP

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/3/2021

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Potentially Remaining Infrastructure

Demolished Historic Infrastructure

Confirmed Remaining Infrastructure

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/GOOGLE

0 50 100 200
Feet

FIGURE 4

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/3/2021

BRW SMELTER AREA
EXISTENCE OF
DURABLE HISTORIC
INFRASTRUCTURE

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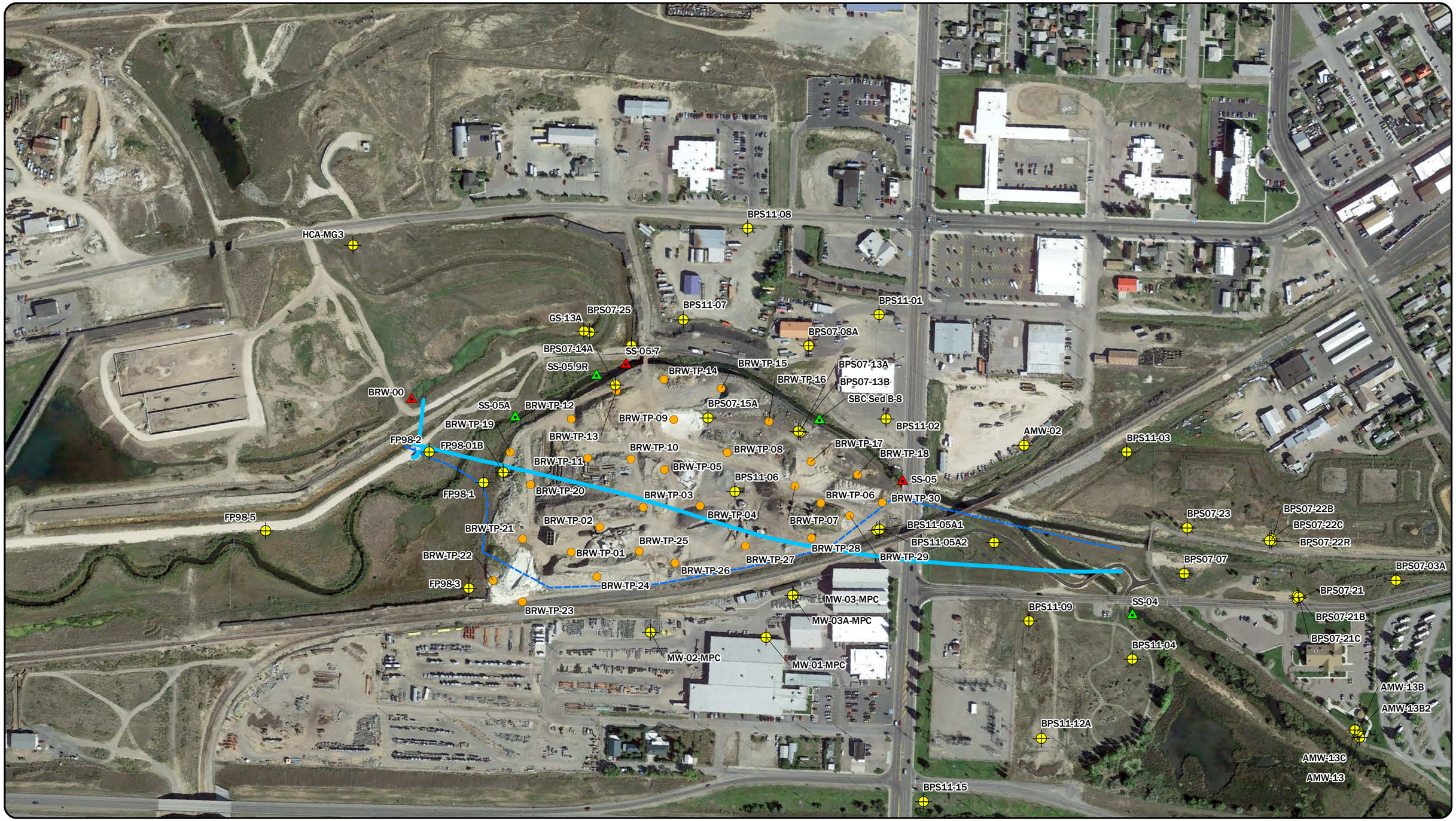


Existing Monitoring Wells
Staff Gage
Staff Gages Equipped with Transducers
Test Pits (Natural Resource Damage Program, 2016)

BPSOU SubdrainPump System Primary Force Main
BPSOU Subdrain Pump System Alternative Discharge Line

Note: Locations shown were installed prior to commencing BRW Phase I Site Investigaion activities.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTN'L FEET
SOURCE: PIONEER

0 150 300 600
Feet

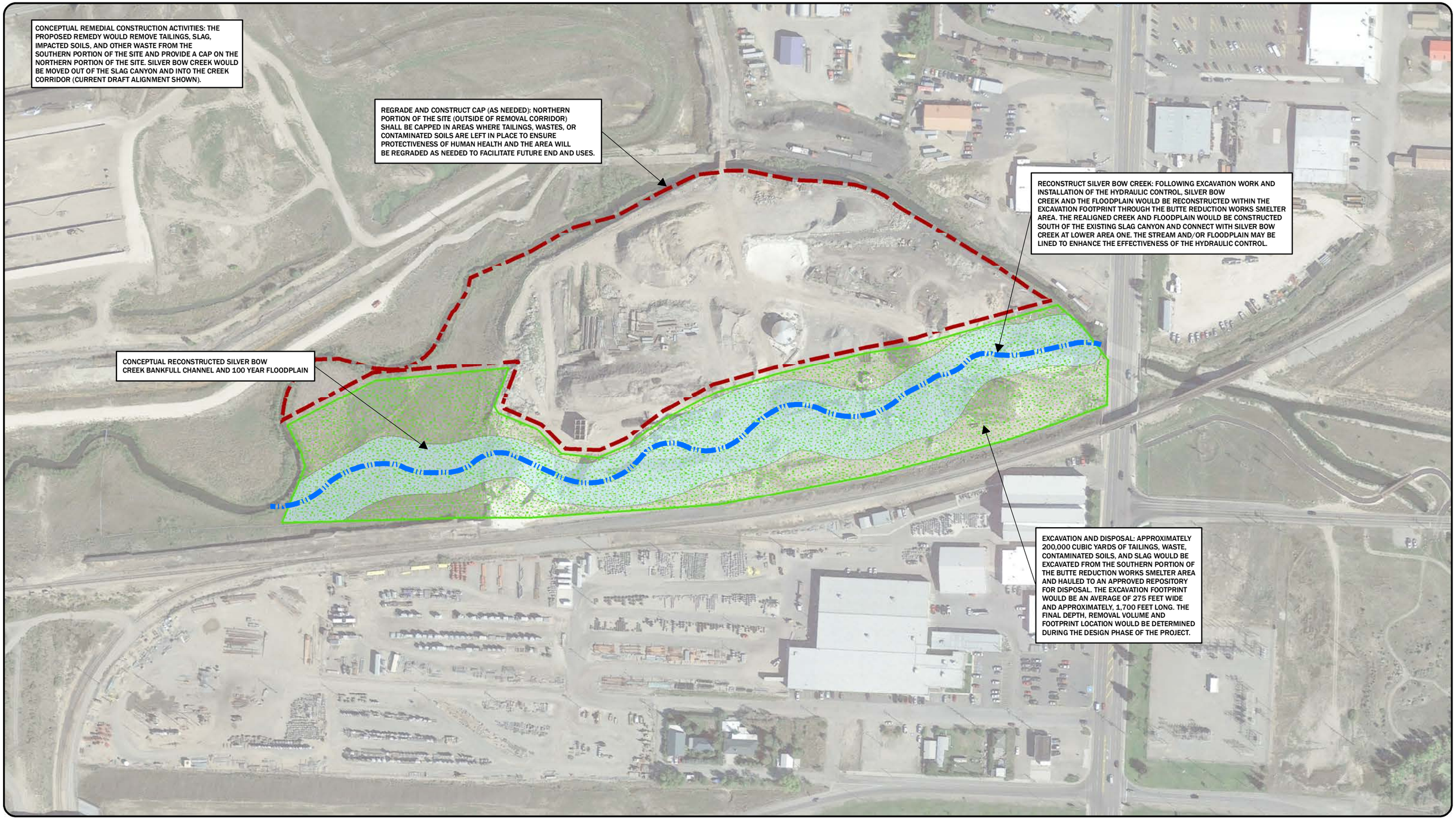
FIGURE 5

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/3/2021

BRW SMELTER AREA PREVIOUS INVESTIGATIONS

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI WP\BRW_PDI_WP_004_PrevInv_21.mxd



N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTN'L FT
SOURCE: PIONEER/CAD-EARTH

0 100 200 400
Feet

FIGURE 6

PIONEER TECHNICAL SERVICES, INC.

BRW SMELTER AREA CONCEPTUAL REMEDIAL ACTION PLAN

DATE: 5/3/2021

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TABLES

Table 1. Summary of Historic Infrastructure

Process/System	Description	Remaining Equipment/Data Gaps	BRW Phase I QAPP Actions (Atlantic Richfield, 2019)	BRW PDI Evaluation Report Observations (Atlantic Richfield, 2020)
Butte Reduction Works				
Concentrator Plant	The second class ore was sent to the concentrator prior to being smelted in the furnaces. The concentrator consisted of various equipment including crushers, trommels, jigs, slime classifiers, chilean mills, and tables used to separate the ore from waste rock.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Previous site investigations support the assumption that the concentrator was demolished. However, a foundation for the tailings elevator may still remain.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
Settling Tanks and Tables	The settling tanks and tables were most likely part of the slime plant which were used to thicken the slimes from the concentrator.	Based on present-day aerial imagery and previous site investigations, infrastructure from the slime plant remains.	**Measurements and photographs** of visible infrastructure will be collected.	Settling ponds are about 5 feet high and about 104 feet long and width is about 15-20 feet. Mostly made of slag. Photos were included in the BRW PDI Evaluation Report.
Open Ore Kilns	Two open ore kilns were built of blocks of slag with a stack centered between the two kilns.	Based on historical information, equipment was most likely demolished sometime between 1900 and 1914. Previous site investigations support the assumption that the kilns were demolished. However, a foundation for the stack may still remain.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
Roasting Furnaces (Main Calcine Furnace Building & Calcine Furnace Building No. 2)	The fine material, or screenings, was put through the roasting (e.g., calcining or desulphurizing) furnaces prior to going to the matte furnaces. The calcine department consisted of two buildings with a total of seven furnaces. The buildings were a steel frame construction, and the furnaces were built of steel and brick with no subsurface support/foundation. The flue dust from the furnaces was captured via an extensive system of elevated flues and dust chambers and sent to the main stack.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Previous site investigations support the assumption that the roasting furnaces were demolished and no foundation remains for the Main Calcine Furnace Building. However, a foundation remains for the Calcine Furnace Building No.2 based on present-day aerial imagery. Additionally, a foundation for the stacks may still remain.	A test pit (**BRW18-TP02**) will be excavated to determine the foundation depth for the Calcine Furnace Building No. 2 (Table 2 and Figure 5).	Total depth of BRW18-TP02 was 4.2 feet due to slag. Pockets of tailings with bigger chunks of slag were observed towards the bottom of the test pit. Photos were included in the BRW PDI Evaluation Report.
Blast Furnaces	The coarse ore material went directly to blast furnaces. The furnaces were built of steel and brick with no subsurface support/foundation. The building was steel frame construction. The flue dust from the furnaces was captured via an extensive system of elevated flues and dust chambers and sent to the main stack.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Could not confirm if a foundation still exists based on available information. Additionally, a foundation for the stack may still remain.	No actions proposed for the BRW Phase I Site Investigation. Unable to excavate a test pit due to current location of Butte-Silver Bow's equipment.	No actions proposed for the BRW Phase I Site Investigation.
Matte Furnaces	The fine ore from the roasting furnaces is sent to the three reverberatory matting-furnaces. The heated gases from the furnaces pass through Worthington boilers. The flue dust from the furnaces was captured via an extensive system of elevated flues and dust chambers and sent to the main stack.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. It appears a foundation for the matte furnace building may remain based on historical imagery.	A test pit (**BRW18-TP03**) will be excavated to determine the foundation depth for the Matte Furnace Building (Table 2 and Figure 5).	Total depth of BRW18-TP03 was 1.3 feet due to slag foundation.
Converting Department	The matte from the furnaces was taken to the converting department. The converter building was steel frame construction with an earth floor. The equipment was primarily built with steel and required no subsurface foundation/support. The converters were connected to the elevated flue and dust chamber via a movable hood and fumes were sent to the main stack.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Previous site investigations support the assumption that the converter building and equipment was demolished.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
Stack	An extensive system of flues and dust chambers collected and sent the flue dust from the equipment to main stack. The stack stood on a slag base 12.5-feet thick. The reinforced concrete base was 42.5-feet by 42.5-feet and 8-feet thick. The stack was 340-feet high, including the concrete base.	Based on historical information, the stack was partially demolished after the BRW discontinued operations in 1910 and was completely demolished after the manganese plant ceased operations with the exception of the slag and concrete bases which still exist today.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
Tracks & Conveyors	There were multiple elevated tracks, conveyors, and tramways used to transport ore, coal, matte, and copper.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
Storage Bins	There were multiple storage bins used for ore and coal at the BRW. The ore bins would most likely have been above ground to allow material to fall out of the bins and onto conveyors, tracks, etc.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. However, there is an ore bin located on the southwest portion of the site that still remains.	**Measurements and photographs** of the remaining ore bins will be collected.	Storage bin is about 44 feet long, 16 feet high, and 16 feet wide. Structure mostly concrete, falling apart, with rebar and what looks like 4-inch channel iron running through it. Photos were included in the PDI Evaluation Report.
Blacktail Creek Flume	The Blacktail Creek Flume was built to channel clean water from Blacktail Creek to the concentrator. The majority of the structure is located underground and is most likely constructed of slag and brick.	Based on aerial imagery and previous site investigations, a portion of the flume remains on the west side of the site. Therefore, it is assumed that a significant portion of the flume may still exist.	A **Geophysical Multichannel Analysis of Surface Waves (MASW) seismic survey** will be completed to locate the Blacktail Creek Flume (Figure 6).	The Geophysical Multichannel Analysis of Surface Waves (MASW) seismic survey was completed. See Appendix C of the BRW PDI Evaluation Report for additional information.
South Culvert	To direct Silver Bow Creek around the tailings, a culvert was built of pilings and plank sidewalls. This culvert was rebuilt and extended during the operations at BRW.	There is little information available on the final construction and alignment of the south culvert.	A **Geophysical Multichannel Analysis of Surface Waves (MASW) seismic survey** will be completed to attempt to verify if the culvert remains (Figure 6).	The Geophysical Multichannel Analysis of Surface Waves (MASW) seismic survey was completed. See Appendix C of the BRW PDI Evaluation Report for additional information.
Misc. Mechanical Systems	Pump House: Consisted of a well, pumps, an iron flue, and stack.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Could not confirm if a foundation remains based on available information. Additionally, a foundation for the stack may still remain.	A test pit (**BRW18-TP01**) will be excavated to determine if a foundation remains and if possible the thickness of the foundation (Table 2 and Figure 5).	Total depth of BRW18-TP01 was 6.4 feet. A brick structure on top of slag was observed at the bottom of the test pit.
	Machine Shop: Constructed with a steel truss roof and contained the blowers for the blast furnaces.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Could not confirm if a foundation remains based on available information.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
	Motor Repair Shop	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Could not confirm if a foundation remains based on available information.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
	Sampling Works: Ore was sampled as it arrived to the BRW.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Could not confirm if a foundation remains based on available information.	No actions proposed for the BRW Phase I Site Investigation. Unable to excavate a test pit due to location underneath a Butte Silver-Bow materials storage pile.	No actions proposed for the BRW Phase I Site Investigation.
	Crusher House	Based on historical information, the crusher house was demolished sometime between 1900 and 1914.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
	Blister Building: The building was a steel frame building with multiple engines, generators, and compressors.	Based on historical information, building was demolished shortly after the BRW discontinued operations in 1910. Based on present-day aerial imagery and previous site investigations, there are remaining concrete structures most likely from engines, generators, compressors, etc. located within the building.	**Measurements and photographs** of visible infrastructure will be collected.	Blister building looks like its about 8-10 feet tall, looks like there are about 4 sets of pillars left, that are about 7 feet wide. Length is roughly 30 feet or so. Looks like mostly concrete, rebar, and 4-inch channel. Photos were included in the BRW PDI Evaluation Report.
	Electric Motor: Assumed to power/move the coal elevators.	Based on historical information, equipment was demolished or removed shortly after the BRW discontinued operations in 1910. Could not confirm if a foundation remains based on available information.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.
Domestic Manganese				
Kilns	The Domestic Manganese kilns were built over the location of the dust chambers for BRW operations which were built of steel frames with a slag base. The building contained two rotary kilns and was constructed of steel frame trusses and posts with wood, concrete, and earth floors.	Based on historical research and previous site investigations, most structures were removed during the 1970s with some remaining infrastructure observed in the early 1990s. Could not confirm if a foundation remains based on available information.	**Measurements and photographs** of visible infrastructure will be collected. Two test pits (**BRW18-TP09 & BRW18-TP16**) will be excavated to determine if a foundation remains and if possible the thickness of the foundation as well as identify if any remaining flue dust is present (Table 2 and Figure 4).	There are 4 structures, roughly 10 feet tall, 7 feet wide, and 13 feet in length. There are 4 concrete structures with rebar, and one of them has steel on the top in the concrete. BRW18-TP09 consisted of demolition debris, railroad ties, and a concrete foundation with a metal lid. BRW18-TP16 consisted of demolition debris, brick, wire, and white ash. Photos were included in the PDI Evaluation Report.
Ore Mill	The building was constructed of wood posts.	Based on historical research and previous site investigations, most structures were removed during the 1970s with some remaining infrastructure observed in the early 1990s. Additionally, it appears that there were some pumps, conveyors, and crushers beneath the surface that may still remain.	**Measurements and photographs** of visible infrastructure will be collected. Test pits (**BRW18-TP08 & BRW18-TP12**) will be excavated to determine if subsurface structures or equipment remains (Table 2 and Figure 5). One borehole (**BRW18-PZ13**) will be drilled to determine if infrastructure remains (Table 2 and Figure 5).	BRW18-TP08 consisted of demolition debris and tailings (white sand). BRW18-TP12 was not excavated. BRW18-PZ13 consisted of slag and brick within the first 5 feet of core collected.
Transformer Yard	No equipment/construction description available.	Based on historical research, structures were removed during the 1970s. However, there is a concern that PCBs may still exist from the transformer operation.	One borehole will be drilled to determine if PCBs are present (**BRW18-BH13**) (Table 2 and Figure 12).	BRW18-BH13 was not drilled due to proximity to asphalt plant. No samples were collected for PCB's.
Misc. Buildings	The buildings once included a carpenter shop, garages, and an office.	Based on historical research, the structures were removed during the 1970s. Based on previous site investigations, the foundations most likely remain.	No actions proposed for the BRW Phase I Site Investigation.	No actions proposed for the BRW Phase I Site Investigation.

Purpose: To identify the potentially remaining durable historic infrastructure with the goal of identifying areas for design related test pit locations.

Observations: There are structures that remain at the BRW Site from both the BRW Smelter and the Domestic Manganese plant. The test pit locations indicated in the table are identified on Figure 5 of the PDI Evaluation Report (Atlantic Richfield, 2020).

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Table 2. Data Gaps Summary

Data Gap Categories	Objectives	Phase I Site Investigation	Additional GW Sampling	Hydrocarbon Investigation	Phase II Site Investigation	Supplemental GW & SW Sampling	Phase III Site Investigation	Phase I Site Investigation (Phase I QAPP)	Additional Groundwater Sampling (Phase I QAPP, RFC 01)	Hydrocarbon Investigation (Phase I QAPP, RFC 03)	Phase II Site Investigation (Phase II QAPP)	Supplemental Groundwater and Surface Water Sampling (Phase II QAPP, RFC 01 and RFC 02)	Phase III Site Investigation (Phase III QAPP)
Solid Material Characterization	Volume and Distribution of Solid Materials												
	Slag	O		O	✓		+	Laboratory and XRF data, soil lithology logs, and photographic logs from test pits and boreholes were used to determine the volume and distribution of solid materials within the BRW Site.	NA	Laboratory and XRF data, soil lithology logs, and photographic logs from hydrocarbon monitoring well boreholes and test pits were used to augment and refine the volume and distribution of solid materials within the BRW Site.	Laboratory and XRF data, soil lithology logs, and photographic logs from new piezometer boreholes and slag investigation test pits were used to augment and refine the volume and distribution of solid materials within the BRW Site.	NA	A final series of boreholes will be constructed to fill any design-related data gaps pertaining to the volume and distribution of impacted materials within the BRW site.
	Demolition Debris	✓		+	+		+						
	Impacted Materials (including Tailings, Alluvium, and Organic Soils)	O		O	O		✓						
	Unimpacted Materials	✓		+	+		+						
	Properties of Solid Materials												
	Metals Concentrations	O		O	O		✓	The test pit and borehole samples were analyzed using an XRF field unit. Select samples were sent for laboratory ICP (metals concentrations) and SPLP analysis (leachability).	NA	Test pit and borehole samples were analyzed using an XRF field unit. Select samples were sent for laboratory ICP (metals concentrations) analyses.	Borehole samples were analyzed using an XRF field unit or sent for laboratory ICP analysis. Select samples were sent for laboratory SPLP (leachability) analyses.	NA	Borehole samples will be analyzed using an XRF field unit or sent for laboratory ICP analysis. Select samples will be sent for laboratory SPLP (leachability) analyses.
	Leachability of Metals	O			✓		+						
	Constructability Considerations												
	Geotechnical Considerations				O		✓	NA	NA	NA	The slag investigation collected data on the physical parameters of the slag and examined means of removing the slag.	NA	Additional boreholes will be drilled during a geotechnical investigation to determine properties of the underlying soil and then evaluate the geotechnical requirements of the end-land use plan and excavation design.
	Location of Subsurface Flume/Culvert	✓						The geophysical MASW Seismic Survey confirmed the existence and location of the subsurface flume/culvert.			NA		NA
	Remaining Infrastructure	✓						Measurements and photographs documented the remaining infrastructure at the BRW Site. Observations from test pits were used to determine the existence of any durable historic infrastructure.					
Groundwater Characterization and Hydraulic Control	Chemistry and Spatial Variability	O	O	O	O	O	✓	Laboratory results from groundwater samples collected from newly installed piezometers were used to determine the spatial variability of the groundwater chemistry within the BRW Site. Low-flow sampling parameters were used to estimate the hydraulic conductivity of the screened aquifer interval. Monthly groundwater levels and transducer data were used to evaluate groundwater elevations, potentiometric surfaces, and seasonal groundwater change. Lithology logs from the piezometer construction and groundwater elevations were used to determine the aquifer geometry.	Additional groundwater sampling and laboratory analyses of the Phase I piezometers and select upgradient existing monitoring wells were used to augment and refine the spatial variability of the groundwater chemistry within the BRW Site. Low-flow sampling parameters were used to estimate the hydraulic conductivity of the screened aquifer interval. Monthly groundwater levels and transducer data were used to evaluate groundwater elevations, potentiometric surfaces, and seasonal groundwater change. Lithology logs from the piezometer construction and groundwater elevations were used to determine the aquifer geometry.	Laboratory results from groundwater samples collected from newly installed hydrocarbon monitoring wells and existing monitoring wells were used to augment and refine the spatial variability of the groundwater chemistry within the BRW Site. Low-flow sampling parameters were used to estimate the hydraulic conductivity of the screened aquifer interval. Lithology logs from the piezometer construction and manual water level measurements were used to determine the aquifer geometry as well as refine and augment the groundwater elevations, potentiometric surfaces, and seasonal groundwater change.	New piezometers were installed, and lithology logs from the piezometer construction and manual groundwater level measurements were used to augment and refine the aquifer geometry. Two pumping test(s) were conducted to determine the transmissivity, hydraulic conductivity, stativity, presence of hydraulic barriers and/or sources of storage, preferential flow, anisotropy, and heterogeneity of the aquifer, role of confining and/or less conductive units, well efficiency, specific yield, and other relevant information specific to the remedial design. Additional groundwater sampling was conducted before and after the pumping test and samples were submitted for laboratory analyses. These samples were used to refine and augment the spatial variability of the groundwater chemitry within the BRW Site. Manual groundwater level measurements collected duirng sampling were used to augment and refine the groundwater elevations, potentiometric surface, and direction of flow. A network of surface water and groundwater monitoring points were used to determine the impact of BRW groundwater on subsections of SBC as well as assess the potential impacts of the dewatering activities on nearby sites. This work included the installation of additional staff gages in SBC, stream gaging, and sampling for COC and Radon-222 to monitor the groundwater and surface water flux and COC loading.	Manual groundwater level measurements and groundwater samples were collected from select piezometers and monitoring wells during low-groundwater and surface water conditions to help refine and augment the spatial variability of the groundwater chemitry within the BRW Site. Low-flow sampling parameters were used to estimate the hydraulic conductivity of the screened aquifer interval. Monthly groundwater levels were used to evaluate groundwater elevations, potentiometric surfaces, and seasonal groundwater change. A network of surface water and groundwater monitoring points were used to determine the impact of BRW groundwater on subsections of SBC during low groundwater and surface water conditions. This work included monitoring of stream gages, sampling for COCs, and Radon-222 tracing tests to monitor groundwater flux, surface water flux, and COC loading.	Groundwater elevations and groundwater samples will be collected from select piezometers and monitoring wells during a representative range of seasonal groundwater and surface water conditions (such as high- and low-groundwater and surface water conditions) to help refine and augment the spatial variability of the groundwater chemitry within the BRW Site. Low-flow sampling parameters will be used to estimate the hydraulic conductivity of the screened aquifer interval. Monthly groundwater levels will be recorded to evaluate groundwater elevations, potentiometric surfaces, and seasonal groundwater change. Additional piezometers will be installed to provide a potential early detection network to ensure that notable concentrations of PCP from the Montana Pole and Treating Plant Site (located to the west of the BRW Site) do not migrate during construction dewatering and/or as a result of implementing the BRW hydraulic control. A network of surface water and groundwater monitoring points will be used to determine the impact of BRW groundwater on subsections of SBC during a representative range of seasonal groundwater and surface water conditions (such as high- and low-groundwater and surface water conditions). This work will include monitoring of stream gages, sampling for COCs, and Radon-222 tracing tests to monitor groundwater flux, surface water flux, and COC loading.
	Conductivity and Transmissivity (Impacted Groundwater Volume)	O	O	O	✓	+	+						
	Groundwater Elevations, Potentiometric Surface, and Direction of Flow	✓	+	+	+	+	+						
	Seasonal Groundwater Elevation Change	✓	+	+	+	+	+						
	Evaluation of Groundwater Impact to SBC				O	O	✓						
	Aquifer Geometry	O		O	✓		+						
Organic Pollutants	Chemistry and Spatial Variability	O	O	O	✓	+	+	Laboratory analyses and PID screening of soil samples from test pits and boreholes and groundwater samples from select piezometers were used to determine the chemistry and spatial variability of hydrocarbons.	Additional groundwater sampling and laboratory analyses at those piezometers and monitoring wells that previously contained organic pollutants were collected to refine the chemistry and spatial variability of organic pollutants.	Groundwater sampling and laboratory analyses of the hydrocarbon monitoring wells and select existing monitoring wells were conducted to refine the chemistry and spatial variability of organic pollutants and help define appropriate Site-specific action levels and determine the proper management plan for soils and groundwater impacted with organic pollutants within the BRW Site.	Data was collected to refine the chemistry and spatial variability of organic pollutants and help define appropriate Site-specific action levels and determine the proper management plan for soils and groundwater impacted with organic pollutants within the BRW Site. Soil from the newly installed piezometers were screened with PIDs for the presence of hydrocarbons with select samples sent for laboratory analyses. Groundwater samples were taken and submitted for laboratory analysis.	Groundwater sampling and laboratory analyses of select existing wells/piezometers were conducted to refine the chemistry and spatial variability of organic pollutants and help define appropriate Site-specific action levels and determine the proper management plan for soils and groundwater impacted with organic pollutants within the BRW Site.	Data will be collected to refine the chemistry and spatial variability of organic pollutants and help define appropriate Site-specific action levels and determine the proper management plan for soils and groundwater impacted with organic pollutants within the BRW Site. Soil from the newly installed piezometers will be screened with PIDs for the presence of hydrocarbons with select samples sent for laboratory analyses. Groundwater samples will be taken from select wells and submitted for laboratory analysis.
	Plan to Manage Impacted Soil and/or Groundwater	O	O	O	✓	+	+						
Silver Bow Creek (SBC) Realignment	SBC Bottom Invert at Upstream and Downstream Tie-in Locations	✓						The survey team determined the bottom invert at the upstream and downstream tie-in locations on SBC.	NA	NA	NA	NA	NA
	Evaluation of Potential Lining of Relocated SBC	O	O	O	O	O	✓	Soil and groundwater chemistry information will be used to determine if a liner will be needed based on the excavation design and the potential impact to the relocated SBC.	The additional groundwater data will be used to refine the decision to line the SBC channel.	The additional groundwater data will be used to refine the decision to line the SBC channel.	The additional soil and groundwater chemistry data and the results of the pumping test will be used to determine the excavation design and will guide the decision of whether to line the SBC channel.	The additional groundwater data will be used to refine the decision to line the SBC channel.	The additional groundwater data will be used to refine the decision to line the SBC channel.

	Objective not covered during indicated investigation phase.
✓	Objective met during indicated investigation phase.
O	Objective partially met during indicated investigation phase.
+	Additional data gathered during indicated investigation phase to refine a completed objective

Acronym Table

BRW - Butte Reduction Works	ICP - Inductively Coupled Plasma	PID - Photoionization Detector	RFC - Request for Change
COC - Contaminant of Concern	MASW - Multichannel Analysis of Surface Waves	QAPP - Quality Assurance Project Plan	SPLP - Synthetic Precipitation Leaching Procedure
GW - Groundwater	NA - Not applicable	SBC - Silver Bow Creek	XRF - X-ray fluorescence

Appendix A
Select Appendices from BRW Test Pit Report

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May 2016

Figure 1

Site Location

Butte Reduction Works Smelter Site /

Silver Bow County Road Dept. Asphalt Plant

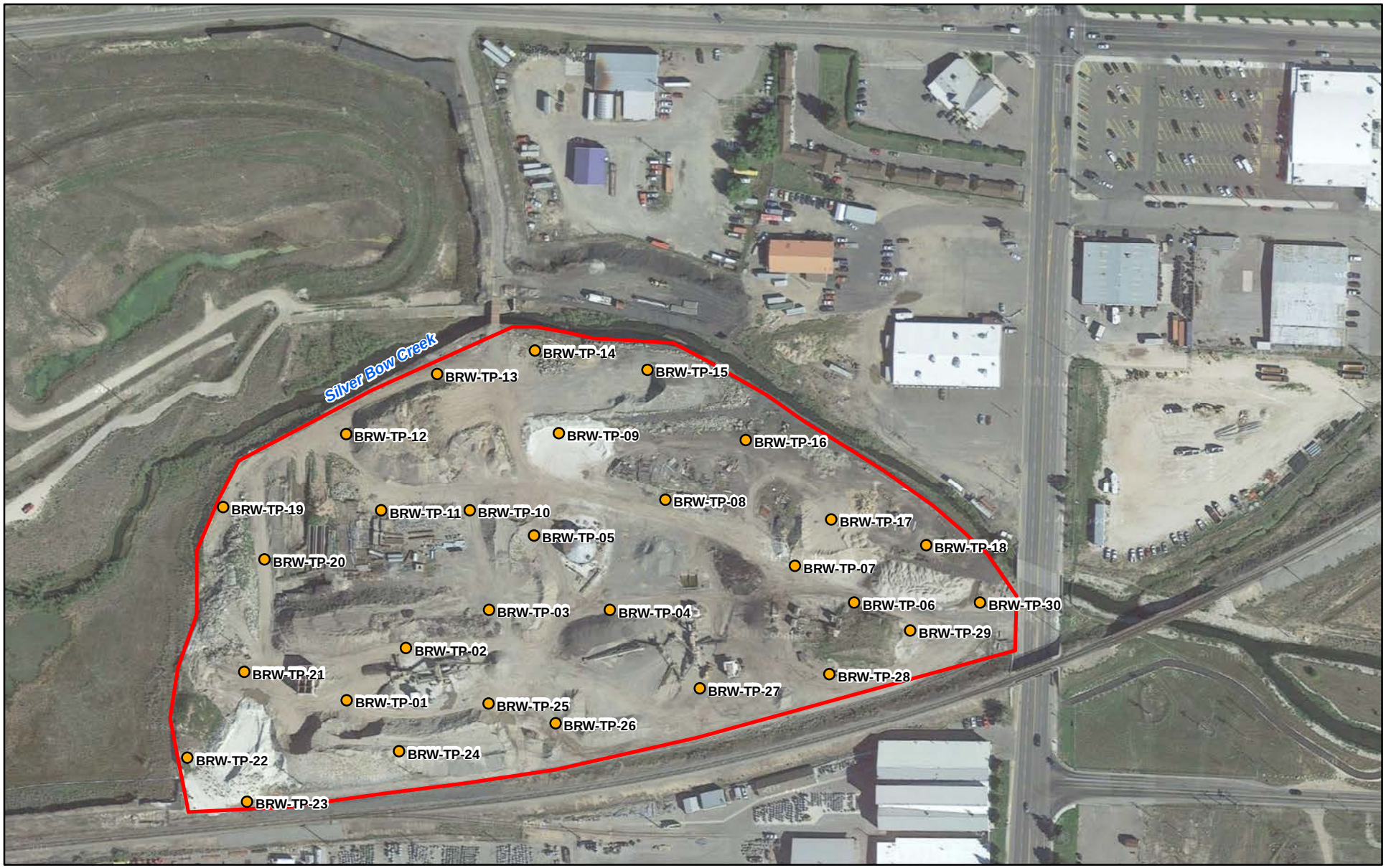
Data Gaps Investigation

Lower Area One
Butte, Montana

Legend

Site Location

Document Path: C:\CData\BAO\BRW\Arcmap\BRWTestPits.mxd



August 2016

N

SCALE IN FEET

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Legend

Test Pit

Butte Reduction Works

Figure 2

Test Pit Locations

Butte Reduction Works Smelter Site

Data Gaps Investigation

Lower Area One

Butte, Montana

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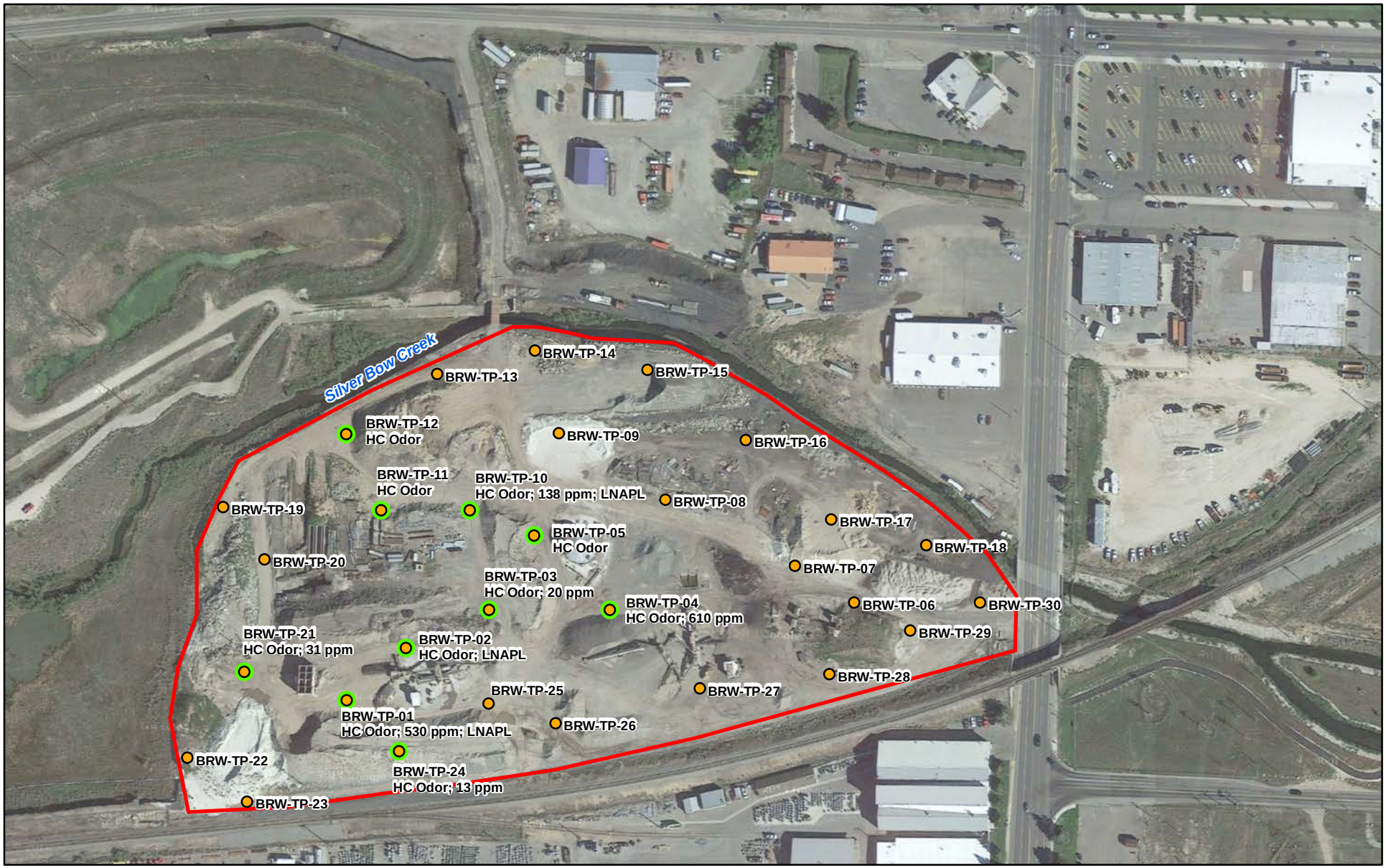

August 2016

N

SCALE IN FEET

0 280

Legend

- Test Pit
- Butte Reduction Works
- Evidence of Hydrocarbon Impacts
  HC Odor - Hydrocarbon Odor; LNAPL - Light Non-aqueous Phase Liquid;
  530 ppm - Concentration measured in Flame Ionization Detector (parts per million)

Figure 3

Test Pit Locations

Butte Reduction Works Smelter Site

Data Gaps Investigation

Lower Area One
Butte, Montana

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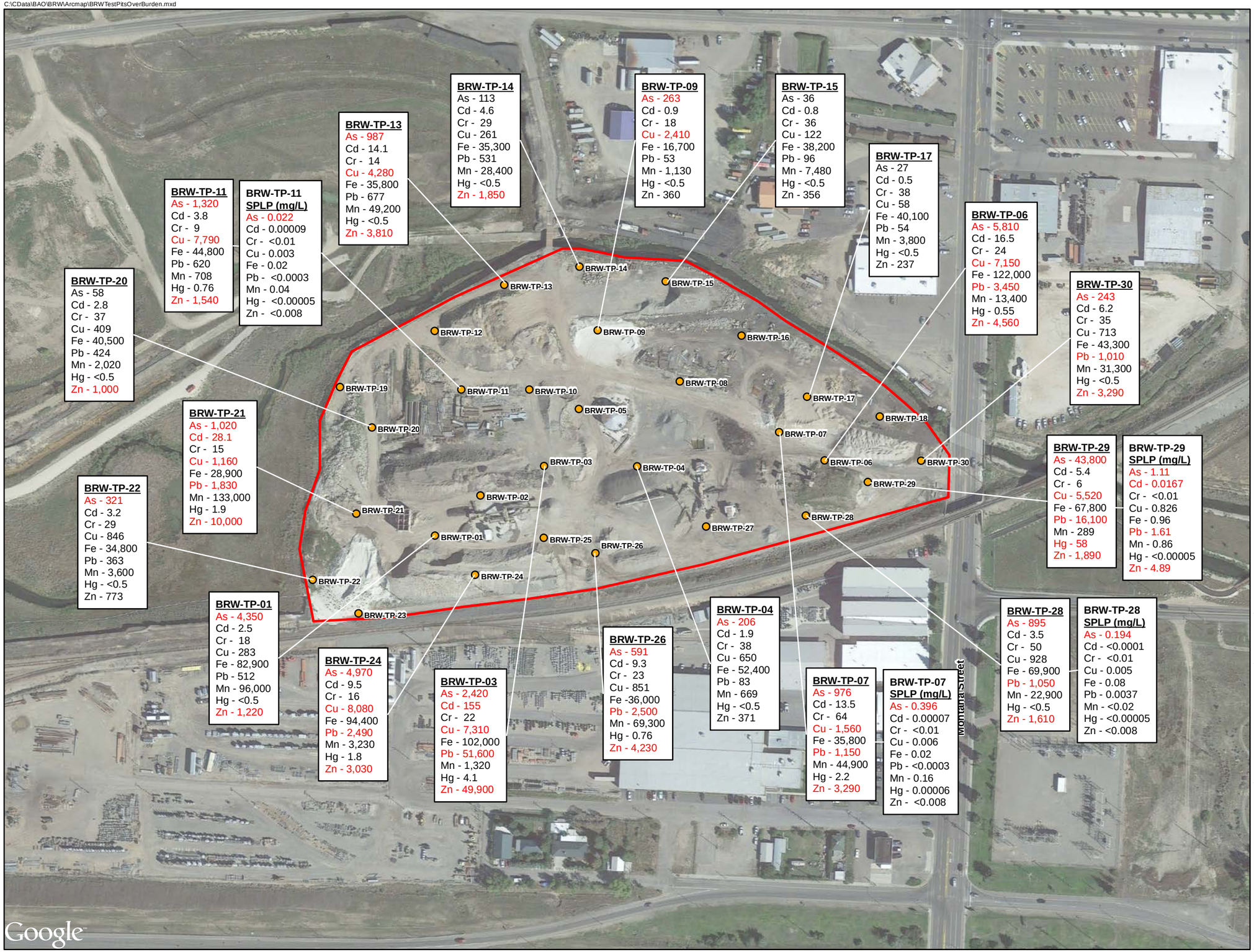

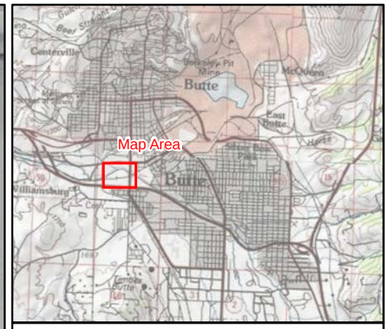

Sample Location
(Units in mg/kg)

Screening Criteria (mg/kg)	
Arsenic	200
Cadmium	20
Chromium	*
Copper	1000
Iron	*
Lead	1000
Manganese	*
Mercury	10
Zinc	1000

** - Not established*

Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

Groundwater Standards	
MT DEQ-7 (mg/l)	
Arsenic	0.01
Cadmium	0.005
Chromium	0.1
Copper	1.3
Iron	*
Lead	0.015
Manganese	*
Mercury	0.002
Zinc	2

** - Not established*

TETRA TECH

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1:2,400

Feet

0 50 100 200

9/8/2016

Overburden/Construction Debris Concentration Map
Butte Reduction Works
Smelter Site
Data Gaps Investigation
Lower Area One
Butte, Montana

Figure 4

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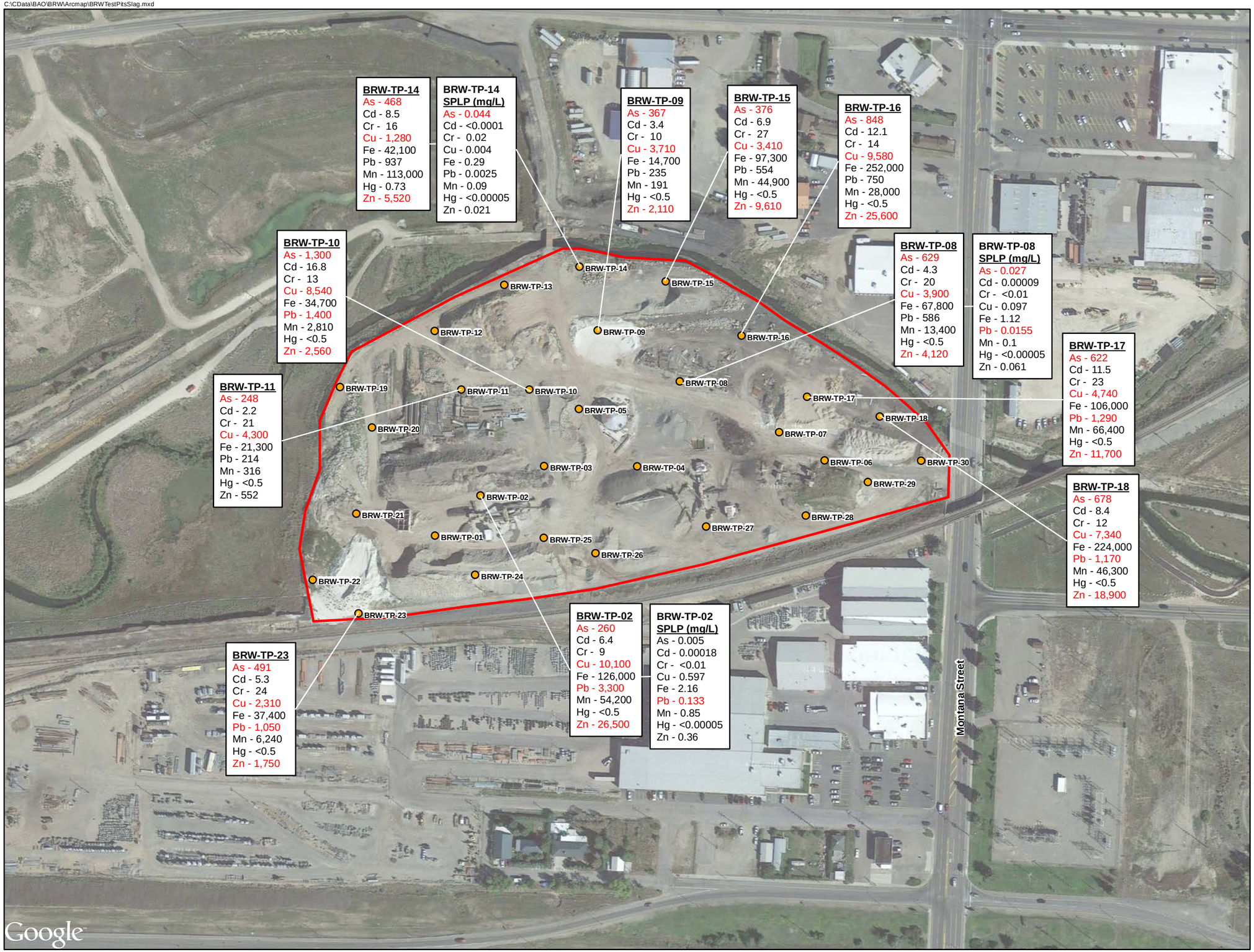

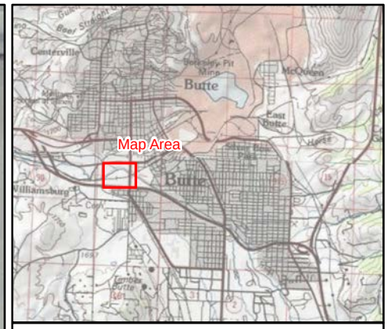

Sample Location
(Units in mg/kg)

Screening Criteria (mg/kg)	
Arsenic	200
Cadmium	20
Chromium	*
Copper	1000
Iron	*
Lead	1000
Manganese	*
Mercury	10
Zinc	1000

** - Not established*

Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

Groundwater Standards	
MT DEQ-7 (mg/l)	
Arsenic	0.01
Cadmium	0.005
Chromium	0.1
Copper	1.3
Iron	*
Lead	0.015
Manganese	*
Mercury	0.002
Zinc	2

** - Not established*

TETRA TECH

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1:2,400

Feet

0 50 100 200

9/7/2016

Slag Concentration Map
Butte Reduction Works
Smelter Site
Data Gaps Investigation
Lower Area One
Butte, Montana

Figure 5

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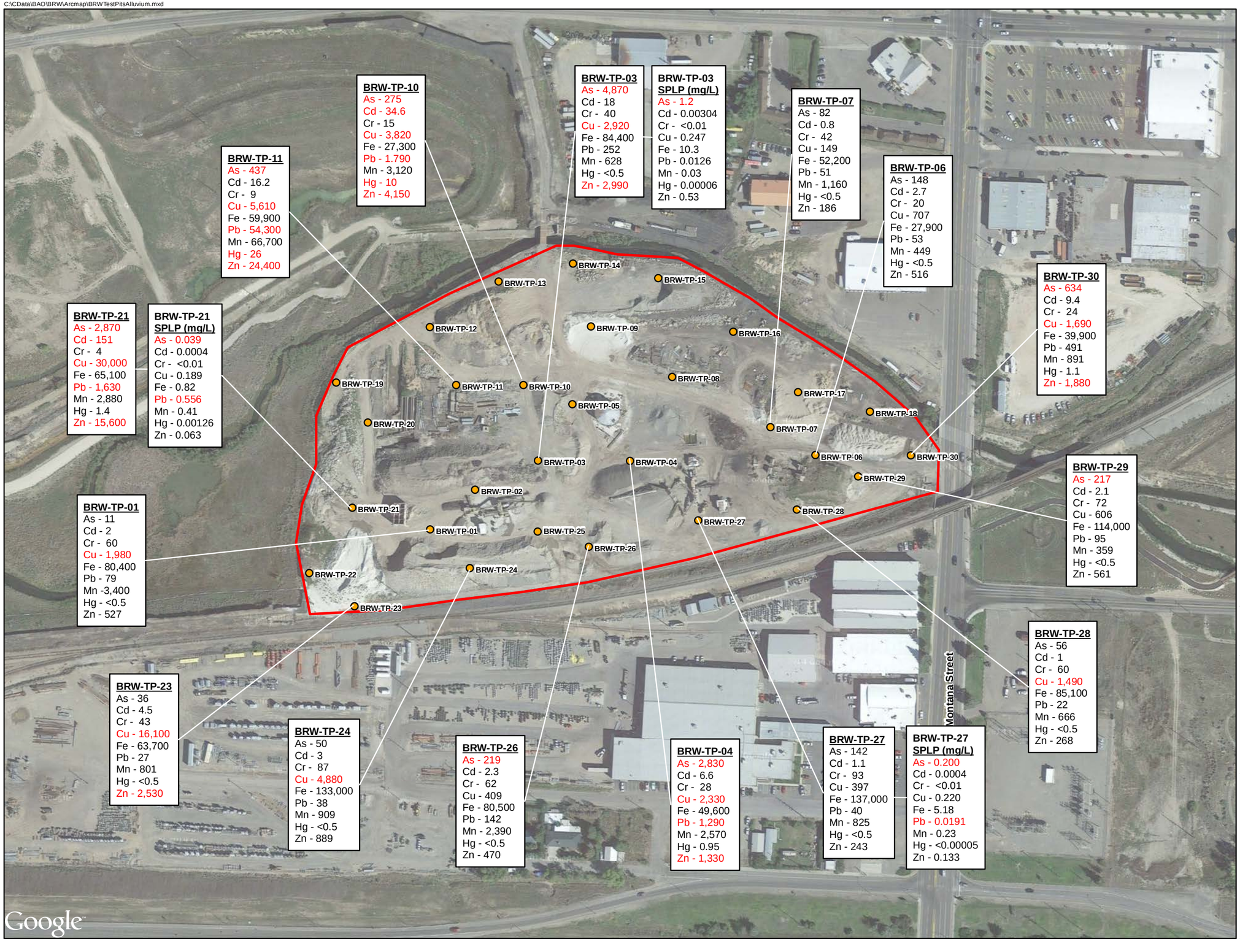

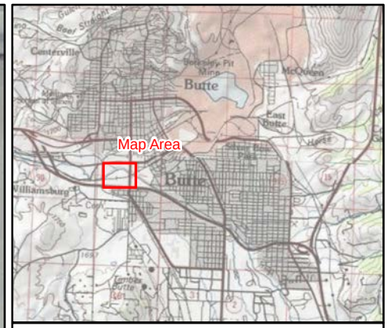

Sample Location
(Units in mg/kg)

Screening Criteria (mg/kg)	
Arsenic	200
Cadmium	20
Chromium	*
Copper	1000
Iron	*
Lead	1000
Manganese	*
Mercury	10
Zinc	1000

** - Not established*

Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

Groundwater Standards MT DEQ-7 (mg/l)	
Arsenic	0.01
Cadmium	0.005
Chromium	0.1
Copper	1.3
Iron	*
Lead	0.015
Manganese	*
Mercury	0.002
Zinc	2

** - Not established*

TETRA TECH

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Feet

0 50 100 200

9/7/2016

Alluvium Concentration Map
Butte Reduction Works
Smelter Site
Data Gaps Investigation
Lower Area One
Butte, Montana

Figure 6

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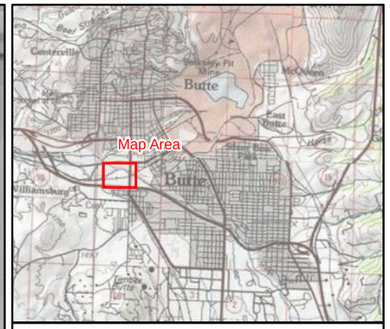

Sample Location
(Top of Slag, Bottom of Slag)

TETRA TECH

N
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S

1:2,400

Feet

0 50 100 200

9/8/2016

Slag Thickness Map
Butte Reduction Works
Smelter Site
Data Gaps Investigation
Lower Area One
Butte, Montana

Figure 7

Table 1. Sample Summary and Lithologic Grouping

ELI WORK ORDER	SAMPLE	DESCRIPTION	XRF Only	[2]Mine Waste Parameters, Sch. 1	[3]Additional Soil Parameters, Sch. 2	[4]Organics, Sch. 3	[1]Organics, MSE	Metals Only on Sch. 1
LITHOLOGIC/MATERIAL TYPE GROUPING								
Overburden/Construction Debris (consisting of a mixture of sand, gravel, silt granular material, bricks, cobbles, boulders, waste rock, broken slag, wooden debris, iron plating and piping, concrete, ash, etc.)								
H16080205	BRW-TP-01(6')-OB	Overburden/red clayey sand and gravel fill with brick		x				
H16080205	BRW-TP-03(1-2')-WT	Misidentified as white tails, likely clean volcanic ash fill		x				
H16080205	BRW-TP-03(3.5')-ASH	Overburden/black ash and burned wood		x				
H16080205	BRW-TP-03(5.5')-YT	Tails/greenish yellow tails		x				
H16080205	BRW-TP-04(3.5')-B&YT	Brick & Yellow Tails/weather brick debris mixed with yellow tails		x				
H16080250	BRW-TP-06(0-1')-OB	Overburden/road base material	x					
H16080250	BRW-TP-06(2-5.5')-CD	Construction debris/blocky slag, red brick mixed with misc. construction debris		x				
H16080250	BRW-TP-07(0.5-7')-OB	Overburden/misc. construction debris (wood, concrete, etc.) in coarse grained sand matrix		x	x			
H16080250	BRW-TP-09(4.5')-YT	Yellow Tails/mine waste or tails		x				
H16080250	BRW-TP-11(1.5-2.0')-YT	Yellow Tails/isolated XRF shot of yellow tailing material	x					
H16080250	BRW-TP-11(1.5-2.0')-YT	Yellow Tails/isolated XRF shot of copper precipitate in YT layer	x					
H16080250	BRW-TP-11(1.5-2.0')-YT	Yellow Tails/true composite XRF shot of YT layer		x	x			
H16080291	BRW-TP-13(0-2')-OB	Overburden/granular slag mixed with road base material		x				
	BRW-TP-13(0-2)-OB	XRF duplicate of BRW-TP-13(0-2)-OB	x					
H16080291	BRW-TP-14(0-2')-OB	Overburden/road base material w/ some granular slag		x				
H16080291	BRW-TP-15(0-0.5')-OB	Overburden/road base material		x				
H16080291	BRW-TP-17(0-0.5')-OB	Overburden/sand and gravel road base material		x				
H16080291	BRW-TP-20(2.5-3')-CD	Construction Debris/asphalt and concrete		x				
H16080291	BRW-TP-21(0-9')-CD	Construction Debris/brick, slag chunks, dark brown soil, and misc. steel, HC staining/slight odor?		x				
	BRW-TP-21(0-9)-CD	XRF duplicate of BRW-TP-21(0-9)-CD	x					
H16080291	BRW-TP-22(3-5')-OB	Overburden/dark brown silty sand mixed with chunks of slag and concrete, etc.		x				
H16080295	BRW-TP-24(3')-OBYT	Overburden/mixture of dark brown silty soil, slag, and yellow tails		x				
H16080295	BRW-TP-26(0.5-3.5')-OB	Overburden/const. debris mixture of silty sand, concrete, bricks, cables, and woody material		x				
H16080295	BRW-TP-28(2.5')-OB&YT	Overburden & Yellow Tails/coarse sand mixed with fine red/yellow sandy tails and dark brown silty sand		x	x			
H16080295	BRW-TP-29(4')-OB	Overburden/mixture of slag, brick, wood debris, glass and steel		x	x			
	BRW-TP-29(4)-OB	XRF duplicate of BRW-TP-29(4)-OB	x					
H16080295	BRW-TP-30(3.5-4')-OB	Overburden/mixture of brick, silty sand, asphalt, rounded boulders, and sand and gravel		x				
Slag (consisting of multiple types; granular, solid/poured, heap roast, broken/angular)								
H16080205	BRW-TP-02(4.5')-SSL	Solid Slag/fractured		x	x			
H16080205	080816-DUP-01	Field Duplicate of BRW-TP-02(4.5)-SSL		x				
H16080250	BRW-TP-08(0.5-6')-SSL	Solid Slag/mixture of heap roast slag and solid blocky slag		x	x			
H16080250	080916-DUP-01	Field duplicate of BRW-TP-08(0.5-6)-SSL		x				
H16080250	BRW-TP-09(9')-SSL	Solid Slag/solid blocky slag		x				
H16080250	BRW-TP-10(10')-SSL	Solid Slag/broken slag and coarse sand, HC odor and staining		x				

H16080250	BRW-TP-11(5')-IS	Impacted sediment/pinkish granular material surrounded by broken slag. Slag		x				
H16080291	BRW-TP-14(3-8')-SSL	Solid Slag/broken and brittle slag with some granular slag and poured "basket" slag		x	x			
	BRW-TP-14(3-8)-SSL	XRF duplicate of BRW-TP-14(3-8)-SSL	x					
	BRW-TP-14(3-8)-SSL	XRF duplicate of BRW-TP-14(3-8)-SSL	x					
	BRW-TP-14(3-8)-SSL	XRF duplicate of BRW-TP-14(3-8)-SSL	x					
H16080291	BRW-TP-15(0.5-7')-SSL	Solid Slag/broken and brittle slag grading to solid poured slag.		x				
	BRW-TP-15(0.5-7)-SSL	XRF duplicate of BRW-TP-15(0.5-7)-SSL	x					
H16080291	BRW-TP-16(4')-RS	Red Slag/heap roast slag residue, pink to red/orange granular with fist-sized cemented fragments		x				
	BRW-TP-16(4)-RS	XRF duplicate of BRW-TP-16(4)-RS	x					
H16080291	BRW-TP-16(10-12')-SSL	Solid Slag/blocky angular slag		x				
	BRW-TP-16(10-12)-SSL	XRF duplicate of BRW-TP-16(10-12)-SSL	x					
H16080291	BRW-TP-17(2.5-12')-SSL	Solid Slag/blocky angular slag		x				
	BRW-TP-17(2.5-12)-SSL	XRF duplicate of BRW-TP-17(2.5-12)-SSL	x					
H16080291	BRW-TP-18(5.5')-SSL	Solid Slag/blocky angular slag		x				
	BRW-TP-18(5.5)-SSL	XRF duplicate of BRW-TP-18(5.5)-SSL	x					
	BRW-TP-18(5.5)-SSL	XRF duplicate of BRW-TP-18(5.5)-SSL	x					
H16080291	BRW-TP-23(1-4.5')-SSL	Solid slag/slag rubble mixture of granular and broken slag		x				
Alluvium (consisting of native sand or sand and gravel, native silt or clay, manganese slime, and tailings which underlie slag deposits)								
H16080205	BRW-TP-01(10')-AL	Alluvium/medium to coarse sand		x				
H16080205	BRW-TP-01(13.5')-AL	Alluvium/Coarse sand, stained black with HC		x				
H16080205	BRW-TP-03(9.5')-RT	Tails/reddish iron stained		x	x			
H16080205	BRW-TP-03(14')-AL	Alluvium/sand and gravel		x				
H16080205	BRW-TP-04(5.0-6.0')-AL	Alluvium/gravely sands, stained dark brown		x				
MSE Lab	BRW-TP-4(7')-AL	Alluvium/coarse sand, iron oxide staining at capillary fringe, HC odor					x	
H16080205	BRW-TP-04(13.5')-AL	Alluvium/coarse sand and pea gravel, natural brown		x				
H16080205	BRW-TP-05(11')-AL	Alluvium/silt and clay w/ lenses of fine black sand, stained with HC		x		x		
H16080250	BRW-TP-06(7.5')-AL	Alluvium/coarse sand, natural brown		x				
	BRW-TP-07(7.5)-AL	Alluvium/coarse sand w/ occasional gravel, natural brown. Capillary fringe sample.	x					
H16080250	BRW-TP-07(9')-AL	Alluvium/coarse sand w/ occasional gravel, natural brown		x				
H16080250	BRW-TP-10(16')-AL	Alluvium/coarse sand w mica flakes interbedded with silty fine sand and wood. Native		x				
H16080250	BRW-TP-11(14')-AL	Alluvium/coarse sand w mica flakes.		x				
	BRW-TP-11(14)-AL	XRF duplicate of BRW-TP-11(14)-AL	x					
H16080291	BRW-TP-21(9')-GT	Grey Tails/dark grey tail w/ abundant pyrite, faint HC odor, possible Mn "slime" deposit		x	x			
	BRW-TP-21(9)-GT	XRF duplicate of BRW-TP-21(9)-GT	x					
	BRW-TP-21(9)-GT	XRF duplicate of BRW-TP-21(9)-GT	x					
H16080291	BRW-TP-21(14')-AL	Alluvium/medium to coarse sand, dark grey, native?		x				
	BRW-TP-21(14)-AL	XRF duplicate of BRW-TP-21(14)-AL	x					
H16080291	BRW-TP-23(4.5-7')-AL	Alluvium/coarse sand, iron oxide stained		x				
H16080291	BRW-TP-23(8')-AL	Alluvium/coarse sand, natural brown w/ nodules of copper cemented sand/copper precipitate		x				
	BRW-TP-23(8)-AL	XRF duplicate of BRW-TP-23(8)-AL	x					
H16080291	BRW-TP-23(9')-AL	Alluvium/silt and clay		x				
	BRW-TP-23(9)-AL	XRF duplicate of BRW-TP-23(9)-AL	x					
H16080295 & MSE Lab	BRW-TP-24(7.5')-AL	Alluvium/coarse sand, iron oxide staining at capillary fringe, HC odor		x			x	
H16080295	BRW-TP-24(15')-AL	Alluvium/coarse sand, black/reduced staining?		x				

H16080295	081116-DUP-01	Field duplicate of BRW-TP-24(15)-AL		x				
H16080295	BRW-TP-26(3.5-4.5')-AL	Alluvium/coarse sand with occasional fine gravel		x				
H16080295	BRW-TP-26(9.5')-AL	Alluvium/coarse sand, capillary fringe sample		x				
H16080295	BRW-TP-27(7')-AL	Alluvium/medium to coarse sand, natural brown color		x	x			
H16080295	BRW-TP-28(14')-AL	Alluvium/coarse sand		x				
H16080295	BRW-TP-29(9')-AL	Alluvium/coarse sand		x				
H16080295	BRW-TP-30(6')-AL	Alluvium/silt and clay, native?		x				
Quality Control (Rinsate Blank-RB and Field Blank-FB)								
H16080205	080816-FB-01	QC sample, field blank						x
H16080205	080816-RB-01	QC sample, rinsate blank						x
H16080250	080916-FB-01	QC sample, field blank						x
H16080250	080916-RB-01	QC sample, rinsate blank						x
H16080291	081016-RB-02	QC sample, rinsate blank						x
H16080291	081016-FB-01	QC sample, field blank						x
H16080295	081116-FB-01	QC sample, field blank						x
H16080295	081116-RB-01	QC sample, rinsate blank						x

Notes:

[1]MSE laboratory analysis of SVOCs, VOCs, EPH, and VPH

[2]Mine waste parameters include the following: pH (sat. paste), Nitrate as N, Conductivity (sat. paste), TOC, total metals As, Cd, Cr, Cu, Fe, Hg, Pb, Mn, Phosphorous, and Zn)

[3]Additional Soil Parameters, Schedule 2 include: Lime as CaCO3NAG pH, Neut. Potential, Acid Potential, Acid/Base Potential, Sulfur (various extracts), Acid Potential Pyritic, Acid/Base Potential Pyritic, and SPLP (As, Cd, Cr, Cu, Hg, Pb, Mn and Zn)

[4]Organics, schedule 3 includes EPH screen, EPH fractionation (if fail screen), and VPH

Table 2. XFR Soil Screening Results

	Index	Reading No	SAMPLE	MISC	FID	As	Cd	Cu	Fe	Pb	Mn	Hg	Zn
						All results in parts per million (mg/kg)							
XRF	23	23	BRW-TP-01(6)-OB	Overburden/red clayey sand and gravel fill with brick		1,483	< LOD	305	73,987	192.1	84,046	< LOD	947
Lab			BRW-TP-01(6')-OB			4,350	2.5	283	82,900	512.0	96,000	<0.5	1,220
					RPD	98		8	11	91	13		25
XRF	24	24	BRW-TP-01(10)-AL	Alluvium/medium to coarse sand		5.9	< LOD	499	30,000	48.5	1,272	< LOD	247
Lab			BRW-TP-01(10')-AL			46.0	1.7	1,160	80,400	79.0	3,400	<0.5	584
					RPD	155		80	91	48	91		81
XRF	25	25	BRW-TP-01(13.5)-AL	Alluvium/Coarse sand, stained black with HC	530	< LOD	< LOD	843	27,239	23.3	1,862	< LOD	243
Lab			BRW-TP-01(13.5')-AL			11.0	2.0	1,980	79,400	17.0	2,710	<0.5	428
					RPD			81	98	31	37		55
XRF	26	26	BRW-TP-02(4.5)-SSL	Solid Slag/fractured, HC odor		394.1	< LOD	23,452	348,774	5,479.2	125,228	50.6	36,100
Lab			BRW-TP-02(4.5')-SSL			260.0	6.4	10,100	126,000	3,300.0	54,200	<0.5	26,500
					RPD	41		80	94	50	79		31
XRF	27	27	080816-DUP-01	Field Duplicate of BRW-TP-02(4.5)-SSL		309.6	< LOD	17,634	320,781	3,568.4	99,413	41.0	25,221
Lab			080816-DUP-01			221.0	6.4	11,800	117,000	2,970.0	48,400	<0.5	25,200
					RPD	33		40	93	18	69		0.08
XRF	29	29	BRW-TP-03(1-2)-WT	Misidentified as white tails, likely volcanic ash fill. HC odor.		36.1	< LOD	319	11,665	72.4	581	< LOD	117
Lab			BRW-TP-03(1-2')-WT			79.0	0.7	328	15,900	186.0	1,320	<0.5	270
					RPD	75		3	31	88	78		79
XRF	30	30	BRW-TP-03(3.5)-ASH	Overburden/black ash and burned wood	20	841.5	< LOD	8,257	30,728	2,079.3	2,134	11.2	1,592
Lab			BRW-TP-03(3.5')-ASH			300.0	1.0	2,730	25,300	71.0	1,130	4.1	438
					RPD	95		101	19	187	62	93	114
XRF	31	31	BRW-TP-03(5.5)-YT	Tails/greenish yellow tails, HC odor.		2,639	90.1	6,446	147,259	38,378.2	707	72.1	64,782
Lab			BRW-TP-03(5.5')-YT			2,420	155.0	7,310	102,000	51,600.0	406	3.9	49,900
					RPD	9	53	13	36	29	54	179	26
XRF	32	32	BRW-TP-03(9.5)-RT	Tails/reddish iron stained, HC odor		2,734	< LOD	685	56,013	44.5	315	< LOD	2,392
Lab			BRW-TP-03(9.5')-RT			4,870	18.0	1,570	84,400	252.0	301	<0.5	2,990
					RPD	56		78	40	140	5		22
XRF	33	33	BRW-TP-03(14)-AL	Alluvium/sand and gravel, HC odor		19.5	< LOD	2,818	25,020	22.8	833	< LOD	1,731
Lab			BRW-TP-03(14')-AL			25.0	4.6	2,920	24,800	26.0	628	<0.5	1,960
					RPD	25		4	1	13	28		12
XRF	34	34	BRW-TP-04(3.5)-B&YT	Brick &Yellow Tails/weather brick debris mixed with yellow tails		55.7	< LOD	266	15,679	64.4	491	< LOD	109
Lab			BRW-TP-04(3.5')-B&YT			206.0	1.9	650	52,400	83.0	669	<0.5	377
					RPD	115		84	108	25	31		110

XRF	35	35	BRW-TP-04(5.0-6.0)-AL	Alluvium/gravely sands, stained dark brown, strong HC odor		2,053	14.1	1,972	65,460	1,419.2	1,531	22.4	669
Lab			BRW-TP-04(5.0-6.0')-AL			2,830	6.6	2,330	49,600	1,290.0	2,570	1.0	1,460
					RPD	38	53	18	24	9	68	184	118
XRF	36	36	BRW-TP-04(13.5)-AL	Alluvium/coarse sand and pea gravel, natural brown, strong HC odor		21.0	9.1	852	16,566	20.6	452	< LOD	148
Lab			BRW-TP-04(13.5')-AL			48.0	0.9	1,020	21,200	22.0	328	<0.5	210
					RPD	129	90	20	28	7	27		42
XRF	39	39	BRW-TP-05(11)-AL	Alluvium/silt and clay w/ lenses of fine black sand, stained with HC		721.7	32.6	15,981	24,858	1,367.6	651	< LOD	6,213
Lab			BRW-TP-05(11')-AL			2,250.0	81.4	28,400	45,800	2,990.0	903	6.7	8,710
					RPD	103	149	56	59	74	32		33
XRF	44	44	BRW-TP-06(0-1)-OB	Overburden/road base material		8.3	9.0	79	25,944	40.5	884	< LOD	135
XRF	45	45	BRW-TP-06(2-5.5)-CD	Construction debris/blocky slag, red brick mixed with misc. construction debris		2,513	< LOD	3,584	83,620	1,643.1	14,725	18.4	2,414
Lab			BRW-TP-06(2-5.5')-Cd			5,810	16.5	7,150	122,000	3,450.0	13,400	0.6	4,560
					RPD	79		66	37	71	9	188	62
XRF	46	46	BRW-TP-06(7.5)-AL	Alluvium/coarse sand, natural brown		74.5	< LOD	440	22,652	28.8	474	< LOD	289
Lab			BRW-TP-06(7.5')-AL			148.0	2.7	707	27,900	53.0	449	<0.5	516
					RPD	66		47	21	59	5		56
XRF	47	47	BRW-TP-07(7.5)-AL	Alluvium/coarse sand w/ occasional gravel, natural brown. Capillary fringe sample.		169.4	< LOD	249	28,119	42.9	1,595	< LOD	347
XRF	48	48	BRW-TP-07(9)-AL	Alluvium/coarse sand w/ occasional gravel, natural brown		19.5	11.7	72	17,295	18.5	413	< LOD	85
Lab			BRW-TP-07(9')-AL			82.0	0.8	149	52,200	51.0	1,160	<0.5	186
					RPD	123	174	69	100	94	95		75
XRF	49	49	BRW-TP-07(0.5-7)-OB	Overburden/misc. construction debris (wood, concrete, etc.) in coarse grained sand matrix		502.3	< LOD	1,079	28,590	644.3	34,631	< LOD	2,127
Lab			BRW-TP-07(0.5-7')-OB			976.0	13.5	1,560	35,800	1,150.0	44,900	2.2	3,290
					RPD	64		36	22	56	26		43
XRF	50	50	BRW-TP-08(0.5-6)-SSL	Solid Slag/mixture of heap roast slag and solid blocky slag		382.2	< LOD	3,789	143,965	535.0	12,374	18.5	4,793
Lab			BRW-TP-08(0.5-6')-SSL			629.0	4.3	3,900	67,800	586.0	13,400	<0.5	4,120
					RPD	49		3	72	9	8		15
XRF	51	51	080916-DUP-01	Field duplicate of BRW-TP-08(0.5-6)-SSL		365.5	< LOD	4,034	133,259	507.3	9,951	< LOD	4,436
Lab			080916-DUP-01			638.0	4.5	4,170	73,800	606.0	13,800	<0.5	4,420
					RPD	54		3	57	18	32		0
XRF	52	52	BRW-TP-09(4.5)-YT	Yellow Tails/mine waste or tails		170.0	< LOD	4,149	44,279	54.4	617	10.5	972
Lab			BRW-TP-09(4.5')-YT			263.0	0.9	2,410	16,700	53.0	1,130	<0.5	360
					RPD	43		53	90	3	59		92
XRF	53	53	BRW-TP-09(9)-SSL	Solid Slag/solid blocky slag		198.8	< LOD	3,024	48,544	239.6	348	< LOD	4,166
Lab			BRW-TP-09(9')-SSL			367.0	3.4	3,710	14,700	235.0	191	<0.5	2,110
					RPD	59		20	107	2	58		66
XRF	54	54	BRW-TP-10(10)-SSL	Solid Slag/broken slag and coarse sand, HC odor and staining	138	414.3	< LOD	4,552	29,153	655.4	1,022	< LOD	1,711

Lab			BRW-TP-10(10')-SSL			1,300.0	16.8	8,540	34,700	1,400.0	2,810	<0.5	2,560
					RPD	103		61	17	72	93		40
XRF	57	57	BRW-TP-10(16)-AL	Alluvium/coarse sand w mica flakes interbedded with silty fine sand and wood. Native		79.3	7.9	724	14,719	613.7	1,996	< LOD	1,759
Lab			BRW-TP-10(16')-AL			275.0	34.6	3,820	27,300	1,790.0	3,120	10.0	4,150
					RPD	110	126	136	60	98	44		81
XRF	58	58	BRW-TP-11(1.5-2.0)-YT	Yellow Tails/isolated XRF shot of yellow tailing material		308.8	< LOD	1,579	32,354	65.8	565	11.6	346
XRF	59	59	BRW-TP-11(1.5-2.0)-YT	Yellow Tails/isolated XRF shot of copper precipitate in YT layer		310.5	< LOD	33,488	34,635	163.5	1,580	< LOD	2,404
XRF	60	60	BRW-TP-11(1.5-2.0)-YT	Yellow Tails/true composite XRF shot of YT layer		484.1	< LOD	8,310	29,112	256.6	685	< LOD	963
Lab			BRW-TP-11(1.5-2.0')-YT			1,320.0	3.8	7,790	44,800	620.0	708	0.8	1,540
					RPD	93		6	42	83	3		46
XRF	61	61	BRW-TP-11(5)-IS	Impacted sediment/pinkish granular material surrounded by broken slag. Overburden		218.1	< LOD	4,517	29,687	200.1	635	< LOD	666
Lab			BRW-TP-11(5')-IS			248.0	2.2	4,300	21,300	214.0	316	<0.5	552
					RPD	13		5	33	7	67		19
XRF	62	62	BRW-TP-11(14)-AL	Alluvium/coarse sand w/ mica flakes.		247.8	47.3	11,338	68,983	21,227.1	60,767	135.6	21,889
Lab			BRW-TP-11(14')-AL			437.0	16.2	5,610	59,900	54,300.0	66,700	26.0	24,400
					RPD	55	98	68	14	88	9	136	11
XRF	63	63	BRW-TP-11(14)-AL	XRF duplicate of BRW-TP-11(14)-AL		482.6	11.8	16,569	57,067	13,412.4	46,061	78.3	16,744
XRF	68	68	BRW-TP-13(0-2)-OB	Overburden/granular slag mixed with road base material		325.5	< LOD	2,278	13,559	179.2	11,300	< LOD	1,089
Lab			BRW-TP-13(0-2')-OB			987.0	14.1	4,280	35,800	677.0	49,200	<0.5	3,810
					RPD	101		61	90	116	125		111
XRF	69	69	BRW-TP-13(0-2)-OB	XRF duplicate of BRW-TP-13(0-2)-OB		373.6	< LOD	2,558	19,929	243.9	19,137	< LOD	1,536
XRF	70	70	BRW-TP-14(0-2)-OB	Overburden/road base material w/ some granular slag		36.4	< LOD	174	24,597	217.0	7,240	< LOD	642
Lab			BRW-TP-14(0-2')-OB			113.0	4.6	261	35,300	531.0	28,400	<0.5	1,850
					RPD	103		40	36	84	119		97
XRF	71	71	BRW-TP-14(3-8)-SSL	Solid Slag/broken and brittle slag with some granular slag and poured "basket" slag		240.9	< LOD	1,754	73,890	535.5	57,331	< LOD	3,942
Lab			BRW-TP-14(3-8')-SSL			468.0	8.5	1,280	42,100	937.0	113,000	0.7	5,520
					RPD	64		31	55	55	65		33
XRF	72	72	BRW-TP-14(3-8)-SSL	XRF duplicate of BRW-TP-14(3-8)-SSL		252.1	< LOD	1,184	61,017	513.5	59,707	< LOD	3,481
XRF	73	73	BRW-TP-14(3-8)-SSL	XRF duplicate of BRW-TP-14(3-8)-SSL		259.0	< LOD	2,049	126,650	505.6	44,734	< LOD	4,682
XRF	74	74	BRW-TP-14(3-8)-SSL	XRF duplicate of BRW-TP-14(3-8)-SSL		308.8	< LOD	1,163	63,440	643.1	124,969	< LOD	4,801
XRF	75	75	BRW-TP-15(0-0.5)-OB	Overburden/road base material		16.6	< LOD	72	25,892	36.6	2,306	< LOD	127
Lab			BRW-TP-15(0-0.5')-OB			36.0	0.8	122	38,200	96.0	7,480	<0.5	356
					RPD	74		52	38	90	106		95
XRF	76	76	BRW-TP-15(0.5-7)-SSL	Solid Slag/broken and brittle slag grading to solid poured slag.		216.2	< LOD	2,868	142,274	377.2	40,230	< LOD	7,823
Lab			BRW-TP-15(0.5-7')-SSL			376.0	6.9	3,410	97,300	554.0	44,900	<0.5	9,610

					RPD	54		17	38	38	11		21
XRF	77	77	BRW-TP-15(0.5-7)-SSL	XRF duplicate of BRW-TP-15(0.5-7)-SSL		452.1	< LOD	3,910	267,335	634.6	50,981	< LOD	14,558
XRF	78	78	BRW-TP-16(4)-RS	Red Slag/heap roast slag residue, pink to red/orange granular with fist-sized cemented fragments		239.6	< LOD	1,359	43,010	326.2	984	< LOD	2,625
Lab			BRW-TP-16(4')-RS			446.0	10.2	1,060	18,900	182.0	1,880	<0.5	2,720
					RPD	60		25	78	57	63		4
XRF	79	79	BRW-TP-16(4)-RS	XRF duplicate of BRW-TP-16(4)-RS		302.9	< LOD	1,446	51,283	268.4	848	< LOD	3,050
XRF	80	80	BRW-TP-16(10-12)-SSL	Solid Slag/blocky angular slag		679.5	< LOD	6,633	462,869	938.4	17,265	< LOD	21,385
Lab			BRW-TP-16(10-12')-SSL			848.0	12.1	9,580	252,000	750.0	28,000	<0.5	25,600
					RPD	22		36	59	22	47		18
XRF	81	81	BRW-TP-16(10-12)-SSL	XRF duplicate of BRW-TP-16(10-12)-SSL		725.2	< LOD	8,403	510,218	965.1	30,746	< LOD	23,109
XRF	82	82	BRW-TP-17(0-0.5)-OB	Overburden/sand and gravel road base material		12.1	10.6	54	34,598	30.4	1,714	< LOD	103
Lab			BRW-TP-17(0-0.5')-OB			27.0	0.5	58	40,100	54.0	3,800	<0.5	237
					RPD	76	182	7	15	56	76		79
XRF	83	83	BRW-TP-17(2.5-12)-SSL	Solid Slag/blocky angular slag		416.7	< LOD	4,940	217,645	822.3	34,556	23.7	10,442
Lab			BRW-TP-17(2.5-12')-SSL			622.0	11.5	4,740	106,000	1,290.0	66,400	<0.5	11,700
					RPD	40		4	69	44	63		11
XRF	84	84	BRW-TP-17(2.5-12)-SSL	XRF duplicate of BRW-TP-17(2.5-12)-SSL		389.4	< LOD	5,076	185,301	824.6	44,020	18.7	9,736
XRF	85	85	BRW-TP-18(5.5)-SSL	Solid Slag/blocky angular slag		833.1	< LOD	10,612	472,222	836.2	20,493	< LOD	14,445
Lab			BRW-TP-18(5.5')-SSL			678.0	8.4	7,340	224,000	1,170.0	46,300	<0.5	18,900
					RPD	21		36	71	33	77		27
XRF	86	86	BRW-TP-18(5.5)-SSL	XRF duplicate of BRW-TP-18(5.5)-SSL		1,162	< LOD	7,218	611,585	1,412.6	62,232	< LOD	21,838
XRF	87	87	BRW-TP-18(5.5)-SSL	XRF duplicate of BRW-TP-18(5.5)-SSL		985.7	< LOD	8,432	707,041	1,839.7	62,515	62.9	27,451
XRF	88	88	BRW-TP-20(2.5-3)-CD	Construction Debris/asphalt and concrete		35.5	< LOD	210	21,875	146.9	1,120	< LOD	444
Lab			BRW-TP-20(2.5-3')-CD			58.0	2.8	409	40,500	424.0	2,020	<0.5	1,000
					RPD	48		64	60	97	57		77
XRF	89	89	BRW-TP-21(0-9)-CD	Construction Debris/brick, slag chunks, dark brown soil, and misc. steel, HC staining/slight odor?	5	777.0	< LOD	1,395	36,563	1,244.5	137,754	< LOD	6,899
Lab			BRW-TP-21(0-9')-CD			1,020.0	28.1	1,160	28,900	1,830.0	133,000	1.9	10,000
					RPD	27		18	23	38	4		37
XRF	90	90	BRW-TP-21(0-9)-CD	XRF duplicate of BRW-TP-21(0-9)-CD		658.3	18.8	885	36,962	1,245.3	167,956	< LOD	6,712
XRF	93	93	BRW-TP-21(9)-GT	Grey Tails/dark grey tail w/ abundant pyrite, faint HC odor, possible Mn "slime" deposit	25	1,230	< LOD	7,759	28,221	5,289.0	6,639	< LOD	132,012
Lab			BRW-TP-21(9')-GT			2,140	798.0	12,100	18,900	7,850.0	3,300	42.0	249,000
					RPD	54		44	40	39	67		61
XRF	94	94	BRW-TP-21(9)-GT	XRF duplicate of BRW-TP-21(9)-GT		1,233	138.1	6,714	28,824	5,470.1	4,807	< LOD	125,271
XRF	95	95	BRW-TP-21(9)-GT	XRF duplicate of BRW-TP-21(9)-GT		1,240	211.0	11,691	25,785	5,215.0	3,792	< LOD	233,257
XRF	96	96	BRW-TP-21(14)-AL	Alluvium/medium to coarse sand, dark grey, native?	31	370.2	11.0	7,250	17,730	392.8	974	< LOD	4,126
Lab			BRW-TP-21(14')-AL			2,870.0	151.0	30,000	65,100	1,630.0	2,880	1.4	15,600

					RPD	154	173	122	114	122	99		116
XRF	97	97	BRW-TP-21(14)-AL	XRF duplicate of BRW-TP-21(14)-AL		546.1	15.6	8,953	12,874	456.7	910	< LOD	4,925
XRF	98	98	BRW-TP-22(3-5)-OB	Overburden/dark brown silty sand mixed with chunks of slag and concrete, etc.		120.4	< LOD	451	24,623	167.5	1,486	< LOD	375
Lab			BRW-TP-22(3-5')-OB			321.0	3.2	846	34,800	363.0	3,600	<0.5	773
					RPD	91		61	34	74	83		69
XRF	99	99	BRW-TP-23(1-4.5)-SSL	Solid slag/slag rubble mixture of granular and broken slag		257.1	< LOD	2,243	29,317	598.2	3,072	< LOD	871
Lab			BRW-TP-23(1-4.5')-SSL			491.0	5.3	2,310	37,400	1,050.0	6,240	<0.5	1,750
					RPD	63		3	24	55	68		67
XRF	4	100	BRW-TP-23(4.5-7)-AL	Alluvium/coarse sand, iron oxide stained		10.8	< LOD	1,378	18,617	27.0	871	< LOD	238
Lab			BRW-TP-23(4.5-7')-AL			65.0	3.3	2,250	53,800	105.0	1,000	<0.5	572
					RPD	143		48	97	118	14		83
XRF	101	101	BRW-TP-23(8)-AL	Alluvium/coarse sand, natural brown w/ nodules of copper cemented sand/copper precipitate		19.8	< LOD	14,762	20,462	16.3	381	< LOD	2,471
Lab			BRW-TP-23(8')-AL			36.0	3.7	16,100	63,700	16.0	592	<0.5	2,530
					RPD	58		9	103	2	43		2
XRF	102	102	BRW-TP-23(8)-AL	XRF duplicate of BRW-TP-23(8)-AL		21.5	< LOD	9,181	42,280	18.6	666	< LOD	1,567
XRF	103	103	BRW-TP-23(9)-AL	Alluvium/silt and clay		5.7	< LOD	1,810	29,562	27.9	1,230	< LOD	671
Lab			BRW-TP-23(9')-AL			7.0	4.5	30,600	30,200	27.0	801	<0.5	1,180
					RPD	20		178	2	3	42		55
XRF	104	104	BRW-TP-23(9)-AL	XRF duplicate of BRW-TP-23(9)-AL		3.8	16.3	2,513	23,704	23.9	937	< LOD	1,158
XRF	109	109	BRW-TP-24(3)-OBYT	Overburden/mixture of dark brown silty soil, slag, and yellow tails, HC odor		954.6	< LOD	1,769	37,558	546.3	916	12.2	812
Lab			BRW-TP-24(3')-OBYT			4,970.0	9.5	8,080	94,400	2,490.0	3,230	1.8	3,030
					RPD	136		128	86	128	112	149	115
XRF	110	110	BRW-TP-24(7.5)-AL	Alluvium/coarse sand, iron oxide staining at capillary fringe, HC odor		24.2	< LOD	466	36,280	19.7	519	< LOD	330
Lab			BRW-TP-24(7.5')-AL			50.0	1.2	641	133,000	38.0	513	<0.5	443
					RPD	70		32	114	63	1		29
XRF	111	111	BRW-TP-24(15)-AL	Alluvium/coarse sand, black/reduced staining?		4.6	< LOD	2,491	21,302	13.2	723	< LOD	433
Lab			BRW-TP-24(15')-AL			14.0	3.0	4,880	37,300	12.0	909	<0.5	889
					RPD	101		65	55	10	23		69
XRF	112	112	081116-DUP-01	Field duplicate of BRW-TP-24(15)-AL		6.5	< LOD	2,786	24,194	13.2	818	< LOD	506
Lab			081116-DUP-01			13.0	2.9	5,020	39,600	10.0	974	<0.5	908
					RPD	67		57	48	27	17		57
XRF	118	118	BRW-TP-26(0.5-3.5)-OB	Overburden/const. debris mixture of silty sand, concrete, bricks, cables, and woody material		299.9	< LOD	620	27,553	764.5	39,927	< LOD	2,137
Lab			BRW-TP-26(0.5-3.5')-OB			591.0	9.3	851	36,000	2,500.0	69,300	0.8	4,230
					RPD	65		31	27	106	54		66
XRF	119	119	BRW-TP-26(3.5-4.5)-AL	Alluvium/coarse sand with occasional fine gravel		12.5	< LOD	169	28,184	29.1	483	< LOD	217
Lab			BRW-TP-26(3.5-4.5')-AL			37.0	2.3	311	80,500	30.0	651	<0.5	466

					RPD	99		59	96	3	30		73
XRF	120	120	BRW-TP-26(9.5)-AL	Alluvium/coarse sand, capillary fringe sample		35.1	< LOD	154	10,768	27.1	514	< LOD	129
Lab			BRW-TP-26(9.5')-AL			219.0	1.8	409	69,900	142.0	2,390	<0.5	470
					RPD	145		91	147	136	129		114
XRF	121	121	BRW-TP-27(7)-AL	Alluvium/medium to coarse sand, natural brown color		41.4	< LOD	194	17,977	20.0	381	< LOD	95
Lab			BRW-TP-27(7')-AL			142.0	1.1	397	137,000	40.0	825	<0.5	243
					RPD	110		69	154	67	74		88
XRF	123	123	BRW-TP-28(2.5)-OB&YT	Overburden & Yellow Tails/coarse sand mix with fine red/yellow sandy tails and dark brown silty sand		295.9	< LOD	429	42,091	264.2	9,595	< LOD	488
Lab			BRW-TP-28(2.5')-OB&YT			895.0	3.5	928	69,900	1,050.0	22,900	<0.5	1,610
					RPD	101		74	50	120	82		107
XRF	124	124	BRW-TP-28(14)-AL	Alluvium/coarse sand		17.0	< LOD	752	33,188	20.0	495	< LOD	113
Lab			BRW-TP-28(14')-AL			56.0	1.0	1,490	85,100	22.0	666	<0.5	268
					RPD	107		66	88	10	29		81
XRF	127	127	BRW-TP-29(4)-OB	Overburden/mixture of slag, brick, wood debris, glass and steel		25,166	13.2	3,354	57,416	6,421.8	487	57.1	1,213
Lab			BRW-TP-29(4')-OB			43,800	5.4	5,520	67,800	16,100.0	289	58.0	1,890
					RPD	54	84	49	17	86	51	2	44
XRF	128	128	BRW-TP-29(4)-OB	XRF duplicate of BRW-TP-29(4)-OB		24,816	< LOD	2,555	64,745	6,619.0	234	61.2	1,105
XRF	129	129	BRW-TP-29(9)-AL	Alluvium/coarse sand		31.6	< LOD	362	28,875	23.9	418	< LOD	288
Lab			BRW-TP-29(9')-AL			217.0	2.1	606	114,000	95.0	359	<0.5	561
					RPD	149		50	119	120	15		64
XRF	132	132	BRW-TP-30(3.5-4)-OB	Overburden/mixture of brick, silty sand, asphalt, rounded boulders, and sand and gravel		38.5	< LOD	138	22,381	124.2	8,421	< LOD	642
Lab			BRW-TP-30(3.5-4')-OB			243.0	6.2	713	43,300	1,010.0	31,300	<0.5	3,290
					RPD	145		135	64	156	115		135
XRF	133	133	BRW-TP-30(6)-AL	Alluvium/silt and clay, native?		291.6	16.3	976	24,057	350.4	541	< LOD	2,006
Lab			BRW-TP-30(6')-AL			634.0	9.4	1,690	39,900	491.0	891.0	1.1	1,880
					RPD	74	54	54	50	33	49		6
RPD- relative percent difference is the absolute difference divided by the absolute value of their arithmetic mean.					**Mean RPD**	**78**	**103**	**51**	**59**	**61**	**53**	**124**	**58**

Table 3
Butte Reduction Works Test Pit Soils Metals Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Benchmarks [a]			200	20	NE	1,000	NE	1,000	NE	10	1,000
BRW-TP-01 (6')-OB	N	08/08/2016	4350 d	2.5 d	18 d	283 d	82900 d	512	96000	< 0.5	1220 d
BRW-TP-01 (10')-AL	N	08/08/2016	--	1.7 d	60 d	1160 d	80400 d	79	3400	< 0.5	527 d
BRW-TP-01 (13.5')-AL	N	08/08/2016	11	2 d	60 d	1980 d	79400 d	17	2710	< 0.5	396 d
BRW-TP-02 (4.5')-SSL	N	08/08/2016	260	6.4 d	9	10100 d	126000 d	3300 d	54200	< 0.5	26500 d
BRW-TP-02 (4.5')-SSL	D	08/08/2016	221	6.4 d	14	11800 d	117000 d	2970 d	48400	< 0.5	25200 d
BRW-TP-03 (1-2')-WT	N	08/08/2016	79	0.7	20 d	328 d	15900 d	186	1320	< 0.5	225 d
BRW-TP-03 (3.5')-ASH	N	08/08/2016	300 d	1	22	2730 d	25300 d	71	1130	4.1	438 d
BRW-TP-03 (5.5')-YT	N	08/08/2016	2420 d	155 d	3	7310 d	102000 d	51600 d	406	3.9	49900 d
BRW-TP-03 (9.5')-RT	N	08/08/2016	4870 d	18 d	40 d	1570 d	84400 d	252	301	< 0.5	2990 d
BRW-TP-03 (14')-AL	N	08/08/2016	25	4.6 d	22 d	2920	24800 d	26	628	< 0.5	1660 d
BRW-TP-04 (3.5')-B/YT	N	08/08/2016	206	1.9 d	38 d	650 d	52400 d	83	669	< 0.5	371 d
BRW-TP-04 (5.0-6.0')-AL	N	08/08/2016	2830 d	6.6 d	28 d	2330 d	49600 d	1290	2570	0.95	1330 d
BRW-TP-04 (13.5')-AL	N	08/08/2016	48	0.9	20 d	1020 d	21200 d	22	328	< 0.5	194 d
BRW-TP-05 (11')-AL	N	08/08/2016	2250	81.4 d	9	28400 d	45800 d	2990 d	903	6.7	8710 d
BRW-TP-06 (2-5.5')-CD	N	08/09/2016	5810 d	16.5	24	7150 d	122000 d	3450 d	13400	0.55	4560 d
BRW-TP-06 (7.5')-AL	N	08/09/2016	148 d	2.7	20	707	27900 d	53 d	449	< 0.5	516 d
BRW-TP-07 (0.5-7')-OB	N	08/09/2016	976 d	13.5	64	1560	35800 d	1150 d	44900	2.2	3290 d
BRW-TP-07 (9')-AL	N	08/09/2016	82	0.8	42	149 d	52200 d	51	1160	< 0.5	186 d
BRW-TP-08 (0.5-6')-SSL	N	08/09/2016	629 d	4.3	20	3900	67800 d	586 d	13400	< 0.5	4120 d
BRW-TP-08 (0.5-6')-SSL	D	08/09/2016	638 d	4.5	21	4170	73800 d	606 d	13800	< 0.5	4420 d
BRW-TP-09 (4.5')-YT	N	08/09/2016	263 d	0.9	18	2410	16700 d	53 d	1130	< 0.5	360 d
BRW-TP-09 (9')-SSL	N	08/09/2016	367 d	3.4	10	3710	14700 d	235 d	191	< 0.5	2110 d
BRW-TP-10 (10')-SSL	N	08/09/2016	1300 d	16.8	13	8540	34700 d	1400 d	2810	< 0.5	2560 d
BRW-TP-10 (16')-AL	N	08/09/2016	275 d	34.6	15	3820	27300 d	1790 d	3120	10	4150 d
BRW-TP-11 (1.5-2.0')-YT	N	08/09/2016	1320 d	3.8	9	7790	44800 d	620 d	708	0.76	1540 d
BRW-TP-11 (5')-IS	N	08/09/2016	248 d	2.2	21	4300	21300 d	214 d	316	< 0.5	552 d

Notes:

mg/kg - Milligrams per kilogram

a - Screening Criteria utilized in previous BAO site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

Table 3
Butte Reduction Works Test Pit Soils Metals Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Benchmarks [a]			200	20	NE	1,000	NE	1,000	NE	10	1,000
BRW-TP-11 (14')-AL	N	08/09/2016	437 d	16.2	9	5610	59900 d	54300 d	66700	26 d	24400 d
BRW-TP-13 (0-2')-OB	N	08/10/2016	987 d	14.1	14	4280 d	35800 d	677 d	49200	< 0.5	3810 d
BRW-TP-14 (0-2')-OB	N	08/10/2016	113	4.6	29	261 d	35300 d	531 d	28400	< 0.5	1850 d
BRW-TP-14 (3-8')-SSL	N	08/10/2016	468	8.5	16	1280 d	42100 d	937 d	113000	0.73	5520 d
BRW-TP-15 (0-0.5')-OB	N	08/10/2016	36	0.8	36	122 d	38200 d	96 d	7480	< 0.5	356 d
BRW-TP-15 (0.5-7')-SSL	N	08/10/2016	376	6.9	27	3410 d	97300 d	554 d	44900	< 0.5	9610 d
BRW-TP-16 (4')-RS	N	08/10/2016	446	10.2	16	1060 d	18900 d	182 d	1880	< 0.5	2720 d
BRW-TP-16 (10-12')-SSL	N	08/10/2016	848 d	12.1	14	9580 d	252000 d	750 d	28000	< 0.5	25600 d
BRW-TP-17 (0-0.5')-OB	N	08/10/2016	27	0.5	38	58 d	40100 d	54	3800	< 0.5	237 d
BRW-TP-17 (2.5-12')-SSL	N	08/10/2016	622 d	11.5	23	4740 d	106000 d	1290 d	66400	< 0.5	11700 d
BRW-TP-18 (5.5')-SSL	N	08/10/2016	678 d	8.4	12	7340 d	224000 d	1170 d	46300	< 0.5	18900 d
BRW-TP-20 (2.5-3')-CD	N	08/10/2016	58	2.8	37	409 d	40500 d	424	2020	< 0.5	1000 d
BRW-TP-21 (0-9')-CD	N	08/10/2016	1020 d	28.1	15	1160 d	28900 d	1830 d	133000 d	1.9	10000 d
BRW-TP-21 (9')-GT	N	08/10/2016	2140 d	798	2	12100 d	18900 d	7850 d	3300	42 d	249000 d
BRW-TP-21 (14')-AL	N	08/10/2016	2870 d	151	4	30000 d	65100 d	1630 d	2880	1.4	15600 d
BRW-TP-22 (3-5')-OB	N	08/10/2016	321	3.2	29	846 d	34800 d	363	3600	< 0.5	773 d
BRW-TP-23 (1-4.5')-SSL	N	08/10/2016	491 d	5.3	24	2310 d	37400 d	1050 d	6240	< 0.5	1750 d
BRW-TP-23 (4.5-7')-AL	N	08/10/2016	65	3.3	34	2250 d	53800 d	105	1000	< 0.5	572 d
BRW-TP-23 (8')-AL	N	08/10/2016	36	3.7	43	16100 d	63700 d	16	592	< 0.5	2530 d
BRW-TP-23 (9')-AL	N	08/10/2016	7	4.5	27	3060 d	30200 d	27	801	< 0.5	1180 d
BRW-TP-24 (3')-OB/YT	N	08/11/2016	4970 d	9.5	16	8080 d	94400 d	2490 d	3230	1.8	3030 d
BRW-TP-24 (7.5')-AL	N	08/11/2016	50	1.2	87	641 d	133000 d	38	513	< 0.5	443 d
BRW-TP-24 (15')-AL	N	08/11/2016	14	3	24	4880 d	37300 d	12	909	< 0.5	889 d
BRW-TP-24 (15')-AL	D	08/11/2016	13	2.9	25	5020 d	39600 d	10	974	< 0.5	908 d
BRW-TP-26 (0.5-3.5')-OB	N	08/11/2016	591 d	9.3	23	851 d	36000 d	2500 d	69300	0.76	4230 d
BRW-TP-26 (3.5-4.5')-AL	N	08/11/2016	37	2.3	62	311 d	80500 d	30	651	< 0.5	466 d

Notes:

mg/kg - Milligrams per kilogram

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NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

Table 3
Butte Reduction Works Test Pit Soils Metals Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Benchmarks [a]			200	20	NE	1,000	NE	1,000	NE	10	1,000
BRW-TP-26 (9.5')-AL	N	08/11/2016	219	1.8	49	409 d	69900 d	142	2390	< 0.5	470 d
BRW-TP-27 (7')-AL	N	08/11/2016	142	1.1	93	397 d	137000 d	40	825	< 0.5	243 d
BRW-TP-28 (2.5')-OBYT	N	08/11/2016	895 d	3.5	50	928 d	69900 d	1050 d	22900	< 0.5	1610 d
BRW-TP-28 (14')-AL	N	08/11/2016	56	1	60	1490 d	85100 d	22	666	< 0.5	268 d
BRW-TP-29 (4')-OB	N	08/11/2016	43800 d	5.4	6	5520 d	67800 d	16100 d	289	58 d	1890 d
BRW-TP-29 (9')-AL	N	08/11/2016	217	2.1	72	606 d	114000 d	95	359	< 0.5	561 d
BRW-TP-30 (3.5-4')-OB	N	08/11/2016	243 d	6.2	35	713 d	43300 d	1010 d	31300	< 0.5	3290 d
BRW-TP-30 (6')-AL	N	08/11/2016	634 d	9.4	24	1690 d	39900 d	491 d	891	1.1	1880 d

Notes:

mg/kg - Milligrams per kilogram

a - Screening Criteria utilized in previous BAO site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

Table 4
Butte Reduction Works Test Pit Soil Physical and Chemical Characteristics, Nutrients, Acid Base Accounting and SPLP Analytical Results

Sample ID	Sample Date	Physical and Chemical Characteristics				Nutrients		Acid - Base Accounting									Synthetic Precipitation Leaching Procedure								
		SC (µmhos / cm)	Saturated Paste pH (s.u.)	NAG pH (s.u.)	TOC (%)	Nitrate as N (mg/L)	Phosphorus (mg/L)	Sulfur, Hot Water Extracable (%)	Sulfur, HCl Extractable (%)	Sulfur, HNO3 Extractable (%)	Sulfur, Residual (%)	Neutral Potential (t/kt)	Acid Base Potential (t/kt)	Acid Base Potential Pyritic (t/kt)	Acid Potential (t/kt)	Acid Potential Pyritic (t/kt)	Arsenic (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron* (mg/L)	Lead (mg/L)	Manganese* (mg/L)	Mercury (mg/L)	Zinc (mg/L)
DEQ-7 Groundwater Quality Standards [c]		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.010**	**0.005**	**0.10**	**1.3**	**140**	**0.015**	**4.3**	**0.002**	**2.0**
BRW-TP-01 (6')-OB N	08/08/2016	3.9	6.2	--	1.7	2.4	4920 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-01 (10')-AL N	08/08/2016	3.3	6.8	--	< 0.1	< 1	1200 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-01 (13.5')-AL N	08/08/2016	0.9	7.1	--	0.1	< 1	1020 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-02 (4.5')-SSL N	08/08/2016	1.3	7.5	7.2	0.1	< 1	272 d	0.03	0.03	0.03	0.27	39	28	38	11	0.87	0.005	0.00018	< 0.01	0.597	2.16	0.133	0.85	< 0.00005	0.36
BRW-TP-02 (4.5')-SSL D	08/08/2016	0.9	7.2	--	0.1	< 1	238 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-03 (1-2')-WT N	08/08/2016	3.2	7.4	--	0.5	1.2	398	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-03 (3.5')-ASH N	08/08/2016	4	4.1	--	36	1.9	2940 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-03 (5.5')-YT N	08/08/2016	7.2	2.5	--	0.8	1	340 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-03 (9.5')-RT N	08/08/2016	0.3	6.7	6.5	< 0.1	< 1	1240 d	0.02	0.08	0.04	0.02	5	0	4	4.8	1.1	1.2	0.00304	< 0.01	0.247	10.3	0.0126	0.03	0.00006	0.53
BRW-TP-03 (14')-AL N	08/08/2016	0.5	7.1	--	< 0.1	2.1	1160	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-04 (3.5')-B/YT N	08/08/2016	0.8	7.1	--	0.1	1.3	963	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-04 (5.0-6.0')-AL N	08/08/2016	3	7.2	--	2.3	< 1	937	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-04 (13.5')-AL N	08/08/2016	0.4	7.3	--	< 0.1	1.6	623	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-05 (11')-AL N	08/08/2016	1.1	6.8	--	2	< 1	918 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-06 (2-5.5')-CD N	08/09/2016	46	6.8	--	8.4	1.3	7520 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-06 (7.5')-AL N	08/09/2016	1.3	7.1	--	< 0.1	< 1	2780	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-07 (0.5-7')-OB N	08/09/2016	46.1	6.4	7.7	2.1	5.3	9800	0.14	0.03	0.03	0.04	79	71	78	7.4	0.84	0.396	0.00007	< 0.01	0.006	0.02	<0.0003	0.16	0.00006	< 0.008
BRW-TP-07 (9')-AL N	08/09/2016	1.1	7.1	--	< 0.1	< 1	1410 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-08 (0.5-6')-SSL N	08/09/2016	4.1	7.4	7.8	2.2	2.4	1050	0.03	0.01	0.08	0.23	31	20	29	11	2.7	0.027	0.00009	< 0.01	0.097	1.12	0.0155	0.1	< 0.00005	0.061
BRW-TP-08 (0.5-6')-SSL D	08/09/2016	4.7	7.3	--	1.8	3.2	1050	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-09 (4.5')-YT N	08/09/2016	2.6	8.2	--	0.3	1.6	2730	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-09 (9')-SSL N	08/09/2016	2.6	7.7	--	0.3	3.7	1470	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-10 (10')-SSL N	08/09/2016	4	6.8	--	4.9	1.2	1270	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-10 (16')-AL N	08/09/2016	1.8	7.4	--	0.4	< 1	801	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-11 (1.5-2.0')-YT N	08/09/2016	3.8	6.8	6.6	0.3	1.5	587	0.21	0.13	0.18	0.05	4	-14	-2	18	5.6	0.022	0.00009	< 0.01	0.003	0.02	<0.0003	0.04	< 0.00005	< 0.008
BRW-TP-11 (5')-IS N	08/09/2016	4	4.8	--	1.8	3.8	1650	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-11 (14')-AL N	08/09/2016	2.1	6.7	--	0.5	< 1	583	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-13 (0-2')-OB N	08/10/2016	2.4	7.5	--	11	2.5	792 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-14 (0-2')-OB N	08/10/2016	2.4	7.8	--	0.5	1.7	1110 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-14 (3-8')-SSL N	08/10/2016	3	7.6	8.7	2.4	5.9	989 d	0.02	0.03	0.02	0.12	52	46	51	5.7	0.48	0.044	< 0.0001 d	0.02	0.004	0.29	0.0025	0.09	< 0.00005	0.021
BRW-TP-15 (0-0.5')-OB N	08/10/2016	0.5	8.3	--	0.2	1.2	789 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-15 (0.5-7')-SSL N	08/10/2016	0.7	8	--	0.4	< 1	737 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-16 (4')-RS N	08/10/2016	0.5	7.5	--	0.2	2.4	1790 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-16 (10-12')-SSL N	08/10/2016	2.2	7.1	--	0.9	1.4	817 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-17 (0-0.5')-OB N	08/10/2016	11.2	7.4	--	0.2	10	829 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-17 (2.5-12')-SSL N	08/10/2016	3.5	7.3	--	0.7	2.2	1150 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-18 (5.5')-SSL N	08/10/2016	2.8	7.3	--	0.2	1.2	403 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-20 (2.5-3')-CD N	08/10/2016	9	7.4	--	1.8	1.3	1240 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

SC - Specific Conductance
NAG - Net Acid Generation
TOC - Total Organic Carbon
µmhos/cm - Micromhos per centimeter
S.U. - Standard Units
% - Percent
t/kt - Tons per kiloton
mg/L - Milligrams per liter

NE - Not established
N - Natural sample
D - Duplicate sample
-- - Sample not collected / analyzed
d - RL increased due to sample matrix
L - Lowest available reporting limit for the analytical method
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value exceeds water quality standard

Classification [b] — Criteria for Classification

Potentially Acid Generating [a]	NP:AP <1 and NNP < -20 t/kt
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 t/kt

[a] NP = Neutralization Potential, AP =Acidification Potential, NNP = Net Neutralizaiton Potential
[b] From BLM (1996) and EPA (1994)
[c] Groundwater Quality Standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 4
Butte Reduction Works Test Pit Soil Physical and Chemical Characteristics, Nutrients, Acid Base Accounting and SPLP Analytical Results

Sample ID	Sample Date	Physical and Chemical Characteristics				Nutrients		Acid - Base Accounting									Synthetic Precipitation Leaching Procedure								
		SC (µmhos / cm)	Saturated Paste pH (s.u.)	NAG pH (s.u.)	TOC (%)	Nitrate as N (mg/L)	Phosphorus (mg/L)	Sulfur, Hot Water Extracable (%)	Sulfur, HCl Extractable (%)	Sulfur, HNO3 Extractable (%)	Sulfur, Residual (%)	Neutral Potential (t/kt)	Acid Base Potential (t/kt)	Acid Base Potential Pyritic (t/kt)	Acid Potential (t/kt)	Acid Potential Pyritic (t/kt)	Arsenic (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron* (mg/L)	Lead (mg/L)	Manganese* (mg/L)	Mercury (mg/L)	Zinc (mg/L)
DEQ-7 Groundwater Quality Standards [c]		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.010**	**0.005**	**0.10**	**1.3**	**140**	**0.015**	**4.3**	**0.002**	**2.0**
BRW-TP-21 (0-9')-CD N	08/10/2016	5.3	7.2	--	2.2	1.3	606 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-21 (9')-GT N	08/10/2016	2.6	6.9	4.5	0.4	< 1	189 d	0.65	0.14	5.4	9.9	8	-500	-160	500	170	0.039	0.0004 d	< 0.01	0.189	0.82	0.556	0.41	0.00126	0.063
BRW-TP-21 (14')-AL N	08/10/2016	2.4	6.7	--	0.3	< 1	581 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-22 (3-5')-OB N	08/10/2016	2.7	7.3	--	1.2	17	1110 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-23 (1-4.5')-SSL N	08/10/2016	1.3	6.8	--	8	3	899 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-23 (4.5-7')-AL N	08/10/2016	0.7	6	--	0.2	< 1	1250 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-23 (8')-AL N	08/10/2016	0.3	6.9	--	< 0.1	< 1	1630 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-23 (9')-AL N	08/10/2016	0.3	6.8	--	0.2	< 1	943 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-24 (3')-OB/YT N	08/11/2016	3.3	4.6	--	0.4	< 1	406 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-24 (7.5')-AL N	08/11/2016	0.7	7	--	< 0.1	< 1	1220 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-24 (15')-AL N	08/11/2016	0.3	7.3	--	0.1	< 1	1360 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-24 (15')-AL D	08/11/2016	0.4	7.3	--	< 0.1	< 1	1400 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-26 (0.5-3.5')-OB N	08/11/2016	3.7	7.5	--	0.8	2.8	1100 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-26 (3.5-4.5')-AL N	08/11/2016	0.4	6.9	--	< 0.1	< 1	993 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-26 (9.5')-AL N	08/11/2016	1.3	7.5	--	0.1	1.4	977 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-27 (7')-AL N	08/11/2016	0.6	6.9	6.2	< 0.1	1.1	1280 d	0.07	0.04	0.02	0.03	5	0	4	5.1	0.53	0.2	0.0004 d	< 0.01	0.22	5.18	0.0191	0.23	< 0.00005	0.133
BRW-TP-28 (2.5')-OBYT N	08/11/2016	11.2	7.2	7.8	0.6	3.7	1320 d	0.1	0.01	0.02	0.05	15	9	14	6	0.73	0.194	< 0.0001 d	< 0.01	0.005	0.08	0.0037	< 0.02	< 0.00005	< 0.008
BRW-TP-28 (14')-AL N	08/11/2016	0.5	7.6	--	0.1	1.2	907 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-29 (4')-OB N	08/11/2016	68.1	3.9	2.6	2.4	< 1	339 d	0.07	0.33	0.51	0.61	4	-44	-12	48	16	1.11	0.0167 d	< 0.01	0.826	0.96	1.61	0.86	< 0.00005	4.89
BRW-TP-29 (9')-AL N	08/11/2016	0.8	7.2	--	0.1	< 1	1150 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-30 (3.5-4')-OB N	08/11/2016	75.9	7.5	--	1.6	< 1	1160 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRW-TP-30 (6')-AL N	08/11/2016	66.3	6.7	--	2.7	< 1	1190 d	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

SC - Specific Conductance
NAG - Net Acid Generation
TOC - Total Organic Carbon
µmhos/cm - Micromhos per centimeter
S.U. - Standard Units
% - Percent
t/kt - Tons per kiloton
mg/L - Milligrams per liter

NE - Not established
N - Natural sample
D - Duplicate sample
-- - Sample not collected / analyzed
d - RL increased due to sample matrix
L - Lowest available reporting limit for the analytical method
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value exceeds water quality standard

Classification [b]	Criteria for Classification
Potentially Acid Generating [a]	NP:AP <1 and NNP < -20 t/kt
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 t/kt

[a] NP = Neutralization Potential, AP =Acidification Potential, NNP = Net Neutralizaiton Potential
[b] From BLM (1996) and EPA (1994)
[c] Groundwater Quality Standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 5. Comparison of Detectable Total Metals Concentrations between Natural and Blind Field Duplicates

SAMPLE	DESCRIPTION	All results in parts per million (mg/kg)								
			As	Cd	Cu	Fe	Pb	Mn	Hg	Zn
BRW-TP-02(4.5')-SSL	Solid Slag/fractured, HC odor		260	6.4	10,100	126,000	3,300	54,200	<0.5	26,500
080816-DUP-01	Field Duplicate of BRW-TP-02(4.5)-SSL		221	6.4	11,800	117,000	2,970	48,400	<0.5	25,200
		RPD	16	0	16	7	11	11		5
BRW-TP-08(0.5-6')-SSL	Solid Slag/mixture of heap roast slag and solid blocky slag		629	4.3	3,900	67,800	586	13,400	<0.5	4,120
080916-DUP-01	Field duplicate of BRW-TP-08(0.5-6)-SSL		638	4.5	4,170	73,800	606	13,800	<0.5	4,420
		RPD	1	5	7	8	3	3		7
BRW-TP-24(15')-AL	Alluvium/coarse sand, black/reduced staining?		14.0	3.0	4,880	37,300	12.0	909	<0.5	889
081116-DUP-01	Field duplicate of BRW-TP-24(15)-AL		13.0	2.9	5,020	39,600	10.0	974	<0.5	908
		RPD	7	3	3	6	18	7		2
RPD- relative percent difference is the absolute difference divided by the absolute value of their arithmetic mean.		**Mean RPD**	**8**	**3**	**8**	**7**	**11**	**7**		**5**

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LOG OF TEST PIT

Test Pit BRW-TP-01

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094652.64 E: 380476.63	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5455.0 ft
Date Started: 8/8/16	**Date Finished:** 8/8/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5453.0							OVERBURDEN; Slightly moist; poorly-graded gravel with sand and boulders.		
4 5451.0									
6 5449.0							OVERBURDEN; moist, silty sand with gravel.	5.5 5449.5	Mine Waste Parameters, Sch. 1
8 5447.0							CONSTRUCTION DEBRIS; moist red brick.	6.5 5448.5	
							SOLID SLAG; moist, black slag with copper color coating; fractured face.	8.5 5446.5	
10 5445.0							ALLUVIUM; moist; tan to light brown, coarse sand. HC like odor present.	9.5 5445.5	Mine Waste Parameters, Sch. 1
12 5443.0							ALLUVIUM; saturated, black coarse sand; strong HC like odor; LNAPL visible in standing water.	12.0 5443.0	
14 5441.0							Boring Depth: 14.0 ft, *Elevation: 5441.0 ft*	14.0 5441.0	Mine Waste Parameters, Sch. 1 FID (530 ppm)

Water Level Observations		Remarks:
After Excavation: 12.0 ft *(5443.0 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-02

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094679.2 E: 308505.57	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5446.0 ft
Date Started: 8/8/16	**Date Finished:** 8/8/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; slightly moist, brown, sandy gravel & rock fragments.	1.0 *5445.0*	
							OVERBURDEN/CONSTRUCTION DEBRIS; grey concrete.		
2 *5444.0*							SOLID SLAG; slightly moist to saturated, black, crystaline slag; very hard; LNAPL present on water surface.	2.0 *5444.0*	
4 *5442.0*							HC odor.		Mine Waste Parameters, Sch. 1 & Sch. 2. Field Duplicate (08016-Dup-01)
6 *5440.0*									
8 *5438.0*									
10 *5436.0*									
12 *5434.0*									
							Refusal.	13.5 *5432.5*	

Boring Depth: 13.5 ft, *Elevation: 5432.5 ft*

Water Level Observations		Remarks:
▼ **After Excavation:** 7.0 ft *(5439.0 ft)*	▽ **During Excavation:** Not Recorded	
	▼ **After Excavation:** Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-03

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094699.11 E: 380546.49	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5448.0 ft
Date Started: 8/8/16	**Date Finished:** 8/8/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** Near Crusher	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; fill.		
							OVERBURDEN; clean volcanic ash; moist, grey/white, clayey sand; HC odor present.	1.0 *5447.0*	Mine Waste Parameters, Sch. 1
2 *5446.0*							OVERBURDEN; moist, black ash heap. roast material.	2.5 *5445.5*	
4 *5444.0*							TAILINGS; Slightly moist, greenish yellow clayey sand.	3.5 *5444.5*	Mine Waste Parameters, Sch. 1 FID (20 ppm)
6 *5442.0*							SOLID SLAG; slag brick paving.	6.0 *5442.0*	Mine Waste Parameters, Sch. 1
							TAILINGS; Saturated, red tailings, dark brown/red coarse-grained sand with oxidized tailings.	7.0 *5441.0*	
8 *5440.0*									
10 *5438.0*									Mine Waste Parameters, Sch. 1 & Sch. 2
12 *5436.0*									
14 *5434.0*							ALLUVIUM; saturated, tan to brown, silty fine sand with mica flakes; no staining present.	14.0 *5434.0*	Mine Waste Parameters, Sch. 1
16 *5432.0*							Boring Depth: 16.0 ft, *Elevation: 5432.0 ft*	16.0 *5432.0*	

Water Level Observations		Remarks:
During Excavation: Not Recorded		
After Excavation: 7.0 ft *(5441.0 ft)*	**After Excavation:** Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-04

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094700.12 E: 380606.75	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5448.0 ft
Date Started: 8/8/16	**Date Finished:** 8/8/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
0	OVERBURDEN; dark brown, sandy gravel.		
2 5446.0	OVERBURDEN/CONSTRUCTION DEBRIS; brick and weathered brick debris.	2.0 5446.0	
4 5444.0			Mine Waste Parameters, Sch. 1
	ALLUVIUM; moist, dark brown, gravelly sand.	5.0 5443.0	Mine Waste Parameters, Sch. 1
6 5442.0			FID (610 ppm)
	ALLUVIUM; saturated, black gravelly sand; strong HC odor present.	7.5 5440.5	
8 5440.0			
10 5438.0			
12 5436.0			
	Boring Depth: 13.5 ft, *Elevation: 5434.5 ft*	13.5 5434.5	Mine Waste Parameters, Sch. 1

Water Level Observations		Remarks:
After Excavation: 9.5 ft *(5438.5 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-05

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094736.57 E: 380568.21	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5449.0 ft
Date Started: 8/8/16	**Date Finished:** 8/8/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** West of AST	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; road base material.		
							SOLID SLAG; red to black, blocky Slag.	1.0 *5448.0*	
2 *5447.0*									
4 *5445.0*									
6 *5443.0*									
8 *5441.0*									
							HC Odor at 9'.		
10 *5439.0*									
							ALLUVIUM; black to grey, silt/clay; thin interbeds of fine-grained sand throughout section.	10.5 *5438.5*	Mine Waste Parameters, Sch. 1 & Organics Sch. 3
12 *5437.0*									
							Boring Depth: 13.0 ft, *Elevation: 5436.0 ft*	13.0 *5436.0*	

Water Level Observations		
After Excavation: 9.0 ft *(5440.0 ft)*	**During Excavation:** Not Recorded	Remarks:
	After Excavation: Not Recorded	

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Test Pit BRW-TP-06

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094706.23 E: 380728.23	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5447.0 ft
Date Started: 8/9/16 **Date Finished:** 8/9/16		**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** Near east entrance gate	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; slightly moist, dark brown, road base material.		XRF
								1.0 *5446.0*	
2 *5445.0*							SOLID SLAG; moist, dark brown slag; south wall of excavation solid and blocky down to 4 feet. Red Brick on the south side of the excavation. Some wood debris present. Pipe in excavation at 6.75 feet.		Mine Waste Parameters, Sch. 1
4 *5443.0*									
								5.5 *5441.5*	
6 *5441.0*							ALLUVIUM; saturated, tan/yellow/orange, coarse-grained sand; some FE oxidations staining present. ▼		
							Boring Depth: 7.5 ft, *Elevation: 5439.5 ft*	7.5 *5439.5*	Mine Waste Parameters, Sch. 1

Water Level Observations		
▼ **After Excavation:** 6.5 ft *(5440.5 ft)*	▽ **During Excavation:** Not Recorded	Remarks:
	▼ **After Excavation:** Not Recorded	

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Test Pit BRW-TP-07

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094723.97 E: 380698.41	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5449.0 ft
Date Started: 8/9/16	**Date Finished:** 8/9/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, brown, road base material with pieces of asphaltic concrete.	0.5 *5448.5*	Mine Waste Parameters, Sch. 1 & Sch. 2
2 *5447.0*							CONSTRUCTION DEBRIS; slightly moist, brown debris in silty sand. Pieces of concrete, wood debris, wire, piping breaks, etc.		
4 *5445.0*									
6 *5443.0*									
8 *5441.0*							ALLUVIUM; wet, tan, coarse-grained sand with occasional gravel seam..	7.5 *5441.5*	XRF
							Boring Depth: 9.0 ft, *Elevation: 5440.0 ft*	9.0 *5440.0*	Mine Waste Parameters, Sch. 1

Water Level Observations		Remarks:
After Excavation: 9.0 ft *(5440.0 ft)*	During Excavation: Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-08

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094755.67 E: 380633.21	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5452.0 ft
Date Started: 8/9/16	**Date Finished:** 8/9/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, dark brown, road base material.	0.5 5451.5	Mine Waste Parameters, Sch. 1 & Sch. 2. Fiel duplicate (080916-Dup-01)
2 5450.0							SOLID SLAG; blocky slag with roast heap and roast reminants. Some brick fragments present.		
4 5448.0									
6 5446.0									
8 5444.0									
10 5442.0									
12 5440.0							Boring Depth: 12.0 ft, *Elevation: 5440.0 ft*	12.0 5440.0	

Water Level Observations		Remarks:
After Excavation: Not Encountered	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-09

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094787.7 E: 380579.46	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5465.0 ft
Date Started: 8/9/16	**Date Finished:** 8/9/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
0							OVERBURDEN; road mix material. grades in color form light grey to brown.		
2 5463.0							SLAG/TAILINGS MIXTURE; pockets of slag, weathered brick, and tailings intermixed.	2.0 5463.0	
4 5461.0									Mine Waste Parameters, Sch. 1
6 5459.0									
8 5457.0							SOLID SLAG; Red to black blocky angular slag; unable to penetrated beyond 12 feet.	8.0 5457.0	Mine Waste Parameters, Sch. 1
10 5455.0									
12 5453.0							Boring Depth: 12.0 ft, *Elevation: 5453.0 ft*	12.0 5453.0	

Water Level Observations		Remarks:
After Excavation: 12.0 ft *(5453.0 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-10

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094748.57 E: 380535.9	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5448.0 ft
Date Started: 8/9/16	**Date Finished:** 8/9/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5446.0							OVERBURDEN; dry, boulders intermixed with road base material.		
								3.0 5445.0	
4 5444.0							SOLID SLAG; moist, red to black slag; blocky slag with brick debris.		
6 5442.0									
8 5440.0								8.0 5440.0	
							SOLID SLAG; wet, broken slag with gravel and coarse sand. HC odor present.		
10 5438.0									Mine Waste Parameters, Sch. 1 FID (138 ppm)
12 5436.0									
14 5434.0									
16 5432.0								16.0 5432.0	Mine Waste Parameters, Sch. 1
							ALLUVIUM; saturated, black clay interbedded with fine to coarse-grained sand; contains some wood debris.	17.0 5431.0	

Boring Depth: 17.0 ft, *Elevation: 5431.0 ft*

Water Level Observations		Remarks:
After Excavation: 10.5 ft *(5437.5 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-11

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094747.57 E: 380491.85	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5448.0 ft
Date Started: 8/9/16 **Date Finished:** 8/9/16		**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; brown road base material with asphaltic concrete pieces.	1.0 5447.0	
2 5446.0							CONSTRUCTION DEBRIS/SOLID SLAG; mix of granite blocks stained blue, gree, and yellow with slag.		Mine Waste Parameters, Sch. 1 & Sch.2 XRF of Yellow Tails; XRF of Copper precipitate in YT layer
4 5444.0							SOLID SLAG; blocky slage with blue green coloring; Pink granular material at 5 feet in north end of excavation extending down to 8 feet deep.	3.0 5445.0	Mine Waste Parameters, Sch. 1
6 5442.0									
8 5440.0									
10 5438.0									
12 5436.0									
14 5434.0							ALLUVIUM; Coarse-grainded sand with occasional gravel seam.	14.0 5434.0	XRF; Mine Waste Parameters, Sch. 1
							Boring Depth: 15.0 ft, *Elevation: 5433.0 ft*	15.0 5433.0	

Water Level Observations		Remarks:
During Excavation: Not Recorded		
After Excavation: 11.0 ft *(5437.0 ft)*	**After Excavation:** Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-12

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094785.29 E: 380473.67	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5454.0 ft
Date Started: 8/9/16	**Date Finished:** 8/9/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) / Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) / Elev. (ft)	Remarks and Other Tests
2 / 5452.0							OVERBURDEN; dry, road mix material and debris..		
								3.0 / 5451.0	
4 / 5450.0							SOLID SLAG; dry, black, blocky competent slag; HC odor in rock fragements noted at 14' BGS. Water estimated to be approximately 17' BGS based on stream channel elevation north of test pit.		
6 / 5448.0									
8 / 5446.0									No sample due to lack of fines
10 / 5444.0									
12 / 5442.0									
14 / 5440.0									
16 / 5438.0							Boring Depth: 16.0 ft, *Elevation: 5438.0 ft*	16.0 / 5438.0	

Water Level Observations		Remarks:
After Excavation: 17.0 ft *(5437.0 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-13

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094811.12 E: 380519.11	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5457.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** Adjacent to well BPS07-14A	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
0							OVERBURDEN; slightly moist, black, sand & gravel road base material.		XRF; Mine Waste Parameters, Sch. 1
2 5455.0								2.5 5454.5	
4 5453.0							SOLID SLAG; Unable to pentrate below ~2.5 feet below ground surface. Estimated depth of 20 feet due to exposure to the north.		
6 5451.0									
8 5449.0									
10 5447.0									
12 5445.0							Boring Depth: 12.0 ft, *Elevation: 5445.0 ft*	12.0 5445.0	

Water Level Observations		Remarks:
▽ **During Excavation:** Not Recorded	▽ **After Excavation:** Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-14

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094824.64 E: 380576.08	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5461.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5459.0							OVERBURDEN; slightly moist, brown sand & gravel with cobbles; road mix material.		Mine Waste Parameters, Sch. 1
								3.0 5458.0	
4 5457.0							SOLID SLAG; red to black, blocky angular slag with some fines. Unable to advane excavation beyond 8 feet below ground surface.		XRF; Mine Waste Parameters, Sch. 1 & Sch. 2
6 5455.0									
8 5453.0							Boring Depth: 8.0 ft, *Elevation: 5453.0 ft*	8.0 5453.0	

Water Level Observations		Remarks:
After Excavation: Not Encountered	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-15

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094818.47 E: 380531.37	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5469.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; slightly moist, brown sand & gravel; road mix material.	0.5 *5468.5*	Mine Waste Parameters, Sch. 1
2 *5467.0*							SOLID SLAG; red to black, slightly moist, blocky angular slag with somefine material. Unable to advance excavation beyond 7.5 feet below ground surface.		XRF; Mine Waste Parameters, Sch. 1
4 *5465.0*									
6 *5463.0*									
							Boring Depth: 7.5 ft, *Elevation: 5461.5 ft*	7.5 *5461.5*	

Water Level Observations		Remarks:
▽ During Excavation: Not Recorded	▽ After Excavation: Not Recorded	
▼ After Excavation: Not Encountered		

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LOG OF TEST PIT

Test Pit BRW-TP-16

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094786.14 E: 380672.72	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5460.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** Approximately 100' west of BPS07+3B & BPS07-13A	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5458.0							GRANULAR SLAG; dry, red to black.		
4 5456.0							IMPACTED SEDIMENT; dry, orange to pink, roast heap residue, granular material, medium-grained with gravel sized material. Some cemented cobble sized fragments.	4.0 5456.0	XRF; Mine Waste Parameters, Sch. 1
6 5454.0									
8 5452.0									
10 5450.0							SOLID SLAG; dry, red to black, blocky angular slag. unable to excavate greater than 12 feet below ground surface.	10.0 5450.0	XRF; Mine Waste Parameters, Sch. 1
12 5448.0							Boring Depth: 12.0 ft, *Elevation: 5448.0 ft*	12.0 5448.0	

Water Level Observations		Remarks:
After Excavation: Not Encountered	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-17

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094747.44 E: 380716.06	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5460.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** Approximately 95 feet south east of BPS07-13A	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, brown sand & gravel road mix material.	0.5 *5459.5*	Mine Waste Parameters, Sch. 1
2 *5458.0*							SOLID SLAG; blocky angular slag.		XRF; Mine Waste Parameters, Sch. 1
4 *5456.0*									
6 *5454.0*									
8 *5452.0*									
10 *5450.0*									
12 *5448.0*							Boring Depth: 12.0 ft, *Elevation: 5448.0 ft*	12.0 *5448.0*	

Water Level Observations		Remarks:
After Excavation: Not Recorded	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-18

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094742.24 E: 380755.75	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5461.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							GRANULAR SLAG; weathered, dry, black, fine-grained material.	0.3 *5460.8*	
2 *5459.0*							SOLID SLAG; dry, red to black, blocky angular slage. Unable to advance excavation beyond 5.5 feet below ground surface.		
4 *5457.0*									
								5.5 *5455.5*	XRF; Mine Waste Parameters, Sch. 1

Boring Depth: 5.8 ft, *Elevation: 5455.2 ft*

Water Level Observations		Remarks:
After Excavation: Not Encountered	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-19

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094747.73 E: 380413.07	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5457.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** Near FP98-01B	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5455.0							OVERBURDEN; dry, brown, silty sand with gravel and occasional cobbles.		
4 5453.0							SOLID SLAG; only able to penetrate surface of slag. No samples obtained.	4.0 5453.0	
							Boring Depth: 4.5 ft, *Elevation: 5452.5 ft*	4.5 5452.5	

Water Level Observations		Remarks:
After Excavation: Not Encountered	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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Test Pit BRW-TP-20

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094732.24 E: 380439.75	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5451.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5449.0							CONSTRUCTION DEBRIS; dry, Brown, silty sand with concrete & asphaltic concrete debris.		Mine Waste Parameters, Sch. 1
4 5447.0									
6 5445.0							SOLID SLAG; competent, unable to penetrate upper surface.	6.0 5445.0	
							Boring Depth: 6.5 ft, *Elevation: 5444.5 ft*	6.5 5444.5	

Water Level Observations		Remarks:
During Excavation: Not Recorded	**After Excavation:** Not Recorded	
After Excavation: Not Encountered		

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LOG OF TEST PIT

Test Pit BRW-TP-21

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094664.78 E: 380425.19	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5450.0 ft
Date Started: 8/10/16 **Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings		
Driller: **Logger:** J. Armstrong/B. Craig	**Comments:**		

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5448.0							CONSTRUCTION DEBRIS; sitly sand with bricks and concrete rubble.		XRF; Mine Waste Parameters, Sch. 1 FID (5 ppm)
4 5446.0									
6 5444.0									
8 5442.0									
10 5440.0							TAILINGS; wet silt and clay sized material.	9.0 5441.0	XRF; Mine Waste Parameters, Sch. 1 & Sch. 2 FID (25 ppm)
12 5438.0									
14 5436.0							ALLUVIUM; wet, brown sand; medium-grained sand with abundant pyrite. HC odor in samples at 13 feet below ground surface. Sample collected.	14.0 5436.0	XRF; Mine Waste Parameters, Sch. 1 FID (31 ppm)
16 5434.0							Boring Depth: 16.0 ft, *Elevation: 5434.0 ft*	16.0 5434.0	

Water Level Observations		Remarks:
During Excavation: Not Recorded	After Excavation: Not Recorded	
After Excavation: Not Recorded		

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LOG OF TEST PIT

Test Pit BRW-TP-22

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094622.47 E: 380397.79	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5452.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
2 5450.0							OVERBURDEN; volcaninc rubble underlain by brown silty, sand loam fill.		
4 5448.0							OVERBURDEN/CONSTRUCTION DEBRIS; Dry, brown, silty sand with construction debris, contains some trash & pieces of slag.	3.0 5449.0	Mine Waste Parameters, Sch. 1
							SOLID SLAG; unable to penetrate beyond 5.5 feet.	5.0 5447.0	
							Boring Depth: 5.5 ft, *Elevation: 5446.5 ft*	5.5 5446.5	

Water Level Observations		
After Excavation: Not Encountered	**During Excavation:** Not Recorded	Remarks:
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-23

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094597.91 E: 380428.68	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5445.0 ft
Date Started: 8/10/16	**Date Finished:** 8/10/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, Tan, Silty Sand with gravel.		
							OVERBURDEN; dry, black, slag rubble.	1.0 *5444.0*	Mine Waste Parameters, Sch. 1
2 *5443.0*									
4 *5441.0*									
							ALLUVIUM; moist, orange to brown, medium to coarse grained sand with gravel. Contains FE oxidation staining.	4.5 *5440.5*	Mine Waste Parameters, Sch. 1
6 *5439.0*							Wet at about 6 feet below ground surface.		
8 *5437.0*							copper precipitates at 8 feet below ground surface; cemented sands with green color.		XRF; Mine Waste Parameters, Sch. 1
							ALLUVIUM; wet, brown fat clay.	9.0 *5436.0*	XRF; Mine Waste Parameters, Sch. 1
							Boring Depth: 9.5 ft, *Elevation: 5435.5 ft*	9.5 *5435.5*	

Water Level Observations		Remarks:
▽ **During Excavation:** Not Recorded	▽ **After Excavation:** Not Recorded	
▼ **After Excavation:** Not Encountered		

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LOG OF TEST PIT

Test Pit BRW-TP-24

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094624.23 E: 380523.12	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5468.0 ft
Date Started: 8/11/16 **Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings		
Driller: **Logger:** J. Armstrong/B. Craig	**Comments:**		

Depth (ft) / Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) / Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; road base material; dry, brown, sandy gravel.	1.0 *5467.0*	
2 *5466.0*							OVERBURDEN; dark brown silt intermixed with slag fragments, yellow tails, and wood debris. HC odor present.		Mine Waste Parameters, Sch. 1
4 *5464.0*									
								5.5 *5462.5*	
6 *5462.0*							ALLUVIUM; moist, brown to grey, coarse-grained sand. Iron oxidation staining prestent.		
8 *5460.0*									Mine Waste Parameters, Sch. 1 MSE Laboratory analysis of SVOCs, VOCs, EPH, and VPH FID (13 ppm)
10 *5458.0*									
12 *5456.0*									
14 *5454.0*									
								15.0 *5453.0*	Mine Waste Parameters, Sch. 1; Field duplicate (081116-Dup-01)
							ALLUVIUM; wet, orange to red due to iron staining, fine to medium-grained sand. abundant pyrite flakes.	15.5 *5452.5*	
							Boring Depth: 15.5 ft, *Elevation: 5452.5 ft*		

Water Level Observations		Remarks:
After Excavation: 7.5 ft *(5460.5 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-25

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094636.55 E: 380571.79	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5446.0 ft
Date Started: 8/11/16	**Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, brown, silty, sand & gravel road mix material.		
							SOLID SLAG; black competent, unable to penetrate surface. No Samples taken.	1.5 *5444.5*	
								1.8 *5444.3*	

Boring Depth: 1.8 ft, *Elevation: 5444.3 ft*

Water Level Observations		Remarks:
After Excavation: Not Encountered	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-26

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094634.37 E: 380612.47	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5446.0 ft
Date Started: 8/11/16	**Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, brown, sand & gravel; road base material.	0.5 *5445.5*	Mine Waste Parameters, Sch. 1
2 *5444.0*							CONSTRUCTION DEBRIS; slightly moist, brown, silty sand with debris including concrete blocks, bricks, cables, and wood debris.		
4 *5442.0*							ALLUVIUM; wet, yellow to tan, coarse-grained, poorly-graded sand with gravel.	4.0 *5442.0*	Mine Waste Parameters, Sch. 1
							Boring Depth: 5.0 ft, *Elevation: 5441.0 ft*	5.0 *5441.0*	

Mine Waste Parameters, Sch. 1

Water Level Observations		Remarks:
During Excavation: Not Recorded		
After Excavation: Not Encountered	**After Excavation:** Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-27

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094602.2 E: 380655.94	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5448.0 ft
Date Started: 8/11/16	**Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:** South of asphalt hot plant	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; dry, brown, silty sand & gravel, road base material.	1.0 *5447.0*	
2 *5446.0*							OVERBURDEN/CONSTRUCTION DEBRIS; moist, brown, silty sand with construction debris including brick & wood debris, and metal piping.		
4 *5444.0*									
								5.5 *5442.5*	
6 *5442.0*							ALLUVIUM; wet, tan to brown, medium to coarse-grained sand.		Mine Waste Parameters, Sch. 1 & Sch. 2
8 *5440.0*									
								9.5 *5438.5*	

Boring Depth: 9.5 ft, *Elevation: 5438.5 ft*

Water Level Observations		Remarks:
After Excavation: 9.5 ft *(5438.5 ft)*	**During Excavation:** Not Recorded	
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-28

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094670.13 E: 380716.65	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5447.0 ft
Date Started: 8/11/16	**Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; brown, granular road mix material.	0.5 *5446.5*	
2 *5445.0*							OVERBURDEN/ALLUVIUM; coarse-grained sand mixed with fine red sand tails and dark brown sandy silt layer. Contains copper cemeted green sand conglomerates.		Mine Waste Parameters, Sch. 1 & Sch. 2
4 *5443.0*									
6 *5441.0*									
8 *5439.0*									
10 *5437.0*									
12 *5435.0*									
14 *5433.0*									Mine Waste Parameters, Sch. 1
								15.0 *5432.0*	

Boring Depth: 15.0 ft, *Elevation: 5432.0 ft*

Water Level Observations		Remarks:
During Excavation: Not Recorded		
After Excavation: 7.5 ft *(5439.5 ft)*	**After Excavation:** Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-29

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094692.75 E: 380756.42	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5446.0 ft
Date Started: 8/11/16	**Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; granular road mix material.	0.3 *5445.8*	
2 *5444.0*							OVERBURDEN; silt with pieces of brick, slag and other debris.		
4 *5442.0*							OVERBURDEN/CONSTRUCTION DEBRIS; brick, charred wood in a sand and gravel matrix.	4.0 *5442.0*	XRF; Mine Waste Parameters, Sch. 1 & Sch. 2
6 *5440.0*									
8 *5438.0*									
							ALLUVIUM; wet coarse-grained sand with gravel; orange to red, iron oxide staining.	9.0 *5437.0*	Mine Waste Parameters, Sch. 1
10 *5436.0*							Boring Depth: 10.0 ft, *Elevation: 5436.0 ft*	10.0 *5436.0*	

Water Level Observations		
After Excavation: 7.0 ft *(5439.0 ft)*	**During Excavation:** Not Recorded	Remarks:
	After Excavation: Not Recorded	

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LOG OF TEST PIT

Test Pit BRW-TP-30

TETRA TECH

Project: Butte Area One - Butte Reduction Works	**Rig:** CAT 336L	**Test Pit Location Coordinates** N: 5094716.42 E: 380782.14	
Project Number: 114-571101	**Dimensions:**	**System:** MT S.P. (E) **Datum:** NAD83	**Top of Excavation Elevation:** 5445.0 ft
Date Started: 8/11/16	**Date Finished:** 8/11/16	**Abandonment Method:** Backfilled with Cuttings	
Driller: **Logger:** J. Armstrong/B. Craig		**Comments:**	

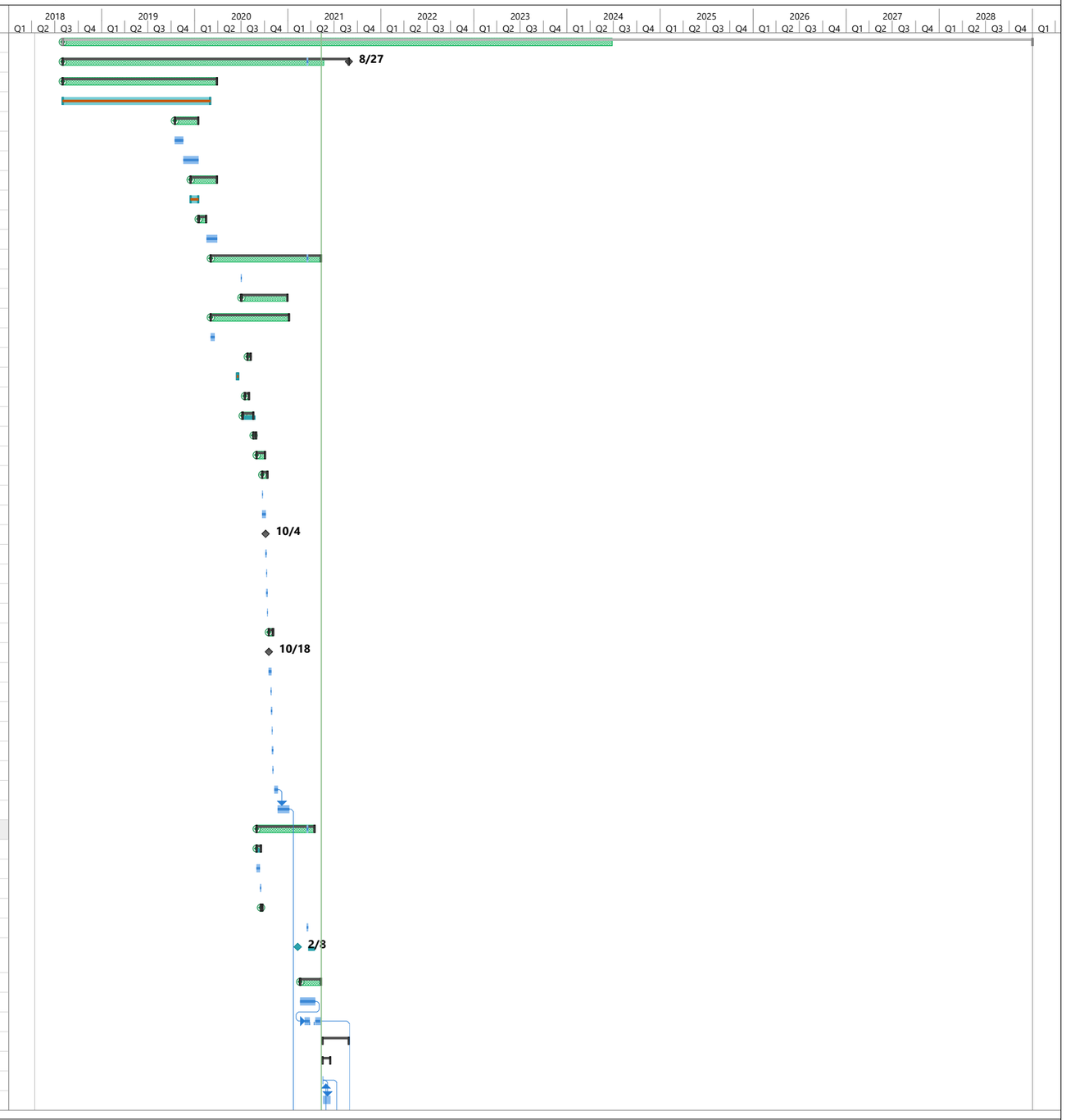
Depth (ft) Elev. (ft)	Sample Type	MC (%)	LL	PL	-200 (%)	Lithology	Material Description	Depth (ft) Elev. (ft)	Remarks and Other Tests
							OVERBURDEN; brown sandy gravel road base material.	0.5 *5444.5*	
2 *5443.0*							OVERBURDEN; back to grey, sandy gravel with pieces of asphaltic concrete, contains cobbles and boulders.		
4 *5441.0*									Mine Waste Parameters, Sch. 1
6 *5439.0*							ALLUVIUM; dary grey, clay with medium plasticity.	6.0 *5439.0*	Mine Waste Parameters, Sch. 1
							Boring Depth: 7.0 ft, *Elevation: 5438.0 ft*	7.0 *5438.0*	

Water Level Observations		Remarks:
After Excavation: Not Encountered	During Excavation: Not Recorded	
	After Excavation: Not Recorded	

Attachment 2
Draft BPSOU BRW Remedial Design/Remedial Action Project Schedule

Attachment 2
DRAFT BPSOU BRW Remedial Design/Remedial Action PROJECT SCHEDULE

ID	Task Name	Duration	Start	Finish	% Complete	Predecessors
0	**BRW RDRA Project Schedule rev 05122021**	**2704 days**	**Wed 8/1/18**	**Sun 12/31/28**	**56%**	
1	**Site Investigation Activities**	**789 days**	**Wed 8/1/18**	**Fri 8/27/21**	**91%**	
2	**Phase I Field Investigation**	**419 days**	**Wed 8/1/18**	**Fri 3/27/20**	**100%**	
3	**Initial Phase I Site Investigation**	400 days	Wed 8/1/18	Sun 3/1/20	100%	
4	**Additional Groundwater Sampling (RFC 01)**	**63 days**	**Tue 10/15/19**	**Tue 1/14/20**	**100%**	
5	Sampling	23 days	Tue 10/15/19	Fri 11/15/19	100%	
6	Lab Analysis	8 wks	Mon 11/18/19	Tue 1/14/20	100%	
7	**Hydrocarbon Investigation (RFC 03)**	**74 days**	**Mon 12/16/19**	**Fri 3/27/20**	**100%**	
8	Installation of Hydrocarbon Wells	21 days	Mon 12/16/19	Tue 1/14/20	100%	
9	**Sampling**	**22 days**	**Thu 1/16/20**	**Fri 2/14/20**	**100%**	
13	Lab Analysis	6 wks	Mon 2/17/20	Fri 3/27/20	100%	
14	**Phase II Field Investigation**	**309 days**	**Wed 3/4/20**	**Mon 5/10/21**	**99%**	
15	Agency Approval & Field Work Start Again	1 day	Wed 7/1/20	Wed 7/1/20	100%	
16	**SBC Loading Sampling**	**129 days**	**Thu 7/2/20**	**Tue 12/29/20**	**100%**	
24	**Pumping Test**	**219 days**	**Wed 3/4/20**	**Mon 1/4/21**	**100%**	
25	Build Access Road	10 days	Wed 3/4/20	Tue 3/17/20	100%	
26	**Set Up Equipment**	**10 days**	**Mon 7/27/20**	**Fri 8/7/20**	**100%**	
28	**Pumping Well Installation & Development (2)**	1 wk	Mon 6/15/20	Fri 6/19/20	100%	
29	**Pre-Installation Sampling Event (Includes Lab Time)**	**12 days**	**Thu 7/16/20**	**Fri 7/31/20**	**100%**	
32	**Installation of Additional Piezometers (26)**	**30 days**	**Tue 7/7/20**	**Mon 8/17/20**	**100%**	
36	**Step Drawdown Test**	**8 days**	**Wed 8/19/20**	**Fri 8/28/20**	**100%**	
44	**Water Treatment System**	**25 days**	**Mon 8/31/20**	**Fri 10/2/20**	**100%**	
47	**Conduct Pumping Test #1**	**15 days**	**Tue 9/22/20**	**Mon 10/12/20**	**100%**	
48	Install Transducers	1 day	Tue 9/22/20	Tue 9/22/20	100%	
49	Water Level Trend Monitoring	1.8 wks	Tue 9/22/20	Sun 10/4/20	100%	
50	Download Transducers	0 days	Sun 10/4/20	Sun 10/4/20	100%	
51	Long Term Pumping Test	3 days	Mon 10/5/20	Wed 10/7/20	100%	
52	Download Transducers	1 day	Fri 10/9/20	Fri 10/9/20	100%	
53	Recovery Test	2 days	Thu 10/8/20	Sun 10/11/20	100%	
54	Download Transducers	1 day	Mon 10/12/20	Mon 10/12/20	100%	
55	**Conduct Pumping Test #2**	**11 days**	**Sun 10/18/20**	**Mon 11/2/20**	**100%**	
56	Install Transducers	0 days	Sun 10/18/20	Sun 10/18/20	100%	
57	Water Level Trend Monitoring	1.2 wks	Sun 10/18/20	Mon 10/26/20	100%	
58	Download Transducers	1 day	Mon 10/26/20	Mon 10/26/20	100%	
59	Long Term Pumping Test	3 days	Tue 10/27/20	Thu 10/29/20	100%	
60	Download Transducers	1 day	Fri 10/30/20	Fri 10/30/20	100%	
61	Recovery Test	2 days	Fri 10/30/20	Mon 11/2/20	100%	
62	Download Transducers	1 day	Mon 11/2/20	Mon 11/2/20	100%	
63	**Post-Test Groundwater Sampling**	10 days	Mon 11/9/20	Fri 11/20/20	100%	
64	Lab Analysis	6.2 wks	Mon 11/23/20	Mon 1/4/21	100%	63
65	**Slag Geotech Investigation**	**163 days**	**Mon 8/31/20**	**Wed 4/14/21**	**100%**	
66	**Stage 1 - Test Pit Excavation**	**13 days**	**Mon 8/31/20**	**Wed 9/16/20**	**100%**	
67	Conduct Test Pit Excavation	10 days	Mon 8/31/20	Fri 9/11/20	100%	
68	Results Review and Core Sample Location Determination	3 days	Mon 9/14/20	Wed 9/16/20	100%	
69	**Stage 2 - Slag Cores**	**4 days**	**Thu 9/17/20**	**Tue 9/22/20**	**100%**	
73	**Stage 3 - Slag Removal with Heavy Equipment**	4 days	Tue 3/16/21	Fri 3/19/21	100%	
74	~~**Stage 4 - Slag Fracturing with Expandable Grout (Not Planned - No Cores Collected)**~~	~~**0 days**~~	~~**Mon 2/8/21**~~	~~**Mon 2/8/21**~~	~~**100%**~~	
79	**RFC 01 & 02 - Low-Groundwater Sampling**	**58 days**	**Thu 2/18/21**	**Mon 5/10/21**	**96%**	
80	Low-GW	42 days	Thu 2/18/21	Fri 4/16/21	100%	
81	Lab Analysis	6 wks	Mon 3/8/21	Mon 5/10/21	90%	80
82	**Phase III Site Investigation**	**75 days**	**Mon 5/17/21**	**Fri 8/27/21**	**0%**	
83	**Installation/Development of Additional Piezometers**	**22 days**	**Mon 5/17/21**	**Tue 6/15/21**	**0%**	
84	Field Work	2 days	Mon 5/17/21	Tue 5/18/21	0%	181
85	Lab Analysis	4 wks	Wed 5/19/21	Tue 6/15/21	0%	84

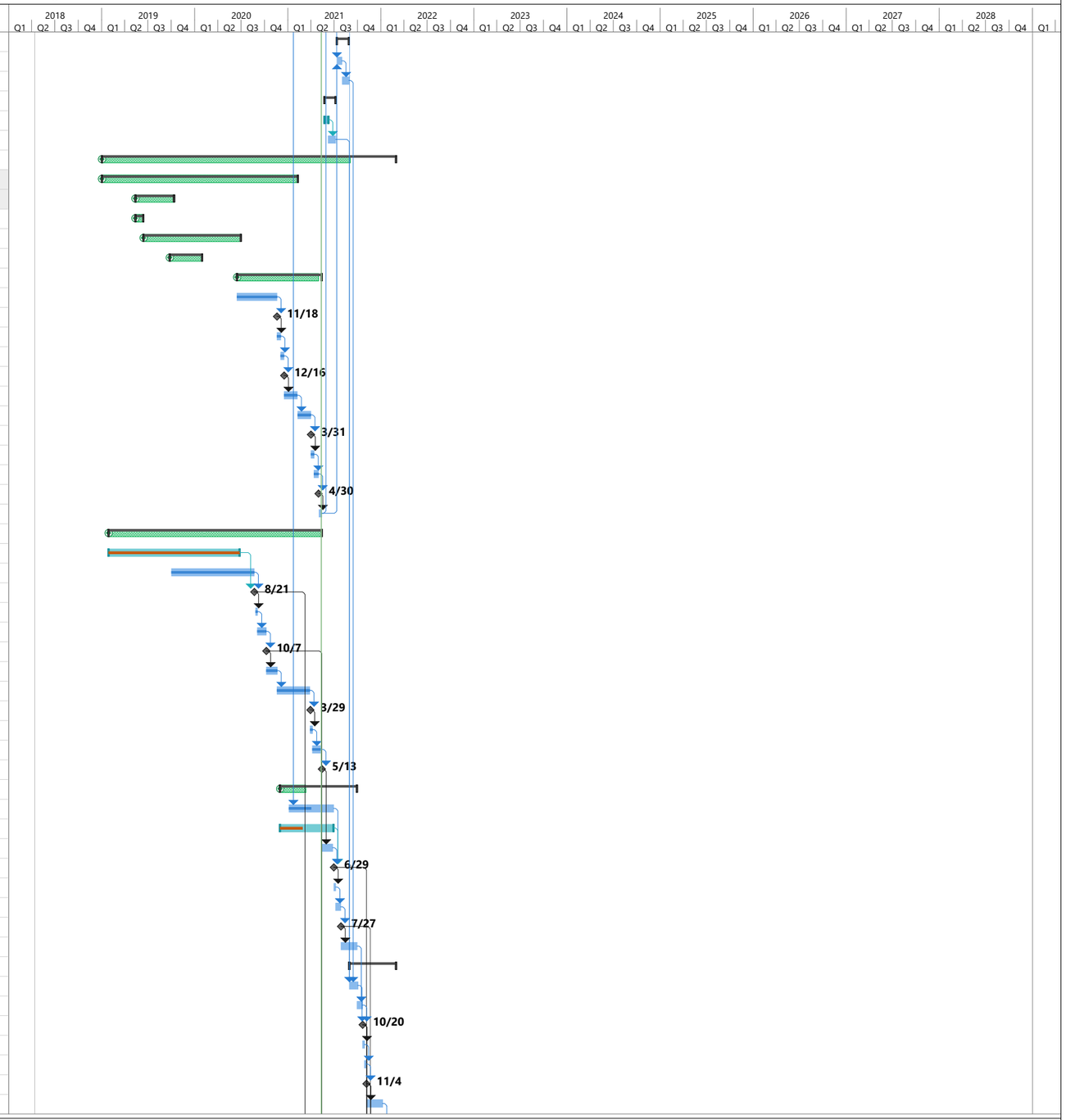


Project: BRW RDRA Project Schedule rev 05122021
Date: Wed 5/12/21

Summary Progress
Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

Attachment 2
DRAFT BPSOU BRW Remedial Design/Remedial Action PROJECT SCHEDULE

ID	Task Name	Duration	Start	Finish	% Complete	Predecessors
86	**Installation of Additional Boreholes & Sampling/Geotech**	**35 days**	**Mon 7/12/21**	**Fri 8/27/21**	**0%**	
87	Field Work	15 days	Mon 7/12/21	Fri 7/30/21	0%	181,84
88	Lab Analysis	4 wks	Mon 8/2/21	Fri 8/27/21	0%	87
89	**High-Groundwater Sampling**	**32 days**	**Mon 5/24/21**	**Tue 7/6/21**	**0%**	
90	Sampling (Estimated)	12 days	Mon 5/24/21	Tue 6/8/21	0%	
91	Lab Analysis	4 wks	Wed 6/9/21	Tue 7/6/21	0%	90
92	**Reporting**	**816 days**	**Wed 1/2/19**	**Mon 2/28/22**	**84%**	
93	**RDWP & PDI Work Plan**	**541 days**	**Wed 1/2/19**	**Mon 2/8/21**	**100%**	
106	**Phase I QAPP Rev - RFC BRW-2019-01 (RFC 01)**	**107 days**	**Mon 5/13/19**	**Fri 10/11/19**	**100%**	
118	**Phase I Results Technical Memo (Preliminary Results)**	**22 days**	**Mon 5/13/19**	**Wed 6/12/19**	**100%**	
124	**Phase II QAPP (Originally RFC 02)**	**266 days**	**Fri 6/14/19**	**Mon 6/29/20**	**100%**	
162	**Slag Investigation RFC (Incorporated into Phase II QAPP)**	**87 days**	**Wed 9/25/19**	**Wed 1/29/20**	**100%**	
169	**Phase III QAPP**	**238 days**	**Mon 6/15/20**	**Wed 5/12/21**	**97%**	
170	Prepare Draft	112 days	Mon 6/15/20	Tue 11/17/20	100%	
171	Submit Draft for AR Review/Comment	1 day	Wed 11/18/20	Wed 11/18/20	100%	170
172	AR Review/Comment Period	10 days	Thu 11/19/20	Wed 12/2/20	100%	171
173	Incorporate AR Comments	9 days	Thu 12/3/20	Tue 12/15/20	100%	172
174	Submit Draft Final to Agencies	1 day	Wed 12/16/20	Wed 12/16/20	100%	173
175	Agency Review/Comment Period	37 days	Thu 12/17/20	Fri 2/5/21	100%	174
176	Incorporate Agency Comments	37 days	Mon 2/8/21	Tue 3/30/21	100%	175
177	Submit Final to AR for Review/Comment	1 day	Wed 3/31/21	Wed 3/31/21	100%	176
178	AR Review/Comment Period	8 days	Thu 4/1/21	Mon 4/12/21	100%	177
179	Incorporate AR Comments	13 days	Tue 4/13/21	Thu 4/29/21	100%	178
180	Submit Final to Agencies	1 day	Fri 4/30/21	Fri 4/30/21	100%	179
181	Agency Review and Approval Period	8 days	Mon 5/3/21	Wed 5/12/21	0%	180
182	**PDI Evaluation Report (Phase I)**	**591 days**	**Mon 1/28/19**	**Thu 5/13/21**	**99%**	
183	Completion of Phase I Data Validation	360 days	Mon 1/28/19	Wed 6/24/20	100%	
184	Prepare Draft	228 days	Wed 10/2/19	Thu 8/20/20	100%	
185	Submit Draft for AR Review/Comment	1 day	Fri 8/21/20	Fri 8/21/20	100%	184,183
186	AR Review/Comment Period	5 days	Thu 8/27/20	Wed 9/2/20	100%	185
187	Incorporate AR Comments	24 days	Thu 9/3/20	Tue 10/6/20	100%	186
188	Submit Draft Final to Agencies	1 day	Wed 10/7/20	Wed 10/7/20	100%	187
189	Agency Review/Comment Period	30 days	Thu 10/8/20	Wed 11/18/20	100%	188
190	Incorporate Agency Comments	92 days	Thu 11/19/20	Fri 3/26/21	100%	189
191	Submit Draft Final Revised to AR for Review/Comment	1 day	Mon 3/29/21	Mon 3/29/21	100%	190
192	AR Review/Comment Period	6 days	Tue 3/30/21	Tue 4/6/21	100%	191
193	Incorporate AR Comments	26 days	Wed 4/7/21	Wed 5/12/21	100%	192
194	Submit Draft Final Revised to Agencies	1 day	Thu 5/13/21	Thu 5/13/21	100%	193
195	**PDI Evaluation Report (Phase II)**	**216 days**	**Tue 12/1/20**	**Tue 9/28/21**	**34%**	
196	Phase II Data Validation	25 wks	Tue 1/5/21	Mon 6/28/21	50%	64
197	Pumping Test Evaluation/Groundwater CSM	150 days	Tue 12/1/20	Mon 6/28/21	42%	
198	Prepare Draft	30 days	Fri 5/14/21	Thu 6/24/21	0%	194
199	Submit Draft for AR Review/Comment	1 day	Tue 6/29/21	Tue 6/29/21	0%	198,196,197
200	AR Review/Comment Period	5 days	Wed 6/30/21	Tue 7/6/21	0%	199
201	Incorporate AR Comments	14 days	Wed 7/7/21	Mon 7/26/21	0%	200
202	Submit Draft Final to Agencies	1 day	Tue 7/27/21	Tue 7/27/21	0%	201
203	Agency Review/Comment Period (Comments incorporated to Phase III)	45 days	Wed 7/28/21	Tue 9/28/21	0%	202
204	**PDI Evaluation Report (Phase III)**	**131 days**	**Mon 8/30/21**	**Mon 2/28/22**	**0%**	
205	Phase III Data Validation	5 wks	Mon 8/30/21	Fri 10/1/21	0%	88,91,81
206	Prepare Draft	15 days	Wed 9/29/21	Tue 10/19/21	0%	203
207	Submit Draft for AR Review/Comment	1 day	Wed 10/20/21	Wed 10/20/21	0%	205,206
208	AR Review/Comment Period	5 days	Thu 10/21/21	Wed 10/27/21	0%	207
209	Incorporate AR Comments	5 days	Thu 10/28/21	Wed 11/3/21	0%	208
210	Submit Draft Final to Agencies	1 day	Thu 11/4/21	Thu 11/4/21	0%	209
211	Agency Review/Comment Period	45 days	Fri 11/5/21	Thu 1/6/22	0%	210

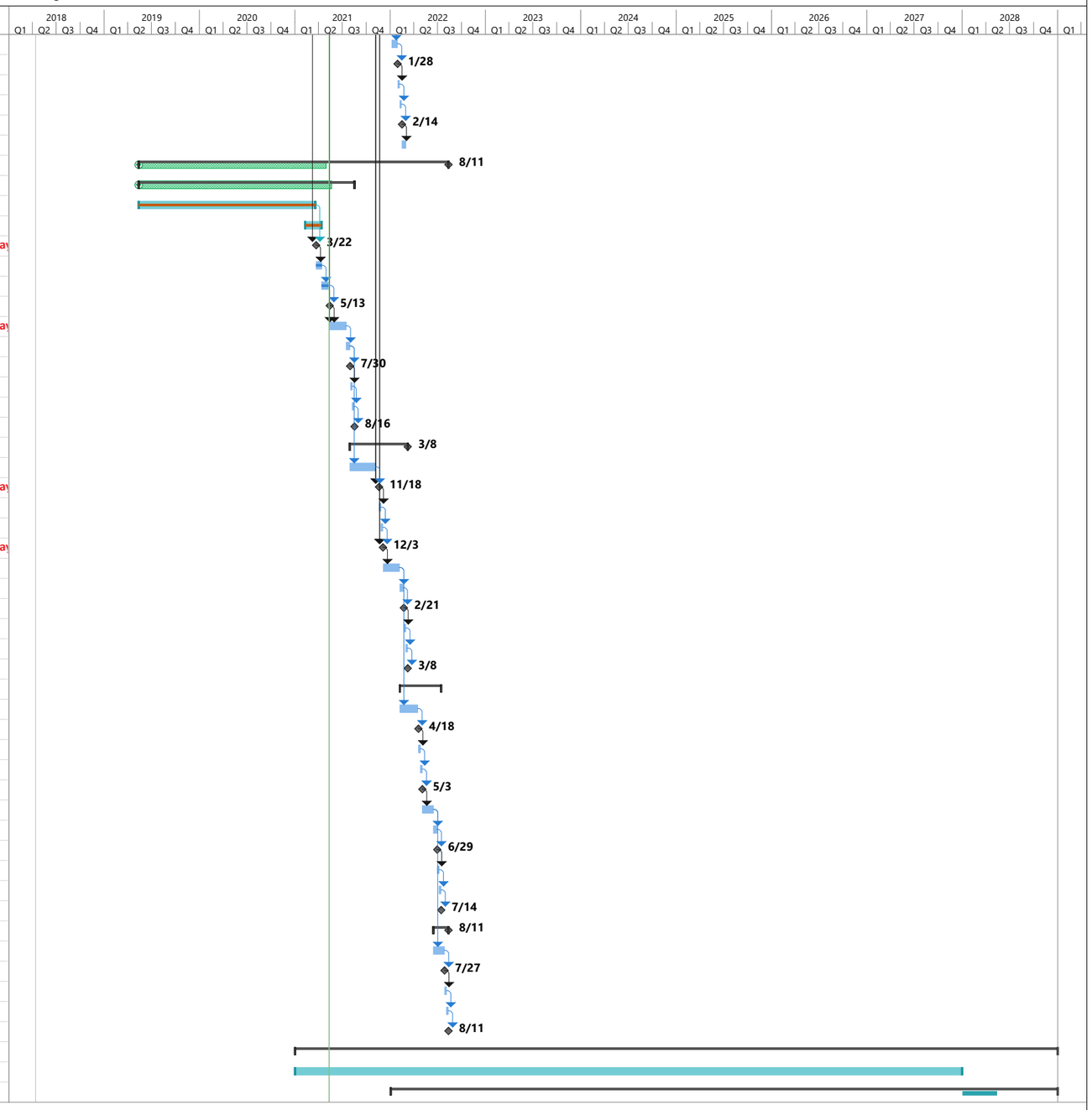


Project: BRW RDRA Project Schedule rev 05122021
Date: Wed 5/12/21

Summary Progress | Milestone | Inactive Task | Manual Task | Manual Summary | External Tasks | Progress
Task | Summary | Inactive Milestone | Duration-only | Start-only | External Milestone | Manual Progress
Split | Project Summary | Inactive Summary | Manual Summary Rollup | Finish-only | Deadline

Attachment 2
DRAFT BPSOU BRW Remedial Design/Remedial Action PROJECT SCHEDULE

ID	Task Name	Duration	Start	Finish	% Complete	Predecessors
212	Incorporate Agency Comments	15 days	Fri 1/7/22	Thu 1/27/22	0%	211
213	Submit Final to AR for Review/Comment	1 day	Fri 1/28/22	Fri 1/28/22	0%	212
214	AR Review/Comment Period	5 days	Mon 1/31/22	Fri 2/4/22	0%	213
215	Incorporate AR Comments	5 days	Mon 2/7/22	Fri 2/11/22	0%	214
216	Submit Final to Agencies	1 day	Mon 2/14/22	Mon 2/14/22	0%	215
217	Agency Review and Approval Period	10 days	Tue 2/15/22	Mon 2/28/22	0%	216
218	**Design Activities**	**842 days**	**Mon 5/13/19**	**Thu 8/11/22**	**60%**	
219	**Preliminary (30%) Design Report**	**584 days**	**Mon 5/13/19**	**Mon 8/16/21**	**89%**	
220	Prepare Draft	478 days	Mon 5/13/19	Fri 3/19/21	100%	
221	Incorporate Agency Comments on RDWP & PDI WP	45 days	Tue 2/9/21	Mon 4/12/21	100%	105
222	Submit Draft for AR Review/Comment	1 day	Mon 3/22/21	Mon 3/22/21	100%	220,185FS+20 da
223	AR Review/Comment Period (Includes RDWP and PDI WP)	15 days	Tue 3/23/21	Mon 4/12/21	100%	222
224	Incorporate AR Comments	22 days	Tue 4/13/21	Wed 5/12/21	100%	223
225	Submit Draft Final to Agencies	1 day	Thu 5/13/21	Thu 5/13/21	100%	224
226	Agency Review/Comment Period	45 days	Fri 5/14/21	Thu 7/15/21	0%	225,188FS+20 da
227	Prepare Comment Response/Incorporate Comments into 60%	10 days	Fri 7/16/21	Thu 7/29/21	0%	226
228	Submit Comment Response to AR for Review/Comment	1 day	Fri 7/30/21	Fri 7/30/21	0%	227
229	AR Review/Comment Period	5 days	Mon 8/2/21	Fri 8/6/21	0%	228
230	Incorporate AR Comments	5 days	Mon 8/9/21	Fri 8/13/21	0%	229
231	Submit Comment Response to Agencies	1 day	Mon 8/16/21	Mon 8/16/21	0%	230
232	**Intermediate (60%) Design Report**	**158 days**	**Fri 7/30/21**	**Tue 3/8/22**	**0%**	
233	Prepare Draft	70 days	Fri 7/30/21	Thu 11/4/21	0%	227
234	Submit Draft for AR Review/Comment	1 day	Thu 11/18/21	Thu 11/18/21	0%	233,199FS+20 da
235	AR Review/Comment Period	5 days	Fri 11/19/21	Thu 11/25/21	0%	234
236	Incorporate AR Comments	5 days	Fri 11/26/21	Thu 12/2/21	0%	235
237	Submit Draft Final to Agencies	1 day	Fri 12/3/21	Fri 12/3/21	0%	236,202FS+20 da
238	Agency Review/Comment Period	45 days	Mon 12/6/21	Fri 2/4/22	0%	237
239	Prepare Comment Response/Incorporate Comments into 95%	10 days	Mon 2/7/22	Fri 2/18/22	0%	238
240	Submit Comment Response to AR for Review/Comment	1 day	Mon 2/21/22	Mon 2/21/22	0%	239
241	AR Review/Comment Period	5 days	Tue 2/22/22	Mon 2/28/22	0%	240
242	Incorporate AR Comments	5 days	Tue 3/1/22	Mon 3/7/22	0%	241
243	Submit Comment Response to Agencies	1 day	Tue 3/8/22	Tue 3/8/22	0%	242
244	**Pre-Final (95%) Design Report**	**114 days**	**Mon 2/7/22**	**Thu 7/14/22**	**0%**	
245	Prepare Draft	50 days	Mon 2/7/22	Fri 4/15/22	0%	238
246	Submit Draft for AR Review/Comment	1 day	Mon 4/18/22	Mon 4/18/22	0%	245
247	AR Review/Comment Period	5 days	Tue 4/19/22	Mon 4/25/22	0%	246
248	Incorporate AR Comments	5 days	Tue 4/26/22	Mon 5/2/22	0%	247
249	Submit Draft Final to Agencies	1 day	Tue 5/3/22	Tue 5/3/22	0%	248
250	Agency Review/Comment Period	30 days	Wed 5/4/22	Tue 6/14/22	0%	249
251	Prepare Comment Response/Incorporate Comments into 100%	10 days	Wed 6/15/22	Tue 6/28/22	0%	250
252	Submit Comment Response to AR for Review/Comment	1 day	Wed 6/29/22	Wed 6/29/22	0%	251
253	AR Review/Comment Period	5 days	Thu 6/30/22	Wed 7/6/22	0%	252
254	Incorporate AR Comments	5 days	Thu 7/7/22	Wed 7/13/22	0%	253
255	Submit Comment Response to Agencies	1 day	Thu 7/14/22	Thu 7/14/22	0%	254
256	**Final (100%) Design Report**	**42 days**	**Wed 6/15/22**	**Thu 8/11/22**	**0%**	
257	Prepare Draft	30 days	Wed 6/15/22	Tue 7/26/22	0%	250
258	Submit Draft for AR Review/Comment	1 day	Wed 7/27/22	Wed 7/27/22	0%	257
259	AR Review/Comment Period	5 days	Thu 7/28/22	Wed 8/3/22	0%	258
260	Incorporate AR Comments	5 days	Thu 8/4/22	Wed 8/10/22	0%	259
261	Submit Final to Agencies	1 day	Thu 8/11/22	Thu 8/11/22	0%	260
262	**RA Construction**	**2086 days**	**Fri 1/1/21**	**Sun 12/31/28**	**0%**	
263	RA Construction	1826 days	Fri 1/1/21	Fri 12/31/27	0%	
264	Remedial Action CCRs	1826 days	Mon 1/3/22	Sun 12/31/28	0%	



Project: BRW RDRA Project Schedule rev 05122021
Date: Wed 5/12/21

Summary Progress | Milestone | Inactive Task | Manual Task | Manual Summary | External Tasks | Progress
Task | Summary | Inactive Milestone | Duration-only | Start-only | External Milestone | Manual Progress
Split | Project Summary | Inactive Summary | Manual Summary Rollup | Finish-only | Deadline