Summer 6-10-2022

Draft Final Revised Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Evaluation Report

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June 10, 2022

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RE: Draft Final Revised Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Evaluation Report

Agency Representatives:

I am writing you on behalf of Atlantic Richfield Company to submit the *Draft Final Revised Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Pre-Design Investigation (PDI) Evaluation Report* (PDI Evaluation Report) for your review.

This PDI Evaluation Report summarizes and evaluates the results of sampling and field activities conducted per the *Butte Reduction Works (BRW) Phase I Quality Assurance Project Plan (QAPP)* and the *Butte Reduction Works (BRW) Phase II Quality Assurance Project Plan (QAPP)* and associated request for changes (RFCs). This PDI Evaluation Report has been revised to address Agency comments received on August 31, 2021, and to incorporate additional data collected as part of the Phase II Site Investigation activities.

This PDI Evaluation Report follows requirements listed in the Butte Priority Soils Operable Unit (BPSOU) Statement of Work (Appendix D to the BPSOU Consent Decree) and contains the following components:

- Summary of the work performed.
- Summary of work results.
- Summary of validated data.
- Data validation reports and laboratory data reports.

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- Narrative interpretation of data and results.
- Results of statistical and modeling analyses.
- Photographs documenting the work conducted.
- Conclusion and recommendations for the remedial design, including design parameters and criteria.

In addition to the above, the report also includes a discussion on remaining data gaps that have been identified based on the investigation findings to date. Note that additional investigations are planned for the Site to fill the data gaps identified, and Atlantic Richfield will incorporate the results of these investigations, including an updated interpretation of the results, into this PDI Evaluation Report and resubmit to Agencies for review prior to submitting the Intermediate (60%) Remedial Design Report.

The report may be downloaded at the following link:

https://pioneertechnicalservices.sharepoint.com/:f:/s/submitted/EuFeLYz8jfhBuxd85M0HaowBOHDgZ_WzvEQL4LvMMeW1EA.

If you have any questions or comments, please call me at (406) 723-1834.

Sincerely,

Josh Bryson, PE, PMP
Liability Manager
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An affiliate of **Atlantic Richfield Company**

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Scott Bradshaw / TREC - email
Brad Archibald / Pioneer - email
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SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Draft Final Revised

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

Atlantic Richfield Company

Revision 1 June 2022

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 PRE-DESIGN INVESTIGATION (PDI) EVALUATION REPORT DATED MAY 14, 2021

PDI Evaluation Report

General Comments:

EPA General Comment 1: *The actual metals results data (laboratory and XRF) used for development of the Leapfrog model and the total waste volume could be presented better in the PDI Evaluation Report or associated appendices. Previous EPA Specific Comment 11 requested these tables. Atlantic Richfield Company response to this previous comment indicated that XRF results are shown on lithology logs and in the electronic database, and that ICP data used in Leapfrog model are included in Leapfrog model tables. This response is both inaccurate and not acceptable based on the following:*

a. *Table 5 presents some metals results but only for SPLP related samples.*
b. *Appendix A, Attachment A and B data summary report tables are appropriately presented with respect to the data validation effort and addition of data quality indicators; however, these tables are not useful for review of data to confirm the waste volume analysis both in their presentational structure and in their content (e.g., ICP-predicted XRF results are not shown). For example, Table 1 in Attachment A of Appendix A to the PDI ER has 15 sub tables presented as A through O and soils results are spread amongst several of these tables rather than all in one place.*
c. *Appendix C Leapfrog Model presents the results of the regression analysis and modeling effort, but again, no tables of actual ICP-predicted results are presented nor is there a comprehensive table of all sample intervals and metals results for each sample location. This directly conflicts with the Comment 11 response.*
d. *The electronic database is important to include but is not a replacement for report tables. Rather, electronic data is an added part of a deliverable. Furthermore, as a Microsoft Access database, this format has limited utility only to data users that have the program and understand how to use it. Excel tables would be preferred.*
e. *In summary, please add a summary table of the final data result and associated qualifier that is used for decisions of classification of waste material in the main PDI ER table set. This table should include all boring, piezometer, and test pit data used in the analysis and modeling. For XRF data, the appropriately adjusted (ICP-predicted) XRF data should be presented in the table. If XRF data is not used, such as that for slag and debris samples, then that should be clearly indicated in some way in the table.*

Atlantic Richfield Company Response: A Microsoft Excel table is now included as Attachment 2 to the *Butte Reduction Works (BRW) Phase I and Phase II Investigation*

Leapfrog Model Inputs Technical Memorandum (Model Inputs Technical Memorandum), which is included as Appendix C.3 of the Pre-Design Investigation (PDI) Evaluation Report. The Microsoft Excel table includes the following information requested in this comment (and other comments):

- All boring, piezometer, and test pit data for contaminants of concern (COCs) (i.e., arsenic, cadmium, copper, lead, mercury, and zinc) and hydrocarbon-compounds, including the depth intervals for each sample.
- Data validation qualifiers (U, J, and R qualified results).
- Indication if the sample result is a laboratory or Pioneer X-ray Fluorescence (XRF) sample result.
- For XRF data, the appropriately adjusted (Inductively Coupled Plasma [ICP]-predicted) result.
- Indication if the sample result is used in the Leapfrog Model.

Specific Comments:

EPA Specific Comment 1*:* Section 2.1: *In general, this section provides sufficient detail on the sampling approach and numbers of test pits and boreholes; however, the number of both field (XRF) and laboratory related soil samples is not explained. Please add sufficient detail to explain the numbers of samples collected and for what analyses. According to the Appendix A DSR Section 2.1.1, the total number of samples collected for laboratory analyses should equal 399 samples and the total number of XRF samples should equal 667. If most efficient, the summary of the number of samples for the different sample types (test pit or boring) could be presented as an exhibit or small table embedded in the text.*

> **Atlantic Richfield Company Response:** Additional details have been added to the text to detail how many XRF and laboratory samples were collected and generally for what analyses. Additionally, a Microsoft Excel table is now included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report) which includes all sample results for COCs and hydrocarbon-compounds.

EPA Specific Comment 2: Section 2.1.2, bullets: *The bullets reference Tables 3 and 4 as if they contain the detailed information on what samples were submitted to the laboratory or by XRF. Table 3 summarizes the sample investigation points (boring, piezometer, well, or test pit) and their associated detail, but does not indicate what intervals were collected and their analysis. Table 4 just provides a summary of methods and associated QC information. Please revise the text to clarify where this information is detailed (and/or provide a table that details this type of information). A comprehensive table of all metals results as suggested in general comments above may achieve this goal.*

> **Atlantic Richfield Company Response:** Additional detail has been added to Tables 3 and 4. Additionally, a Microsoft Excel table is now included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report) which includes all boring, piezometer, and test pit data for COCs and hydrocarbon-compounds, including the depth intervals for each sample.

EPA Specific Comment 3: *<u>Section 2.2, last paragraph:</u> Silver acute aquatic life performance standards are applicable to thesite as are all acute standards. Silver is unusual in that it does not have a chronic aquatic life performance criterion.*

Atlantic Richfield Company Response: The following statement has been removed from the text "acute standards are not applicable to this site".

EPA Specific Comment 4: *<u>Section 3</u>: Please present data in table and figure format. If this is the site characterization, these are essential data to present.*

Atlantic Richfield Company Response: Data collected as part of the Site investigation activities are presented in either a table and/or figure. Additionally, a Microsoft Excel table is now included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report) which includes all boring, piezometer, and test pit data for COCs and hydrocarbon-compounds, including the depth intervals for each sample. If there are specific data that Agencies would like presented in either a table and/or figure format, please specify which data are being referred to.

EPA Specific Comment 5: *<u>Section 3.1.1:</u>*

a. *This section lays out the basis and methods for generating the interpreted volume of waste material that exceeds the waste criteria; however, a summary should be provided to link spatially sampling locations (e.g., borings) to the assumed depth of waste estimated in the Leapfrog model. Please provide a summary table of waste depths for each boring, piezometer, well, and test pit. Based on the presentation in Appendix C, it appears this depth should be calculated from the Leapfrog model?*
b. *One of the key properties to be presented and assessed/interpreted are the SPLP results. These results should be evaluated spatially throughout the BRW to determine the range/magnitude of COC concentrations and whether certain areas of the site and/or depths have greater or lower leachable concentrations. This assessment is stated in Section 4.1.3 that it will be completed after further data collection; however, initial assessment of Phase 1 data should have been included in this report. Please add an evaluation of the data presented in Table 5.*

Atlantic Richfield Company Response:

a. Table 13 has been added to PDI Evaluation Report which indicates the depth for bottom of waste in each investigation point (as determined in the Leapfrog Model) along with the excavation depth based on current design.
b. The synthetic Precipitation Leaching Procedure (SPLP) results from Phase I and Phase II Site Investigations have been incorporated into the Leapfrog Model, and the results have been included in Appendix C.2.

EPA Specific Comment 6: *<u>Section 5.0, last subsection:</u> Last subsection is labeled 5.1, but it follows section 5.5. Please number this subsection 5.6.*

Atlantic Richfield Company Response: The last subsection has been properly numbered.

EPA Specific Comment 7: *Table 3:*

a. *Please add the date of sampling for each location to this table.*
b. *Under Analytes Techniques columns, several numbers are presented which correspond referenced to a different document. Please revise accordingly.*

Atlantic Richfield Company Response:

a. The date of sampling for each location has been added to Table 3.
b. The Analyte Group numbers were defined in Table 4. However, the reference in the column heading on Table 3 was incorrect and created confusion. This reference has been corrected.

EPA Specific Comment 8: *Table 4, Energy Laboratories SPLP: In the justification cell, please adjust reference to read BRW Phase I QAPP Appendix A Section 2.4.1.*

Atlantic Richfield Company Response: The justification column has been removed.

EPA Specific Comment 9: *Table 5:*

a. *Results are presented for 60 samples; however, the DSR indicated 399 samples were collected for laboratory analysis and 667 were collected for XRF analysis. Please explainwhy only a few results were presented in Table 5. See general comment above and revisereport tables accordingly.*
b. *The order of this table is unclear, it does not appear to be organized by sample collection type or location ID as presented in the draft submittal of the PDI ER. Please revise the sorting of this table to reflect location ID alphanumerically and then by interval depth(s) within a location.*

Atlantic Richfield Company Response:

a. Table 5 is meant to only present the results from SPLP samples. All SPLP samples were analyzed via ICP prior to the SPLP analysis and those results are included in Table 5 as well. The title of Table 5 has been revised to clarify this. Additionally, a Microsoft Excel table is now included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report) which includes all boring, piezometer, and test pit data for COCs.

b. Table 5 is organized first by "Initial Geological Unit Classification" and then by the order the samples were selected for SPLP analysis based on the criteria included in the BRW Phase I Quality Assurance Project Plan (QAPP), included at the bottom of Table 5. A footnote has been added to Table 5 to clarify the organization of the table.

EPA Specific Comment 10: *Table 8, footnote 1: Please use color highlights to designate the four different outlier groups, as it is difficult to see with the large table and small superscript* *numbering.*

> **Atlantic Richfield Company Response:** Table 9 (previously Table 8) has been revised to use color highlights to designate the four outlier groups as well as superscripts.

Appendix A: Phase 1 Data Summary Report

<u>Specific Comments:</u>

EPA Specific Comment 1: <u>*Executive Summary, last paragraph:*</u> *Appendix A does not quite meet the format content of the CFRSSI Pilot Data Report Addendum requirements. For example, the detail of what and how sampling was conducted is presented in the PDI ER and not the DSR. Please clarify in the executive summary what content is presented and where and ensure the required content and structure of the Pilot Data Report Addendum is followed as has been completed for many other DSRs for the Site.*

> **Atlantic Richfield Company Response:** Appendix A.1 (previously Appendix A) has been edited to ensure the format content of the Clark Fork River Superfund Site Investigations (CFRSSI) Pilot Data Report Addendum is met. A bullet list has been added to the Executive Summary which indicates where the required information is included within Appendix A.1 (previously Appendix A) and/or the main PDI Evaluation Report.

EPA Specific Comment 2: <u>Section 2.1.1.1:</u> *Please add language in this section stating that 9 of the collected soil samples were sent to Energy Laboratories and were validated at a Level II as required. It would be good to add a couple of sentences at the beginning of the section on why these samples were collected and that they were to be Level II.*

> **Atlantic Richfield Company Response:** The samples referenced were collected as part of the Phase I Site Investigation from hydrocarbon-bearing soil generated from Site investigation activities. These samples were not originally accounted for in the Phase I QAPP, and the samples were collected solely for the purpose of determining the proper treatment and/or disposal requirements for the hydrocarbon-bearing soil. As a result, it was determined by the Contractor Project Manager (CPM) and Contractor Quality Assurance Officer (QAO) that Level 2 data validation was appropriate.
>
> Additional detail has been added to Section 2.1.2 (previously Section 2.1.1) on why certain samples were collected and why they were validated against Level 2 criteria.

EPA Specific Comment 3: <u>Section 2.1.1.2:</u> *Going forward it is good practice to just collect field duplicates as required. This would have allowed the data to possibly meet both Level A and B criteria. Was, not collecting field duplicates a deviation to the QAPP?*

> **Atlantic Richfield Company Response:** The samples referenced were collected as part of the Phase I Site Investigation from hydrocarbon-bearing soil generated from Site investigation activities. These samples were not originally accounted for in the Phase I

QAPP, and the samples were collected solely for the purpose of determining the proper treatment and/or disposal requirements for the hydrocarbon-bearing soil. As a result, it was determined by the CPM and Contractor QAO that field duplicates were not required. Deviations have been added to Table A.1-1 (previously Table 1) for (1) collecting additional samples not specified in the QAPP, and (2) not collecting field duplicates as required by the QAPP.

EPA Specific Comment 4: *<u>Section 2.1.2:</u> It is understood that more detail is provided in the Attachment B XRF DVR; however, please at least explain generally why so many results were J flagged and why some results were rejected.*

Atlantic Richfield Company Response: Additional detail was added to Section 2.1.3 (previously Section 2.1.2) to generally summarize the findings from the XRF Data Validation Report (Attachment 2 to the Data Summary Report) for the J qualified and rejected results.

EPA Specific Comment 5: *<u>Section 2.2:</u> Going forward it is good practice to just collect field duplicates as required for 4 added groundwater samples associated with the hydrocarbon treatability study. This would have allowed the data to possibly meet both Level A and B criteria. Was, not collecting field duplicates a deviation to the QAPP?*

Atlantic Richfield Company Response: The samples referenced were collected as part of the Phase I Site Investigation from hydrocarbon-bearing water generated from Site investigation activities. These samples were not originally accounted for in the Phase I QAPP, and the samples were collected solely for the purpose of determining the proper treatment and/or disposal requirements for the hydrocarbon-bearing water. As a result, it was determined by the CPM and Contractor QAO that field duplicates were not required. Deviations have been added to Table A.1-1 (previously Table 1) for (1) collecting additional samples not specified in the QAPP, and (2) not collecting field duplicates as required by the QAPP.

EPA Specific Comment 6: *<u>Section 3.0 Deviations from the Sampling and Analysis Plan</u>: Please organize the deviations in Table 1 by field deviations and then laboratory deviations. The data validation reports indicate that the completeness goals were met for all the data that was supposed to be collected, but in the deviation table there seems to be many cases where samples were not able to be collected as planned. Please ensure that this is appropriately evaluated as the completeness goals for data that was planned to be collected may not be 100% as is currently stated.*

Atlantic Richfield Company Response: Table A.1-1 (previously Table 1) has been reorganized as requested.

In regard to the completeness goals, there were cases where investigation points were modified based on field conditions. However, it was determined by the Field Team Leader and CPM that the Data Quality Objectives (DQOs) would be met with the modified locations. Additionally, the Phase I QAPP states that the actual location and number of the test pits and boreholes may be modified, as determined by the Field Team Leader and/or CPM. Therefore, the completeness percentage was not affected by the modified locations.

EPA Specific Comment 7: *<u>Section 4.1:</u> The text indicates that the DQOs are presented in the PDI ER. The DQOs are not presented in the ER but should be either in that report or in Appendix A, per CFRSSI Pilot Data Report Addendum requirements. A clear presentation of each DQO should be presented and a detailed analysis of whether the DQO was met, and if not, what the impacts are for the project. Currently there is no statement as to whether DQOs were met or not as stated in Table 3-2 of the QAPP and associated RFCs.*

Atlantic Richfield Company Response: The DQOs have been added to Section 3.1 (previously Section 4.1).

EPA Specific Comment 8: *<u>Section 4.2, Data Review, Page 6:</u> If the completeness evaluation changes based on the previous completeness comment for Section 3.0 above, the completeness discussions in this section may need to be updated.*

Atlantic Richfield Company Response: See response to Specific Comment 6.

EPA Specific Comment 9: *<u>Table 1, Deviations to BRW Phase I QAPP, No. 15</u>: Replicates (re-analyses on the same samples) can be performed after the fact, but not duplicates, which must be collected in the field. XRF subsamples collected from the same bag are splits. In general, there will be less variability for replicates or splits than duplicates due to soil heterogeneity. Please change the Impact on DQOs tostate that only replicates and splits were performed and that the calculated variability is underestimated (precision is overestimated).*

Atlantic Richfield Company Response: Per BRW Phase I QAPP and Pioneer's Standard Operating Procedures (SOPs) (attached to BRW Phase I QAPP), XRF Replicate and XRF Duplicate samples were collected as follows:

- An XRF Replicate is a sample that is run twice without being removed from the XRF aperture.
- An XRF Duplicate is a sample that is run twice, but the sample is removed from the XRF aperture between runs to be kneaded in order to the mix the sample before being replaced and re-analyzed in the XRF aperture.

Field duplicates for XRF analysis (i.e., a duplicate sample collected in the field) were not intended to be collected per the BRW Phase I QAPP and Pioneer's SOPs. Field duplicates were only intended to be collected for the laboratory samples submitted to Pace Analytical Services, Inc. (Pace) and Energy Laboratories.

An additional test has been added to the text to clarify this approach. Additionally, Atlantic Richfield Company (Atlantic Richfield) understands the value in collecting field duplicates for XRF analysis and will include a requirement to collect field duplicates for XRF analysis in any future QAPPs for the Site.

Attachment A – BRW Phase 1 Data Validation Report

EPA Specific Comment 10: *Section 1.0 Data Validation Report Summary, Page 3, Second Paragraph: Please provide more information in this section, including how many results were rejected, how many analytes were rejected, and the reason for the rejected data.*

> **Atlantic Richfield Company Response:** Additional detail has been added to Section 1.0 including how many results were rejected, how many analytes were rejected, and the reason for the rejected data.

EPA Specific Comment 11: *Section 1.0 Data Validation Report Summary, Page 3, Table: The percentage of enforcement quality data seems low for the Phase 1 2018 Energy Soils Additional data set and the Additional 2020 Pace Soils data set. Please explain if there were any global issues identified in sampling practices and or laboratory analyses that would require corrective actions going forward.*

> **Atlantic Richfield Company Response:** The percentage of enforcement quality data is low due to hold time exceedances for the "Phase I 2018 Energy Soils Additional" and the "Additional 2020 Pace Soils" sample groups. For the "Phase I 2018 Energy Soils Additional" sample group, the method required hold time was exceeded due to the amount of time it took the field team to collect all the samples, complete the required XRF analysis, and then use that information to select the samples to be submitted for SPLP analysis. Atlantic Richfield recognized this problem during the Phase I Site Investigation and has adjusted the sampling procedures for subsequent Site investigations to prevent hold time exceedances for samples being submitted for SPLP analysis. For the "Additional 2020 Pace Soils" sample group, these samples were submitted for analysis after the method required hold time at the request of Agencies (via email correspondence on March 25, 2020). For this later group of samples, it was recognized by both the Agencies and Atlantic Richfield that these samples were out of hold time and no corrective actions are proposed. This explanation was previously included in the Data Summary Report (DSR) and has been added to Section 1.

EPA Specific Comment 12: *Section 2.1 Field Quality Control Samples, Page 5: Please provide more information on corrective actions that will be followed going forward to ensure that all field QC samples are collected at the required frequency and that all methods will be analyzed as required.*

> **Atlantic Richfield Company Response:** The samples referenced were collected as part of the Phase I Site Investigation from hydrocarbon-bearing soil and water generated from Site investigation activities. These samples were not originally accounted for in the Phase I QAPP, and the samples were collected solely for the purpose of determining the proper treatment and/or disposal requirements for the hydrocarbon-bearing soil. As a result, it was determined by the CPM and Contractor QAO that field duplicates were not required. Since the samples were not originally accounted for in the Phase I QAPP, there is no effect to the DQOs.

EPA Specific Comment 13: _Section 2.2, Laboratory Quality Control Samples, Page 7:_ *It is noted in the report that only the parent sample for MS, laboratory duplicates, and serial dilution samples are qualified if quality control results are outside of criteria. If samples in the SDG are considered similar enough to the parent sample, all results should be qualified and/or it should be noted that the other samples in the SDG are not considered similar enough to be qualified. Please revise accordingly.*

> **Atlantic Richfield Company Response:** Atlantic Richfield agrees that if samples in the sample delivery group (SDG) are considered similar enough to the parent sample, all results should be qualified and/or it should be noted that the other samples in the SDG are not considered similar enough to be qualified if quality control (QC) results are outside of criteria. This assessment was previously completed in the data validation checklists. Additional text has been added to Section 2.2 to clarify this approach.

EPA Specific Comment 14: _Section 3.0 Level A/B Assessment, Page 8:_ *Please include a note that if a result is qualified asestimated "J" by the laboratory because it is between the MDL and RL, those results are considered enforcement quality if no other qualifications are required.*

> **Atlantic Richfield Company Response:** Text has been added to Section 3.0, as requested.

EPA Specific Comment 15: _Section 4.4, Completeness, Page 11_: *Please provide more information for the rejected results regarding the analytes that were rejected and if they affected project data quality objectives.*

> **Atlantic Richfield Company Response:** Additional detail has been added to Section 4.4 for the rejected results. The rejected results do not affect the DQOs, and an explanation on the effect to the DQOs has been added to Section 3.2 of the Phase I DSR.

EPA Specific Comment 16: _Section 4.6, Sensitivity, Page 12:_ *Energy laboratories should report values between the MDL and RL/CRQL as detected but estimated "J." Please have the laboratory report the values in this manner going forward.*

> **Atlantic Richfield Company Response:** Moving forward, all labs will be requested to report values between the minimum detection limit (MDL) and the Reporting Limit (RL) as detected but estimated "J".

EPA Specific Comment 17: _Section 4.6, Sensitivity, Page 13:_ *There is discussion on the reporting limit for nickel being greater than the CRQL. It was noted that some of the samples had an RL of 0.002 mg/L (in the data package) = 2 ug/L and some had an RL of 0.02 mg/L (in the data package) = 20 ug/L. There were no dilutions. Please explain why the RL changed between samples (matrix affects?) Someof sample RLs may be equal to the CRQL values.*

Atlantic Richfield Company Response: Additional information has been added to Section 4.5.1 (previously Section 4.6) explaining the RL change between samples.

Attachment B – BRW Phase 1 XRF Data Validation Report

EPA Specific Comment 18: *Section 1.0, Data Validation Report Summary, Page 1, last paragraph: There is discussion that the XRF data met Level A criteria only. Please explain why the data did not meet Level B criteria.*

Atlantic Richfield Company Response: All XRF samples met the Level A criteria, but not the Level B criteria due to inadequate field documentation. Details on the sample container preparation, field custody, and traceable sample designation were insufficient to meet Level B criteria. Additional detail was added to Section 3.0 (referenced in Section 1.0) on why the data did not meet Level B criteria.

EPA Specific Comment 19: *Section 1.0, Data Validation Report Summary, Page 2, third paragraph: There is discussion on rejected results. Please provide more details as to how many results were rejected, the analytes rejected, and if data quality objectives were affected because of the rejected data.*

Atlantic Richfield Company Response: The 80 rejected data points were the results (arsenic, cadmium, calcium, chromium, copper, iron, lead, manganese, silver, and zinc) for the 8 natural samples analyzed on October 4, 2018, with XRF instrument identification (ID) 101731. These data points were rejected because there was no energy calibration check, Silicon Dioxide standard, Calibration Check Sample, XRF duplicate or XRF replicate sample analyzed during that analytical run. Despite the fact that 80 data points were rejected, there was no effect to the DQOs since there were sufficient results from the remaining samples to determine the volume, distribution, and properties of solid materials within the Site.

Additional details were added to Section 1.0 including how many results were rejected, how many analytes were rejected, and the reason for the rejected data. Additionally, a discussion on the effect of the rejected results on the DQOs has been added to Section 3.2.1 of the Phase I DSR.

EPA Specific Comment 20: *Section 2.1.1, Energy Calibration Check, Page 3: It is noted that 8 samples were rejected based on an energy calibration check not being performed before these samples were analyzed. It is recommended that consideration should be given to not rejecting these results if all other quality control parameters were within criteria.*

Atlantic Richfield Company Response: No QC samples were run for these 8 samples; therefore, the data must be rejected. Additional detail has been added to Section 2.1.1 to clarify.

EPA Specific Comment 21: *Section 3.0, Level A/B Assessment, Page 4: It is stated that the Level B criteria was not met "due to inadequate field documentation." Please explain the* *corrective actions going forward so that future XRF data is documented correctly.*

> **Atlantic Richfield Company Response:** Corrective actions have been implemented internally. Field staff have been trained to record all XRF sample IDs in the field logbook and an additional data sheet was created to record the sample preparation (i.e., sieving, drying, and then place into Mylar cup). Additional detail on the corrective actions has been added to Section 2.1.3 of the Phase I DSR.

EPA Specific Comment 22: *<u>Section 4.1, Precision:</u> Please change "duplicates" to "splits" and mention that no duplicates were collected in the field and that the calculated precision would be lower if duplicates were collected.*

> **Atlantic Richfield Company Response:** See response to Specific Comment 9 for the Phase I DSR.

EPA Specific Comment 23: *<u>4.4, Completeness, Page 6:</u> It is noted in the report that 4 analytes were not able to be analyzed for 59 samples due to the instrument not set to the proper ranges to include analyses for these analytes. Please detail what the corrective action plan is going forward to ensure this discrepancy does not occur for future sampling events?*

> **Atlantic Richfield Company Response:** The referenced 59 samples were slag "rock" samples which could not be analyzed following the procedures in Pioneer's SOP-SFM-02 (i.e., using the XRF stand) because the slag consisted of large aggregate materials. Instead, the XRF gun was held directly against the large aggregate material. The run time was reduced to 30 seconds (compared to 270 seconds) since it was determined that it would be unlikely that field staff could maintain steady contact with the aggregate for an extended length of time. As a result of the shortened run time; cadmium, calcium, chromium, and silver results were not generated for the 59 samples.
>
> Additional detail has been added to Section 4.4, and this deviation has been added to Table A.1-1 (previously Table 1) of the Phase I DSR. There was no effect to the DQOs since there were sufficient results from the remaining samples to determine the volume, distribution, and properties of slag within the Site. No corrective action plan is needed moving forward.

Draft Final Revised BRW Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site PDI Evaluation Report – Appendix C Leapfrog Model

<u>General Comments:</u>

EPA General Comment 1: *The XRF to ICP Correlation and Regression Analysis memorandum and/or the Leapfrog memorandum should take the analysis one step further by better explaining the following details:*

a. *Based on the final regression variables for each COC, please add detail on the number of sample results for each COC that were modified to an ICP-*

predicted value out of the 667 XRF samples collected. Since ICP values would be used for decision purposes where collected, then subtracting the 137 or 136 (cadmium only) paired ICP and XRF samples, leaves 530 to 531 XRF samples available for ICP-predicted correction. Furthermore, any XRF results flagged with a U, UJ, or R qualifier would also not be modified to an ICP- predicted value. Accordingly, for each COC, please detail the number of U, J, and R qualified results and the number of results modified to an ICP-predicted value.

b. *For those XRF results modified to an ICP-predicted value, please present the original XRF result and the resulting ICP-predicted value(s) side by side in a table(s). The table(s) should provide the documentation to cross-check that calculations for ICP-predicted results were completed correctly. Most efficiently, such a table(s) would provide the sample IDs within rows and then show the original and ICP-predicted XRF results side by side in adjacent columns.*

c. *As noted in previous comments, a table should be presented somewhere either in Appendix C or the main PDI ER report that summarizes all of the data used in the Leapfrog model. Appendix C is titled "Leapfrog Model Inputs", and as such should detail the data inputs usedin the model. In addition, where certain data is not used in the model, such as slag and debris sample results, these data should be clearly identified as not used in any summary tables. These data should still be presented but flagged as not used for purposes of modeling.*

Atlantic Richfield Company Response: As requested, the following additional details have been added to Appendix C.1 of the PDI Evaluation Report.

a. A Microsoft Excel table with details on the number of XRF sample results for each COC that were modified to an ICP-predicted value is included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report).

   All R results have been removed from the XRF to ICP regression analyses and the Leapfrog Model. The U and UJ results (non-detect [ND] values) have been removed from the XRF to ICP regression analyses; however, the U and UJ results (ND values) are still included within the Leapfrog Model. Otherwise, those values would be "blank" and the Leapfrog Model would interpolate through that "blank" interval based on the results from the intervals above and below which could overestimate the volume of waste within the BRW Site. Therefore, all U and UJ results (ND values) will be used in the Leapfrog Model and the "confidence interval" from the XRF unit corrected with the regression will be used as the result. This remains a conservative approach in determination of the excavation surface.

b. A Microsoft Excel table with details on the original XRF result and the resulting ICP-predicted value(s) is included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report).

c. A Microsoft Excel table with details on all the data used in the Leapfrog Model is included as Attachment 2 to the Model Inputs Technical Memorandum (Appendix C.3 of the PDI Evaluation Report).

Specific Comments (Butte Reduction Works Phase I Site Investigation XRF to ICP Correlation and Regression Analysis)

EPA Specific Comment 1: *Section 2, First Paragraph, Last Sentence: Please confirm that non-detect XRF data were not usedin the correlation with ICP data. If so, please state this."*

> **Atlantic Richfield Company Response:** The U and UJ results (ND values) have been removed from the XRF to ICP regression analyses. Additional detail has been added to *Butte Reduction Works Phase I and Phase II Site Investigations XRF to ICP Correlation and Regression Analysis Technical Memorandum* (included as Appendix C.1 of the PDI Evaluation Report) to clarify this.

EPA Specific Comment 2: *Section 2.2, Regression Analysis: There has been some discussion on the method of setting up the linear regression analysis. One method is to place the more accurate data on the x-axis and the less accurate data on the y-axis in accordance with linear regression methodology. This is consistent with instrument calibration methodology for laboratory analysis of metals, for example, or for calibration of an XRF instrument based on ICP measurements. Another method is to place the XRF instrument data on the x-axis as the independent value and the ICP data on the y-axis as the dependent value because the goal is to predict an ICP result from an XRF measurement. Both setups have been previously used at various sites. EPA will be evaluating the appropriate setup to be used based on site objectives. For the BRW design, please complete the linear regression using both methods, recalculate the estimated volumes and excavation surface in the Leapfrog model, and present the difference in volumes/extent of the model in a similar way that the linear versus upper 95% confidence limit regression is currently presented. Similar to uncertainty used in the model, this analysis may show that more or less false positive (Type 1) versus false negative (Type2) decision errors result in the differing regression approach. Based on this analysis, the agencies will evaluate the results and evaluate whether the linear regression setup has a substantial impact on the design.*

> **Atlantic Richfield Company Response:** A linear regression analysis was completed using both methods described and is included in *Butte Reduction Works Phase I and Phase II Site Investigations XRF to ICP Correlation and Regression Analysis Technical Memorandum* (included as Appendix C.1 of the PDI Evaluation Report). The analysis included identifying where the bottom of waste points changed between the two methods, and there were minimal changes in the bottom of waste extents based on the data collected. Therefore, Atlantic Richfield proposes to continue to use the previously presented approach (i.e., place the XRF instrument data on the x-axis as the independent value and the ICP data on the y-axis as the dependent value). Two different Leapfrog Models were not created to recalculate and compare the estimated columns and excavation surface because there was minimal change in the waste bottom extents between the two methods.

<u>Specific Comments (Butte Reduction Works Phase I Investigation Leapfrog Model Inputs)</u>

EPA Specific Comment 3: <u>*Section 1*</u>*: Soil sampling for Phase II was completed in 2020. The results should have been incorporated into the model. Figure 1 shows 2020 boring locations. Does this mean 2020 data are included? Please clarify and revise as needed.*

> **Atlantic Richfield Company Response:** The Phase II Site Investigation results have been incorporated into the Leapfrog Model.

EPA Specific Comment 4: <u>Section 2.1.2</u>:

a. *The XRF to ICP correlations are to be recalculated as indicated in comment 2 of this section. Depending on the results of the recalculation, changes might be necessary and will need to propagate through the PDI ER.*
b. *If axes are to remain as presented, only the upper 95% confidence level correlation XRF data are to be used in the model. This is necessary to account for uncertainty in the XRF data. If axes are flipped, only the lower 95% confidence level should be used.*

> **Atlantic Richfield Company Response:** See response to Specific Comment 2 above. The linear regression and the upper 95% regression correlated XRF data are both included in the Leapfrog Model to demonstrate how using the upper 95% regression provides a level of confidence/factor of safety in the modeled waste extents. In determining the waste extents for the excavation design, only the upper 95% regression correlated XRF data is used.

EPA Specific Comment 5: <u>*Section 2.2*</u>*: The fourth bullet uses Figure BRW-1 of the CD for the site boundary. This same figure has a conceptual removal corridor. Why wasn't this removal corridor used in the model? The proposed removal corridor shown on Figure 3 has not been approved at this time.*

> **Atlantic Richfield Company Response:** The waste removal corridor shown in the figures attached to the *Butte Reduction Works (BRW) Phase I and Phase II Investigation Leapfrog Model Inputs Technical Memorandum* (included as Appendix C.3 of the PDI Evaluation Report) was designed to remove the suspected copper-loading source located in the northern west-to-central portion of the Site, while maintaining the BPSOU Consent Decree required 275-foot average width excavation. Note that the waste removal corridor shown is preliminary and only shown as a reference at this point. The waste removal corridor and excavation surface will be refined as data interpretation and remedial design progresses.

EPA Specific Comment 6: <u>*Section 2.4:*</u> *In all the model inputs and variables presented in this section, as stated in the general comments above for the design report, it is unclear how the assumptions made account for overall factors of safety of the waste excavation within areas of unknown waste extent. In other words, in areas (borings) where the maximum sample collected still contained waste, indicating an unbounded location (e.g., no clean sample below the waste), what factor of safety depth is assumed beyond that deepest known depth of waste? It is* *understood this may not be a straightforward single answer and would likely vary based on the data in each boring, but can this be exemplified in the sensitivity analysis in some way?*

> **Atlantic Richfield Company Response:** Additional detail has been added to Section 3.0 of the *Butte Reduction Works (BRW) Phase I and Phase II Investigation Leapfrog Model Inputs Technical Memorandum* (included as Appendix C.3 of the PDI Evaluation Report) clarifying how the Bottom of Waste Surface was created to ensure all waste within the Site is captured within the surface. Additionally, a table has been added to the main text of the PDI Evaluation Report which demonstrates how the bottom of waste surface extends to or beyond the last interval that fails the waste criteria in each investigation location.

EPA Specific Comment 7: Section 2.4.1: *If axes are to remain as presented, only the upper 95% confidence level correlation XRF data are to be used in the model. If axes are flipped, only the lower 95% confidence level should be used.*

> **Atlantic Richfield Company Response:** Please see response to Specific Comment 4 above.

EPA Specific Comment 8: Section 2.5: *Please explain the difference in estimated total waste volume observed in the model between the normal and upper 95% confidence level regression.*

> **Atlantic Richfield Company Response:** Figure C.3-32 of the *Butte Reduction Works (BRW) Phase I and Phase II Investigation Leapfrog Model Inputs Technical Memorandum* (included as Appendix C.3 of the PDI Evaluation Report) present the waste volume for the linear regression, upper 95% regression, and the waste volume added by the upper 95% regression for the selected approach (i.e., place the XRF instrument data on the x-axis as the independent value and the ICP data on the y-axis as the dependent value).

EPA Specific Comment 9: Figure 13: *The southwest corner shows a large wedge of waste remaining due to slope constraints.This seems to be artificial based on not using the corridor specified on Figure BRW-1 which followed the slag wall. The model needs to be rerun using the boundary following the toe of the railroad slope and the slag wall. The FRE SOW identifies this boundary as "The width of this removal area shall be an average of 275 feet from the toe of the south railroad grade, as shown onFigure BRW-1…" Please revise the boundary and rerun the model.*

> **Atlantic Richfield Company Response:** The waste removal corridor boundary has been revised as requested. However, this boundary (consistent with that of Figure BRW-01 of the FRESOW) is only a representation of where excavation of waste materials is to begin and is not indicative of field conditions that will dictate safe and practical performance of the excavation activities. The final excavation surface will be developed to meet the requirements of the BPSOU Consent Decree, while maintaining a stable excavation slope to protect worker safety.

Draft Final Revised BRW Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site PDI Evaluation Report – Appendix F Risk-Based Corrective Action Guidance Evaluation for Petroleum-Impacted Material at BRW

Specific Comments:

EPA Specific Comment 1: *Pg. 2, Site Background: Please discuss the discovery of the sheen during the NRD test pit evaluation and the reporting of the release at that time. This reporting results in the creation of a DEQ file for the site and triggers the RBCA process.*

> **Atlantic Richfield Company Response:** A discussion on the discovery of the sheen during the Natural Resource Damage Program test pit evaluation and the reporting of the release at that time has been added to *Risk-Based Corrective Action Guidance Evaluation for Petroleum-Impacted Material at Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Technical Memorandum* (Appendix F to the PDI Evaluation Report).

EPA Specific Comment 2: *Pg. 7, 3rd paragraph, 3rd sentence: Please state that institutional controls will prohibit installation of drinking water wells.*

> **Atlantic Richfield Company Response:** The following text has been added to Section 6, *"Direct groundwater exposure pathways are also considered incomplete because institutional controls currently prohibit installation of public service drinking wells within the Site for future land use (EPA, 2020)".*

EPA Specific Comment 3: *Pg. 10, last paragraph:*

a. *If a RBCA Tier 3 evaluation is to be performed, keep in mind that additional data may need to be collected to support any planned modeling efforts. For example, soil TOC, dry bulk density, and other parameters, depending on the model used. Currently, the Phase III QAPP does not include all of the parameters that may be required. However, Tier 3 analyses could be done as part of the RBCA evaluation without an RFC to the Phase III QAPP, because the organic contaminants are regulated by the State of Montana.*
b. *The proposed Tier 3 approach and model should be discussed with DEQ prior to conducting the Tier 3 evaluation.*

> **Atlantic Richfield Company Response:** The evaluation of data (i.e., Tier 1 and Tier 2 Evaluations) have been updated based on additional data collected as part of the Phase II Site Investigation activities. As a result, the further evaluation section has been updated.

EPA Specific Comment 4: *Table 8: The RBSLs presented in Table 8 are the same as in the lookup tables in the RBCA guidance (i.e. DAF = 10). In Tier 2, the RBSLs are adjusted using site-specific information and simple equations. For the leaching to groundwater adjustment,* *the gradient, hydraulic conductivity, aquifer thickness, source length parallel to groundwater flow, and infiltration rate areused to calculate a mixing zone depth and site-specific dilution attenuation factor (DAF), used to calculate the site-specific RBSLs. The RBCA guidance does list the first step of the Tier 2 analysis as completing a Tier 1 analysis. However, if this is all you do it is simply a Tier 1 evaluation and not a preliminary Tier 2 analysis. Please either include the Tier 2 adjustment to the RBSLs, if sufficient data are available, or do not refer to this table as a Tier 2 evaluation.*

> **Atlantic Richfield Company Response:** The adjusted Tier 2 screening levels are included in the revised *Risk-Based Corrective Action Guidance Evaluation for Petroleum-Impacted Material at Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Technical Memorandum* (Appendix F to the PDI Evaluation Report).

End of Comments.

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

Draft Final Revised

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

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Revision 1 June 2022

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DOCUMENT MODIFICATION SUMMARY

Revision No.	Version	Description	Date
Rev. 0	Draft	Internal Atlantic Richfield Company Review	8/21/2020
Rev. 1	Draft Final	Agency Review	10/06/2020
Rev. 2	Draft Final Revised	Internal Atlantic Richfield Company Review	3/26/2021
Rev. 3	Draft Final Revised	Agency Review	5/13/2021
Rev. 4	Draft Final Revised	Internal Atlantic Richfield Company Review	3/31/2022
Rev. 5	Draft Final Revised	Agency Review	06/10/2022

ACRONYMS

Term	Definition
ARM	Administrative Rules of Montana
Atlantic Richfield	Atlantic Richfield Company
ATO	Alluvium, Tailings, and Organic Soil
BNSF	Burlington Northern Santa Fe (Railway)
BPSOU	Butte Priority Soils Operable Unit
BRW	Butte Reduction Works
BSB	Butte-Silver Bow
BH	Borehole
BTL	Butte Treatment Lagoons
CD	Consent Decree
COC	Contaminant of Concern
CSM	Conceptual Site Model
DCI	DCI Engineers
DEQ	Montana Department of Environmental Quality
eV	Electron-Volt
FEWA	Functionally Effective Wetland Area
GPS	Global Positioning System
HCC	Hydraulic Control Channel
ICP-OES	Inductively Coupled Plasma – Optical Emission Spectrometry
LAO	Lower Area One
LiDAR	Light Detection and Ranging
LNAPL	Light Non-Aqueous Phase Liquid
MASW	Multichannel Analysis of Surface Waves
Mg/kg	Milligrams per kilogram
MPTP	Montana Pole and Treating Plant
MWR	Mine Waste Repository
NAD	North American Datum
NAVD	North American Vertical Datum
NWE	NorthWestern Energy
O&M	Operation and Maintenance
PCB	Polychlorinated Biphenyls
PCP	Pentachlorophenol
PDI	Pre-Design Investigation
PID	Photoionization Detector
Pioneer	Pioneer Technical Services, Inc.
ppm	Parts per Million
PZ	Piezometer
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RBCA	Risk-Based Corrective Action

Term	Definition
RBSL	Risk-Based Screening Level
RD	Remedial Design
RDWP	Remedial Design Work Plan
RFC	Request for Change
SBC	Silver Bow Creek
SPLP	Synthetic Precipitation Leaching Procedure
TEH	Total Extractable Hydrocarbons
USACE	U.S. Army Corps of Engineers
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

The Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site (Site) is one of 9 further remedial elements addressed in the *Butte Priority Soils Operable Unit* (BPSOU) *Consent Decree* (CD) (EPA, 2020), referred to herein as the BPSOU CD. The BPSOU CD requires a 275-foot average width removal of waste from the southern portion of the Site (referred to herein as the waste removal corridor). The BPSOU CD specifies that "*An excavation surface (subject to EPA approval, in consultation with DEQ) shall be developed during design and will consider the results of the predesign investigation. The excavation surface will define the vertical extent of removal within the removal corridor.*" After removing the waste material, Silver Bow Creek (SBC) will be rerouted from its current path through the slag canyon along the northern portion of the Site through the excavated waste removal corridor. The BPSOU CD also requires the management of groundwater impacted with contaminants of concern (COCs) (i.e., arsenic, cadmium, copper, mercury, lead, and zinc) through hydraulic control.

As part of the Remedial Design (RD) for the Site, additional data have been collected during two Site investigations. To begin determining the excavation surface within the waste removal corridor and the nature and extent of impacted groundwater within the Site, Atlantic Richfield Company (Atlantic Richfield) conducted the BRW Phase I Site Investigation (Phase I Site Investigation) according to the *Butte Reduction Works (BRW) Phase I Quality Assurance Project Plan (QAPP)* (Atlantic Richfield Company, 2021a) (referred to herein as BRW Phase I QAPP). Following the Phase I Site Investigation, Atlantic Richfield completed the BRW Phase II Site Investigation (Phase II Site Investigation) according to the *Butte Reduction Works (BRW) Phase II Quality Assurance Project Plan (QAPP)* (Atlantic Richfield Company, 2021b) (referred to herein as BRW Phase II QAPP). The Phase II Site Investigation addressed additional design-related data gaps pertaining to the future hydraulic control and construction dewatering and included additional data collection related to the characterization of solid materials, particularly slag and groundwater within the Site.

This Pre-Design Investigation (PDI) Evaluation Report summarizes and evaluates the results of sampling and field activities conducted per the BRW Phase I and Phase II QAPPs and associated request for changes (RFCs). Phase I Site Investigation activities were completed from August 2018 through February 2020, with the exception of groundwater-level measurements, which continued through June 2021. Phase II Site Investigation activities were completed from March 2020 through March 2021.

This PDI Evaluation Report is written to provide a summary of the work performed, general interpretation of results, and provide RD recommendations. Additional details on the work performed and more detailed interpretation of results can be found in the attached appendices:

- Appendix A: Data Summary Reports for the Phase I and Phase II Site Investigations.
- Appendix B: Lithology Logs for Phase I and Phase II Site Investigation Locations.
- Appendix C: Leapfrog Model Results.
- Appendix D: Butte Reduction Works Multichannel Analysis of Surface Waves Survey Final Report.

- Appendix E: 2019 Butte Reduction Works Waters of the U.S. Delineation Report.
- Appendix F: Risk-Based Corrective Action Guidance Evaluation for Hydrocarbon-Impacted Material at Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site.
- Appendix G: BRW Pumping Tests Interpretation Technical Memorandum.
- Appendix H: BRW Hydraulic Control and Construction Dewatering Technical Report.
- Appendix I: Hydrologic Evaluation of Landfill Performance at Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site.
- Appendix J: Further Remedial Elements Scope of Work RD/Remedial Action, Butte Priority Soils Operable Unit Cultural Resource Inventory, Evaluation, and Recommendations.
- Appendix K: Structural Assessment of Existing Bridge and Historic Structures, Butte Reduction Works Smelter Site, Butte, Montana.

This PDI Evaluation Report follows requirements listed in the BPSOU Statement of Work (Appendix D to the BPSOU CD) and contains the following components:

- Summary of the work performed (Section 2.0).
- Summary of work results (Section 2.0).
- Summary of validated data (Section 2.0, Appendix A, and Appendix B).
- Data validation reports and laboratory data reports (Appendix A).
- Narrative interpretation of data and results (Section 3.0).
- Results of statistical and modeling analyses (Section 3.0, Appendix C, Appendix G, Appendix H, and Appendix I).
- Photographs documenting the work conducted (Appendix A).
- Conclusion and recommendations for the RD, including design parameters and criteria (Section 5.0).

In addition to the above, Section 4.0 discusses remaining data gaps that have been identified based on the investigation findings to date. As a result, additional investigations are planned for the Site, to fill the data gaps identified in Section 4.0. Atlantic Richfield will incorporate the results of these investigations, including an updated interpretation of the results, into this PDI Evaluation Report and resubmit to Agencies for review prior to the submittal of the Intermediate (60%) RD Report. Additional details on these planned investigations are included in Section 1.7.

1.1 Site Background and Description

The Site covers approximately 24 acres in Butte, Montana, to the immediate west of Montana Street between SBC and the north side of the Burlington Northern Santa Fe (BNSF) Railway Company railroad line (Figure 1 and 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 Montana Pole and Treating Plant (MPTP) Water Treatment Plant treats groundwater impacted by 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 (Figure 2) (EPA, 2017). NorthWestern Energy (NWE) has a storage yard and operating center immediately south of the Site (Figure 2). The storage yard has existed since 1899 and is a Comprehensive Environmental Cleanup and Responsibility Act 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).

Beginning in 1885 and to the time of this writing, the Site has been the location of multiple industrial operations including a copper smelter and a zinc concentrator, and it was also used by the Domestic Manganese and Development Company (Sanborn, 1943) and Rocky Mountain Phosphates, Inc. (GCM Services, Inc., 1991). Additionally, Butte-Silver Bow (BSB) operated an asphalt plant and aggregate crushing plant at the Site from the mid-1990s to late 2020. Currently, BSB uses the Site to store construction and aggregate materials.

The Site contains a complex distribution of materials (including slag, tailings, manganese waste, demolition debris, foundations, and other historic structures) as well as impacted soil and groundwater arising from past operations and from upstream sources that released metals and mineral processing waste onto the Site.

1.2 Remedial Design

The BRW remedial action (RA) is to include removal of tailings, waste, COC-impacted soil, and slag within the SBC 100-year floodplain reconstruction area (i.e., waste removal corridor) to a depth to be determined during the RD activities. The conceptual RD, shown on Figure 3, will include the following elements:

- Waste removal (as defined by the BPSOU CD Waste Identification Screening Criteria and listed in Table 1) from the Site in the waste removal corridor to a depth determined during the RD.
- Management of soil and groundwater within the Site impacted by organic pollutants, as appropriate and in a manner that is complementary with the RA. Organic pollutants (hydrocarbon compounds, PCBs, PCP, and dioxins) are secondary concerns for the Site. Soil and groundwater within the Site that have been impacted by these pollutants will be addressed/managed as necessary to implement the remedy, but the long-term management and remediation of soil and groundwater impacted with organic pollutants is not required by the BPSOU CD.
- Realign SBC and construct the bank-full channel and 100-year floodplain within the 275-foot average width waste removal corridor.
- Regrade and construct caps over the tailings, waste, impacted soil, and slag left in place.
- Hydraulically manage COC-impacted groundwater at the Site to control discharge of COC-impacted groundwater to surface water and sediment in BPSOU generally and within the Site specifically.

1.3 Previous Investigations

A number of investigations have previously occurred at the Site, and a detailed discussion of the Site description, history, and previous investigations is included in the *BRW Remedial Design Work Plan (RDWP)* (Atlantic Richfield Company, 2021c) and the BRW PDI Work Plan, included as an attachment to the RDWP. Figure 4 shows the locations of investigation activities and existing monitoring wells installed as part of previous investigations.

1.4 Summary of Phase I Site Investigation

The Phase I Site Investigation sought to fill four main design data gaps and was completed in three stages from August 2018 through February 2020, with the exception of groundwater level measurements which continued through June 2021. The Phase I Site Investigation was completed according to the procedures and protocols detailed in the BRW Phase I QAPP (and associated RFC documents, RFC BRW-2019-01 and RFC BRW-2019-03, included with the BRW Phase I QAPP). The second RFC to the BRW Phase I QAPP (RFC BRW-2019-02) was revised and submitted as the BRW Phase II QAPP discussed in Section 1.5.

1. **Stage 1: Initial Phase I Site Investigation** (August 2018 to March 2019).

2. **Stage 2: Additional Groundwater Sampling** (October 2019 to November 2019) (RFC BRW-2019-01).

3. **Stage 3: Hydrocarbon Investigation** (December 2019 to February 2020) (RFC BRW-2019-03).

The four objectives of the Phase I Site Investigation activities listed below are detailed in the BRW Phase I QAPP and associated RFCs:

1. **Solid Materials Characterization:** Collect additional information to estimate the volume, distribution, and properties of solid materials within the Site including slag, demolition debris, and impacted materials (including alluvium, tailings, and organic soil [ATO]). Locate and identify historic infrastructure and/or certain conditions (i.e., wetlands) within the Site that may affect constructability of remedial elements.

   The data will be used to improve the characterization of materials within the Site and will be used to guide the excavation, SBC reconstruction, hydraulic control, and end land use elements of the RD for the Site.

2. **Groundwater Characterization:** Collect additional information about the groundwater elevations, potentiometric surface, and direction of groundwater flow (including seasonal groundwater changes); the spatial variability of groundwater chemistry within the alluvial aquifer at the Site; and the aquifer geometry.

   The data will be used to improve the characterization of groundwater within the Site, to guide a subsequent hydrogeological investigation (i.e., Phase II Site Investigation), to support development of a groundwater model, and to guide the excavation, SBC reconstruction, and hydraulic control elements of the RD for the Site.

3. **Organic Pollutants:** Collect additional information to estimate the nature and extent of soil and groundwater within the Site impacted by select organic pollutants (hydrocarbon compounds, PCBs,

PCP, and dioxins). The data will be used to improve the characterization of soil and groundwater impacted by select organic pollutants and to develop a plan to manage the impacted soil and groundwater within the Site as part of the RD.

4. **SBC Realignment:** Collect survey data related to the bottom invert at the upstream and downstream tie-in locations of SBC. The data will be used to design the reconstructed floodplain and SBC profile in the floodplain, as well as guide SBC alignment as shown on Figure 3. Data from the prior three objectives (i.e., solid materials, groundwater, and organic pollutants), along with data collected from a subsequent hydrogeological investigation (i.e., Phase II Site Investigation), will be used to evaluate the need for placing a liner beneath the channel of the relocated SBC.

   Table 2 lists the design data gaps and details how this Phase I Site Investigation addressed data gaps. The data gaps identified in Table 2 were originally identified in the BPSOU Statement of Work (Appendix D to the BPSOU CD) and have been edited as Site investigation activities have been completed and the RD has progressed. Figure 5, Figure 6, and Figure 7 show the investigation locations for the Phase I Site Investigation. Additional details on the Phase I Site Investigation are included in Section 2.1.

1.5 Summary of Phase II Site Investigation

The Phase II Site Investigation addressed additional data gaps pertaining to design of the future hydraulic control and construction dewatering system, and collected additional data related to characterization of solid materials, particularly slag, and of groundwater within the Site. The Phase II Site Investigation included two pumping tests, pre- and post-pumping-test groundwater analysis, chemical loading analysis, additional opportunistic solid material characterization, and an investigation of slag physical properties and evaluation of limited demolition methods (slag investigation). The slag investigation consisted of multiple stages to further delineate the horizontal and vertical extents of the slag within the Site and to collect appropriate information on the potential effectiveness of methods needed for slag removal.

Site investigation activities occurred from March 2020 to March 2021, according to the procedures and protocols detailed in the BRW Phase II QAPP (originally submitted as the second RFC to the BRW Phase I QAPP [RFC BRW-2019-02] which was revised and submitted as the BRW Phase II QAPP per Agencies request). The four objectives of the Phase II Site Investigation activities listed below are detailed in the BRW Phase II QAPP:

1. **Pumping Tests:** Further define the aquifer parameters, boundary conditions, anisotropy, etc.; as well as the rate and quality of pumped groundwater within the Site to adequately design the dewatering system, BRW hydraulic control, and provide needed information on additional flows to the Butte Treatment Lagoons (BTL).
2. **Pre- and Post-Pumping Test Groundwater Analysis:** Provide finer detail on the nature and extent of COC- and hydrocarbon-impacted groundwater within the Site and upgradient of the Site to guide the design and implementation for the realigned SBC and the BRW hydraulic control.
3. **Silver Bow Creek Loading Analysis:** Collect additional information needed to determine the nature, extent, and source of the chemical loading to SBC from the area between SBC surface water monitoring points SS05B and SS06A (Figure 2).

4. **Additional Solid Material Characterization:** Collect additional information needed to refine the volume and location of waste materials and additional information needed on the chemical stability/leachability of solid materials that may remain after the RA is complete.

Table 2 lists the design data gaps that were identified prior to the Phase II Site Investigation and details how this Phase II Site Investigation addressed those data gaps. The data gaps identified in Table 2 were originally identified in the BPSOU Statement of Work (Appendix D to the BPSOU CD) and have been updated as Site investigation activities have been completed and the RD has progressed. Figure 8 and Figure 9 show the Phase II Site Investigation locations. Additional details on the Phase II Site Investigation are included in Section 2.2.

Note that Agencies approved two RFCs to the BRW Phase II QAPP (RFC BRW-2021-01 and RFC BRW-2021-02), which enabled a supplemental groundwater and surface water sampling event to occur during low-groundwater conditions. However, the objectives related to the sampling are detailed in the *Draft Final Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Phase III Quality Assurance Project Plan (QAPP)* (Atlantic Richfield Company, 2021d) (referred to herein as BRW Phase III QAPP). To allow the sampling event to occur during low-groundwater conditions, Agencies approved the data collection (i.e., sampling) as part of the BRW Phase II QAPP while the BRW Phase III QAPP was being finalized. As a result, the data validation and interpretation associated with the supplemental sampling event will be included in the updated PDI Evaluation Report along with the additional data collected during the future Site investigation activities.

1.6 Other Site Investigation Activities

In addition to the activities completed as part of the Phase I and Phase II Site Investigations, a structural assessment, cultural resource inventory, and wetland delineation were conducted at the Site. These evaluations are important for instructing the RD, in accordance with the BPSOU CD. Additional details on the structural assessment, cultural resource inventory and wetland delineation are included in Section 2.3.1, Section 2.3.2 and Section 2.3.3 respectively.

1.7 Future Site Investigation Activities

The remaining Site investigation activities for the Site which have QAPPs approved by Agencies include the following:

- **Phase III Site Investigation**: The Phase III Site Investigation focuses on collecting design-related data to finalize the excavation design surface and hydraulic control design and to collect data regarding the geotechnical considerations at the Site. The Phase III Site Investigation has four objectives: additional solid material characterization, geotechnical investigation, groundwater characterization, and SBC COC-loading analysis. An additional objective is to establish a baseline for groundwater conditions (hydraulic gradient and chemistry) between the MPTP site and the Site to inform the design of the future BRW hydraulic control and/or construction dewatering efforts that will take place during the RA. Details of the investigation activities are outlined in the BRW Phase III QAPP. Field activities for the Phase III Site Investigation have already been completed; however, the results of the investigation are not included in this PDI Evaluation Report because the data has not gone through the necessary data review, verification, and validation procedures.

- **Microbial Analysis and Biotreatability Study:** The Microbial Analysis and Biotreatability Study will advise appropriate Site-specific action levels for hydrocarbon-impacted soil by collecting data on the characteristics of the soil (hydrocarbon leachability, microbial activity, etc.). Additionally, if treatment of hydrocarbon-impacted soil is necessary to successfully implement the RA, the study will help identify the proper treatment option (i.e., chemical oxidation, landfarming, expedited natural attenuation under improved conditions, etc.) and advise the management plan for hydrocarbon-impacted soil. Details of the investigation activities are outlined in the *Final Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Quality Assurance Project Plan (QAPP) for Microbial Analysis and Biotreatability Study* (Atlantic Richfield Company, 2021e) (referred to herein as Biotreatability QAPP) which was approved by Agencies on January 5, 2022.

Table 2 summarizes each investigation's activities in relation to fulfilling design-related data gaps and objectives identified for the Site. Atlantic Richfield will incorporate the results of these future Site investigation activities, including an updated interpretation of the results, into this PDI Evaluation Report and resubmit to Agencies for review as part of the RD process.

2.0 SUMMARY OF WORK PERFORMED

Work performed during the Phase I and Phase II Site Investigations is summarized in the sections below. Table 3 shows the investigation locations along with the samples collected, and Table 4 shows the field and laboratory analytical methods. The following tables summarize the investigation results:

- Synthetic Precipitation Leaching Procedure (SPLP) (Table 5 and Table 6)
- Historic Infrastructure at the Site (Table 7)
- Groundwater and Surface Water Analytical Results (Table 8)
- Monthly Depth to Groundwater Measurements (Table 9)

Additional details on the work performed and data collected are included in the sections below.

2.1 Phase I Site Investigation

Work performed for the Phase I Site Investigation is categorized into Solid Materials Characterization, Groundwater Characterization, Organic Pollutants, and Site Survey. The following sections detail the work performed according to the BRW Phase I QAPP.

2.1.1 Solid Materials Characterization

The following activities were completed to estimate the volume, distribution, and properties of solid materials within the Site as part of the Phase I Site Investigation:

- Excavated 15 test pits and drilled 60 boreholes (Section 2.1.1.1, Section 2.1.1.2, and Figure 5).
- Documented lithology of test pits and boreholes to determine the distribution of materials (Appendix B).
- Collected soil samples from lithological layers and had them analyzed for COCs (arsenic, cadmium, copper, mercury, lead, and zinc) and additional constituents of interest (e.g., manganese, trace elements, organic pollutants) to determine the properties of solid materials including the chemical stability/leachability of these solid materials within the Site.

The target of the Phase I Site Investigation included collecting solid material samples both within and adjacent to the waste removal corridor (Figure 3). The purpose of including materials adjacent to the waste removal corridor was to identify other potential source areas within the Site to facilitate decision making for response actions in the area, including design-level information to optimize the balance between any potential additional source removal beyond the required waste removal corridor and the BRW hydraulic control.

Field X-ray fluorescence (XRF) field analysis was used as a guide to determine the depth of test pits and boreholes and to identify materials from test pits to be submitted for laboratory SPLP analysis. The field samples were collected in a ziplock bag and mixed prior to analysis with the XRF unit. The samples were not dried before analysis since these samples were meant for field screening information only.

Pioneer Technical Services, Inc. (Pioneer) laboratory XRF samples were analyzed with the XRF unit in the Pioneer field office at 244 Anaconda Road in Butte, Montana. These samples were dried, screened, and placed in a small plastic cup with a mylar film cover prior to analysis. Only XRF samples prepared/analyzed in the Pioneer field office were considered official sample results and used for data interpretation. The total number of Pioneer laboratory XRF samples was 667 for the Phase I Site Investigation. Pioneer laboratory XRF samples were analyzed most often for COCs (arsenic, cadmium, copper, mercury, lead, and zinc) as well as calcium, chromium, iron, manganese, and silver. Additional detail on the number of samples and analyses completed is included in Appendix A.

There were 403 natural soil samples (344 borehole samples, 32 test pit samples, 14 surface samples, and 13 miscellaneous) collected and submitted to the laboratory (Pace Analytical, LLC [Pace] or Energy Laboratories, Inc.[Energy]) for analysis. A natural sample indicates samples were field samples, not field QC samples (i.e., not a field duplicate, field blank, or equipment rinsate blank). The miscellaneous samples included 9 samples to help determine the proper disposal of hydrocarbon bearing material generated from investigation activities and 4 samples collected for asbestos analysis. The samples were analyzed most often for metals, general chemistry, asbestos, and organic pollutants (e.g., hydrocarbons). Analysis for PCBs was intended to occur but was not completed due to safety concerns regarding the proximity of active BSB operations to the proposed sampling locations. The BSB asphalt plant and supporting operations, including utilities, were located too close to the target area (proposed sampling locations) for the field investigation work to be completed safely. Additional detail on the number of samples and analyses completed is included in Appendix A.

The following efforts were also completed to locate and identify historic infrastructure within the Site that may affect constructability of remedial elements:

- Collected measurements and photographs to document the remaining infrastructure at the Site (Section 2.1.1.3).
- Conducted a geophysical Multichannel Analysis of Surface Waves (MASW) seismic survey to confirm the existence and location of a subsurface flume(s)/culvert(s) within the Site (Section 2.1.1.4 and Appendix D).

The sections below provide additional detail on the work performed for the solid materials characterization.

2.1.1.1 Test Pits

In the Initial Phase I Site Investigation (Stage 1), 12 test pits were excavated and sampled to refine the location of durable historic infrastructure, evaluate any remaining manganese impacts, and determine the distribution and properties of solid materials within the Site. Three additional test pits were excavated during the Hydrocarbon Investigation (Stage 3) to determine the presence and distribution of hydrocarbon-impacted materials and solid materials within the Site. The location of each test pit is shown on Figure 5.

Test pits were dug with an excavator until the equipment hit refusal (i.e., could not excavate through material), the equipment's safe digging limits were met, or until other Site-specific limitations were encountered (e.g., groundwater, sidewall stability became insufficient, etc.). The field logs note whether the excavator encountered refusal or groundwater at the final depth. The field data sheets and logbook entries are included in the Phase I Data Summary Report (Appendix A). The final depth and lithology of each test pit are also shown in the Lithology Logs (Appendix B).

Samples were collected following the procedures and protocols detailed in the BRW Phase I QAPP and associated RFCs. Generally, samples were collected using a disposable hand scoop by scraping soil from the sidewall or collecting it from the appropriate excavated piles or from the excavator bucket. Samples were then placed in the appropriate sampling containers. For each lithological layer, Pioneer laboratory XRF samples were collected in a ziplock bag, mixed in the field, and then prepped (dried, screened, and placed in a small plastic cup with a mylar film cover) and analyzed at the Pioneer field office using an XRF field unit. Select samples were submitted to the laboratory (Pace or Energy) for specified metals analyses by inductively coupled plasma – optical emission spectrometry (ICP-OES) (Table 3 and Table 4). The Pioneer laboratory XRF and ICP-OES results for each soil sample collected from the test pits are shown in the Lithology Logs (Appendix B) and are also presented in a Microsoft Excel file attached to the *Butte Reduction Works (BRW) Phase I and Phase II Investigation Leapfrog Model Inputs Technical Memorandum* (included in Appendix C).

During the Initial Phase I Site Investigation (Stage 1), selected samples (from each major type of impacted materials including slag, demolition debris, tailings, peat/organic soil, and alluvium) were collected and sent to Energy for SPLP. Samples were selected based on visual inspection of impacted materials, the total number of SPLP samples per lithologic unit, and the concentration action levels as described in the BRW Phase I QAPP. Analytical results for each sample submitted for SPLP analysis are summarized in Table 5 and included in the Phase I Data Summary Report (Appendix A).

Additional samples were collected and are further discussed in Section 2.1.3. No water samples were collected from the test pits for laboratory analysis. The field sheets, logbook entries, and laboratory results for each test pit are included in the Phase I Data Summary Report (Appendix A).

2.1.1.2 Boreholes

Sixty boreholes were drilled during the Phase I Site Investigation to refine the distribution and properties of solid materials and evaluate the presence of hydrocarbon compounds. Boreholes were drilled using either a Geoprobe® or sonic drill rig, both of which collected nearly continuous core from which to record lithology and collect samples. The borehole locations are shown on Figure 5 and detailed in Table 3. The 60 borehole locations include the 23 locations marked with a "BH" designation, the 24 groundwater piezometers installed during the Initial Phase I Site Investigation (Stage 1) identified with a "PZ" designation, and the 13 hydrocarbon monitoring piezometers installed during the Hydrocarbon Investigation (Stage 3) identified with a "HCW" designation. Lithology for each borehole (with or without installed piezometers) is shown in the Lithology Logs (Appendix B). The field sheets and logbook entries are included in the Phase I Data Summary Report (Appendix A).

Samples were collected following the procedures and protocols detailed in the BRW Phase I QAPP. Generally, during the Initial Phase I Site Investigation (Stage 1), samples were collected as follows:

For each lithological layer of at least 2 feet in thickness (as observed in the core), samples were collected in the appropriate sampling containers and submitted to the laboratory (Pace or Energy) for metals analysis by ICP-OES (Table 3 and Table 4).
For lithological layers of less than 2 feet in thickness, Pioneer laboratory XRF samples were collected in a ziplock bag for XRF analyses at the Pioneer field office (Table 3 and Table 4).

- Selected samples (from each major type of impacted materials including slag, demolition debris, tailings, peat/organic soil, and alluvium) were collected and sent for SPLP analysis to Energy. Samples were selected based on visual inspection of impacted materials, the total number of SPLP samples per lithologic unit, and the concentration action levels as described in the BRW Phase I QAPP. Additional detail on sample selection and the analytical results for each sample submitted for SPLP analysis are summarized in Table 5.

Additional samples were collected and submitted for laboratory analyses and are further discussed in Section 2.1.3.

A slightly different sampling methodology was required for the Hydrocarbon Investigation (Stage 3), which included collecting samples near the saturated layer (in the capillary fringe) for laboratory analysis (Section 2.1.3) and additional guidelines for unpaired and paired piezometer locations.

- For paired locations (i.e., a location within approximately 5 feet of a deeper previously completed investigation point), each lithology layer was documented and no samples were collected for metals analysis if the lithology was similar to the paired location, as determined by field personnel based on material type, lithological layer thickness, and recovery. There were 9 paired locations drilled during the Hydrocarbon Investigation (Stage 3).
- For unpaired locations, lithology was documented and a Pioneer laboratory XRF sample was collected from each discrete lithological layer for XRF analyses at the Pioneer field office. Additionally, a confirmation sample of the first lithological layer that passed the Waste Identification Screening Criteria (Table 1), based on field XRF analyses, was collected and submitted for metals analyses via ICP-OES (Table 3 and Table 4).
- Additional samples were collected and submitted for laboratory analyses as further discussed in Section 2.1.3.

The field sheets, logbook entries, and laboratory results for each borehole are included in the Phase I Data Summary Report (Appendix A). The Pioneer laboratory XRF and ICP-OES results for each soil sample collected from the boreholes are shown in the Lithology Logs (Appendix B) and are also presented in a Microsoft Excel file attached to the *Butte Reduction Works (BRW) Phase I and Phase II Investigation Leapfrog Model Inputs Technical Memorandum* (included in Appendix C).

2.1.1.3 Quantification of Existing Durable Historic Infrastructure

Most of the durable historic infrastructure at the Site was removed after the industrial operations were discontinued. However, some infrastructure items were not demolished or were partially demolished and remain, or potentially remain, at the Site. Additional quantification of the existing durable historic infrastructure was necessary to characterize the infrastructure that remains within the Site. Measurements and photographs were taken to document the remaining infrastructure at the Site, and the details are listed in Table 7 and shown on Figure 6.

2.1.1.4 Geophysical Investigation

In September 2018, a geophysical MASW seismic survey was completed to confirm the existence and location of a subsurface flume(s)/culvert(s) within the Site. Site observations and historic research indicated there may be at least two remaining flumes/culverts within the Site: the Blacktail Creek flume and the historic SBC channel south culvert (Table 7 and Figure 7).

Pioneer completed MASW surveys along three separate transects at the Site. Pioneer positioned the east and west MASW survey transect lines to intersect the approximate location of the flume(s) and to cross as much of the southern part of the Site as possible. The Middle Transect was positioned near an exposed brick roof of one flume or culvert. Based on the analysis of the MASW survey and background information, the historic flume can be traced across the Site, as shown on Figure 7, from the exposed brick and slag tunnel near the west end of the Site through a void identified in the Middle Transect, the exposed brick roof of the flume in the middle of the Site, and finally the void identified in the East Transect. Additional detail on this investigation can be found in Appendix D.

2.1.2 Groundwater Characterization

In the Initial Phase I Site Investigation (Stage 1), piezometers were installed in 24 locations to fill data gaps regarding groundwater elevations, potentiometric surface, and direction of groundwater flow within the Site, as well as determining seasonal groundwater elevation change (Table 3). Additional work was completed to characterize groundwater chemistry and spatial variability as well as aquifer geometry (i.e., identify depths to bedrock). The 24 piezometers were sampled, along with some existing monitoring wells, during Stage 2 of the Phase I Site Investigation. The results of the analyses are presented in Table 8. Additionally, during the Hydrocarbon Investigation (Stage 3), piezometers were installed in 4 unpaired locations and in 9 locations paired with existing piezometers to refine the spatial extent of hydrocarbon compounds and associated concentrations (Section 2.1.3). Each piezometer location is shown on Figure 5. Piezometers that were anticipated to encounter difficult drilling conditions were installed with a sonic drill rig, and the remainder were installed using a Geoprobe®. The construction for each piezometer is shown on the Lithology Logs in Appendix B, and the field logs for each piezometer are in the Phase I Data Summary Report (Appendix A).

Beginning in January 2019, monthly groundwater levels were collected from the locations identified in Table 3 using an electronic depth-to-water indicator tape (E-tape). Monthly groundwater level monitoring for the additional piezometers installed during the Hydrocarbon Investigation (Stage 3) began in January 2020. The additional piezometers and previously installed locations identified in Table 3 were monitored for monthly water levels for the Phase I Site Investigation and will continue to be monitored through the Phase III Site Investigation. Transducers were installed in select piezometers (Table 3), and data from these transducers are downloaded as part of the monthly groundwater level monitoring efforts. Table 9 lists the monthly groundwater level data from January 2019 to June 2021, and Figure 10 shows the manually documented groundwater elevation variations over time. Figure 11 and Figure 12 show the groundwater contours during low water conditions (February 2021) for both the shallow and deep aquifer units, respectively.

During all three stages of the Phase I Site Investigation, groundwater samples were collected from specified locations and submitted to the laboratory (Pace or Energy) for specified analyses (Table 3 and Table 4). The results of the analyses are presented in Table 8 and Figure 13 through Figure 18.

2.1.3 Organic Pollutants

The Hydrocarbon Investigation (Stage 3) specifically focused on defining the nature and extent to which soil and groundwater within the Site have been impacted by organic pollutants (hydrocarbon compounds, PCB, PCP, and dioxins); however, data were collected during all three stages of the Phase I Site Investigation to help estimate the nature and extent of impacted soil and groundwater within the Site.

During the Initial Phase I Site Investigation (Stage 1), field personnel used photoionization detectors (PIDs) and visual and olfactory observations to screen for the presence of hydrocarbon compounds in heavy vehicular traffic areas, maintenance areas, areas with historic or present-day industrial activities, stained or aromatic areas, borehole cores, and test pit material. The PIDs used were a MiniRae 3000 with a 10.6 electron-volt (eV) lamp and an UltraRae 3000 with an 9.8 eV lamp. Two different lamps were used to differentiate between the different types of hydrocarbon compounds being encountered in the field and provide the team with additional information when selecting laboratory samples to be collected and submitted for laboratory analyses (Table 3 and Table 4). Additionally, groundwater samples were generally collected from piezometers where soil samples had a positive PID detection during drilling activities, and the samples were submitted for laboratory analyses (Table 3 and Table 4). Groundwater samples were also collected from select piezometers during the Additional Groundwater Sampling (Stage 2), and the samples were submitted for laboratory analyses (Table 3 and Table 4).

While activities in the first 2 stages of the Phase I Site Investigation collected relevant data, the Hydrocarbon Investigation (Stage 3) focused specifically on defining the nature and extent of the soil and groundwater within the Site impacted by organic pollutants (e.g., hydrocarbon compounds and PCBs) and identifying if light non-aqueous phase liquid (LNAPL) was present. Thirteen piezometers were installed at strategic locations to better delineate groundwater impacts and detect potential LNAPL (Figure 5). The piezometer screens were installed across the water table (i.e., approximately 5 feet above and 10 feet below the groundwater table) to detect potential LNAPL. The construction for each piezometer is shown on the Lithology Logs in Appendix B. Additionally, 3 test pits were excavated to help delineate the potential impacted soil near borehole BRW18-BH11 (Figure 5). The final depth and lithology of each test pit is shown in the Lithology Logs in Appendix B.

During the Hydrocarbon Investigation (Stage 3), field personnel continued to use PIDs and visual and olfactory observations to screen for the presence of hydrocarbon compounds in borehole cores and test pit material. Based on the field screening, the following samples were collected as follows:

- For all unpaired locations:
    - If the presence of hydrocarbon compounds was detected (via sight, smell, and/or detection with a PID) in the cores from the sonic rig or in the test pit soil, a representative sample was most often collected for laboratory analyses (Table 3 and Table 4).

- For all boreholes and test pits, a soil sample was collected, when possible, near the top of the saturated layer (in the capillary fringe) for laboratory analyses (Table 3 and Table 4) even if there was no evidence of hydrocarbon compounds.

- For paired locations (i.e., a location within approximately 5 feet of a deeper previously completed investigation point), samples were not collected if that location was previously sampled for hydrocarbon compounds.

Once all the hydrocarbon piezometers were installed, groundwater samples were collected from existing and newly installed piezometers and submitted for laboratory analyses (Table 3 and Table 4). The results of the hydrocarbon compound laboratory analyses are included in the Risk-Based Corrective Action (RBCA) Evaluation in Appendix F, and the PCB, PCP, and dioxin laboratory analyses are included in Table 10.

2.1.3.1 Records Review

Historic and contemporary records were reviewed to determine the source of organic pollutants within the Site. These records included Montana Department of Environmental Quality (DEQ) reports from the following neighboring sites with documented releases of organic pollutants (Figure 2):

- 400 Oxford Street: Location of a leaking underground storage tank managed by the DEQ in 1995 (DEQ, 2019).
- 759 South Montana Street: Formerly the location of a Cenex Convenience Store. The site received reimbursement from the Petroleum Tank Release Compensation Board for releases in 1990 and 2006 (DEQ, 2018a).

2.1.3.2 Treatment and Disposal of Hydrocarbon-Impacted Soil from Field Activities

During the Initial Phase I Site Investigation (Stage 1), a temporary bermed containment area, lined with low-density polyethylene plastic sheeting, was set up on the Site to temporarily store soil generated from drilling and potholing activities with detectable hydrocarbon compounds. Per the RFC to the Butte Mine Waste Repository (MWR) Operation and Maintenance (O&M) Manual (BPSOU-MWR OMM-RFC-01) (Atlantic Richfield Company, 2019), the soil was transported from the Site to the Butte MWR for treatment and disposal.

A bermed area was constructed on the upper deck of the Butte MWR by BSB to landfarm the hydrocarbon-impacted soil from the Site. The hydrocarbon compounds in the soil were treated using landfarming techniques, which were conducted in accordance with the Administrative Rules of Montana (ARM) Title 17, Chapter 50, Sub-Chapter 16, Landfarm License and Operation Standards (ARM 17.50.16). Atlantic Richfield monitored the concentrations in the soil until the total hydrocarbon concentrations (the sum of total extractable hydrocarbons plus total petroleum hydrocarbons) was below 100 parts per million (ppm) (the required threshold for disposal at the Butte MWR [Atlantic Richfield Company, 2015]) and to determine if the soil would meet the Tier 1 risk-based screening levels (RBSLs) listed in the Montana RBCA

Guidance for Petroleum Releases (RBCA Guidance) (DEQ, 2018b). Table 11 lists the analytical results compared to the Tier 1 residential surface soil RBSLs, the most stringent RBSLs in the RBCA Guidance. Analytical results were compared to the Tier 1 residential surface soil (less than 10 feet to groundwater) RBSLs to determine if these limits were achievable with landfarming techniques, which will help inform future remedial activities at the Site.

Final measurements indicated that the total hydrocarbon concentrations and extractable petroleum hydrocarbons concentrations from the soil contained at the Butte MWR (Table 11) decreased from approximately 920 ppm to 8.3 ppm and from 1,070 ppm to 244 ppm, respectively. The initial samples were collected on November 2, 2018, and the values decreased to below the threshold for disposal at the Butte MWR by May 29, 2020. As a result, the soil was removed and disposed of at the Butte MWR and the landfarm was closed (i.e., the berms were reclaimed to pre-landfarm conditions, and the final surface was graded to prevent ponding and erosion).

Based on the final samples collected, the soil meets both the required threshold for disposal at the Butte MWR as well as the Tier 1 residential surface soil (less than 10 feet to groundwater) RBSLs. A background sample met all the standards except for benzo(a)pyrene where the concentration was 0.34 ppm, which exceeds the residential surface soil RBSL of 0.13 ppm. However, the background soil sample met the required threshold for disposal at the Butte MWR (total hydrocarbons less than 100 ppm). Based on these results, data indicate landfarming techniques were successful which helps to inform future remedial activities for the Site.

2.1.4 Site Survey

The Site survey with known utilities is shown on Figure 19. The survey data for the Site include an existing ground surface, stream elevations at the general upstream and downstream tie-in locations, critical utility locations, and other general Site conditions.

Due to the consistently changing conditions at the Site (i.e., BSB's operations), the current existing ground surface was estimated from Light Detection and Ranging (LiDAR) data collected in 2020 with the stockpiles of useable material removed from the surface. A base station was operating during the LiDAR flight, at a known location, to provide reference data for the positional coordinate sensor and altitude sensor onboard the aircraft. During post-processing, aircraft data, indexed by Global Positioning System (GPS) time, are corrected and calibrated against reference data to ensure precision (0.102 feet relative vertical accuracy, 0.40 feet horizontal accuracy) of the LiDAR data set that is used to generate surfaces in various software (i.e., Global Information Systems or AutoCAD) (QSI Corvallis, 2020). The existing ground surface was developed by taking LiDAR metadata provided by Quantum Spatial, measured in horizontal datum – North American Datum (NAD) 83 (CORS96; international feet), North American Vertical Datum – (NAVD)88 (GEOID12B; survey feet), and trimming out the varying topography of material stockpiles that exist on the Site which are anticipated to be removed before the RA begins. Ground surface points within a dataset were trimmed by either defining a boundary and excluding anything outside of the boundary from the surface or by selecting all the points that need to be trimmed and removing them from the surface.

OneCall tickets were created for the Site. Representatives from BSB, NWE, and CenturyLink were notified and provided markings for on-Site utilities. In accordance with Atlantic Richfield's overhead utility and ground disturbance defined practice, utility locations were confirmed using blind sweeping and potholing methods during Site investigation activities.

2.2 Phase II Site Investigation

Work performed for the Phase II Site Investigation is categorized into Solid Materials Characterization, Groundwater Characterization, and Organic Pollutants. The following sections detail the work performed in accordance with the Phase II QAPP.

2.2.1 Solid Material Characterization

Generally, the following activities were completed to estimate the volume, distribution, and properties of solid materials within the Site as part of the Phase II Site Investigation:

- Excavated 44 test pits and drilled 5 boreholes for the Slag Investigation and documented information (i.e., physical properties of the slag, equipment production rates, etc.) to inform the potential effectiveness of methods that may be employed to remove the slag (Section 2.2.1.1 and Figure 8).
- Drilled 26 boreholes used for additional solid material characterization. Piezometers were installed in these boreholes and used for groundwater characterization. (Section 2.2.1.2 and Figure 9).
- Collected test pit and borehole soil samples from select lithological layers and had them analyzed for COCs (i.e., arsenic, cadmium, copper, mercury, lead, and zinc) and/or additional constituents of interest (e.g., manganese, trace elements, organic pollutants, etc.) to determine the properties of solid materials including the chemical stability/leachability of these solid materials within the Site (Section 2.2.1.3).
- Documented lithology of test pits and boreholes to determine the distribution of materials (Appendix B).

The subsections below provide additional detail on the work performed for the solid materials characterization.

2.2.1.1 Investigation of Slag Physical Properties and Demolition Method

Generally, the following activities were completed to help refine the extent and physical characteristics of the slag within the Site as part of the Phase II Site Investigation:

- Stage 1: Excavated 40 test pits at locations within the Site where slag is anticipated to be removed during remedial activities and investigate the remaining smelter stack foundation which is constructed on a slag base. Documented physical features of the slag (e.g., visual description, bedding, discontinuities, weathering, hardness, color, etc.).

- Stage 2: Drilled 5 boreholes at locations where slag caused refusal during the excavation of test pits. Attempted to collect core samples to submit for laboratory analysis to determine tensile strength, compressive strength, and the fracture toughness of the slag.
- Stage 3: Conducted field tests at four select locations within the Site and recorded production data to help determine the effectiveness of heavy equipment for slag removal.

For all stages, the lithology of test pits and boreholes was documented, and opportunistic soil samples were collected for analysis of metals and/or hydrocarbon compounds as required by the BRW Phase II QAPP. The work completed for each stage is described in the following subsections.

Stage 1: Test Pits

During the Stage 1 of the Slag Investigation, 39 test pits were excavated and sampled to refine the extent and characteristics of slag in areas where slag is planned to be removed during RA activities. One additional test pit was excavated to determine the extents of the slag foundation base. The location of each test pit is shown on Figure 8. In accordance with the Phase II QAPP, all test pits were logged, and opportunistic soil samples were collected from select test pits within the waste removal corridor for analysis of metals and/or hydrocarbon compounds. Additional details on the soil samples collected are included in Section 2.2.1.3.

Test pits were dug with a 312C Caterpillar excavator and a 320 Caterpillar backhoe until the equipment hit refusal (i.e., could not excavate through material), reached the equipment limitations, or until other Site-specific limitations were encountered. Test pit excavation was constrained by the following equipment limitations and Site-specific conditions:

- The limit of the excavator/backhoe was achieved. There were 2 test pit locations that were completed to maximum depth of the equipment.
- Groundwater was encountered within the test pit. Groundwater was generally encountered during test pit excavation along the southern boundary of the Site and within the waste removal corridor.
- Sidewall stability of the test pit was determined to be unsafe. In a few locations, the Field Team Leader determined that excavation could not continue due to concerns about the stability of the test pit. Demolition debris and void spacing between slag layers were noted for soil instability.
- The excavation equipment met refusal (i.e., the equipment could not excavate through the material). Hard slag was located near the northern Site boundary along the slag wall. Refusal was encountered in some test pits overburdened with fill material from BSB operations or demolition debris from previous operations at the Site. The slag that was beneath the fill or demolition debris was particularly difficult to excavate.

The specific constraint for each location is shown on Figure 8, and additional details on the constraints for each test pit (including the final depths of each test pit) are documented in logbook entries; field logs note the final depths of each test pit.

The one additional test pit that was excavated to determine the extents of the stack foundation confirmed that the general construction of the stack foundation as reported in historic documents (Table 7) is accurate.

The logbook entries, field data sheets, and photographs are included in Appendix A, and the final depth and lithology of each test pit are also shown in the Lithology Logs (Appendix B).

Stage 2: Slag Core Sample Collection

During Stage 2 of the Slag Investigation, 5 boreholes were drilled to collect samples for laboratory tests to determine the tensile strength, compressive strength, and fracture toughness of slag throughout the Site. Test pit results from Stage 1 informed borehole locations for Stage 2 (Figure 8).

Boreholes were drilled using a sonic drill rig, capable of drilling both by traditional (i.e., rotating drill bit) and sonic methods. The borehole locations are shown on Figure 8 and detailed in Table 3. The extracted slag cores were fragile, and lengths were insufficient for laboratory analysis. As a result, no samples were submitted for laboratory testing. Without laboratory analysis, expandable grout could not be specified for the planned field test (Stage 4); however, boreholes were completed to observe physical properties of the slag and to determine potential heavy equipment needed for removal in Stage 3.

The logbook entries, field data sheets, and photographs are included in Appendix A. The final depth and lithology of each borehole are shown in the Lithology Logs (Appendix B).

Stage 3: Heavy-Equipment Removal

During Stage 3 of the Slag Investigation, 4 additional test pits (BRW21-TP1 through BRW21-TP4) were excavated along the northern Site boundary to determine if the slag could be removed with heavy equipment and which piece and/or combination of equipment would be most effective. Test pit locations were determined based on the results from Stage 1 and Stage 2.

Heavy equipment used during Stage 3 consisted of a 350G John Deere excavator with ripper, hammer, and bucket attachments This was supplemented with a 312C Caterpillar excavator with a bucket attachment. The following general procedures were followed during the excavation of each test pit:

- A 312C Caterpillar excavator was used to clear overburden from the test pit locations and the area of exposed slag was surveyed.
- A 350G John Deere excavator was then used to remove the slag. Dependent on the nature of the slag, the Field Team Leader and equipment operator determined the most appropriate attachment to attempt to remove the slag.

- The start and stop time to remove the slag was documented on the Field Data Sheet (Appendix A) for each attachment (i.e., ripper, hammer, and bucket).
- The excavation area/void was surveyed to determine the volume of slag removed.
- Excavation at each test pit was continued until the total depth of slag was determined, the equipment reached refusal (i.e., could not excavate through material), or other Site-specific limitations were encountered (e.g., groundwater, insufficient sidewall stability, etc.).

A digital video camera (or equivalent) was used to record the fracture and removal of slag, as directed by the Field Team Leader. Test pits were logged, and soil samples were collected using techniques detailed in the Phase II QAPP. Only one opportunistic soil sample was collected during Stage 3. A sample was collected from BRW21-TP2 and sent for laboratory analysis of hydrocarbon compounds due to a strong hydrocarbon odor observed while drilling (Appendix B). The logbook entries, field data sheets, and photographs are included in Appendix A. The final depth and lithology of each test pit are also shown in the Lithology Logs (Appendix B).

Stage 4: Expandable Grout Field Test

As stated in the BRW Phase II QAPP, an expandable grout field test was considered as a removal option for the more challenging areas of the slag within the Site. However, knowing the physical properties of the slag (i.e., tensile strength, compressive strength, and fracture toughness) was necessary to safely complete the expandable grout field test. As stated in the Stage 3 summary above, the extracted slag cores were fragile, and lengths were insufficient for laboratory analysis. As a result, the tensile strength, compressive strength, and fracture toughness of the slag could not be determined, and Atlantic Richfield was unable to safely complete the expandable grout field test.

2.2.1.2 Piezometer Installation

Twenty-six boreholes were drilled during the Phase II Site Investigation to install piezometers for the pumping tests. Boreholes were drilled using either a Geoprobe® or sonic drill rig, both of which collected nearly continuous core from which to record lithology and collect samples. The locations are shown on Figure 9 and detailed in Table 3. Lithology for each borehole (with the piezometer construction details) is shown in the Lithology Logs (Appendix B). The field sheets and logbook entries are included in the Phase II Data Summary Report (Appendix A).

2.2.1.3 Field Analysis and Sampling

Soil samples were collected to further define the nature and extent of the COCs and organic pollutants at the Site and to collect additional information regarding the chemical stability/leachability of solid materials that may remain after the RA is complete. A total of 381 natural soil samples were collected from 44 sample locations. A natural sample indicates samples were field samples, not field QC samples (i.e., not a field duplicate, field blank, or equipment rinsate blank). Samples were most often analyzed for metals and organic pollutants. Additional detail on the number of samples is included in Appendix A.

Samples were generally collected from test pits and boreholes following the procedures described below and detailed in the Phase II QAPP.

- Field metals analysis was conducted for each material horizon via the XRF unit, unless determined otherwise by field personnel. The field samples were collected in a ziplock bag and mixed prior to analysis with the XRF unit. The samples were not dried before analysis since these samples were meant for field screening information only.
- A sample was collected from each lithological layer in each borehole and test pit and submitted for metals analysis via ICP-OES, unless the lithological layer was too thin and there was not enough material to fulfill the required sample volume. In this instance, a sample was collected and prepared for Pioneer laboratory XRF analysis. Pioneer laboratory XRF samples were analyzed with the XRF unit in the Pioneer field office at 244 Anaconda Road in Butte, Montana. These laboratory XRF samples were dried, screened, and placed in a small plastic cup with a mylar film cover prior to analysis. Only XRF samples prepared/analyzed in the Pioneer field office were considered official sample results and used for data interpretation. The total number of Pioneer laboratory XRF samples was 130 for the Phase II Site Investigation. Pioneer laboratory XRF samples were most often analyzed for COCs (arsenic, cadmium, copper, mercury, lead, and zinc) as well as calcium, chromium, iron, manganese, and silver. Additional detail on the number of samples and analyses completed is included in Appendix A.
- Selected samples were collected and sent for SPLP analysis. Samples were selected based on location of the sample, soil type of the sample, and if the concentration action level was exceeded (e.g., 367 milligrams per kilogram [mg/kg] copper) as described in the BRW Phase II QAPP. Additional detail on sample selection and the analytical results for each sample submitted for SPLP analysis are summarized in Table 6.
- Additional samples were collected and submitted for laboratory analyses as further discussed in Section 2.2.3.

Note that samples were not collected from boreholes or test pits within approximately 5 feet of a deeper, previously completed investigation point or outside the waste removal corridor unless determined necessary by the field personnel.

The field sheets, logbook entries, and laboratory results for each borehole are included in the Phase II Data Summary Report (Appendix A). The Pioneer laboratory XRF and ICP-OES results for each soil sample collected from the boreholes are shown in the Lithology Logs (Appendix B) and are also presented in a Microsoft Excel file attached to the *Butte Reduction Works (BRW) Phase I and Phase II Investigation Leapfrog Model Inputs Technical Memorandum* (included in Appendix C).

2.2.2 Groundwater Characterization

Groundwater characterization consisted of two pumping tests, pre- and post-pumping-test groundwater analysis, and SBC loading analysis. The pumping tests and analyses addressed additional design-related data gaps relevant to future hydraulic control and construction dewatering.

2.2.2.1 Pumping Tests

The first pumping test occurred in the western portion of the Site (BRW-PW-01A) and the second pumping test (BRW-PW-01B) occurred within the industrial area of the Site, approximately 550 feet to the east of the first pumping test. The following activities were completed as outlined in the Phase II QAPP:

- Installed and developed pumping test wells BRW-PW-01A and BRW-PW-01B.
- Installed additional piezometers for water level monitoring.
- Completed baseline water level monitoring.
- Conducted step-drawdown test, 72-hour pumping test, and recovery test along with associated monitoring.

Pumping test well BRW-PW-01A was installed near piezometer BRW18-PZ02, in an area identified for relatively high hydraulic conductivity, proximity to potential sources of COCs, and proximity to SBC. The second pumping test well, BRW-PW-01B, was installed in a conductive zone near piezometer BRW18-PZ21 to gather additional data about the area of influence that extends into the east and central areas of the waste removal corridor. Additionally, 26 piezometers were installed prior to the pumping tests to monitor local groundwater elevations during the pumping tests. Phase II Site Investigation Locations, including the pumping wells, are shown on Figure 9.

Pressure transducers were installed to determine groundwater elevations for at least 7 days before and after each pumping test. After determining baseline conditions, each pumping test included a step-drawdown test to determine an effective pumping rate for the 72-hour pumping test. Then the 72-hour pumping test was conducted at the pumping rate determined from step-drawdown test results, and a 72-hour recovery test was conducted immediately after the pumping test to observe the aquifer recovery at the pumping test well and at nearby monitoring locations. Additional details on the pumping tests are included in Appendix G.

2.2.2.2 Pre- and Post-Pumping-Test Groundwater Analysis

Various locations, summarized in Table 3, were used for pre- and post-pumping-test sampling. Samples were collected prior to either pumping test occurring and then again after both pumping tests were completed (i.e., two sampling events total). The purpose this sampling was to collect additional data that will be used to improve the overall characterization of groundwater chemistry within the Site.

A total of 30 natural groundwater samples were collected prior to the pumping tests, and 31 natural groundwater samples were collected after the pumping tests. A natural sample indicates samples were field samples, not field QC samples (i.e., not a field duplicate, field blank, or equipment rinsate blank). Field parameters were documented following the procedure detailed in the Phase II QAPP, and samples were most often analyzed for COCs and organic pollutants. The Phase II Data Summary Report (Appendix A) breaks down pre- and post-pumping groundwater sampling by analytical group and the number of samples sent for each.

Analytical results for COCs are included in Table 8 and on Figure 13 through Figure 18; the PCB, PCP, and dioxin laboratory analyses are included in Table 10; and the results of the hydrocarbon compound laboratory analyses are included in the RBCA Evaluation in Appendix F.

2.2.2.3 Silver Bow Creek Loading Analysis

A network of surface water and groundwater monitoring points were used during the pumping tests to evaluate the potential impact of adjacent groundwater on sections of SBC. The work included monitoring staff gages in SBC, stream gaging, and sampling groundwater and surface water for COCs and Radon-222 to estimate groundwater and surface water flux and chemical loading. Stream flow measurements and water quality samples of SBC were collected during low-flow and/or stable surface water flow conditions before, during, and after each pumping test at existing and new staff gages (Figure 9). Groundwater samples were collected from 5 groundwater monitoring locations adjacent to SBC before and after each pumping test, but not during the pumping test to avoid disrupting transducer readings. The samples were collected at locations identified in Table 3 and analyzed for constituents shown in Table 4. A total of 15 natural groundwater samples were collected, and a total of 30 natural surface water samples were collected. A natural sample indicates samples were field samples, not field QC samples (i.e., not a field duplicate, field blank, or equipment rinsate blank). Additional details on the procedures followed as part of the analysis are included in the BRW Phase II QAPP, and evaluation of the data can be found in Appendix H.

2.2.3 Organic Pollutants

The Phase II Site Investigation further delineated the nature and extent of soil and groundwater within the Site that have been impacted by organic pollutants (hydrocarbon compounds, PCB, PCP, and dioxins).

Field personnel used PIDs, visual observations, and olfactory observations to screen for the presence of hydrocarbon compounds in heavy vehicular traffic areas, maintenance areas, areas with historic or present-day industrial activities, visually stained or aromatic areas, borehole cores, and test pit material. The PIDs used were a MiniRae 3000 with a 10.6 eV lamp and an UltraRae 3000 with an 9.8 eV lamp. Two different lamps were used to differentiate between the different types of hydrocarbon compounds being encountered in the field and to provide the team with additional information when selecting samples to be collected and submitted for laboratory analyses (Table 3 and Table 4).

Groundwater samples were collected from select piezometers based on results from previous investigations, and the samples were submitted for laboratory analyses (Table 3 and Table 4). Additionally, field personnel screened investigation locations for LNAPL, but LNAPL was not identified at any location during the Phase II Site Investigation.

The results of the hydrocarbon compound laboratory analyses are included in the RBCA Evaluation in Appendix F; and PCB, PCP, and dioxin laboratory analyses are included in Table 10.

2.3 Other Site Investigation Activities

Work performed for Other Phase II Site Investigation activities is categorized into Structural Assessment, Cultural Resource Inventory and Water Delineation Survey. The following sections detail the work performed in accordance with the Phase II QAPP.

2.3.1 Structural Assessment

DCI Engineers (DCI) performed a structural assessment of various structures at the Site in 2021. These included a single span bridge with steel girders and wooden deck supported by slag walls on the northern boundary of the Site, the historic ore bin structure supported by concrete columns, and furnace foundation structures constructed of slag and concrete. The parallel slag walls that run along either side of the existing SBC (Slag Canyon) were not included with this structural assessment. The structures evaluated are shown in Figure 6 and described in Table 7.

On July 28, 2021, DCI completed a visit to the Site, where the structures were visually inspected along with taking measurements and photographs. Based on the observations, DCI made the following conclusions for the structures included as part of the assessment (DCI Engineers, 2021):

- Bridge: The bridge should be closed to all vehicle traffic and pedestrians because the construct of the bearings could not be evaluated. The bridge superstructure and deck are in fair or better condition; however, the bridge deck and superstructure are only rated for light vehicles and could not be used for highway trucks or emergency vehicles even after the condition of the bearings is known.
- Ore Bin Structure: Parts of the ore bin structure are severely deteriorated due to exposure to weather, and the structure will continue to lose structural integrity over time and may collapse in the future (at any time or possibly during a seismic event).
- Furnace Foundation Structures: Visible furnace foundations vary in condition from good to completely failed. These foundations only support themselves, and their buried portions could not be evaluated. Signs of moderate to severe deterioration have occurred indicating their condition will continue to worsen with time, leading to partial or complete collapse.

Additional information on the recommendations for the RD are included in Section 5.0, and a copy of the structural report is attached as Appendix K.

2.3.2 Cultural Survey

A cultural resource inventory and evaluation for BPSOU was conducted by Mitzi Rossillon (Consulting Archaeologist, LLC). Six separate areas covering approximately 121 acres were evaluated. Of the six, the Site accounts for approximately 70 acres. This inventoried area is larger than the Site area identified by the BPSOU CD (Section 1.1), but the features discussed only pertain to BPSOU CD area.

The fieldwork portion of the project was completed in April and May 2021. The Site area (and surrounding area) was inventoried with meandering transects across the Site, and cultural resources were documented and/or redocumented (as necessary) for those previously documented on standard Montana Cultural Resource Information System forms. Features were photographed and field mapped using a combination of a resource-grade GPS and reference to Google Earth imagery. As part of the cultural survey, a variety of historic documents were examined as well as completing on-line research.

A total of 24 structures were evaluated. The structures evaluated within the Site are shown on Figure 6 and described in Table 7. Based on the observations, the following structures within the Site were either previously listed or are eligible for listing in the National Register of Historic Places (Rossillon, 2021):

- Network of slag walls (previously listed in Butte-Anaconda Historic District).
- Smoke flue, Blacktail Creek flume, and slag trench (associated with the smoke flue and Blacktail Creek flume).
- Possible reverberatory furnace foundation and settling tables.
- Blister building/blowing engine building foundation.
- Ore bin.
- Concrete and slag culvert and headgate.

These surviving features retain sufficient integrity (i.e., design, workmanship, evoked historic feeling) to their known or presumed functions to warrant consideration to being listed in the National Register of Historic Places. However some structures will be removed due to poor structural integrity and to meet cleanup goals established by the BPSOU CD. Additional information on the recommendations for the RD are included in Section 5.0, and a copy of the cultural survey report is attached as Appendix J.

2.3.3 Wetland Delineation Survey

In June of 2019, Pioneer conducted a wetlands assessment to determine Functionally Effective Wetland Area (FEWA) units (defined as delineated wetland acreage adjusted by an overall rating for functional value) at the Site. The full wetland delineation report is included in Appendix E. Methods set forth in the U.S. Army Corps of Engineers (USACE) *Wetland Delineation Manual* (Environmental Laboratory, 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (USACE, 2010) were applied to complete the FEWA evaluation.

For functional assessment purposes, the Site was divided into 2 areas based on current conditions. These areas are shown on Figure 1 of Appendix E. The first area is immediately west of Montana Street consisting of the “Slag Canyon” and BSB maintenance materials area and is identified as the “BRW-BSB” site and is 19.0 acres. The overall FEWA rating for the BRW-BSB site was 0.9 out of 3.0 with a low or very low rating for all functional categories except for Sediment Stabilization and Erosion Control, which was rated high. In total, 0.06 acres of wetland areas were identified and mapped within the BRW-BSB site.

The second area is located to the west of the BRW-BSB site and is identified as the “BRW-Lower Area One (LAO)” site and is 4.2 acres. The overall FEWA rating for the BRW-LAO site was 1.68 out of 3.0. The BRW-LAO site scored a high reading for Hydrologic Support and Sediment Stabilization/Erosion Control. The BRW-LAO site scored moderately for the following:

- Production Export/Food Chain Support.
- Wildlife Diversity/Abundance: Breeding.
- Wildlife Diversity/Abundance: Wintering.
- Threatened and Endangered Species Habitat.

The BRW-LAO site scored low for the following:

- Flood Flow Alteration.
- Water Purification.
- Aquatic Diversity/Abundance.
- Wildlife Diversity/Abundance: Migration.

In total, 3.14 acres of wetland areas were identified and mapped within the BRW-LAO site.

3.0 INTERPRETATION OF RESULTS

The following sections provide an interpretation of the results from the work performed for the Phase I and Phase II Site Investigations in relation to the data gaps and objectives identified in Table 2. Please note that additional interpretation of future Site investigations will be incorporated into this PDI Evaluation Report and resubmitted to Agencies for review as the RD progresses.

3.1 Solid Material Characterization

The Phase I and II Site Investigations collected substantial design-related data to estimate the volume, distribution, and properties of solid materials within the Site and evaluate some constructability concerns regarding materials and structures within the Site. Solid materials collected in the field were categorized into four broad waste categories:

- Slag – A stone and glass-like waste product that results from the smelting of ore. Slag tends to have a black appearance within the Site and is difficult to dig and drill through.
- Demolition Debris – Material from previously demolished structures. Soil is mixed with timbers, brick, concrete, asphalt, and nails.

- ATO – The ATO waste category is an acronym for alluvium, tailings, and organic soil. Alluvium is a general term that describes deposits of clay, silt, sand, and gravel. Tailings typically refers to waste rock that was pulverized to a fine sand. Organic soil describes subsurface native dirt that lies near or below waste in a soil column with high organic content.
- Other – This category describes material that was stockpiled by BSB, the drill pad and access road in the flood plain, and material that lies above waste at the top of a soil column. Generally, "Other" is material that was not identified as slag, demolition debris, or ATO.

Waste categories are further discussed in the Leapfrog Model (Appendix C). Interpretations of the results are provided below. Additional design-related data will be collected during the additional Site investigations and will be incorporated into the Leapfrog model.

3.1.1 Volume, Distribution, and Properties of Solid Materials

Based on the results summarized in Sections 2.1.1.1 and 2.1.1.2, the Leapfrog Works software was used to estimate the volume, distribution, and properties (i.e., COC concentrations and leachability) of solid materials (slag, demolition debris, ATO, and other). The software was further used to identify the volume and distribution of impacted and unimpacted ATO (which informed the evaluation of waste at the Site) and to provide information to inform the Conceptual Site Model (CSM) within the BRW Hydraulic Control and Construction Dewatering Technical Report (Appendix H) and RBCA Evaluation (Appendix F).

Waste

Observations of slag and demolition debris were noted in the borehole logs from the Phase I and Phase II Site Investigations, the BRW Smelter Site Test Pit Report (NRDP, 2016), and the installation of existing monitoring wells. These observations were imported into the Leapfrog Works software to generate the models depicting the distribution of slag and demolition debris. Figure 20 and Figure 21 show the distribution of slag and demolition debris, respectively, within the Site.

To estimate the quantity and distribution of waste material (i.e., material above the waste identification criteria in the BPSOU CD [Table 1]) within the Site and within the waste removal corridor, chemical properties (i.e., COC concentration data from soil samples collected during the Phase I and Phase II Site Investigations) were imported into the Leapfrog Works software (Appendix C). The Pioneer laboratory XRF concentration data were adjusted to the regression for the upper 95% confidence interval, referred to as the upper 95% regression, using paired samples with the ICP-OES concentration data prior to being imported. Figure 22 shows the interpreted volume of material that exceeds the waste criteria, and Figure 23 shows the interpreted volume of material that passes the waste criteria. The approximate volume of slag, demolition debris, and waste materials within the Site and within the waste removal corridor are shown in Table 12. Table 13 lists the depth to bottom of waste in each of the boreholes and test pits located within the waste removal corridor. The table also compares bottom of waste depth to the excavation depth in each location and lists the average excavation depths below bottom of waste in each location. The average excavation depth below the bottom of waste is 1.6 feet when compared to the bottom of waste using the COC concentrations, with Pioneer laboratory XRF adjusted with the upper 95% regression, and material types. The average excavation depth below the modeled waste using the COC concentrations is 0.9 feet. When you remove locations where no waste was found in the borehole data, the averages are 1.1 feet and 0.8 feet, respectively (Table 13). The excavation surface therefore provides an average of between 0.8 foot to 1.6 foot factor of safety. Further details on how these models were generated are discussed in Appendix C.

Leachability
In addition to the concentrations of COCs within the materials at the Site, the potential leachability of those materials was evaluated and modeled. Materials that have highly leachable concentrations of COCs have the potential to continue impacting groundwater at the Site after the RA is complete. The evaluation of the potential leachability of the on-Site materials informs the design of the overall remediation efforts, specifically the BRW hydraulic control and waste removal corridor. The following four items were derived from leachability concentrations modeled in the Leapfrog model:

1. Average soil depth in each percolation area for the Hydrologic Evaluation of Landfill Performance Model (Appendix I).
2. Average leachable COC concentration in each percolation area for the CSM (Appendix H).
3. Length of source parallel to groundwater, a measurement of the hydrocarbon impacts at the Site which was used in the RBCA Evaluation (Appendix F).
4. Leachable copper source volume, which became targeted for removal and was used to update the waste removal corridor.

Additional details on how these items were created in the Leapfrog model are described in Appendix C.

3.1.2 Constructability Considerations

Constructability considerations within the Site were investigated during the Phase I and II Site Investigations (quantification of historical infrastructure and geophysical investigation) (Section 2.1.1), the slag investigation (Section 2.2.1.1), structural assessment (Section 2.3.1), and cultural resource survey (Section 2.3.2). Each assessment targeted different aspects of structures and materials within the Site (i.e., nature/extent, physical properties, demolition considerations, stability, and historic significance).

From the slag investigation it was determined that the physical properties of the slag material within the Site are highly variable; in some areas the slag is very difficult to remove due to equipment limitations, the groundwater table, and overall stability of soil and slag once it is disturbed. Slag removal using heavy equipment, produced mixed results (Figure 8). The ripper, hammer, and bucket attachments were ineffective at BRW21-TP1 and BRW-TP2, where slag was nearly impenetrable. Slag was penetrated at BRW21-TP3, but the attachments were insufficient for complete removal of slag. Slag was easily excavated with a bucket attachment at BRW21-TP4 and did not require other attachments.

The remaining infrastructure within the Site was identified and summarized in Sections 2.1.1, 2.3.1, and 2.3.2. Recommendations for the RD are included in Section 5.0, and no additional interpretation is necessary.

3.2 Groundwater Characterization

The purpose of groundwater characterization within the Phase I and II Site Investigations was to collect preliminary groundwater elevation information to support creation of potentiometric surfaces and interpretation of groundwater flow direction (including seasonal groundwater changes); evaluate the spatial variability of groundwater chemistry within the alluvial aquifer at the Site; and assess the aquifer geometry. Based on the data collected from the Phase I Site Investigation, the Phase II Site Investigation work activities consisted of two pumping tests, pre- and post-pumping test groundwater analysis, and the SBC loading analysis. The objectives of the Phase II Site Investigation work activities included collection of additional information on the aquifer characteristics to help address design-related data gaps relevant to future hydraulic control and construction dewatering.

3.2.1 Chemistry and Spatial Variability

Groundwater quality samples collected at piezometers and pumping wells installed during field investigations indicate the presence of COC-impacted groundwater at the Site. Groundwater samples were collected during the Phase I and Phase II Site Investigations as discussed in Section 2.1.2 and Section 2.2.2, respectively.

All monitoring locations were sampled periodically during the Phase I and II Site Investigations depending on the objectives of the site investigation activities specified in the BRW Phase I QAPP and BRW Phase II QAPP. The results of the sampling are presented in Table 8. Figure 13 through Figure 18 illustrate the results of groundwater quality analysis for metal COCs in locations sampled during field investigations. Sample results for each metal COC are reported for a subset of monitoring locations screened in either the shallow aquifer (upper portion of each figure) or deep aquifer (lower portion of each figure). For all six metal COCs analyzed, a greater number of sampling locations exceeded groundwater quality thresholds in the shallow-screened locations than in the deeper locations.

It should be noted that limited detection of mercury prevented conclusive spatial interpretation of its extent, but mercury was detected to a greater degree in shallow groundwater than deep groundwater. Except for mercury, every metal COC displayed at least one location where analyzed concentrations exceeded both the chronic surface water standard and the groundwater remedial goal in both shallow and deep aquifer units, indicating widespread impact from historic disturbance. The occurrence of the highest concentrations and greatest number of detections in the shallow aquifer unit supports the planned removal of saturated waste in the shallow aquifer. Most metal COCs exhibit higher concentrations on the western portion of the Site than the eastern portion of the Site. Additional analysis and interpretation of groundwater quality can be found in Appendix H.

As discussed in Section 2.2.2.2, samples were collected before either pumping test occurred and then again after both pumping tests were completed (i.e., two sampling events total). Comparison of analytical results before and after the pumping tests show that there is no observed trend in the data between COC concentrations before and after the pumping tests. The COC concentrations increased in some piezometers during the pumping test (e.g., BRW19-PZ05S), while COC concentrations in other piezometers decreased (e.g., BRW18-PZ01). Since the objective of collecting additional groundwater samples before and after the pumping tests was to collect additional data to provide finer detail on the nature and extent of COC- and hydrocarbon-impacted groundwater within the Site, no further evaluation or data interpretation was done comparing the COC concentrations before and after the pumping tests. Characterization of production water from the two pumping tests performed at the Site is discussed further in Appendix G.

3.2.2 Groundwater Surface and Direction of Flow

Groundwater contours and direction of flow were developed based on the results from the Phase I and Phase II Site Investigations. Groundwater elevations were calculated by subtracting depth to water measurements (documented manually during the monthly water level readings) from the surveyed measuring point elevation (typically the north side of the inner casing) for each investigation point. The elevation of the water table at the Site generally ranges from approximately 5,442 to 5,435 feet above mean sea level (NAVD 88).

Compilation of groundwater potentiometric surface contours (Figure 11 and Figure 12) indicates typical groundwater gradients at the Site of approximately 0.003 to 0.005 feet per foot. The groundwater contours were created by interpolating the measured groundwater elevations at the monitoring locations with kriging algorithms. Based on the shallow and deep potentiometric surfaces, groundwater traveling under the Site generally flows from the southeast to the northwest, towards BRW-00 and the Hydraulic Control Channel (HCC).

Table 9 lists the monthly groundwater level data from January 2019 to June 2021. Figure 10 shows the manually documented groundwater elevation variations over time, Figure 11 and Figure 12 show the groundwater contours during low water conditions (February 2021) for both the shallow and deep aquifer units, respectively. Both figures contain the monitoring locations that inform the groundwater contours. These monitoring locations (Contour Data Points) are listed in the upper left corner and omitted locations, with reasoning, are listed in the upper right corner of Figure 11 and Figure 12. Standard deviation data are used within kriging algorithms that generate the shading shown in each figure. The standard deviation values used to generate shading are highlighted in green in Table 9.

3.2.3 Aquifer Parameters and Geometry

Collection of groundwater elevation data during the pumping tests allowed analysis of the aquifer response to pumping stress. Numerical evaluation of the data provided estimates of aquifer parameters (transmissivity and storativity), identified possible hydraulic boundaries, and evaluated preferential flow and anisotropy. Detailed discussion of the pumping test analysis is found in Appendix G.

The two pumping tests were performed in the western portion of the Site; both tests involved subjecting the aquifer to pumping stress and evaluating the response in a network of monitoring wells (Section 2.2.2). The pumping wells were considered representatively connected to both shallow and deep areas of the aquifer, which responded similarly to pumping stress. The shallow aquifer unit likely exhibits more historic disturbance, whereas the deeper aquifer unit contains a greater portion of cleaner alluvial sands and gravels (Appendix B).

Estimates of transmissivity between the 2 pumping tests were within the same order of magnitude. Aquifer thickness, interpreted from the associated well logs (Appendix B), allowed calculation of estimated horizontal hydraulic conductivity. Average (plus or minus one Standard Deviation) transmissivity values in the Pumping Test A area result in estimated hydraulic conductivity values of 213 plus or minus 113 feet per day, and average transmissivity values in the Pumping Test B area result in hydraulic conductivity values of 168 plus or minus 46 feet per day. A detailed discussion of aquifer conductivity and spatial heterogeneity is found in Appendix G. Estimates of groundwater quantities at the Site resulting from this analysis can be found in Appendix H.

Aquifer material at the Site consists of a mix of naturally lain alluvial material (historic SBC sediment) and tailings (the aquifer primarily consists of ATO material). The shallow aquifer contains portions of saturated industrial fill and demolition debris. It is likely that historic SBC in this area was a braided, low-gradient stream affected by beaver dams and channels, and that a range of fine (silts and clays with varying organic content) to coarse (sands and gravels) sediments were deposited given the historical progression of stream morphology. Groundwater flowing through these materials is subject to preferential channels and intermittent low-conductivity lenses, and thus groundwater does not flow or slope in a uniform fashion across the Site.

The thickness of the alluvial aquifer at the Site generally ranges from 25 to 30 feet; the bottom of the alluvial aquifer is bounded by the bedrock surface. Some groundwater likely travels through a layer of weathered bedrock at the bottom of the aquifer, but the exchange with the bedrock aquifer is considered minimal in relation to alluvial flow. The deeper aquifer unit at the Site is slightly thicker than the shallow aquifer unit, which thins slightly to the west. This estimate is based on approximating the elevation of lower conductivity material in the middle portion of the aquifer that may behave as an intermittent or semi-confining aquitard (clay material). This clay was likely deposited in low energy beaver ponds and overbank floodplain environments and is not uniform across the Site. Many boreholes showed multiple clay layers, and some did not contain clay at all. A discussion of the functional characteristics of the aquifer layers and simplifications of the lithology used for assessing contaminant loading and modeling design scenarios are in Appendix H.

3.2.4 Seasonal Groundwater Elevation Change

Figure 10 shows the manually documented groundwater elevation variations from January 2019 through June 2021. Generally, the highest groundwater elevations were observed in March, April, and October, while the lowest groundwater elevations were observed in the winter months

(December through February). Table 9 presents data collected from January 2019 through June 2021 and identifies the peaks and troughs (red and blue highlights) of seasonal variations as well as shaded cells with superscripts for dataset determinations (i.e., outliers, abnormal seasonal fluctuation). Figure 11 and Figure 12 shows the lowest groundwater contours (February 2021) for the deep and shallow aquifer units.

Outlier Determination
As indicated in Table 9 and on Figure 10, professional judgement was used to identify manual groundwater level measurement outliers. Since the overall seasonal water elevation trends are the targeted information that will be used to advise the design of the BRW hydraulic control and construction dewatering, individual measurements are not as important, and the professional judgement focused on quality data regarding the seasonal trends. The outlier measurements included groundwater elevations that did not follow the general seasonal trends of the majority of wells/piezometers at the Site (where no transducer measurements were available) and/or were notably different from trends recorded from pressure transducers.

The seasonal variation in groundwater elevations across the Site is relatively small. The standard deviation for the depth-to-water measurements taken at wells/piezometers where no outliers were identified ranged from approximately 0.07 feet to 0.6 feet in the deep aquifer unit and 0.15 feet to 1.02 feet in the shallow aquifer unit (green highlighted cells on Table 9). Figure 10 shows how the groundwater elevations increased slightly in the spring, fell in the early summer, rose slightly again in the fall, and declined in the winter. Most of the wells/piezometers followed this pattern and overall, the change in elevation was consistent between monitoring points located across the Site.

For those wells/piezometers without transducers (identified in Table 3), the outlier identification was conducted visually. The groundwater elevations were plotted on a graph similar to that shown on Figure 10. When the change in groundwater elevation between the preceding and following month did not match the overall pattern observed in the other wells/piezometers for that month, the manual groundwater level measurement was identified as an outlier. Any depth-to-water measurement identified as an outlier was compared to the field logbook (Appendix A) to ensure the value matched that in the logbook. Outlier measurements may indicate the heterogeneity of the alluvial aquifer, given the wide range of materials present at the Site, or may be a result of measurement error.

The April depth-to-water measurement for BRW18-PZ06 (8.33 feet [Table 9]) provides an excellent example of the outlier determination process for locations with no transducer. In relation to the March (4.15 feet) and May (3.86 feet) depth-to-water measurements, the magnitude of the change in elevation is significantly greater than that shown at the other wells/piezometers. Additionally, the groundwater elevation increased from March to April for many of the other wells/piezometers. The 8.33-foot depth-to-water measurement in BRW18-PZ06 would have resulted in a significant drop in groundwater elevation. This change was not observed in any of the nearby wells/piezometers. These discrepancies qualified the April monthly depth-to-water measurement as an outlier. Other outliers, presented in Table 10, identified by following the same selection process, are indicated by a superscript 1 and yellow highlight.

For those wells/piezometers with transducers (identified in Table 3), the monthly depth-to-water measurement was compared to the data collected by the transducer as well as to the transducer data of other wells/piezometers at the Site. Where the manual depth-to-water measurement could not be reconciled with the transducer data, the point was identified as an outlier. The outliers were either close to the transducer data but did not meet the 0.05-foot acceptable drift tolerance or were significantly different than the transducer data. In the latter case, accounting for changes in the placement of the transducer after it was removed and replaced could not reconcile the manual depth-to-water measurement. Efforts have been made to improve the accuracy of the manual groundwater measurements including using the same meter each month, if possible, and confirming the measured water level with both a traditional water level meter and the water level meter with an interface probe.

3.2.5 Evaluation of Groundwater Impact to SBC

Analysis of surface water and groundwater data collected as part of the SBC loading analysis determined the potential for impacted groundwater to discharge into SBC adjacent to the Site. Analysis of recent head observations indicate that the reach of SBC adjacent to the Site is generally a losing reach (adjacent the BRW-00 and HCC capture features), but management of the capture features, observed seasonal variability, and select aquifer areas with upward gradient indicate the possibility that impacted groundwater may reach or have reached SBC under past or future conditions. During field investigations, estimates of groundwater flux to SBC using field stream flow measurements and mass balance methods resulted in method error greater than calculated groundwater flux to SBC. A discussion of surface water/groundwater interaction during the pumping tests is included in Appendix G, and an evaluation of contaminant migration pathways to surface water is included in Appendix H.

3.3 Organic Pollutants

The Phase I and Phase II Site Investigations collected information to estimate the nature and extent of soil and groundwater within the Site impacted by select organic pollutants (hydrocarbon compounds, PCBs, PCP, and dioxins). The data will then be used to develop a plan to manage the impacted soil and groundwater within the Site as part of the RD.

Atlantic Richfield has completed a risk evaluation for the hydrocarbon-impacted materials within the Site following the RBCA Guidance (DEQ, 2018b). The RBCA evaluation is included in Appendix F and was completed to the extent possible based on the data from the Phase I and Phase II Site Investigations. For the current RBCA evaluation, the data were compared to Tier 1 and Tier 2 RBSLs to determine whether additional evaluation was needed. Once the Phase III Site Investigation and the Microbial Analysis and Biotreatability Study are completed, the revised RBCA evaluation will be resubmitted with the revised PDI Evaluation Report.

In addition to the RBCA evaluation, which only addressed contamination resulting from petroleum releases (i.e., hydrocarbon compounds), additional groundwater samples were collected for the remaining organic pollutants (PCBs, PCP, and dioxins). The results for the additional samples collected for the remaining organic pollutants are shown in Table 10.

3.3.1 Chemistry and Spatial Variability

The Tier 2 evaluation identified recurring RBSL exceedances based on data collected during the Phase I and Phase II Site Investigations. Soil RBSL exceedances do not correspond to groundwater RBSL exceedances, which suggests that hydrocarbon-impacted soil is fixed vertically in the soil column where the sample was collected. Furthermore, groundwater RBSL exceedances do not demonstrate a plume migrating toward SBC, and the hydrocarbon compounds appear to be isolated in the shallow groundwater aquifer beneath the industrial area of the Site. Additionally, all groundwater samples collected during the pumping tests from pumping wells BRW-PW-01A and BRW-PW-01B were below the applicable RBSLs.

Data from the Phase I and Phase II Site Investigations were also used to estimate a potential source area based on the reported soil concentrations of total extractable hydrocarbons (TEH). Based on the analytical results from the Phase I and II Site Investigations, it was decided that a conservative estimate of the source area could be represented by soils with TEH concentrations greater than 100 mg/kg (TEH volume). This source area was then used to inform the potential risk of remaining hydrocarbon-impacted materials leaching to groundwater in the RBCA evaluation. Additional details on the development of the source area are included in Appendix C, and additional details on the RBCA evaluation are included in Appendix F.

All groundwater samples collected as part of the Phase I and Phase II Site Investigations had non-detectable concentrations of PCBs, PCPs, and dioxins (Table 10).

Additional groundwater sampling of hydrocarbon compounds, PCB, PCP, and dioxins will occur per the Phase III QAPP and results will be incorporated. The chemistry and spatial variability of organic pollutants will be re-evaluated after additional data are collected from the future site investigations.

3.3.2 Plan to Manage Impacted Soil and/or Groundwater

The Biotreatability QAPP outlines additional data to be collected to characterize soil and more specifically, the biological degradation potential for hydrocarbon-impacted soil. Specific analysis of potential influence on biological degradation from metal concentrations and reduced species is needed to inform the management plan for hydrocarbon-impacted soil. Data will inform whether landfarming and/or chemical oxidation are feasible treatment options for hydrocarbons within the soil at the Site. Hydrocarbon-impacted groundwater would require treatment based on the current sampling results; however, the RA is expected to reduce potential source concentrations remaining within the Site below applicable RBSLs. The plan to manage impacted soil and/or groundwater will be included in an updated version of this PDI Evaluation Report after the Phase III QAPP and Biotreatability QAPP field activities are completed.

3.4 Silver Bow Creek Realignment

As part of Site RA, SBC will be removed from its current location to the north of the Site and reconstructed through the waste removal corridor. The new preliminary SBC alignment can be seen on Figure 3. Additional detail regarding construction of the new SBC channel will be provided in the Intermediate (60%) RD Report submittal.

3.4.1 SBC Bottom Invert at Upstream and Downstream Tie-in Locations

The SBC runs east to west through the Site. The SBC bottom invert at the upstream and downstream tie-in locations for the preliminary stream alignment was surveyed, and the results are shown on Figure 19. Tie-in locations will be resurveyed to account for changes in stream dynamics or other design modifications based on current field conditions. No additional interpretation is necessary for this objective.

3.4.2 Evaluation of Potential Lining of Relocated SBC

The BPSOU CD outlines the potential for installation of a liner material underneath the reconstructed segment of SBC. The liner would form a hydraulic barrier between the reconstructed channel and groundwater beneath the creek. Installation of a liner is evaluated along with other technologies for hydraulic control in Appendix H. Drawbacks of a liner include the increased construction difficulty and increased level of long-term maintenance and monitoring required. Given effective hydraulic control design, reconstructed SBC through the Site will be a losing reach, similar to the reaches below it through LAO. Appropriate selection of bed material that minimizes bed conductivity will allow for a more natural stream system that prevents excess surface water from entering the capture system while simultaneously allowing for long-term channel stability. Additional discussion of SBC liners is included in Appendix H.

4.0 REMAINING DATA GAPS

Data were collected during the Phase I and Phase II Site Investigations to help fulfill the following objectives from Table 2:

- Solid Material Characterization:
    - Determine the volume and distribution of slag and solid materials that fail the waste criteria within the Site.
    - Determine the leachability of metals within the soils that will remain within the Site after removal of waste materials to properly design the BRW hydraulic control.
    - Identify constructability concerns (e.g., slag, historic infrastructure, subsurface voids, etc.).
- Groundwater Characterization:
    - Define the spatial variability of groundwater chemistry within the Site.
    - Define the hydraulic conductivity and transmissivity of the aquifer within the Site.
    - Define the aquifer geometry.
    - Evaluate the interaction between groundwater and surface water and impact of such on the subsection of SBC.

- Organic Pollutants:
  - Define the chemistry and spatial variability of groundwater and soil within the Site that is impacted with organic pollutants (hydrocarbon compounds, PCB, PCP, and dioxins).
  - Develop a plan to manage the impacted groundwater and soil within the Site.
- SBC Realignment
  - Determine reconstructed SBC upstream and downstream tie in locations.
  - Evaluate if a lining will be needed for the new SBC channel.

Based on the data collected from the Phase I and Phase II Site Investigations, these objectives were not completely met, and additional data have been/will be collected during future site investigation activities (Section 1.7). The sections below detail the Site activities, data collection, and data interpretation to be completed to fill the above data gaps and inform the RD. Prior to the submittal of the Intermediate (60%) RD Report, Atlantic Richfield intends to incorporate the data, interpretation of results, and subsequent RD recommendations into this PDI Evaluation Report and resubmit to Agencies for review.

4.1 Solid Materials Characterization

Additional data has been/will be collected during forthcoming site investigations to fulfill the following data gaps:

- Evaluate the volume and distribution of solid materials that fail the waste criteria at select borehole locations within the Site to complete the design of an excavation surface.
- Determine the leachability of metals within the soils from a final series of samples collected from archived cores to complete the design of the excavation surface and to properly design the BRW hydraulic control.
- Identify existing subsurface voids, if any, within the Site for excavation and constructability considerations.
- Assess the geotechnical properties of soils in the western portion of the Site to characterize a clay layer and for constructability considerations (e.g., end-land use, feasibility of slag removal).

The sections below detail how additional data will fulfill the above data gaps. Atlantic Richfield intends to collect the additional data detailed in the sections below in 2022 which will allow the Intermediate (60%) Remedial Design to be completed in 2023.

4.1.1 Volume and Distribution of Waste Materials

As part of creating the Leapfrog model (Section 3.1.1), an evaluation was completed to determine where additional data may be needed to refine the waste volumes and complete the design of an excavation surface. Figure 24 shows the locations of the completed investigation points for the Phase III Site Investigation (reference Appendix C for additional information on how these points were selected). During the Phase III Site Investigations, field personnel documented the lithology and collected samples for metals analysis as specified in the BRW Phase III QAPP. Once data received from these additional locations undergo data validation, the Leapfrog model will be updated following the general procedures used to create the model (Appendix C), and the excavation surface will be completed.

In addition to the Phase III Site Investigation, Atlantic Richfield plans to collect additional samples from archived cores and submit for SPLP analysis. Based on the sample results from the Phase I Site Investigation, Atlantic Richfield has identified the need to collect additional samples for SPLP analysis to help refine the extent of leachable material in the western portion of the Site and help refine the estimate of leachability from the slag materials. The procedures and protocols for these samples will be incorporated into the BRW Phase III QAPP and submitted to Agencies for review and approval prior to initiating sample analysis. Once the data are collected, the Leapfrog model will be updated following the general procedures used to create the model (Appendix C), and the extent of the leachable source material will be finalized.

4.1.2 Geotechnical Properties

During the Phase III Site Investigation, a geotechnical analysis of Site conditions was completed for soils that will be encountered during RA activities and soils that may remain in place after the RA is complete. Figure 24 shows the locations of the completed investigation points for the Phase III Site Investigation.

In additional to the Phase III Site Investigation, a geoseismic survey is planned to help identify potential subsurface voids within the waste excavation or end-land use structure boundary and some final geotechnical sampling is planned to characterize the clay layer within the western portion of the Site. The procedures and protocols for these tentatively planned Site investigation activities will be incorporated into the applicable QAPP and submitted to Agencies for review and approval prior to initiating field work.

4.2 Groundwater Characterization and Hydraulic Control

Additional data were collected during the Phase III Site Investigation to help refine the spatial variability of groundwater chemistry within the Site during high- and low-groundwater conditions in 2021. As specified in the BRW Phase III QAPP, groundwater data were collected during high- and low-groundwater and surface water conditions to further characterize seasonal variation of groundwater at the Site. Groundwater samples were most often analyzed for COCs and organic pollutants. An updated SBC loading analysis was conducted from the area between SS-05B and SS-06A (Figure 2) during high- and low-groundwater and surface water conditions to determine changes in chemical concentration and potential loading to SBC during a representative range of seasonal groundwater and surface water conditions.

The seasonal variation data collected from the Phase III Site Investigation, including information compiled into the updated Leapfrog model, will be incorporated into the CSM that will be used to evaluate options and select designs for the BRW hydraulic control and construction dewatering (Appendix H).

4.3 Organic Pollutants

Additional data will be incorporated from the BRW Phase III Site Investigation and the Microbial Analysis and Biotreatability Study to fulfill the following data gaps:

- Define the spatial variability of groundwater and soil within the Site that is impacted with organic pollutants (hydrocarbon compounds, PCB, PCP, and dioxins).
- Develop a plan to manage the organic pollutant-impacted groundwater and soil within the Site.

The field activities and data collection for the Phase III Site Investigation activities are outlined in the BRW Phase III QAPP, and the field activities and data collection planned for the Microbial Analysis and Biotreatability Study are outlined in the Biotreatability QAPP. Additional soil and groundwater samples will be collected during both the Phase III Site Investigation and Microbial Analysis and Biotreatability Study, and then submitted for analysis of organic pollutants (hydrocarbon compounds, PCB, PCP, and dioxins).

In addition to the Phase III Site Investigation and the Microbial Analysis and Biotreatability Study, additional sampling may be completed to delineate the extent of organic pollutants (i.e., PCBs, PCP, and/or dioxins) within and adjacent to the Site. This work is dependent upon further review of records for the BNSF, MPTP, and NWE sites located near the BRW Site. The procedures and protocols for these tentatively planned Site investigation activities will be incorporated into the applicable QAPP and submitted to Agencies for review and approval prior to initiating field work.

With the additional data, Atlantic Richfield Company intends to complete the Tier 2 evaluation and develop a management plan for impacted groundwater and soil within the Site. This management plan will be incorporated into the Intermediate (60%) RD Report.

5.0 CONCLUSIONS AND REMEDIAL DESIGN RECOMMENDATIONS

5.1 Excavation Design

5.1.1 Waste Removal Extents

The BPSOU Statement of Work (Appendix D to the BPSOU CD) requires removal of all tailings, waste, contaminated soil, and slag within the waste removal corridor that exceed the Waste Identification Screening Criteria (BPSOU CD). Figure 22 shows all material that fails the Waste Identification Screening Criteria with additional information contained in Appendix C. The width of the waste removal corridor will be an average of 275 feet beginning at (or as close as feasible to) the northerly toe of the railroad extending north into the Site, and the depth of removal will be determined based on the results of the Site investigations and will be agreed upon during the RD. The preliminary waste removal corridor has been designed to achieve the average width of 275 feet while optimizing the removal of leachable materials. Additional details on the configuration of the waste removal corridor are included in Section 3.1.1 and Appendix C.

5.1.2 Waste Characterization for Proper Disposal

Waste material to be removed from the Site contains concentrations of COCs (arsenic, cadmium, copper, lead, mercury, and zinc) above the waste identification criteria in the BPSOU CD. A suitable repository location will be determined following completion of a repository siting study. Proper disposal of materials impacted with organic pollutants is discussed in Section 5.5.

5.1.3 Preservation and Demolition of Existing Durable Historic Infrastructure

Many structures within the Site are eligible for listing in the National Historic Register (Section 2.3.2). However, initial RD for the Site indicate historic features contained within the Site boundary will be impacted by the RA, and a structural assessment performed indicates that many of the historical smelting structures are in deteriorating condition. As a result, the following structures/features within the Site will be demolished and documented through on-Site interpretation and low-level, professional grade, still photography and videography (Rossillon, 2021):

- Smoke flue, Blacktail Creek flume, and slag trench (associated with the smoke flue and Blacktail Creek flume).
- Possible reverberatory furnace foundation and settling tables.
- Blister building/blowing engine building foundation.
- Ore bin.

These and others are pieces of infrastructure may be challenging to remove with typical heavy equipment, specifically the stack foundation, the Blacktail Creek Flume, the slag wall (particularly on the east side of the Site) and remaining building foundations. The anticipated construction materials and dimensions of these structures will be provided for contractor consideration within construction documents, and information from the slag investigation will be provided to the contractor prior to initiating RA activities.

The following structures are to be further evaluated and/or preserved:

- Removal of the slag wall will be limited to approximately 1,050 feet in total, and the slag culvert/abandoned aqueduct should be left in-tact if possible (Figure 6). A Site investigation and engineering analysis of intrinsic properties of the preserved slag wall to remain on Site are recommended.
- Use of the northern bridge for final design should only be considered after the north and south bearings are further investigated or after the bearings have been rebuilt. Additionally, the costs of further investigation and potential reinforcement of the bridge should be evaluated against the costs of constructing a new bridge that does not rely on the slag walls for support and could carry larger vehicles.
- All buried components should be further investigated to identify any possible subsurface voids in the area.

These efforts will allow for the RA to be completed in a way that meets the requirements within the BPSOU CD while also preserving historic smelting structures in a way that can be enjoyed and understood for years to come.

5.1.4 Wetland Protection and Mitigation Recommendations

Approximately five years following completion of the RA, the Site will be re-delineated, and re-evaluated to determine the post-construction FEWA scores in accordance with the "no net loss" Superfund goal for wetlands. Due to the nature of the RA, it is anticipated that from pre- to post-construction, wetland acreage and function will improve. If there is a net wetland loss, Atlantic Richfield will assess options for mitigation/offset within the upper Clark Fork River Superfund Sites watershed.

5.1.5 Utility Avoidance

It is anticipated that most of the on-Site utilities will be moved, rerouted, or abandoned while other utilities will be avoided during construction. The overhead electrical distribution line, including the underground portion that provides power to the BSB asphalt plant and crusher, will be abandoned beginning from the southern Site boundary. The sewer, natural gas, communications, and water lines servicing the BSB asphalt plant and crusher will be abandoned up to their connections at Montana Street.

The main utility lines along Montana Street and the BPSOU subdrain pump system alternate discharge line, will be avoided. The BPSOU subdrain pump system primary force main will be moved/rerouted during construction. Details on how the BPSOU subdrain pump system primary force main will be moved/rerouted, along with plans to maintain the line through construction, will be described later in the RD. New utilities will be installed to service any end land use amenities, these utilities will be described later in the RD.

5.1.6 Construction Dewatering

Removal of groundwater during construction will be important to safely and efficiently remove and transport saturated waste material at the Site. Significant dewatering will be required in portions of the Site. The proposed system of construction dewatering will involve implementation of a series of steps to minimize dewatering volumes, minimize unnecessary mobilization of contaminants, efficiently execute waste removal, and allow for safe travel of equipment and personnel.

- <u>Hydraulic Barrier Installation:</u> To minimize dewatering impact on adjacent sites, a hydraulic barrier may be installed along the southern boundary of the Site. The hydraulic barrier will act as a no-flow barrier during dewatering and limit the influence of Site dewatering to the south. This will prevent unnecessary impacts to the NWE, MPTP, and BNSF sites, and any potential mobilization of contaminants in these areas due to the required changes to groundwater gradient and elevation for Site excavation. This barrier will also include installation of an upgradient capture system. The upgradient capture drain will prevent groundwater mounding or reversal of flow direction in the area upgradient of the barrier. A detailed discussion of dewatering technologies and dewatering scenarios is included in Appendix H.

- Installation and Testing of Dewatering Network: After installation of the hydraulic flow barrier and associated upgradient capture drain, the dewatering network will be installed and tested. The proposed dewatering network will be a system of dewatering wells (Appendix H). Wells will be installed by the contractor at the locations and to the specifications provided by the engineer. Following installation and development of the dewatering wells, pumps and conveyance lines will be installed and tested. During this phase, each well may be tested individually to assure it can extract groundwater within the range of required dewatering rates.
- SBC Diversion and Phased Removal: Prior to beginning construction dewatering, SBC adjacent the Site will be diverted into a pipe along the SBC channel from above the east tie-in to below the west tie-in location. Routing SBC through a hard pipe will facilitate construction at the tie-in areas with the reconstructed stream and minimize stream leakage into the excavation area.

The areas requiring the greatest dewatering are in the west vegetated area and the east stream tie-in area. Due to the volume of waste requiring removal, and the distance between the deep dewatering areas, waste excavation will be phased at the Site. Dewatering will commence first in the west vegetated area for the first season of construction, be turned off, and then dewatering will begin in the east tie-in area.

The design of the hydraulic barrier and dewatering network will be accomplished using data collected for the Site along with the numerical flow model generated for the Site. Simulations of construction dewatering can be viewed in Appendix H. Additional details regarding Site dewatering and excavation will be provided in the Intermediate (60%) RD Report.

5.2 Backfill and Site Grading

There are no design recommendations for this design element at this time. Additional design recommendations will be incorporated as additional Site investigations activities are completed.

5.3 Silver Bow Creek Reconstruction

There are no design recommendations for this design element at this time. Additional design recommendations will be incorporated as additional Site investigations activities are completed.

5.4 Hydraulic Control

To prevent discharge of impacted groundwater into the reconstructed SBC, hydraulic control will be installed to maintain gradient away from SBC. Under observed conditions, impacted groundwater travels towards existing capture in BRW-00 and the HCC. Impacted groundwater has the potential to flow towards the reconstructed SBC after RA, when the stream is moved upgradient of its current alignment. Additionally, after RA is complete, groundwater flowing into the Site from upgradient will likely remain impacted with metal COCs and potentially with organic pollutants which are not identified in the BPSOU CD. Preventing discharge of this impacted groundwater to reconstructed SBC will be important to successful RA.

Evaluation of hydraulic control technologies and simulations of hydraulic control using a numerical flow model are included in Appendix H. Given the design objectives for hydraulic control, the recommended hydraulic control design will include installation of a drain within the shallow aquifer on the north side of the reconstructed SBC. The drain will capture impacted groundwater from upgradient and ensure this groundwater flows beneath SBC. It will also protect the reconstructed SBC from potential discharge of impacted groundwater from the north. Where possible, hydraulic control should be designed with optimization in mind (e.g., multiple independent drain segments allowing for operational adjustments). Captured groundwater will be transmitted to the HCC, and then to BTL for treatment and discharge. Estimates of capture flow are included in Appendix H. Additional detail regarding construction of the capture drain will be included in the Intermediate (60%) RD Report submittal.

5.5 Management of Soil and Groundwater Impacted with Organic Pollutants

Generally, management of organic pollutants depends on applicable standards for water quality and material disposal.

Based on the results from the RBCA evaluation (Appendix F), the preliminary Tier 2 evaluation identified direct contact and leaching to groundwater RBSL soil exceedances. Hydrocarbon-impacted soil will be excavated within the waste removal corridor or capped if it is located outside of the waste removal corridor, eliminating potential exposure pathways. Hydrocarbon-impacted soils exceeding the DEQ RBSLs within the waste removal corridor will need to be segregated during excavation and sampled prior to disposal at a repository. Based on the hydrocarbon compound concentrations, the soils may require treatment prior to disposal.

Hydrocarbon-impacted groundwater would require treatment based on the current sampling results; however, the RA is expected to reduce potential source concentrations remaining within the Site below applicable RBSLs.

Management of soil and groundwater impacted with organic pollutants will be detailed in an updated version of this PDI Evaluation Report after the Phase III QAPP and Biotreatability QAPP field activities have been completed.

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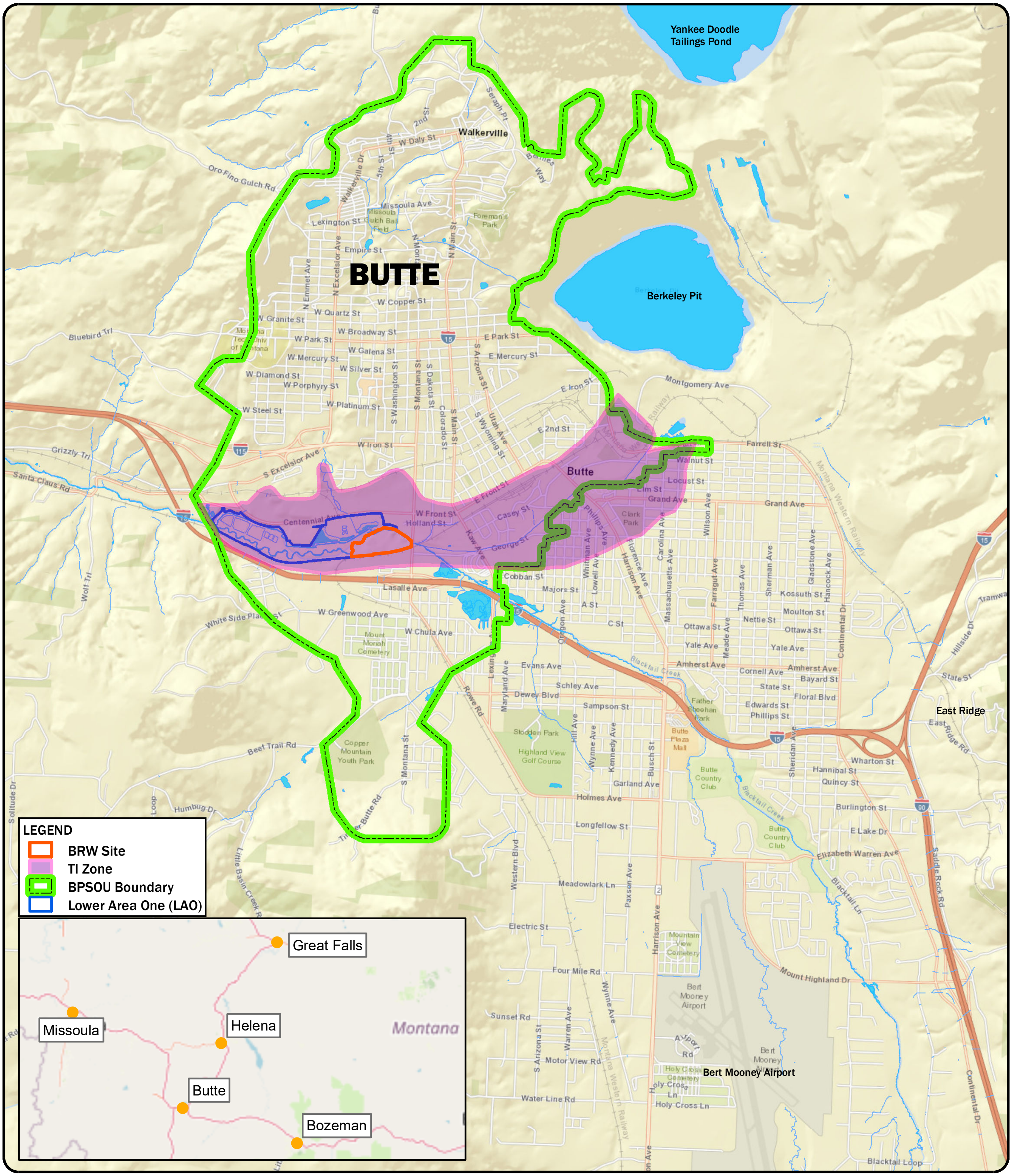
FIGURES



DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INT'L FT
SOURCE: PIONEER/ARCO/BSB

0 0.375 0.75 1.5
Miles

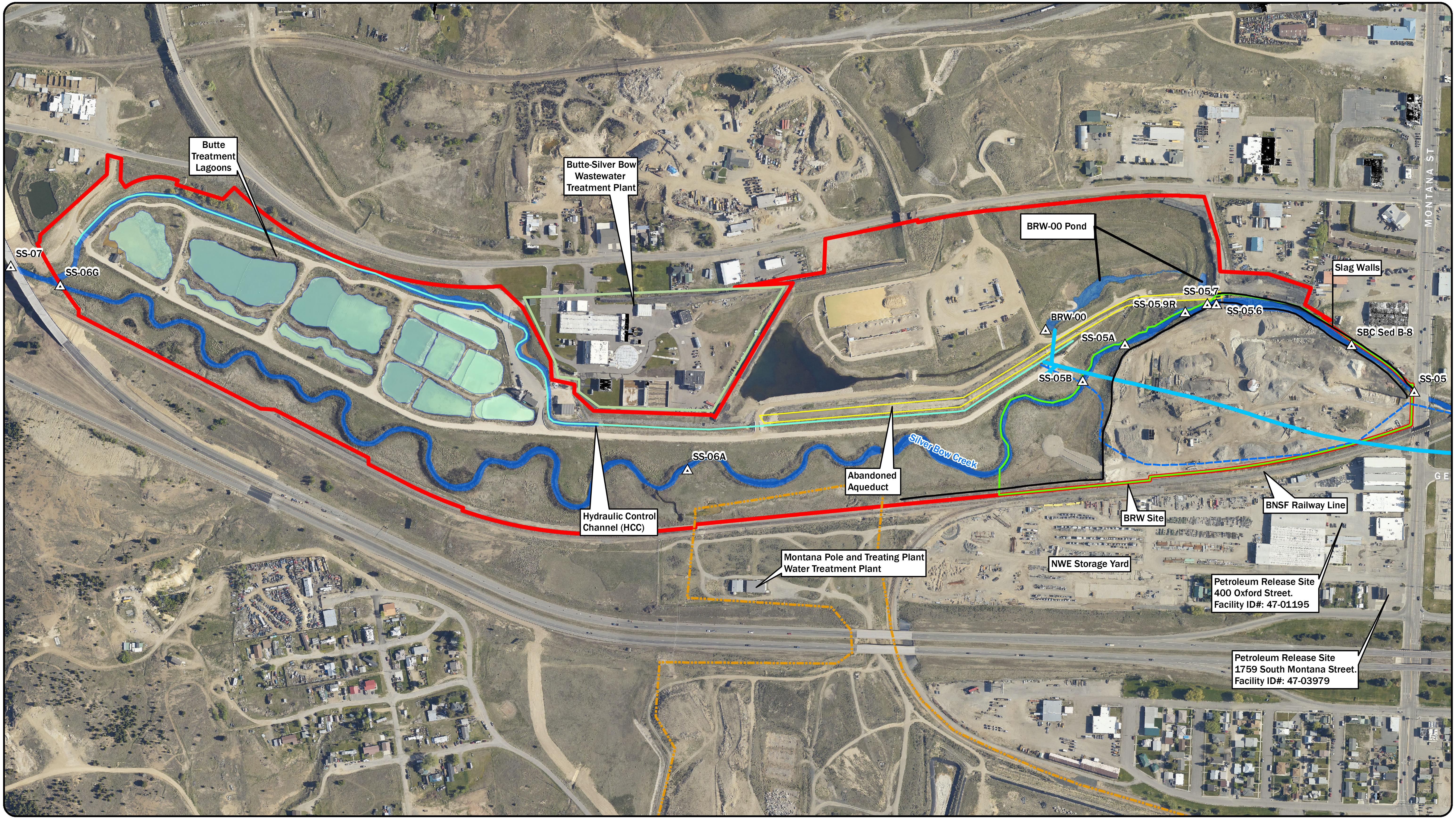
FIGURE 1

SITE LOCATION MAP

PIONEER TECHNICAL SERVICES, INC.

Date: 8/11/2021

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report_PI\BRW_PI_PDIER_001_LocMp_21.mxd



△ 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 Site Boundary

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/TREC/QSI 2020

0 200 400 800
Feet

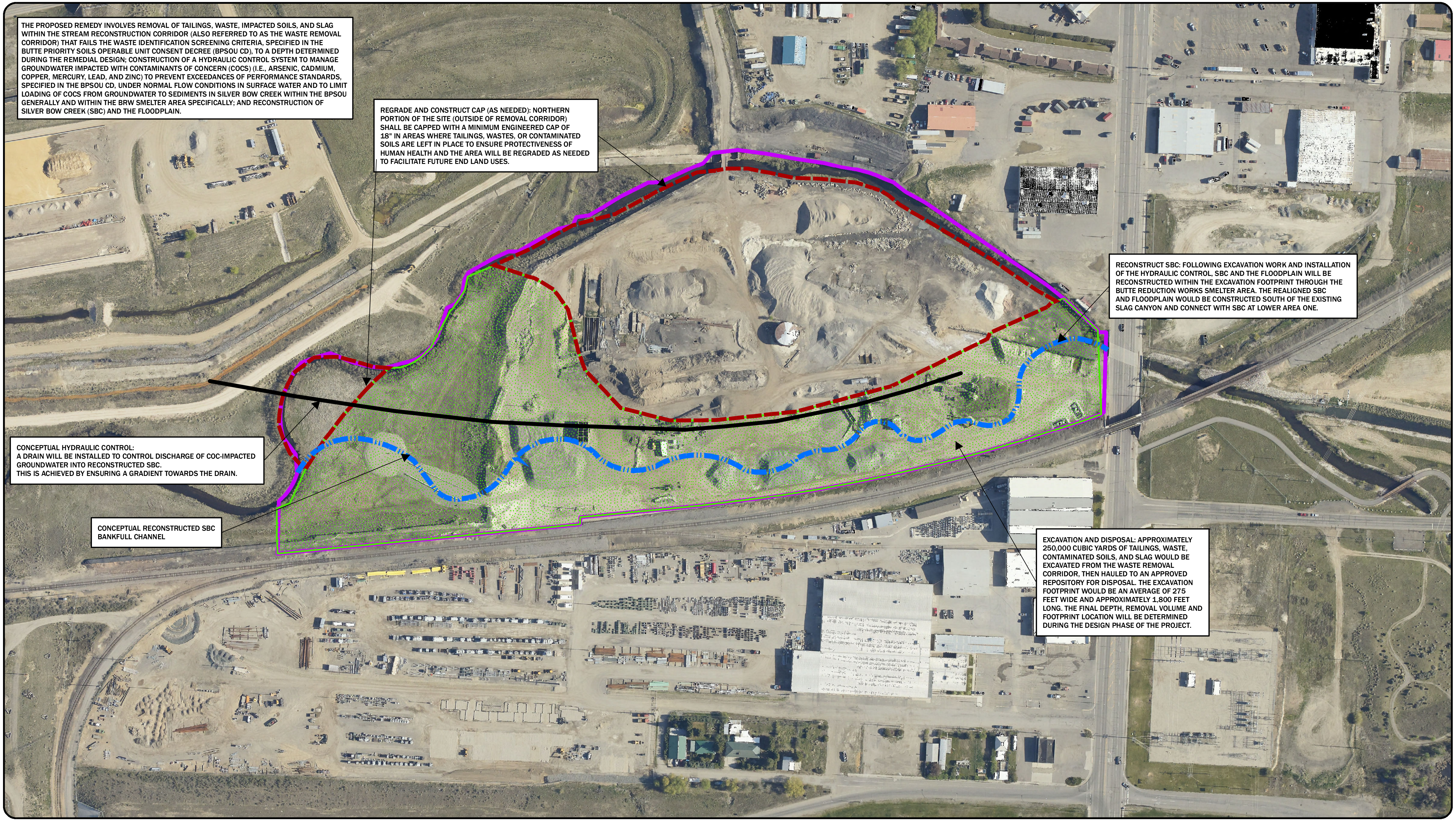
FIGURE 2

LOWER AREA ONE AND BRW SMELTER AREA SITE MAP

PIONEER TECHNICAL SERVICES, INC.

DATE: 3/14/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_002_SteMp_22.mxd



LEGEND

- Engineered Cap
- Preliminary Waste Removal Corridor
- BRW Site Boundary
- Conceptual Hydraulic Control
- Conceptual Reconstructed SBC

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INT'L FT
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

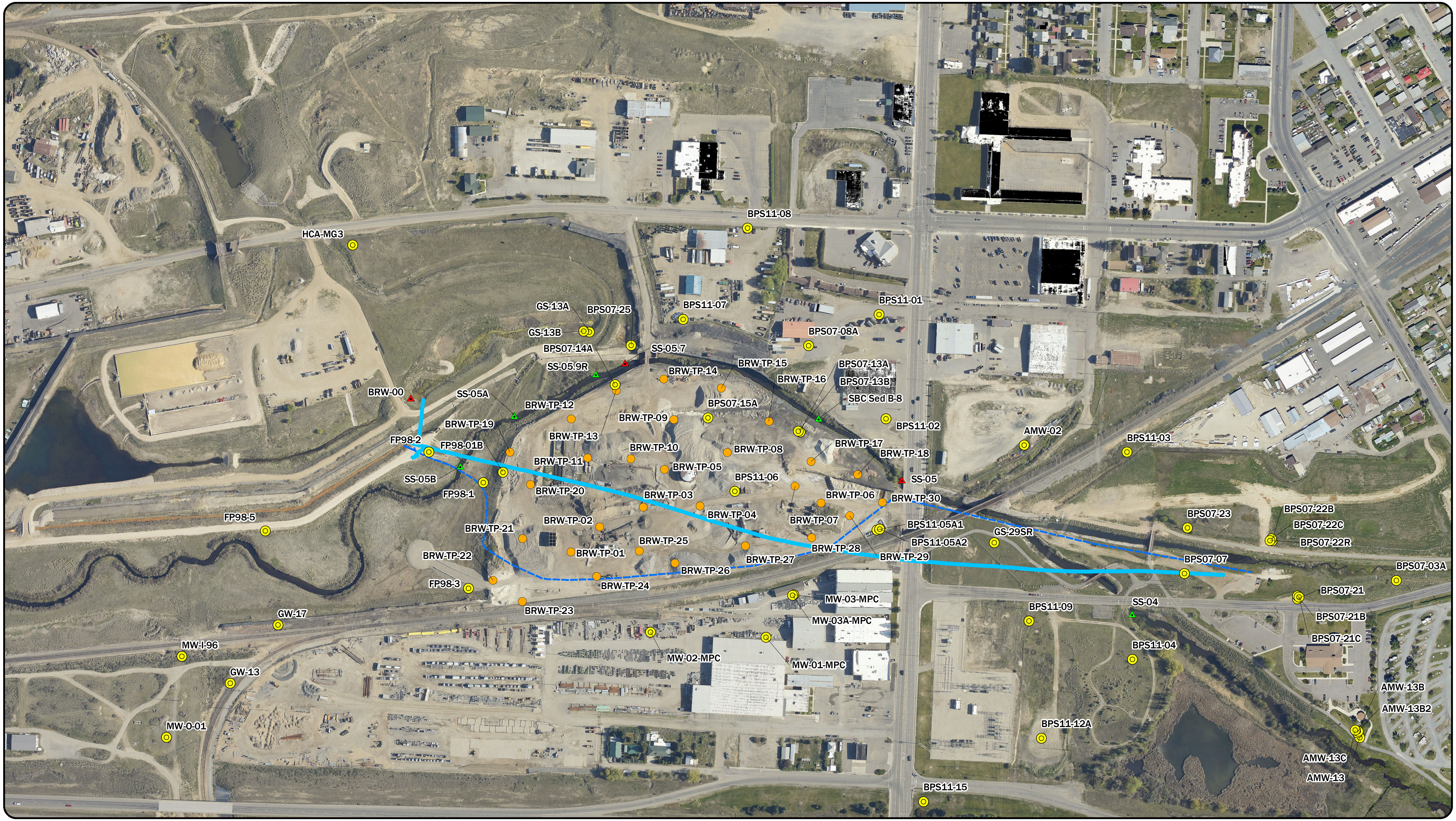
FIGURE 3

PIONEER TECHNICAL SERVICES, INC.

BRW SMELTER AREA CONCEPTUAL REMEDIAL ACTION PLAN

DATE: 6/8/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_008_RDPln_22.mxd



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

BPSOU Subdrain Pump System Alternative Discharge Line (approximate alignment)
BPSOU Subdrain Pump System Primary Force Main (approximate alignment)

Note:
Locations shown were installed prior to commencing BRW Phase I Site Investigation activites.

N

DISPLAYED AS:	
PROJECTION/ZONE:	MSP
DATUM:	NAD 83
UNITS:	INT'L FEET
SOURCE:	PIONEER/QSI 2020

0 150 300 600
Feet

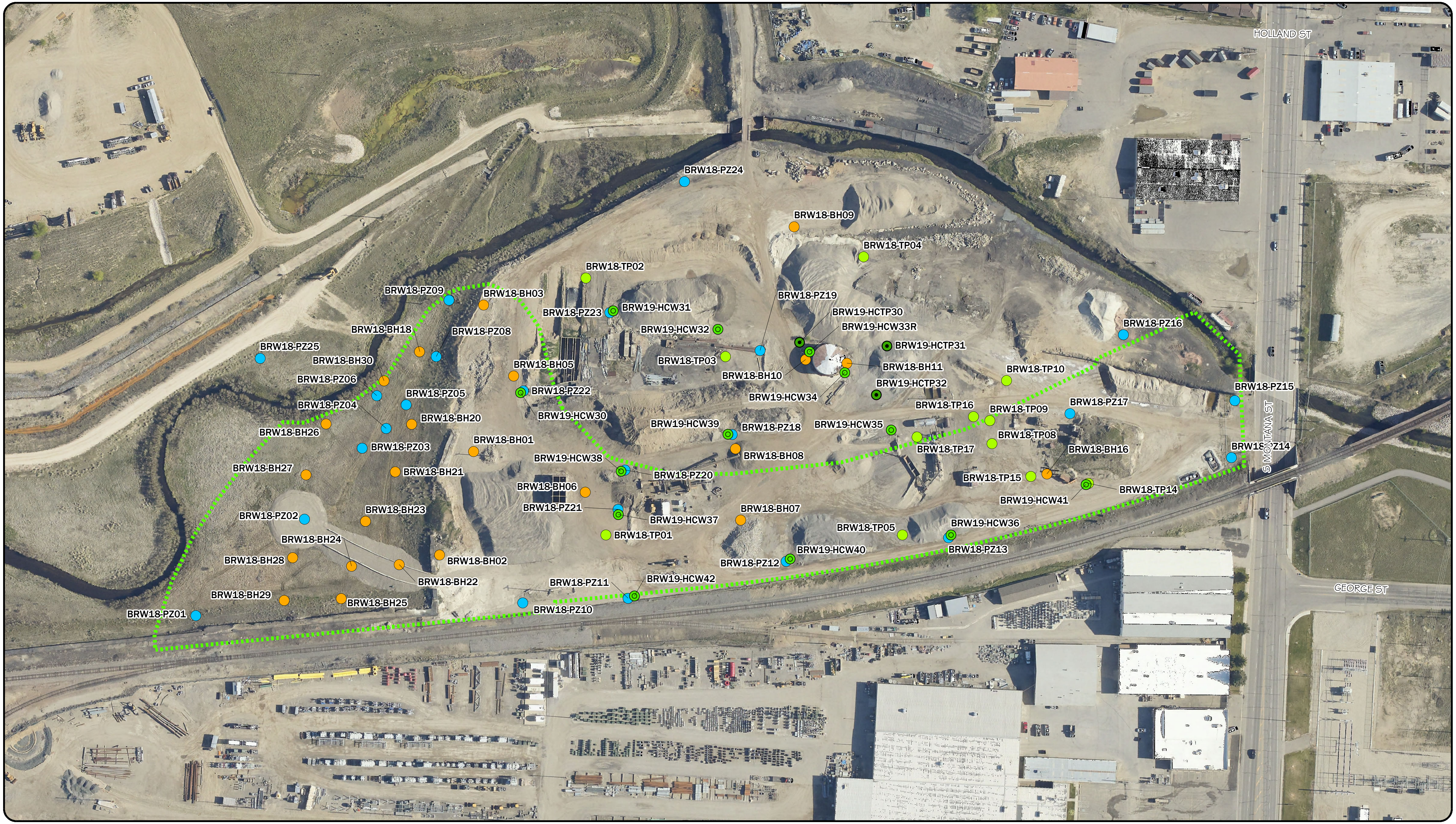
FIGURE 4

PREVIOUS INVESTIGATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 3/28/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_005_PrevInv_22.mxd



PHASE I LOCATIONS
- Phase I Borehole
- Phase I Piezometer
- Phase I Test Pit

PHASE I, STAGE 3 HYDROCARBON INVESTIGATION
- Hydrocarbon Piezometer
- Hydrocarbon Test Pit
- Preliminary Waste Removal Corridor

N

DISPLAYED AS:	
PROJECTION/ZONE:	MSP
DATUM:	NAD 83
UNITS:	INT'L FEET
SOURCE:	PIONEER/QSI 2020

0 75 150 300
Feet

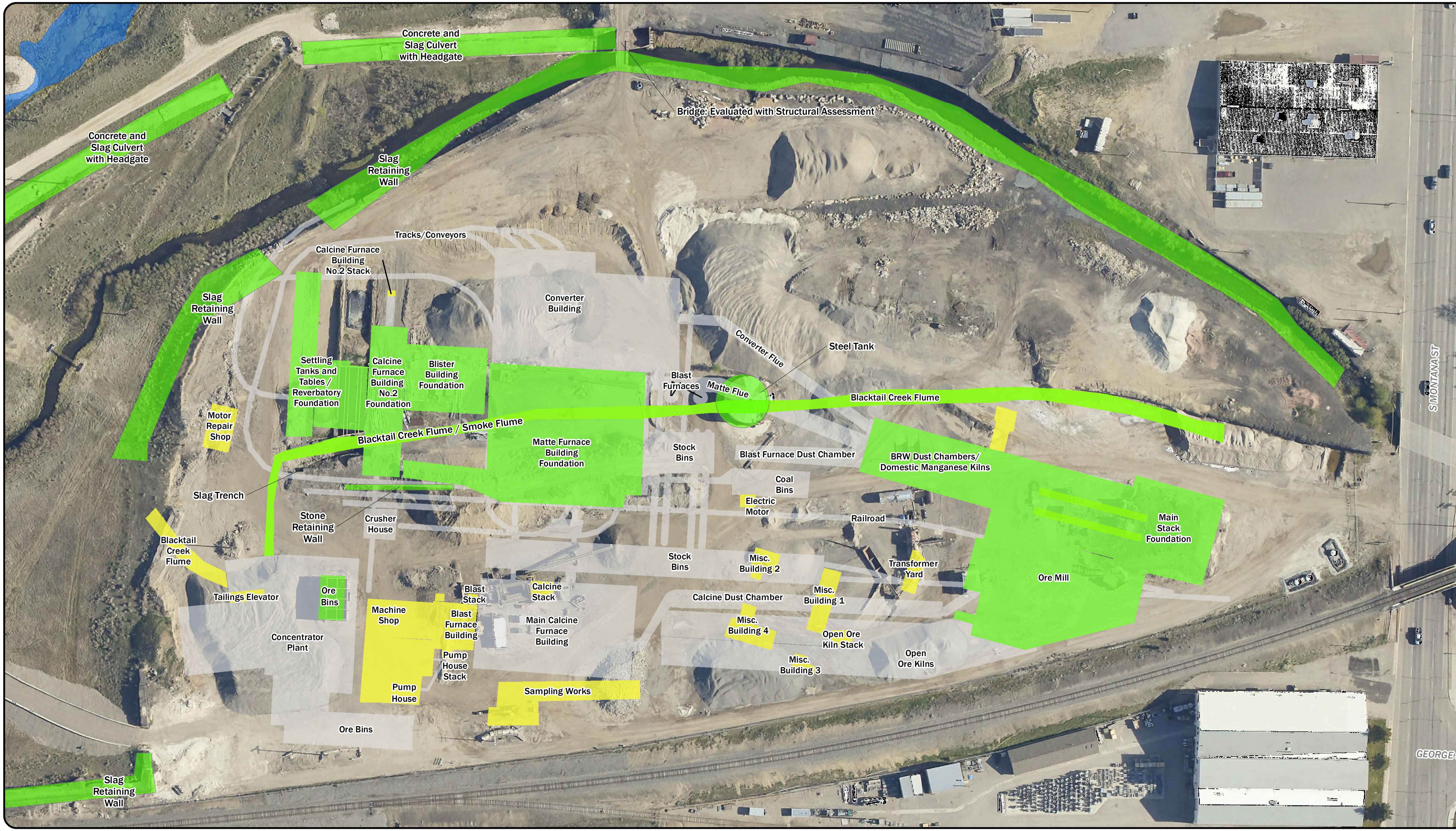
FIGURE 5

PIONEER TECHNICAL SERVICES, INC.

SITE INVESTIGATION LOCATIONS INSTALLED DURING PHASE I

DATE: 3/28/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_010_PrevSamp_22.mxd



Potentially Remaing Infrastructure	
Demolished Historic Infrastructure	
Confirmed Remaining Infrastructure	

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 50 100 200
Feet

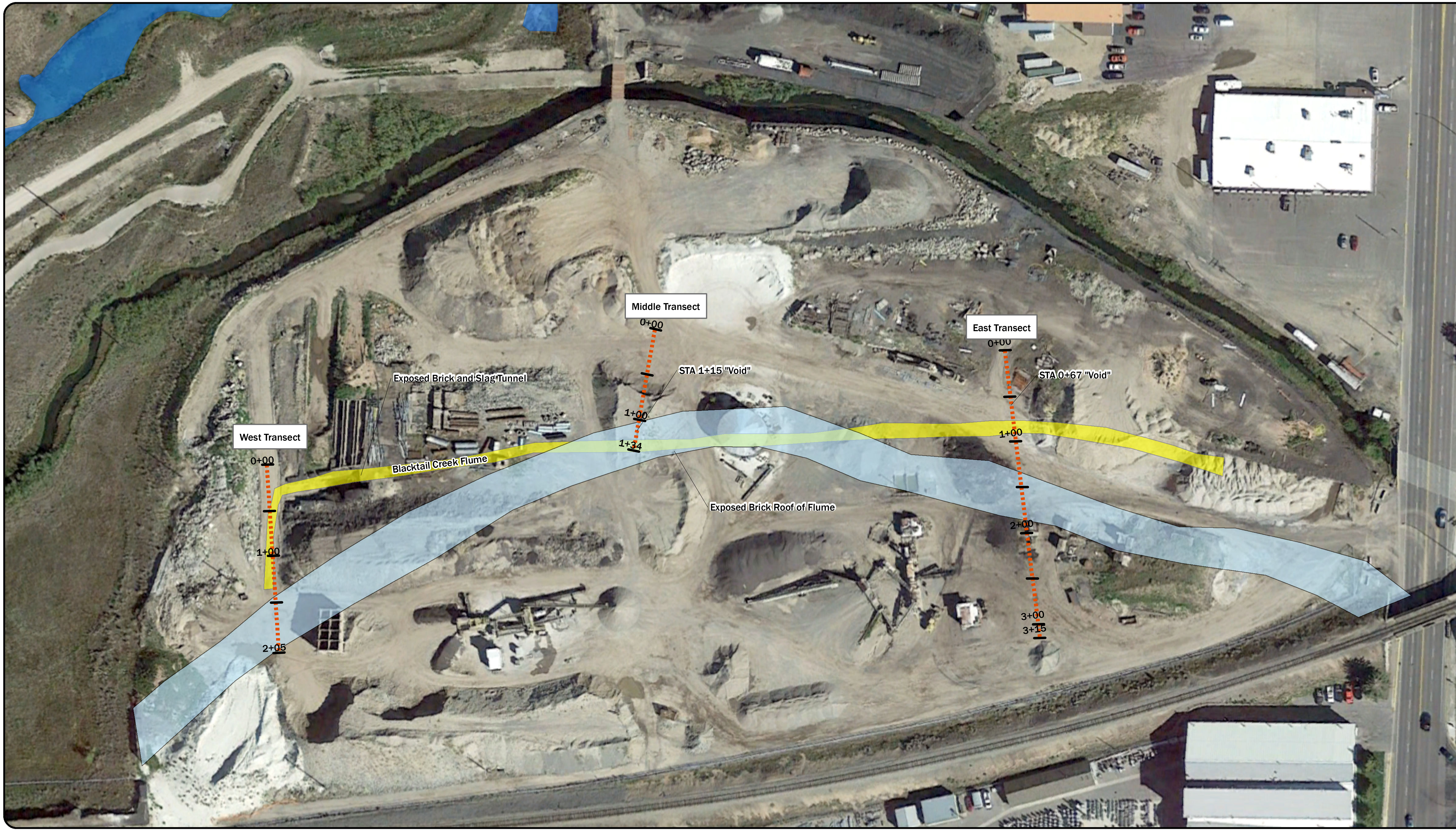
FIGURE 6

PIONEER TECHNICAL SERVICES, INC.

EXISTENCE OF DURABLE HISTORIC INFRASTRUCTURE WITHIN BUTTE REDUCTION WORKS SITE

DATE: 3/23/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_004_Infra_22.mxd



Blacktail Creek Flume (Sanborn, 1890)

Historic Silver Bow Creek Channel South Culvert (Baker and Harper, 1889)

Multichannel Analysis of Surface Waves (MASW) seismic survey alignments

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

0 50 100 200
Feet

FIGURE 7

SUBSURFACE FLUME(S) / CULVERT(S) WITHIN THE SITE

PIONEER TECHNICAL SERVICES, INC.

DATE: 8/2018

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_003_Subflume_22.mxd

Preliminary Waste Removal Corridor
Target Borehole Areas

Phase II Slag Investigation Stage 1
- Encountered Groundwater
- Capacity of Excavator
- Stability of Test Pit
- Refusal
- Main Stack Foundation

Phase II Slag Investigation Stage 2
- 2020 Borehole

Phase II Slag Investigation Stage 3
- 2021 Test Pit

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTN'L FEET
SOURCE: PIONEER/ QSI 2020

0 100 200 400
Feet

FIGURE 8

PIONEER TECHNICAL SERVICES, INC.

PHASE II
SLAG INVESTIGATION
STAGES 1-3

DATE: 3/15/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_001_SlgDist_22.mxd

Piezometer
Pumping Well
Surface Water Location
Preliminary Waste Removal Corridor

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTN'L FEET
SOURCE: PIONEER/QSI 2020

0 125 250 500
Feet

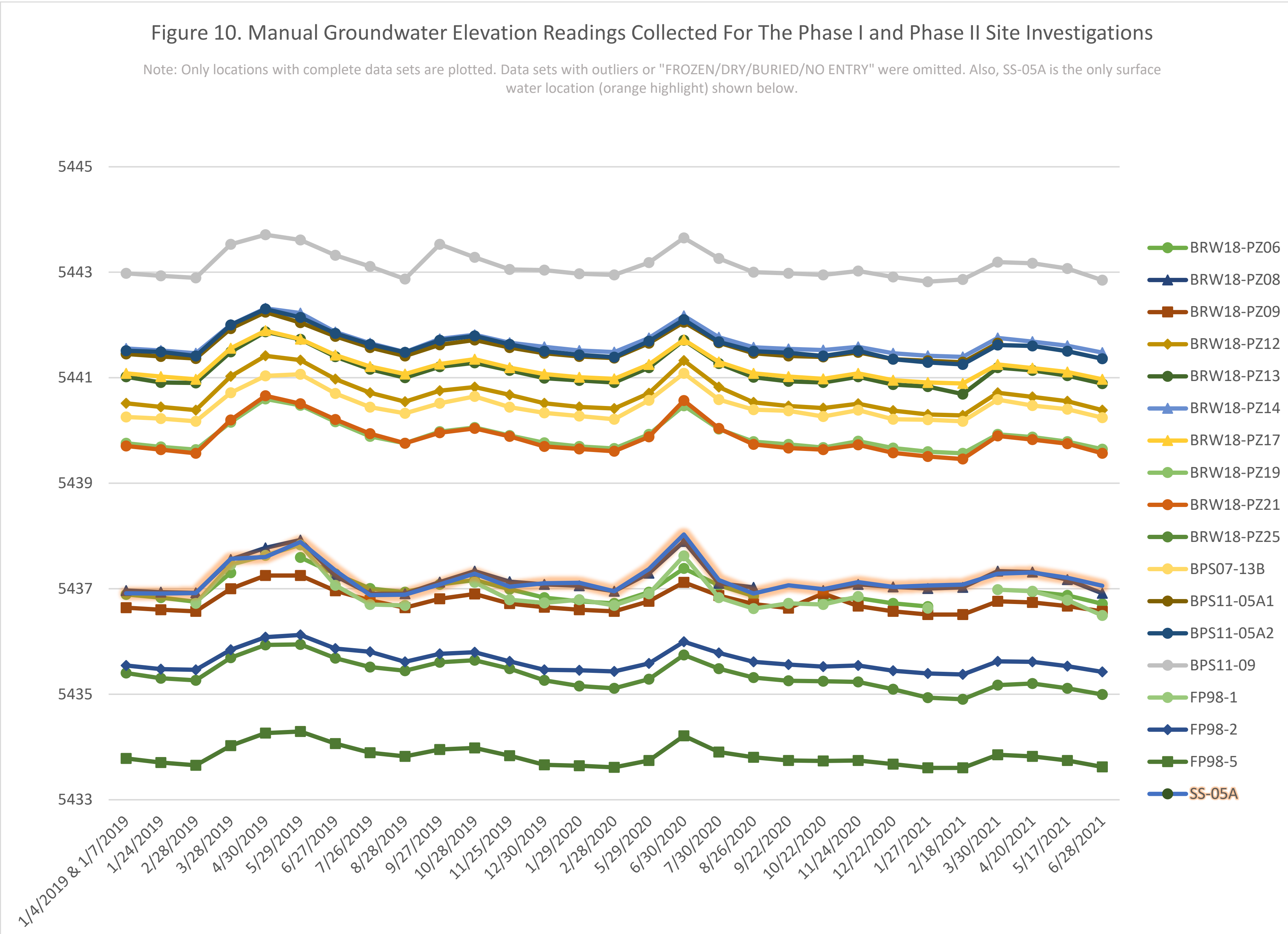
FIGURE 9

PIONEER TECHNICAL SERVICES, INC.

SITE INVESTIGATION LOCATIONS INSTALLED DURING PHASE II

DATE: 3/28/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_021_PrevSamp_22.mxd



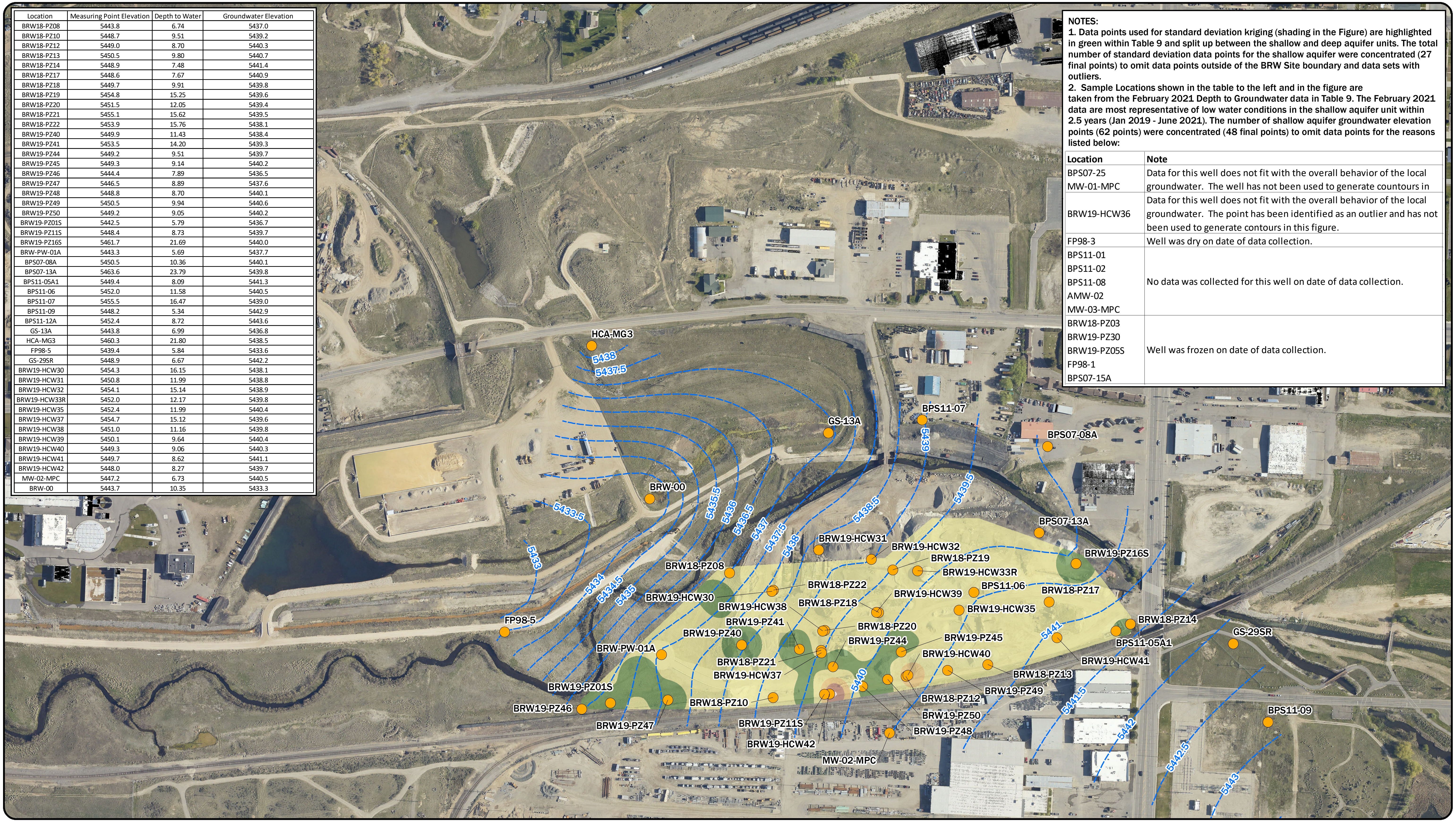
Data isn't present for March (3/2020) and April 2020 (4/2020) due to the COVID Pandemic.

Location	Measuring Point Elevation	Depth to Water	Groundwater Elevation
BRW18-PZ08	5443.8	6.74	5437.0
BRW18-PZ10	5448.7	9.51	5439.2
BRW18-PZ12	5449.0	8.70	5440.3
BRW18-PZ13	5450.5	9.80	5440.7
BRW18-PZ14	5448.9	7.48	5441.4
BRW18-PZ17	5448.6	7.67	5440.9
BRW18-PZ18	5449.7	9.91	5439.8
BRW18-PZ19	5454.8	15.25	5439.6
BRW18-PZ20	5451.5	12.05	5439.4
BRW18-PZ21	5455.1	15.62	5439.5
BRW18-PZ22	5453.9	15.76	5438.1
BRW19-PZ40	5449.9	11.43	5438.4
BRW19-PZ41	5453.5	14.20	5439.3
BRW19-PZ44	5449.2	9.51	5439.7
BRW19-PZ45	5449.3	9.14	5440.2
BRW19-PZ46	5444.4	7.89	5436.5
BRW19-PZ47	5446.5	8.89	5437.6
BRW19-PZ48	5448.8	8.70	5440.1
BRW19-PZ49	5450.5	9.94	5440.6
BRW19-PZ50	5449.2	9.05	5440.2
BRW19-PZ01S	5442.5	5.79	5436.7
BRW19-PZ11S	5448.4	8.73	5439.7
BRW19-PZ16S	5461.7	21.69	5440.0
BRW-PW-01A	5443.3	5.69	5437.7
BPS07-08A	5450.5	10.36	5440.1
BPS07-13A	5463.6	23.79	5439.8
BPS11-05A1	5449.4	8.09	5441.3
BPS11-06	5452.0	11.58	5440.5
BPS11-07	5455.5	16.47	5439.0
BPS11-09	5448.2	5.34	5442.9
BPS11-12A	5452.4	8.72	5443.6
GS-13A	5443.8	6.99	5436.8
HCA-MG3	5460.3	21.80	5438.5
FP98-5	5439.4	5.84	5433.6
GS-29SR	5448.9	6.67	5442.2
BRW19-HCW30	5454.3	16.15	5438.1
BRW19-HCW31	5450.8	11.99	5438.8
BRW19-HCW32	5454.1	15.14	5438.9
BRW19-HCW33R	5452.0	12.17	5439.8
BRW19-HCW35	5452.4	11.99	5440.4
BRW19-HCW37	5454.7	15.12	5439.6
BRW19-HCW38	5451.0	11.16	5439.8
BRW19-HCW39	5450.1	9.64	5440.4
BRW19-HCW40	5449.3	9.06	5440.3
BRW19-HCW41	5449.7	8.62	5441.1
BRW19-HCW42	5448.0	8.27	5439.7
MW-02-MPC	5447.2	6.73	5440.5
BRW-00	5443.7	10.35	5433.3

NOTES:

1. Data points used for standard deviation kriging (shading in the Figure) are highlighted in green within Table 9 and split up between the shallow and deep aquifer units. The total number of standard deviation data points for the shallow aquifer were concentrated (27 final points) to omit data points outside of the BRW Site boundary and data sets with outliers.
2. Sample Locations shown in the table to the left and in the figure are taken from the February 2021 Depth to Groundwater data in Table 9. The February 2021 data are most representative of low water conditions in the shallow aquifer unit within 2.5 years (Jan 2019 - June 2021). The number of shallow aquifer groundwater elevation points (62 points) were concentrated (48 final points) to omit data points for the reasons listed below:

Location	Note
BPS07-25 MW-01-MPC	Data for this well does not fit with the overall behavior of the local groundwater. The well has not been used to generate countours in
BRW19-HCW36	Data for this well does not fit with the overall behavior of the local groundwater. The point has been identified as an outlier and has not been used to generate contours in this figure.
FP98-3	Well was dry on date of data collection.
BPS11-01 BPS11-02 BPS11-08 AMW-02 MW-03-MPC	No data was collected for this well on date of data collection.
BRW18-PZ03 BRW19-PZ30 BRW19-PZ05S FP98-1 BPS07-15A	Well was frozen on date of data collection.



Sample Locations

Feb. 2021 Groundwater Contours (NAVD 88) (0.5-foot interval)

STANDARD DEVIATION (FEET) IN DEPTH TO WATER

- 0.15' - 0.25'
- 0.25' - 0.5'
- 0.5' - 0.75'
- 0.75' - 1'
- 1' - 1.02'

Note: Groundwater contours shown in the figure do not assume a connection between Silver Bow Creek and the shallow aquifer.

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 150 300 600
Feet

FIGURE 11

PIONEER TECHNICAL SERVICES, INC.

GROUNDWATER CONTOURS FOR LOW WATER CONDITIONS (FEB. 2021) IN THE SHALLOW AQUIFER UNIT

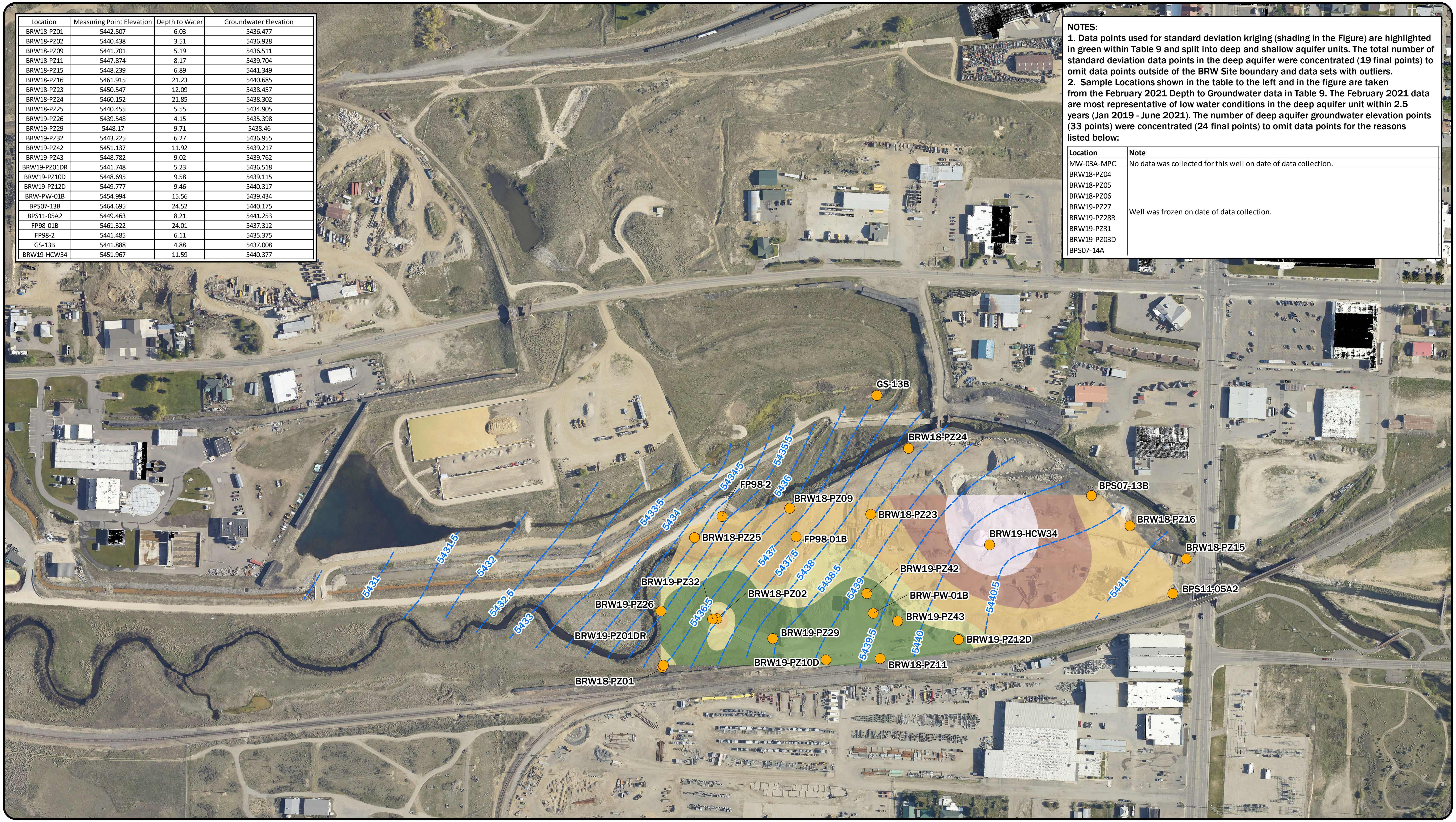
DATE: 3/31/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_029_H2OLevels_Sh_22.mxd

Location	Measuring Point Elevation	Depth to Water	Groundwater Elevation
BRW18-PZ01	5442.507	6.03	5436.477
BRW18-PZ02	5440.438	3.51	5436.928
BRW18-PZ09	5441.701	5.19	5436.511
BRW18-PZ11	5447.874	8.17	5439.704
BRW18-PZ15	5448.239	6.89	5441.349
BRW18-PZ16	5461.915	21.23	5440.685
BRW18-PZ23	5450.547	12.09	5438.457
BRW18-PZ24	5460.152	21.85	5438.302
BRW18-PZ25	5440.455	5.55	5434.905
BRW19-PZ26	5439.548	4.15	5435.398
BRW19-PZ29	5448.17	9.71	5438.46
BRW19-PZ32	5443.225	6.27	5436.955
BRW19-PZ42	5451.137	11.92	5439.217
BRW19-PZ43	5448.782	9.02	5439.762
BRW19-PZ01DR	5441.748	5.23	5436.518
BRW19-PZ10D	5448.695	9.58	5439.115
BRW19-PZ12D	5449.777	9.46	5440.317
BRW-PW-01B	5454.994	15.56	5439.434
BPS07-13B	5464.695	24.52	5440.175
BPS11-05A2	5449.463	8.21	5441.253
FP98-01B	5461.322	24.01	5437.312
FP98-2	5441.485	6.11	5435.375
GS-13B	5441.888	4.88	5437.008
BRW19-HCW34	5451.967	11.59	5440.377

NOTES:
1. Data points used for standard deviation kriging (shading in the Figure) are highlighted in green within Table 9 and split into deep and shallow aquifer units. The total number of standard deviation data points in the deep aquifer were concentrated (19 final points) to omit data points outside of the BRW Site boundary and data sets with outliers.
2. Sample Locations shown in the table to the left and in the figure are taken from the February 2021 Depth to Groundwater data in Table 9. The February 2021 data are most representative of low water conditions in the deep aquifer unit within 2.5 years (Jan 2019 - June 2021). The number of deep aquifer groundwater elevation points (33 points) were concentrated (24 final points) to omit data points for the reasons listed below:

Location	Note
MW-03A-MPC	No data was collected for this well on date of data collection.
BRW18-PZ04	Well was frozen on date of data collection.
BRW18-PZ05	
BRW18-PZ06	
BRW19-PZ27	
BRW19-PZ28R	
BRW19-PZ31	
BRW19-PZ03D	
BPS07-14A	



Sample Locations

Feb. 2021 Groundwater Contours (NAVD 88) (0.5-foot interval)

STANDARD DEVIATION (FEET) IN DEPTH TO WATER

- 0.07' - 0.15'
- 0.15' - 0.2'
- 0.2' - 0.3'
- 0.3' - 0.4'
- 0.4' - 0.6'

Note: Groundwater contours shown in the figure do not assume a connection between Silver Bow Creek and the deep aquifer.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 150 300 600
Feet

FIGURE 12

GROUNDWATER CONTOURS FOR LOW WATER CONDITIONS (FEB. 2021) IN THE DEEP AQUIFER UNIT

PIONEER TECHNICAL SERVICES, INC.

DATE: 3/31/2022

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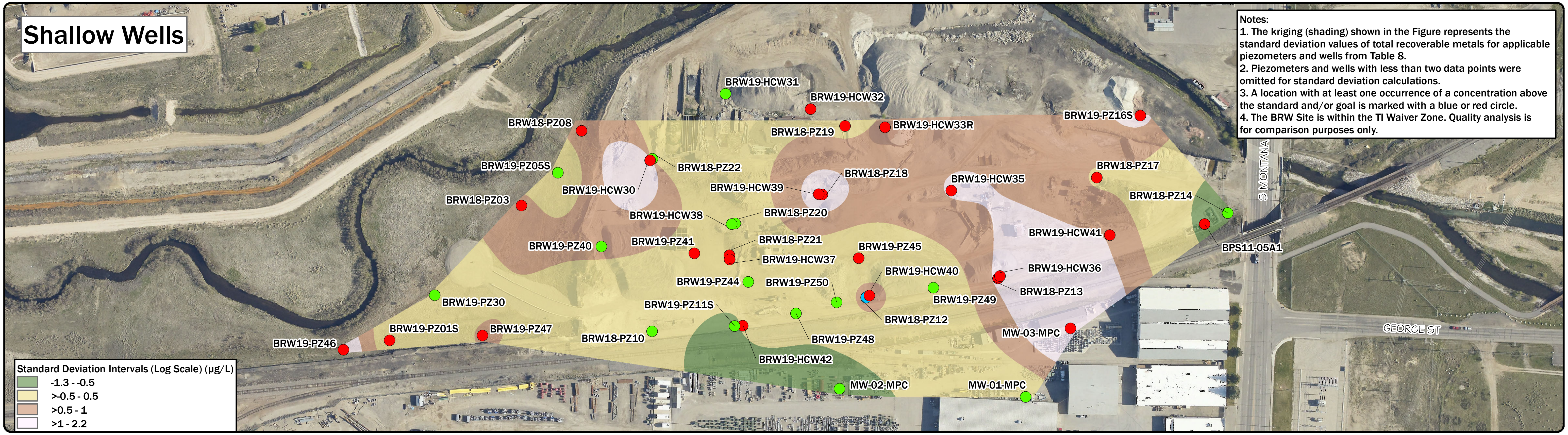
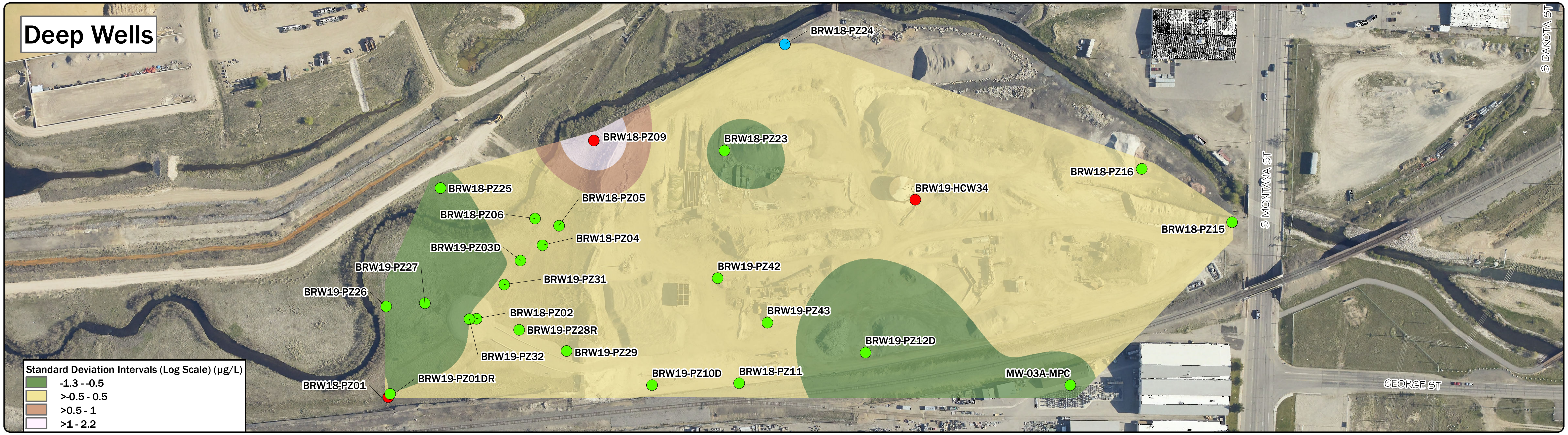




LEGEND

Note: There is no hardness calculation for Arsenic.

- Below Arsenic CD Chronic Surface Water Standard (10 µg/L - Total Recoverable)
- Above Arsenic CD Chronic Surface Water Standard and Below Groundwater Remedial Goal (10 µg/L - Dissolved)
- Above Arsenic CD Chronic Surface Water Standard and Groundwater Remedial Goal (10 µg/L - Dissolved)

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

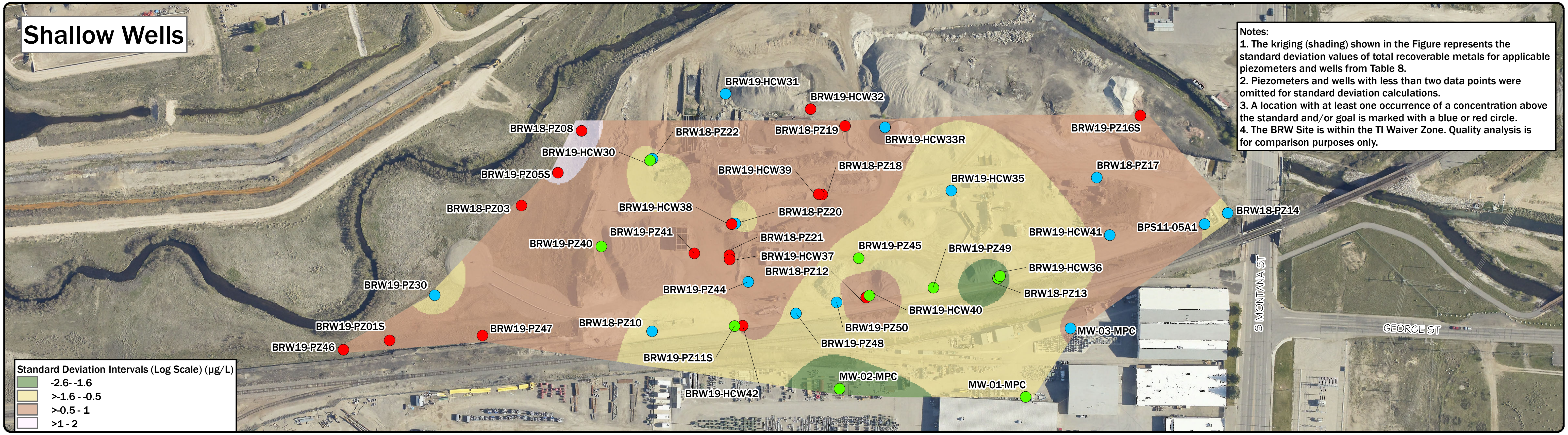
FIGURE 13

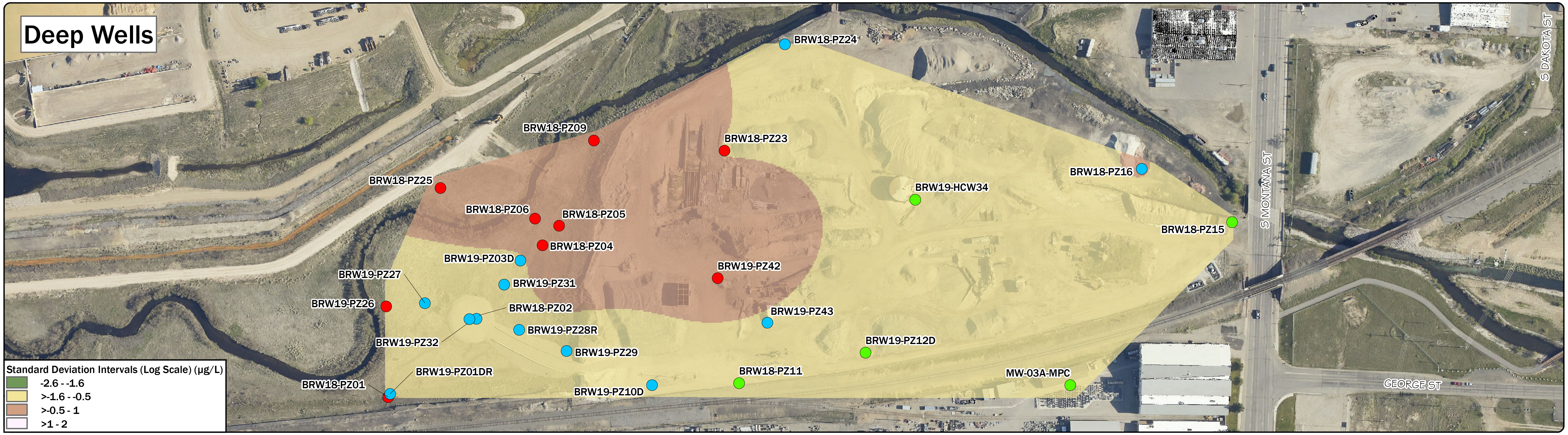
PIONEER TECHNICAL SERVICES, INC.

DATE: 6/6/2022

GW QUALITY ANALYSIS OF ARSENIC COMPARED TO CD PERFORMANCE STANDARDS

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_012_As_GW_Chem_22.mxd





LEGEND
- Below Cadmium CD Chronic Surface Water Standard (1.0 µg/L- Total Recoverable)
- Above Cadmium CD Chronic Surface Water Standard and Below Groundwater Remedial Goal (5 µg/L - Dissolved)
- Above Cadmium CD Chronic Surface Water Standard and Groundwater Remedial Goal (5 µg/L - Dissolved)

Note: A hardness value of 138 mg/L (reported as CaCO3) was used to calculate the Chronic Surface Water Standard for Cadmium.
This hardness value is from USGS Station 12323240 (SS-04), recorded on February 19, 2014.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

FIGURE 14

PIONEER TECHNICAL SERVICES, INC.

DATE: 6/6/2022

GW QUALITY ANALYSIS OF CADMIUM COMPARED TO CD PERFORMANCE STANDARDS

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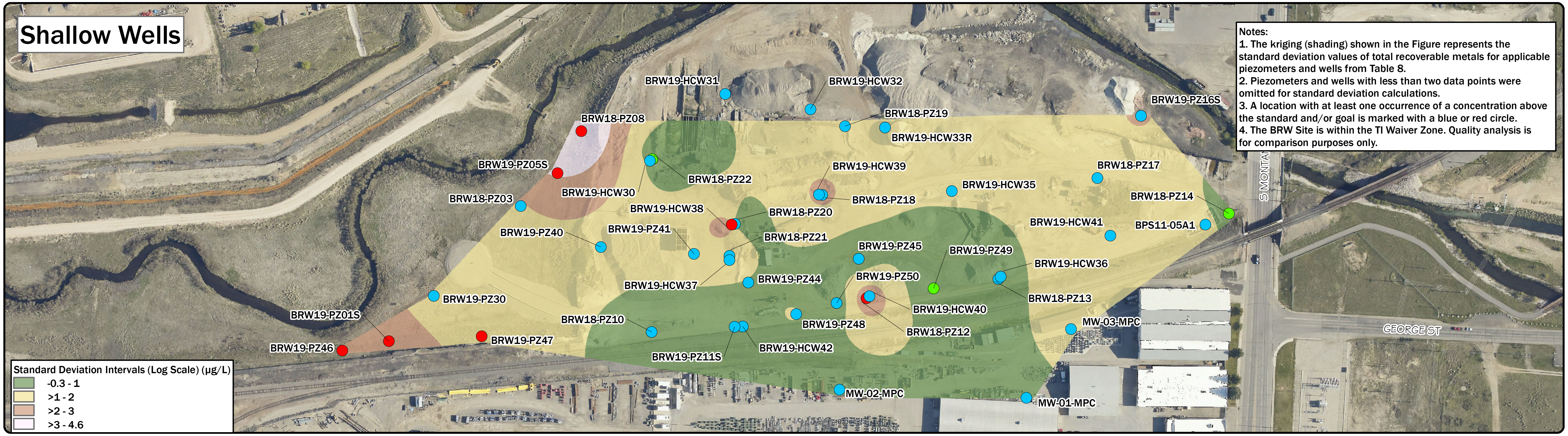
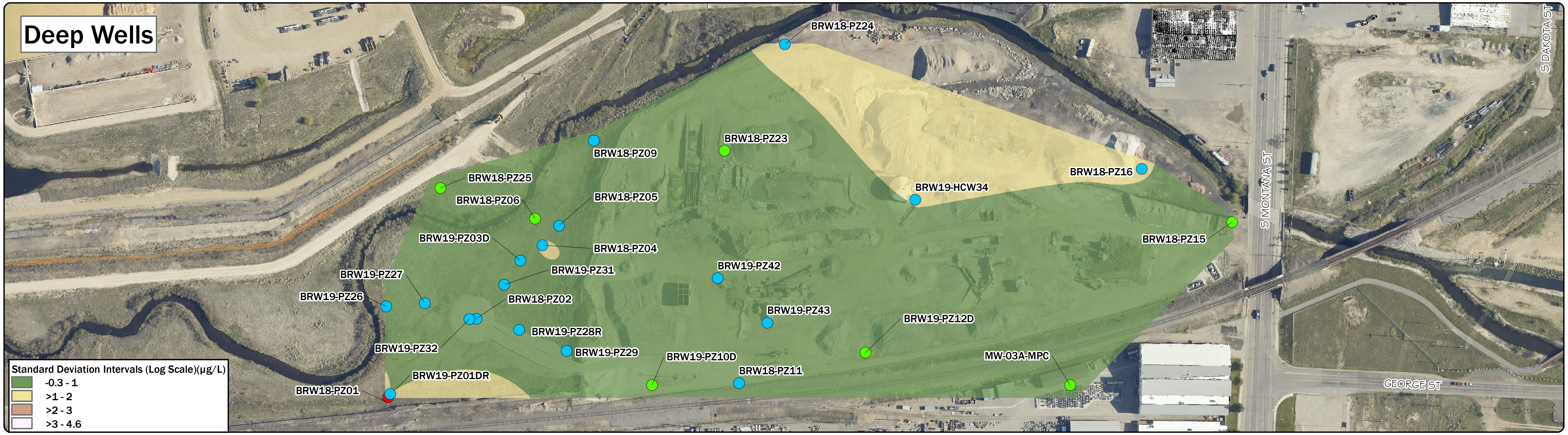




LEGEND

- Below Copper CD Chronic Surface Water Standard (12.3 µg/L - Total Recoverable)
- Above Copper CD Chronic Surface Water Standard and Below Groundwater Remedial Goal (1300 µg/L - Dissolved)
- Above Copper CD Chronic Surface Water Standard and Groundwater Remedial Goal (1300 µg/L - Dissolved)

Note: A hardness value of 138 mg/L (reported as CaCO3) was used to calculate the Chronic Surface Water Standard for Copper.
This hardness value is from USGS Station 12323240 (SS-04), recorded on February 19, 2014.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

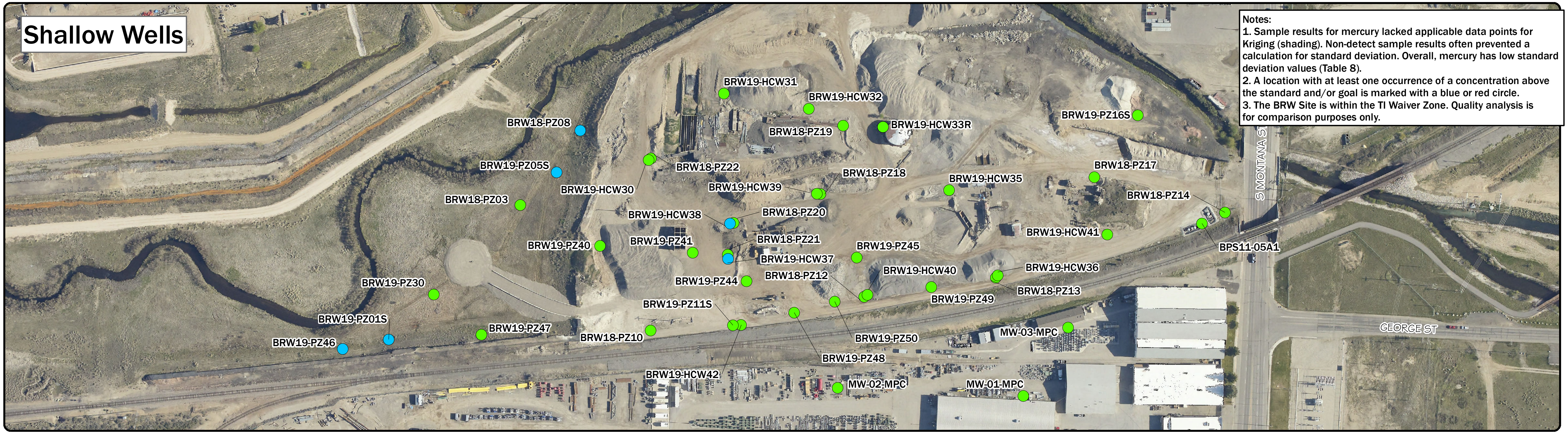
FIGURE 15

PIONEER TECHNICAL SERVICES, INC.

DATE: 6/6/2022

GW QUALITY ANALYSIS OF COPPER COMPARED TO CD PERFORMANCE STANDARDS

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_009_Cu_GW_Chem_22.mxd



LEGEND

- Below Mercury CD Chronic Surface Water Standard (0.05 µg/L - Total Recoverable)
- Above Mercury CD Chronic Surface Water Standard and Below Groundwater Remedial Goal (2 µg/L - Dissolved)
- Above Mercury CD Chronic Surface Water Standard and Groundwater Remedial Goal (2 µg/L - Dissolved))

Note: There is no hardness calculation for Mercury.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

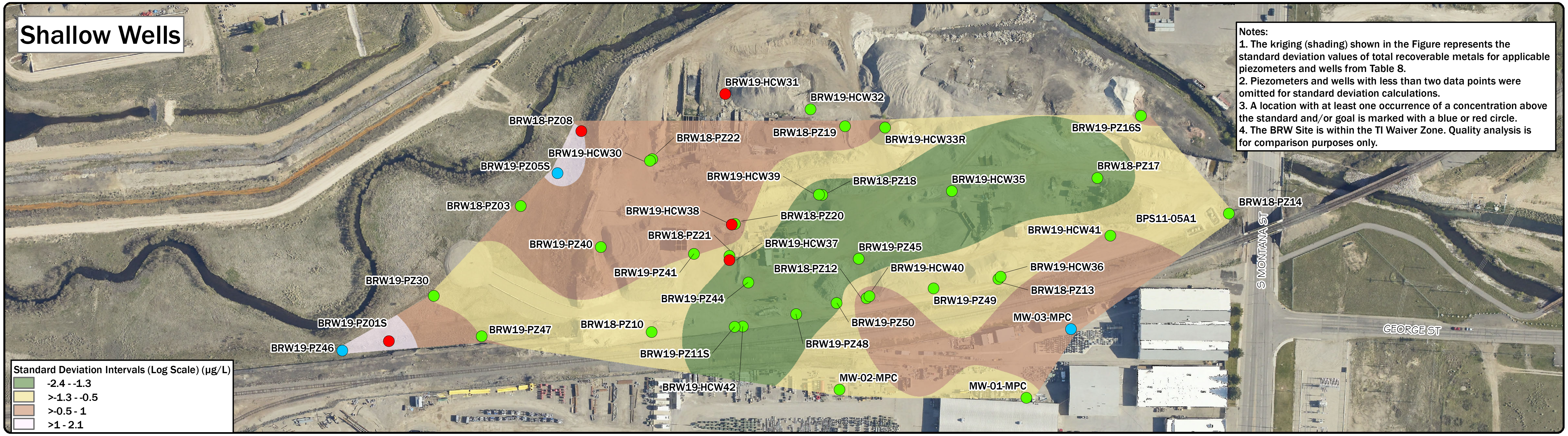
FIGURE 16

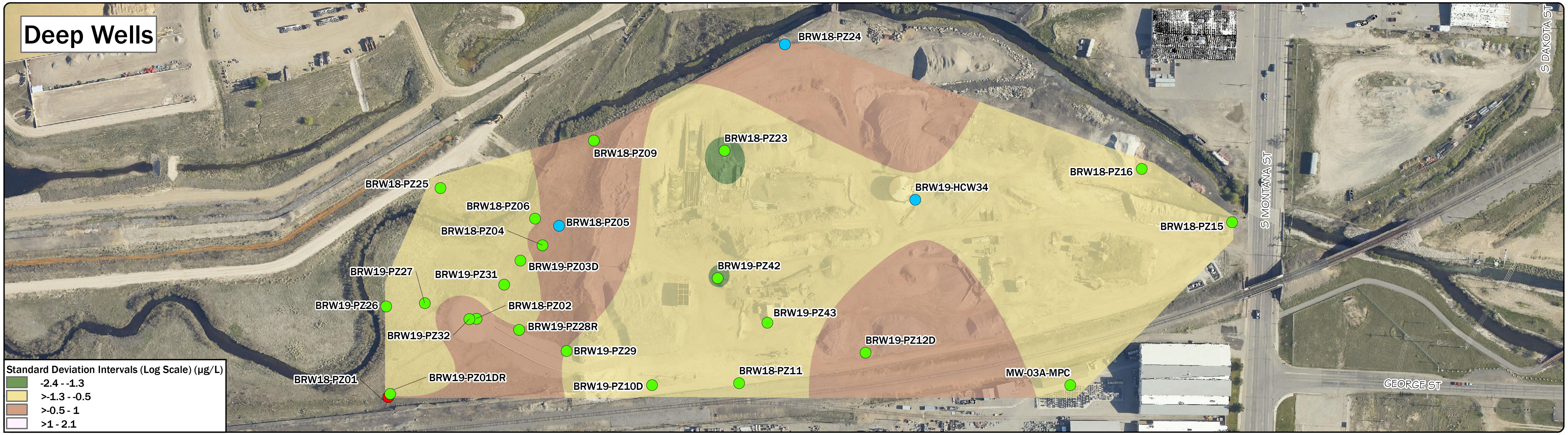
PIONEER TECHNICAL SERVICES, INC.

DATE: 6/6/2022

GW QUALITY ANALYSIS OF MERCURY COMPARED TO CD PERFORMANCE STANDARDS

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_007_Hg_GW_Chem_22.mxd





LEGEND

- Below Lead CD Chronic Surface Water Standard (4.79 µg/L - Total Recoverable)
- Above Lead CD Chronic Surface Water Standard and Below Groundwater Remedial Goal (15 µg/L - Dissolved)
- Above Lead CD Chronic Surface Water Standard and Groundwater Remedial Goal (15 µg/L - Dissolved)

Note: A hardness value of 138 mg/L (reported as CaCO3) was used to calculate the Chronic Surface Water Standard for Lead.
This hardness value is from USGS Station 12323240 (SS-04), recorded on February 19, 2014.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

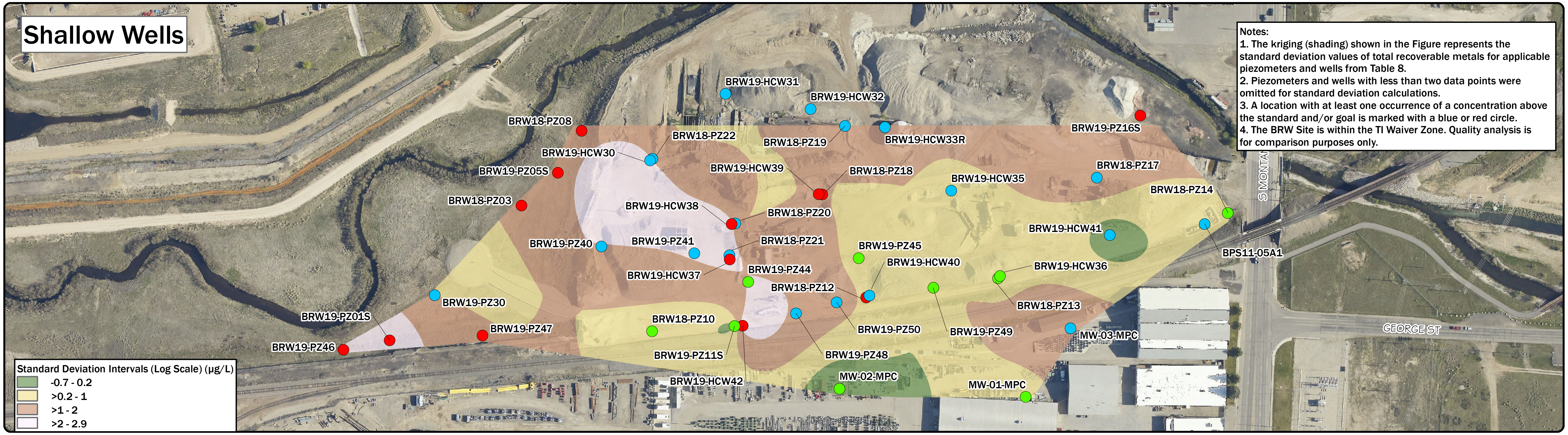
FIGURE 17

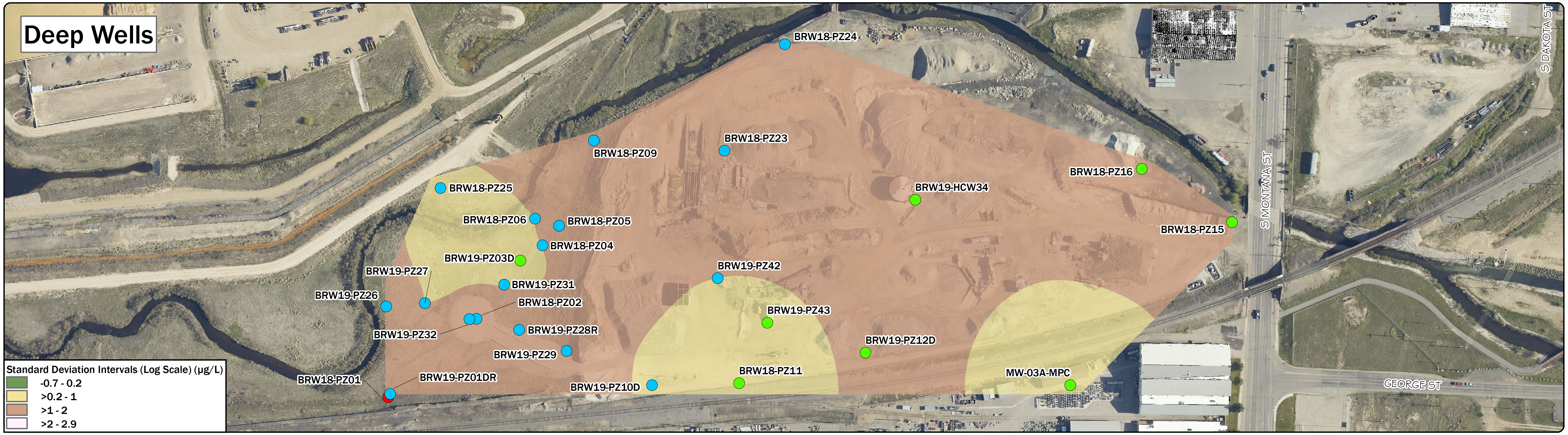
PIONEER TECHNICAL SERVICES, INC.

DATE: 6/6/2022

GW QUALITY ANALYSIS OF LEAD COMPARED TO CD PERFORMANCE STANDARDS

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_011_Pb_GW_Chem_22.mxd





LEGEND

- Below Zinc CD Chronic Surface Water Standard (157 µg/L - Total Recoverable)
- Above Zinc CD Chronic Surface Water Standard and Below Groundwater Remedial Goal (2000 µg/L - Dissolved)
- Above Zinc CD Chronic Surface Water Standard and Groundwater Remedial Goal (2000 µg/L - Dissolved)

Note: A hardness value of 138 mg/L (reported as CaCO3) was used to calculate the Chronic Surface Water Standard for Zinc.
This hardness value is from USGS Station 12323240 (SS-04), recorded on February 19, 2014.

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTERNATIONAL FEET
SOURCE: PIONEER/QSI 2020

0 100 200 400
Feet

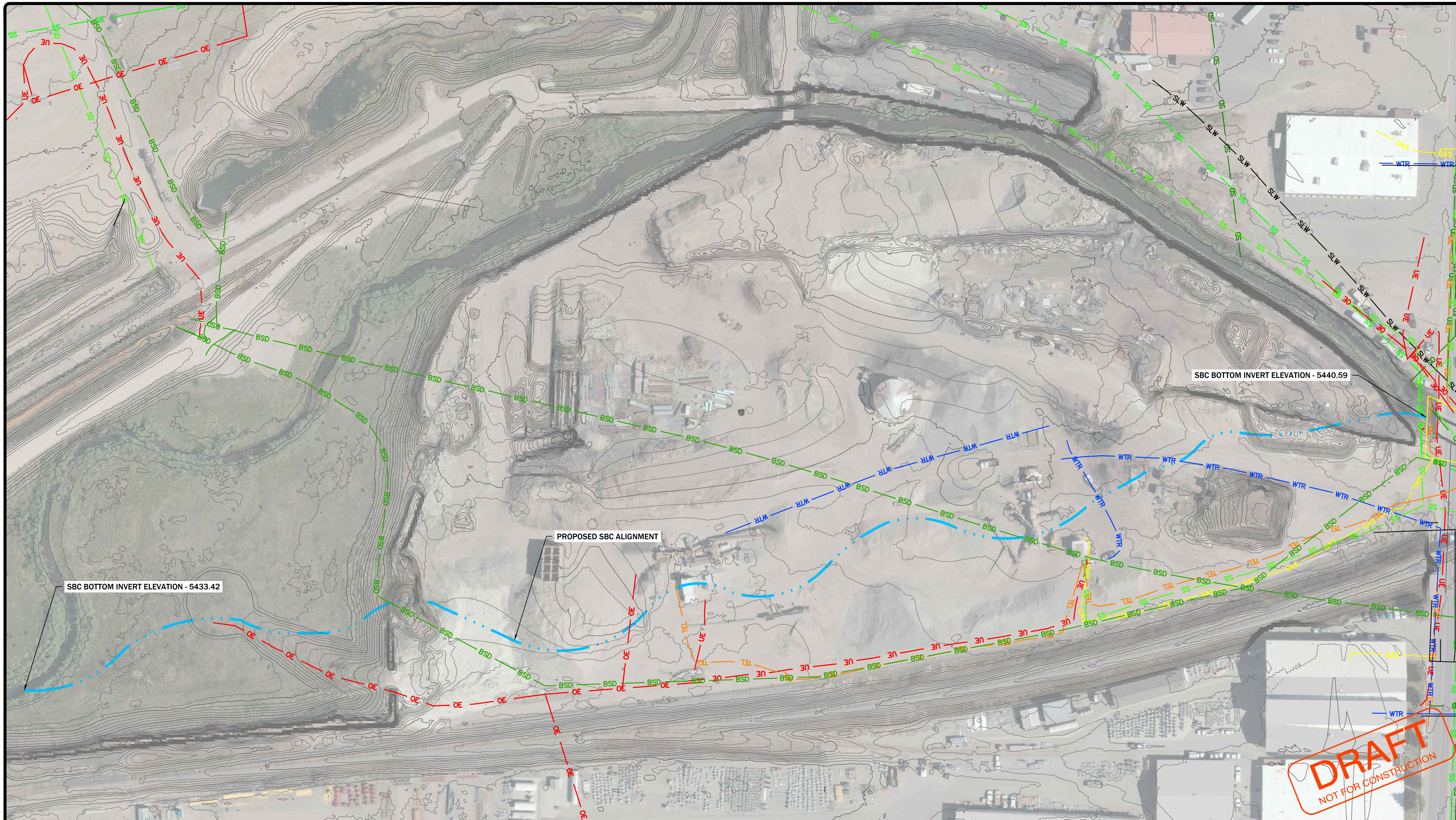
FIGURE 18

GW QUALITY ANALYSIS OF ZINC COMPARED TO CD PERFORMANCE STANDARDS

PIONEER TECHNICAL SERVICES, INC.

DATE: 6/6/2022

Path: Z:\Shared\Active Projects\ARCO\BPSOU\BRW\GIS\Z_PDI Evaluation Report PII\BRW_PII_PDIER_006_Zn_GW_Chem_22.mxd



LEGEND:

- BSD — BPSOU SUBDRAIN LINE
- WTR — WATER LINE
- GAS — GAS LINE
- TEL — TELEPHONE LINE
- UE — UNDERGROUND ELECTRIC LINE
- SLW — SILVER LAKE WATER LINE
- SS — SANITARY SEWER LINE
- SD — STORM DRAIN LINE
- OE — OVERHEAD ELECTRIC LINE

NOTE:

1. UTILITY LOCATIONS SHOW ARE APPROXIMATE. THE APPROXIMATE UTILITY LOCATIONS SHOWN ARE BASED ON PHOTOGRAMMETRY, RECORDS PROVIDED BY THE UTILITY OWNERS, THIRD PARTY UTILITY LOCATES, AND/OR POTHOLE ACTIVITIES. ALL UTILITY LOCATIONS SHOWN ARE LIMITED TO THE ACCURACY OF THE LOCATION METHODS. ADDITIONAL UTILITY VERIFICATION WILL BE REQUIRED TO FURTHER DEFINE THE UTILITY LOCATIONS AS NECESSARY TO COMPLETE THE FUTURE REMEDIAL ACTION WORK.
2. THE CONTOURS SHOWN ON THIS FIGURE DO NOT REPRESENT CURRENT CONDITIONS. THESE CONTOURS ESTIMATE THE GROUND SURFACE FOLLOWING THE REMOVAL OF MATERIALS IMPORTED BY BUTTE-SILVER BOW.

N

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
0 60 120

FIGURE 19

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

SITE SURVEY AND UTILITIES

DATE: 3/2022

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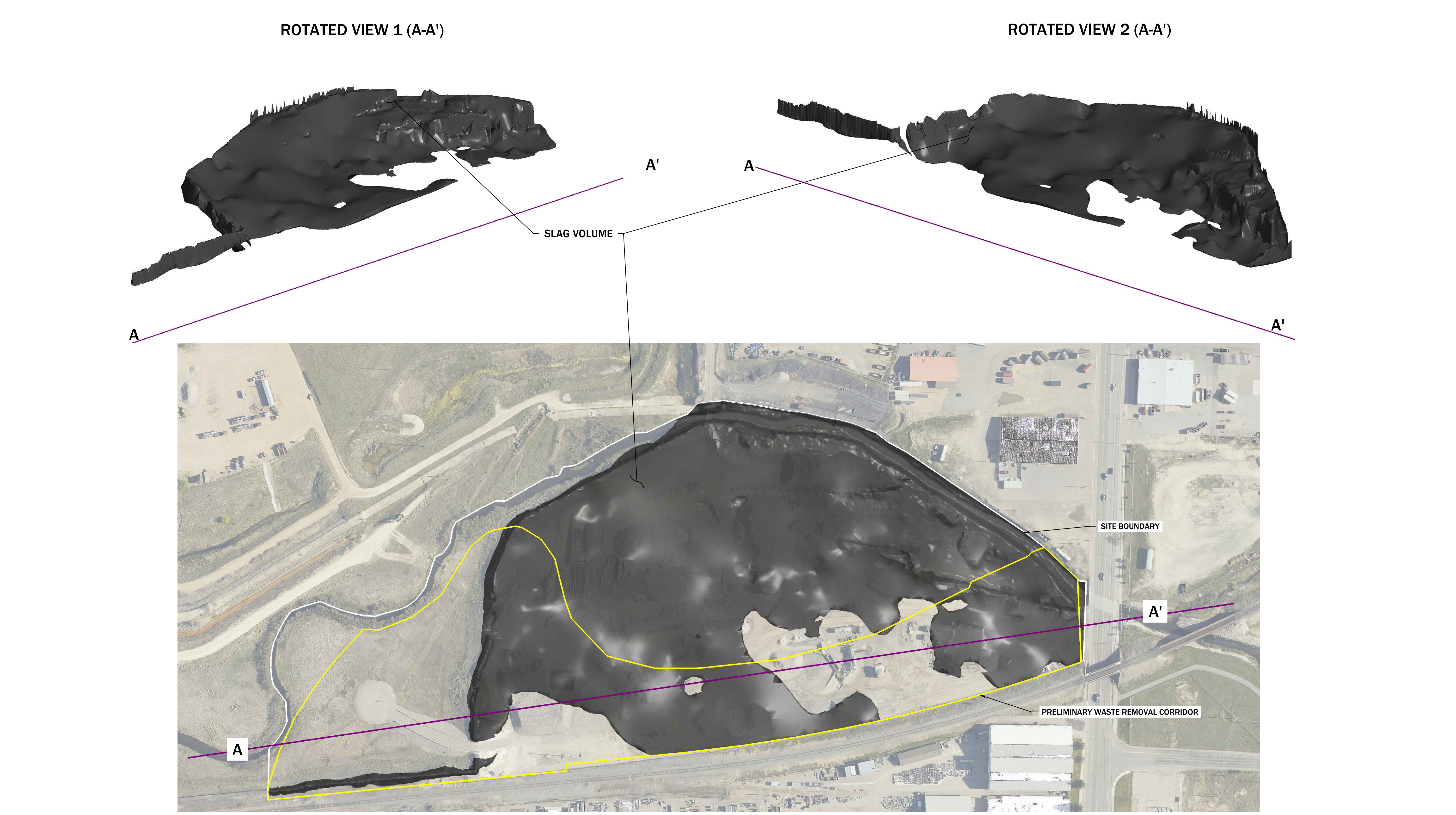


NOTE:

1. THIS FIGURE AND MODELED VOLUMES WERE GENERATED USING LEAPFROG WORKS. THE VOLUME IS A MODELED APPROXIMATION BASED ON THE BOREHOLE AND TEST PIT DATA COLLECTED DURING THE BRW PHASE I AND PHASE II SITE INVESTIGATIONS AS WELL AS OBSERVATIONS FROM PREVIOUS INVESTIGATIONS AND THE INSTALLATION OF OLDER MONITORING WELLS. THE ROTATED VIEWS HAVE BEEN SCALED SO THE ELEVATION (Z) AXIS IS 5 TIMES GREATER THAN THE NORTHING (Y) AND EASTING (X) AXES.
2. THE WASTE REMOVAL CORRIDOR SHOWN IS PRELIMINARY AND ONLY SHOWN AS A REFERENCE AT THIS POINT. THE WASTE REMOVAL CORRIDOR AND EXCAVATION SURFACE WILL BE REFINED FURTHER DURING THE REMEDIAL DESIGN AND WILL BE SUBMITTED FOR AGENCIES' REVIEW AND APPROVAL.

N

DISPLAYED AS:
COORD SYS/ZONE: NA
DATUM: NA
UNITS: NA
SOURCE: PIONEER/QSI 2020

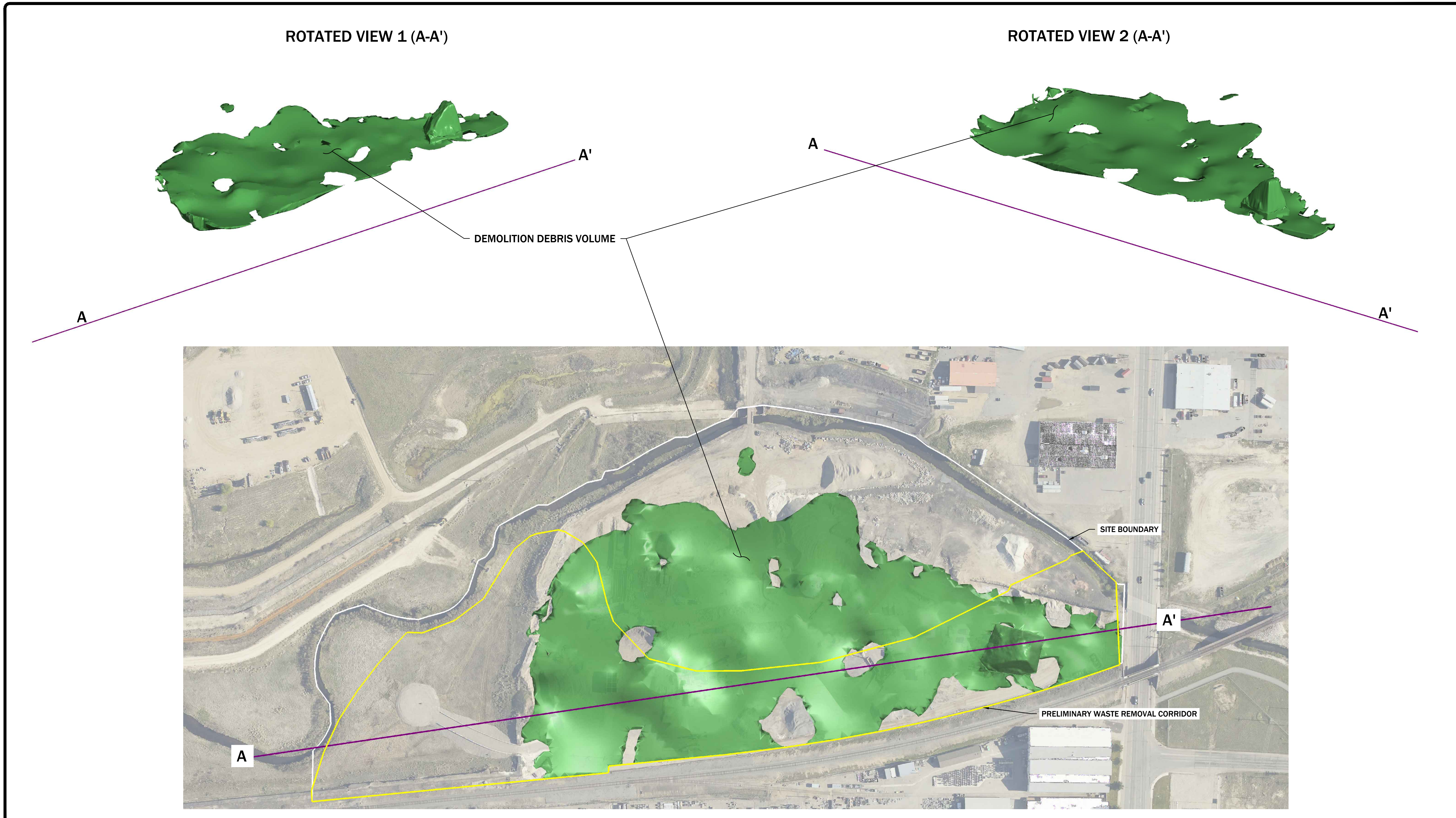
SCALE IN FEET
0 N.T.S.

FIGURE 20

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

SLAG DISTRIBUTION WITHIN THE SITE

DATE: 3/2022



NOTE:

1. THIS FIGURE AND MODELED VOLUMES WERE GENERATED USING LEAPFROG WORKS. THE VOLUME IS A MODELED APPROXIMATION BASED ON THE BOREHOLE AND TEST PIT DATA COLLECTED DURING THE BRW PHASE I AND PHASE II SITE INVESTIGATIONS AS WELL AS OBSERVATIONS FROM PREVIOUS INVESTIGATIONS AND THE INSTALLATION OF OLDER MONITORING WELLS. THE ROTATED VIEWS HAVE BEEN SCALED SO THE ELEVATION (Z) AXIS IS 5 TIMES GREATER THAN THE NORTHING (Y) AND EASTING (X) AXES.
2. THE WASTE REMOVAL CORRIDOR SHOWN IS PRELIMINARY AND ONLY SHOWN AS A REFERENCE AT THIS POINT. THE WASTE REMOVAL CORRIDOR AND EXCAVATION SURFACE WILL BE REFINED FURTHER DURING THE REMEDIAL DESIGN AND WILL BE SUBMITTED FOR AGENCIES' REVIEW AND APPROVAL.

N

DISPLAYED AS:

COORD SYS/ZONE: NA
DATUM: NA
UNITS: NA
SOURCE: PIONEER/QSI 2020

SCALE IN FEET
0 N.T.S.

FIGURE 21

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

DEMOLITION DEBRIS DISTRIBUTION WITHIN THE SITE

DATE: 3/2022

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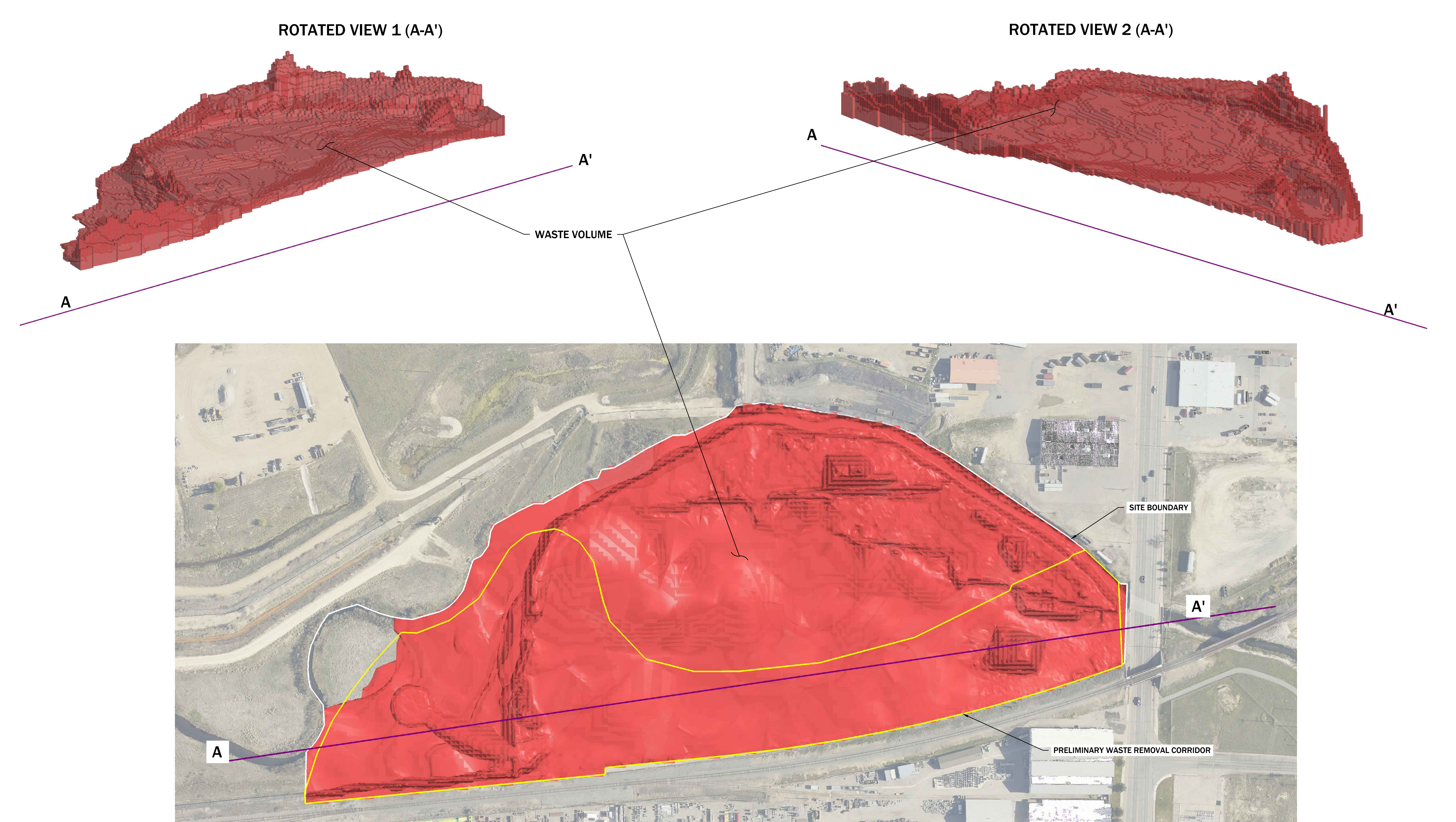


NOTE:

1. THIS FIGURE AND MODELED VOLUMES WERE GENERATED USING LEAPFROG WORKS. THE VOLUME IS A MODELED APPROXIMATION BASED ON THE BOREHOLE AND TEST PIT DATA COLLECTED DURING THE BRW PHASE I AND PHASE II SITE INVESTIGATIONS AS WELL AS OBSERVATIONS FROM PREVIOUS INVESTIGATIONS AND THE INSTALLATION OF OLDER MONITORING WELLS. THE ROTATED VIEWS HAVE BEEN SCALED SO THE ELEVATION (Z) AXIS IS 5 TIMES GREATER THAN THE NORTHING (Y) AND EASTING (X) AXES.
2. THE WASTE REMOVAL CORRIDOR SHOWN IS PRELIMINARY AND ONLY SHOWN AS A REFERENCE AT THIS POINT. THE WASTE REMOVAL CORRIDOR AND EXCAVATION SURFACE WILL BE REFINED FURTHER DURING THE REMEDIAL DESIGN AND WILL BE SUBMITTED FOR AGENCIES' REVIEW AND APPROVAL.
3. "WASTE" IN THIS FIGURE IS DEFINED AS MATERIAL THAT HAS CONCENTRATIONS ABOVE THE WASTE IDENTIFICATION CRITERIA IN THE BPSOU CD (TABLE 1). ONLY WASTE WITHIN THE PRELIMINARY REMOVAL CORRIDOR WILL BE REMOVED, IF PRACTICABLE.

N

DISPLAYED AS:

COORD SYS/ZONE:	NA
DATUM:	NA
UNITS:	NA
SOURCE:	PIONEER/QSI 2020

SCALE IN FEET
0 N.T.S.

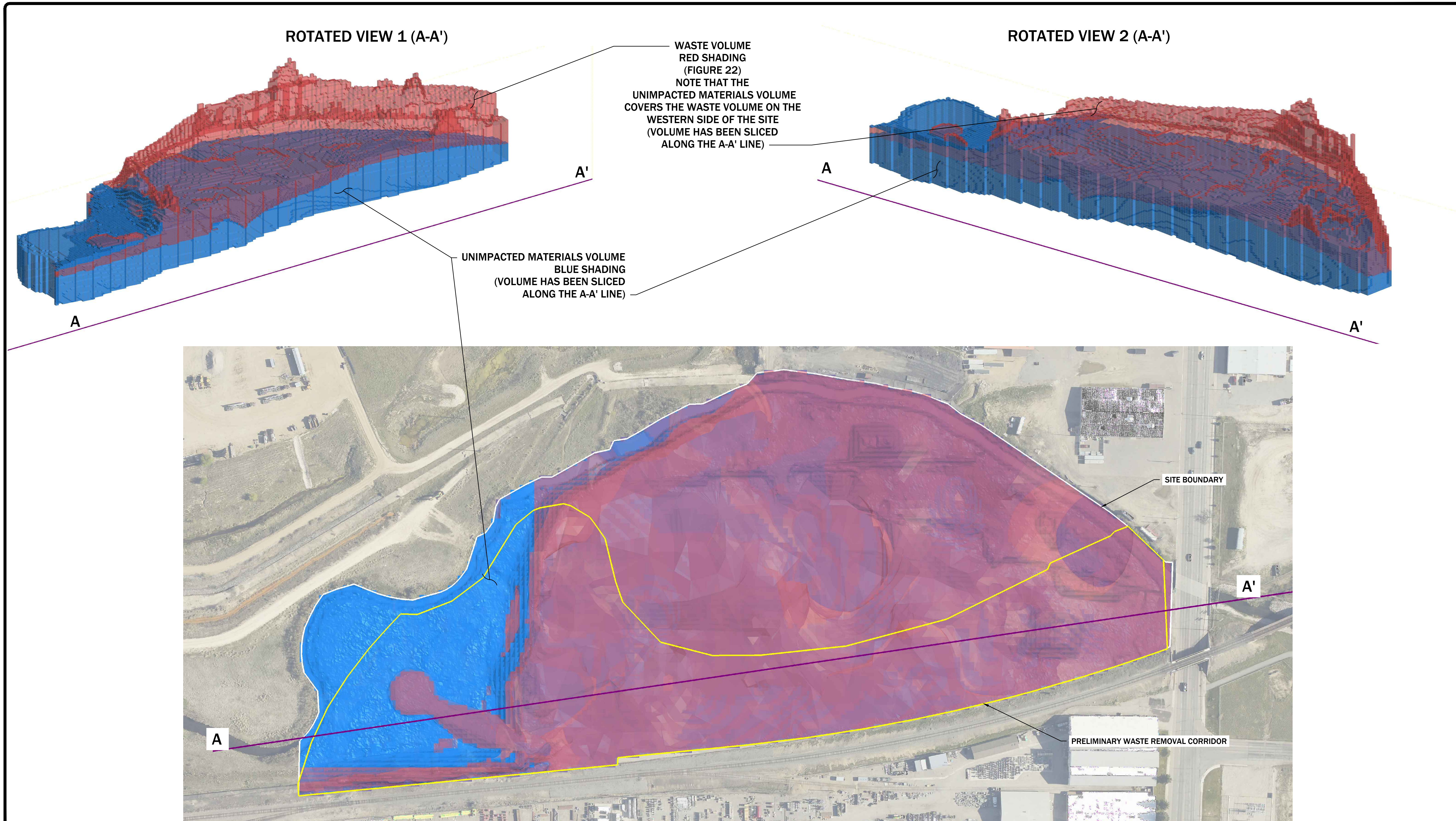
FIGURE 22

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

WASTE DISTRIBUTION WITHIN THE SITE

DATE: 3/2022

3/14/2022 12:03:21 PM Z:\SHARED\ACTIVE PROJECTS\ARCO\BPSOU\BRW\CADD\FIGURES\BRW_FG_PLN-015-21.DWG



NOTE:

1. THIS FIGURE AND MODELED VOLUMES WERE GENERATED USING LEAPFROG WORKS. THE VOLUME IS A MODELED APPROXIMATION BASED ON THE BOREHOLE AND TEST PIT DATA COLLECTED DURING THE BRW PHASE I AND PHASE II SITE INVESTIGATIONS AS WELL AS OBSERVATIONS FROM PREVIOUS INVESTIGATIONS AND THE INSTALLATION OF OLDER MONITORING WELLS. THE ROTATED VIEWS HAVE BEEN SCALED SO THE ELEVATION (Z) AXIS IS 5 TIMES GREATER THAN THE NORTHING (Y) AND EASTING (X) AXES.
2. THE WASTE REMOVAL CORRIDOR SHOWN IS PRELIMINARY AND ONLY SHOWN AS A REFERENCE AT THIS POINT. THE WASTE REMOVAL CORRIDOR AND EXCAVATION SURFACE WILL BE REFINED FURTHER DURING THE REMEDIAL DESIGN AND WILL BE SUBMITTED FOR AGENCIES' REVIEW AND APPROVAL.
3. "WASTE" IN THIS FIGURE IS DEFINED AS MATERIAL THAT HAS CONCENTRATIONS ABOVE THE WASTE IDENTIFICATION CRITERIA IN THE BPSOU CD (TABLE 1). ONLY WASTE WITHIN THE PRELIMINARY REMOVAL CORRIDOR WILL BE REMOVED, IF PRACTICABLE.

N

DISPLAYED AS:

COORD SYS/ZONE:	NA
DATUM:	NA
UNITS:	NA
SOURCE:	PIONEER/QSI 2020

SCALE IN FEET
0 N.T.S.

FIGURE 23

UNIMPACTED MATERIALS DISTRIBUTION WITHIN THE SITE

PIONEER TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

DATE: 3/2022

3/24/2022 10:25:00 AM Z:\SHARED\ACTIVE PROJECTS\ARCO\BPSOU\BRW\CADD\FIGURES\BRW_FG_PLN-016-21.DWG

Preliminary Waste Removal Corridor

EXISTING PHASE III LOCATIONS

- Phase III Waste Characterization Boreholes
- Geotech Analysis Boreholes
- Phase III Piezometers

Note:
Phase III locations were installed according to the Phase III QAPP. Data collected has not yet been validated. Once data has been reviewed and validated it will be included in PDI Evaluation Report

N

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PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INT'L FEET
SOURCE: PIONEER/ QSI 2020

0 100 200 400
Feet

FIGURE 24

PIONEER TECHNICAL SERVICES, INC.

PHASE III SITE INVESTIGATION POINTS

DATE: 3/15/2022

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TABLES

Table 1
Waste Identification Criteria

If three of the six contaminant criteria listed are exceeded or any one contaminant is above 5,000 milligram per kilogram (mg/kg) then, the material is considered tailings, waste, or contaminated soil.

Arsenic	200 mg/kg
Cadmium	20 mg/kg
Copper	1,000 mg/kg
Lead	1,000 mg/kg
Mercury	10 mg/kg
Zinc	1,000 mg/kg
Any single analyte above 5,000 mg/kg	

Table 2. Data Gaps Summary

Data Gap Categories	Objectives	Phase I Site Investigation	Additional GW Sampling	Hydrocarbon Investigation	Phase II Site Investigation	Phase III Site Investigation	Additional Investigations	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)	Phase III Site Investigation (Phase III QAPP) Supplemental Groundwater and Surface Water Sampling (Phase II QAPP, RFC 01 and RFC 02)	Additional Investigations to Fill Remaining Data Gaps
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.	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.	A final series of boreholes were constructed. Laboratory and XRF data, soil lithology logs, and photographic logs from boreholes will be used to fill any design-related data gaps pertaining to the volume and distribution of impacted materials within the BRW site.	NA
	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).	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.	Borehole samples were analyzed using an XRF field unit or sent for laboratory ICP analysis. Select samples were sent for laboratory SPLP (leachability) analyses.	As part of the Microbial Analysis and Biotreatability Study, additional samples from test pits will be sent for metals analysis. Additional samples from archived cores will be collected and submitted for SPLP analysis.
	Leachability of Metals	O			O	O	✓					
	Constructability Considerations											
	Geotechnical Considerations				O	O	✓	NA	NA	The slag investigation collected data on the physical parameters of the slag and examined means of removing the slag.	Additional boreholes were drilled during a geotechnical investigation to determine properties of the underlying soil and then the data will be used to evaluate the geotechnical requirements of the end-land use plan and excavation design.	A final geotechnical survey will be performed on the western portion of the site to characterize a clay layer by drilling boreholes and collecting geotechnical samples (i.e., direct shear, gradation, consolidation testing, Atterberg limits).
	Location of Subsurface Flume/Culvert	✓					+	The geophysical MASW Seismic Survey confirmed the existence and location of the subsurface flume/culvert.		NA	NA	Completion of a primary wave seismic investigation will provide additional data needed to determine if subsurface voids exists within BRW Site where excavation or end-land use structures will be constructed.
	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 for BPSOU COCs	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, the hydraulic conductivity of the screened aquifer. Manual groundwater level measurements were used to augment and refine the groundwater elevations, potentiometric surfaces, and seasonal groundwater change.	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.	Groundwater elevations and groundwater samples were collected from select piezometers and monitoring wells during high (Phase III QAPP) and low (Phase II RFC 01 and 02) groundwater and surface water conditions to help refine and augment the spatial variability of the groundwater chemistry within the BRW Site. Low-flow sampling parameters will be used to estimate the hydraulic conductivity of the screened aquifer interval. Monthly groundwater levels were recorded and used to evaluate groundwater elevations, potentiometric surfaces, and seasonal groundwater change. A network of surface water and groundwater monitoring points will be used to determine the impact of BRW groundwater on subsections of SBC during high and low groundwater and surface water conditions. This work included monitoring stream gages, sampling for COCs, and Radon-222 tracing tests to monitor groundwater flux, surface water flux, and COC loading.	NA
	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	✓						
	Aquifer Geometry	O		O	✓	+						
Organic Pollutants	Chemistry and Spatial Variability of organic pollutants	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.	Data was collected and sent for labortory analysis from select wells/piezometers for soil and groundwater 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 was screened with PIDs for the presence of hydrocarbons with select samples sent for laboratory analyses.	Additional organic pollutant data collection will provide more data for the chemistry and spatial variability within BRW Site. Soil samples and analyses for COC's, nutrients, hydrocarbon concentrations/leachability, and microbial quantification will help to determine impacts to both the existing microbial community and inhibited biological processes that naturally occur in soil. Data will also assist with determining if chemical oxidation is a practical treatment method.
	Plan to Manage Impacted Soil and/or Groundwater	O	O	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	Complete a bathymetric survey of the anticipated tie in locations for the reconstructed SBC. The sediment samples will be taken near the tie in locations and submitted for particle sizing analysis to help instruct the design of the SBC channel.
	Evaluation of Potential Lining of Relocated SBC	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.	

	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
COC - Contaminant of Concern	MASW - Multichannel Analysis of Surface Waves	QAPP - Quality Assurance Project Plan
GW - Groundwater	NA - Not applicable	SBC - Silver Bow Creek

Table 3. Investigation Points and Analyses For Phase I and Phase II Site Investigations

Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase I Site Investigation - Borehole and Piezometer Installation												
BRW18-PZ01	9/20/2018	12/4/2018 10/22/2019 7/16/2020 8/24/2020 11/10/2020	X	-	1-A, 2-A, 3-A, 4-A, 6A, 7-A	1-B, 2-B	-	1-D, 2-D, 3-D 5-D, 7-D	-	1-D, 2-D, 3-D, 5-D, 7-D	-	-
BRW18-PZ02	9/20/2018	12/5/2018 10/24/2019 10/1/2020 10/12/2020 11/5/2020	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B, 5-B	-	-	1-D	-	1-D, 2-D, 3-D, 8-D	-
BRW18-PZ03	9/19/2018 5/12/2020	12/4/2018 10/22/2019 10/1/2020 10/12/2020 11/4/2020	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B	-	-	1-D	-	1-D, 2-D, 3-D, 8-D	-
BRW18-PZ04	9/19/2018	12/4/2018 10/22/2019 11/12/2020	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 7-A	1-B, 2-B	-	-	-	1-D, 2-D, 3-D	-	-
BRW18-PZ05	9/17/2018	12/4/2018 10/18/2019	X	X	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B, 5-B	-	-	1-D	-	-	-
BRW18-PZ06	9/18/2018 5/12/2020	12/3/2018 10/18/2019	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B	-	-	-	-	-	-
BRW18-PZ07*	-	-	-	-	-	-	-	-	-	-	-	-
BRW18-PZ08	9/18/2018	12/3/2018 10/17/2019 10/1/2020 10/12/2020 11/4/2020	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B, 5-B	-	-	-		1-D, 2-D, 3-D, 8-D	-
BRW18-PZ09	9/19/2018	12/3/2018 10/17/2019 10/1/2020 10/12/2020 11/4/2020	X	X	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B, 5-B	-	-	-		1-D, 2-D, 3-D, 8-D	-
BRW18-PZ10	9/28/2018	11/28/2018 10/21/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 7-A	1-B, 2-B, 5-B	-	-	1-D	-	-	-

*Proposed investigation point wasn't installed. Table 1 of BRW Phase I DSR (Appendix A) details these points.
**Water levels only.
***Groundwater samples were collected before and after the pumping test.

****Due to field conditions, multiple boreholes were drilled for this location. The second borehole is indicated with a "R" in the location name. The official location name is the borehole in which the piezometer was installed. Sample names reported within this report include the borehole location name that the sample was collected from.

Table 3. Investigation Points and Analyses For Phase I and Phase II Site Investigations (cont.)

Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	Transducer	Initial Phase I Site Investigation (August 2018 to 2019)	Additional Groundwater Sampling: RFC BRW-2019-01 (October to November 2019)	Hydrocarbon Investigation: RFC BRW-2019-03 (December 2019 to February 2020)	Pre-Pumping Test (August 2020)	Pumping Test (October 2020)	Post-Pumping Test (November 2020)	Silver Bow Creek Metals Load Analysis*** (October to November 2020)	Slag Investigation (September 2020 and March 2021)
BRW18-PZ11	10/8/2018	11/29/2018 10/21/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A,7-A	1-B, 2-B, 5-B	-	-	1-D	-	-	-
BRW18-PZ12	10/5/2018 5/12/2020	11/28/2018 10/21/2019	X	X	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	-	-	1-D	-	-	-
BRW18-PZ13	10/11/2018 5/12/2020	11/28/2018 10/21/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B, 5-B	-	-	-	-	-	-
BRW18-PZ14	10/8/2018 5/12/2020	11/29/2018 10/15/2019 11/16/2020	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 7-A	1-B, 2-B	-	-	-	1-D, 2-D, 3-D	-	-
BRW18-PZ15	10/5/2018 5/12/2020	11/29/2018 10/15/2019 11/16/2020	X	X	1-A, 2-A, 3-A, 4-A, 6-A, 6b-A, 6c-A, 7-A, 12-A	1-B, 2-B	-	-	-	1-D, 2-D, 3-D	-	-
BRW18-PZ16	10/10/2018	11/29/2018 10/21/2019	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 7-A	1-B, 2-B	-	-	1-D	-	-	-
BRW18-PZ17	10/15/2018 5/13/2020	11/29/2018 10/15/2019 11/16/2020	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 7-A	1-B, 2-B	-	-	-	1-D, 2-D, 3-D	-	-
BRW18-PZ18	10/3/2018 5/12/2020 5/13/2020	11/27/2018 10/25/2019 11/17/2020	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 7-A, 10-A, 11-A	1-B, 2-B, 5-B	-	-	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW18-PZ19	9/27/2018	11/27/2018 10/23/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	-	-	-	-	-	-
BRW18-PZ20	10/3/2018	11/30/2018 10/25/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	-	-	1-D	-	-	-
BRW18-PZ21	10/4/2018 5/12/2020	11/26/2018 10/25/2019 2/14/2020	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	1-C, 2-C, 4-C	-	1-D	-	-	-
BRW18-PZ22	9/26/2018 5/12/2020	11/30/2018 10/25/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	-	-	1-D	-	-	-
BRW18-PZ23	10/9/2018 5/13/2020	11/27/2018 10/24/2019	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	-	-	-	-	-	-
BRW18-PZ24	10/9/2018	11/28/2018 10/24/2019 11/13/2020	X	-	1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	1-B, 2-B, 5-B	-	-	-	1-D, 2-D, 3-D, 6-D	-	-
BRW18-PZ25	10/10/2018	12/5/2018 10/22/2019	X	-	1-A, 2-A, 3-A, 4-A, 6-A, 7-A	1-B, 2-B	-	-	1-D	-	-	-

*Proposed investigation point wasn't installed. Table 1 of BRW Phase I DSR (Appendix A) details these points.
**Water levels only.
***Groundwater samples were collected before and after the pumping test.

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase I Site Investigation - Borehole Only												
BRW18-BH01	10/12/2018 05/12/2020	NA	-	-	6-A, 7-A, 10-A, 11-A, 12-A	-	-	-	-	-	-	-
BRW18-BH02	10/12/2018 10/17/2018		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH03	9/24/2018 9/25/2018 5/12/2020		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH04*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH05	9/25/2018		-	-	6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	-	-	-	-	-	-	-
BRW18-BH06	10/2/2018		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH07	10/2/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH08	9/28/2018 10/1/2018 5/12/2020		-	-	6-A, 7-A, 10-A, 11-A	-	-	-	-	-	-	-
BRW18-BH09	9/24/2018 5/12/2020		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH10	9/27/2018 9/28/2018 5/12/2020		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH11	10/11/2018 5/12/2020		-	-	6-A, 6b-A, 6c-A, 7-A, 10-A, 11-A, 12-A	-	-	-	-	-	-	-
BRW18-BH12*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH13*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH14*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH15*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH16	10/12/2018 5/12/2020		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH17*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH18	9/18/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH19*	-		-	-	-	-	-	-	-	-	-	-
BRW18-BH20	9/17/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH21	9/13/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH22	9/13/2018 5/12/2020		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH23	9/13/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH24	9/13/2018 5/12/2020		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH25	9/13/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH26	9/14/2018		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH27	9/14/2018		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH28	9/14/2018		-	-	6-A, 6b-A, 6c-A, 7-A, 12-A	-	-	-	-	-	-	-
BRW18-BH29	9/17/2018 5/12/2020		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-BH30	9/17/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase I Site Investigation - Test Pit												
BRW18-TP01	10/26/2018		-	-	6-A, 7-A, 10-A	-	-	-	-	-	-	-
BRW18-TP02	10/25/2018		-	-	6-A, 10-A	-	-	-	-	-	-	-
BRW18-TP03	10/25/2018		-	-	6-A	-	-	-	-	-	-	-
BRW18-TP04	10/25/2018		-	-	6-A, 7-A, 8-A	-	-	-	-	-	-	-
BRW18-TP05	10/25/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-TP06*	-		-	-	-	-	-	-	-	-	-	-
BRW18-TP07*	-		-	-	-	-	-	-	-	-	-	-
BRW18-TP08	10/24/2018 5/12/2020		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-TP09	10/24/2018	NA	-	-	6-A, 6b-A, 6c-A, 7-A, 8-A, 12-A	-	-	-	-	-	-	-
BRW18-TP10	10/24/2018 5/12/2020		-	-	6-A, 6b-A, 6c-A, 7-A, 8-A	-	-	-	-	-	-	-
BRW18-TP11*	-		-	-	-	-	-	-	-	-	-	-
BRW18-TP12*	-		-	-	-	-	-	-	-	-	-	-
BRW18-TP13*	-		-	-	-	-	-	-	-	-	-	-
BRW18-TP14	10/23/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-TP15	10/24/2018		-	-	6-A, 7-A	-	-	-	-	-	-	-
BRW18-TP16	10/24/2018		-	-	6-A, 7-A, 8-A	-	-	-	-	-	-	-
BRW18-TP17	10/25/2018		-	-	6-A, 7-A, 10-A		-	-	-	-	-	-

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase I Site Investigation - Hydrocarbon Investigation Monitoring Wells (borehole and piezometer installation)												
BRW19-HCW30	12/18/2019	2/4/2020 11/18/2020	X	-	-	-	1-C, 2-C, 4-C, 7-C, 9-C	-	-	1-D, 2-D, 3-D, 6-D	-	-
BRW19-HCW31	12/17/2019	1/28/2020	X	-	-	-	1-C, 2-C, 4-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCW32	12/19/2019 5/12/2020	1/30/2020	X	-	-	-	1-C, 2-C, 4-C, 6-C, 7-C, 8-C, 9-C	-	-	-	-	-
BRW19-HCW33R****	1/14/2020 5/12/2020	2/5/2020	X	-	-	-	1-C, 2-C, 4-C, 6-C, 7-C, 8-C, 9-C	-	-	-	-	-
BRW19-HCW34	1/10/2020	2/5/2020	X	-	-	-	1-C, 2-C, 4-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCW35	1/9/2020 1/10/2020 5/12/2020	2/4/2020 11/19/2020	X	-	-	-	1-C, 2-C, 4-C, 6-C, 7-C, 8-C, 9-C	-	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-HCW36	-	2/5/2020	X	-	-	-	1-C, 2-C, 3-C, 4-C, 7-C	-	-	-	-	-
BRW19-HCW37	1/6/2020	2/5/2020	X	-	-	-	1-C, 2-C, 4-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCW38	1/7/2020	2/6/2020 11/18/2020	X	-	-	-	1-C, 2-C, 4-C, 7-C, 9-C	-	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-HCW39	1/9/2020	2/5/2020	X	-	-	-	1-C, 2-C, 4-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCW40	12/17/2019	1/28/2020	X	-	-	-	1-C, 2-C, 3-C, 4-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCW41	1/8/2020 5/13/2020	1/28/2020 11/18/2020	X	-	-	-	1-C, 2-C, 3-C, 4-C, 6-C, 7-C, 8-C, 9-C	-	-	1-D, 2-D, 3-D, 6-D	-	-
BRW19-HCW42	1/6/2020	1/28/2020 11/13/2020	X	-	-	-	1-C, 2-C, 3-C, 4-C, 7-C, 9-C	-	-	1-D, 2-D, 3-D, 6-D	-	-
Phase I Site Investigation - Hydrocarbon Investigation Test Pits												
BRW19-HCTP30	1/16/2020	NA	-	-	-	-	6-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCTP31	1/16/2020		-	-	-	-	6-C, 7-C, 9-C	-	-	-	-	-
BRW19-HCTP32	1/16/2020		-	-	-	-	6-C, 7-C, 9-C	-	-	-	-	-

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	Transducer	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase I and Phase II Site Investigations - Existing Monitoring Wells												
AMW-02			X	-	-	-	-	-	-	-	-	-
BPS07-08A			X	-	-	-	-	-	-	-	-	-
BPS07-13A			X	X	-	-	-	-	-	-	-	-
BPS07-13B			X	X	-	-	-	-	-	-	-	-
BPS07-14A		-	X	X	-	-	-	-	-	-	-	-
BPS07-15A			X	X	-	-	-	-	-	-	-	-
BPS07-25			X	X	-	-	-	-	-	-	-	-
BPS11-01			X	-	-	-	-	-	-	-	-	-
BPS11-02			X	-	-	-	-	-	-	-	-	-
BPS11-05A1		1/27/2020	X	X	-	-	1-C, 2-C, 4-C	-	-	-	-	-
BPS11-05A2			X	X	-	-	-	-	-	-	-	-
BPS11-06			X	X	-	-	-	-	-	-	-	-
BPS11-07			X	-	-	-	-	-	-	-	-	-
BPS11-08		-	X	-	-	-	-	-	-	-	-	-
BPS11-09			X	-	-	-	-	-	-	-	-	-
BPS11-12A			X	-	-	-	-	-	-	-	-	-
FP98-01B			X	X	-	-	-	-	-	-	-	-
FP98-1		3/2/2021 6/1/2021	X	X	-	-	-	-	1-D	-	-	-
FP98-2			X	-	-	-	-	-	1-D	-	-	-
GS-13A	NA		X	-	-	-	-	-	-	-	-	-
GS-13B			X	-	-	-	-	-	-	-	-	-
HCA-MG3		-	X	-	-	-	-	-	-	-	-	-
FP98-3			X	-	-	-	-	-	-	-	-	-
FP98-5			X	-	-	-	-	-	-	-	-	-
GS-29SR			X	-	-	-	-	-	-	-	-	-
MW-01-MPC		10/23/2019 11/14/2019 1/30/2020	X	-	-	1-B, 2-B, 3-B, 4-B, 5-B	1-C, 2-C, 3-C, 4-C	-	-	-	-	-
MW-02-MPC		10/23/2019 11/14/2019 1/30/2020	X	-	-	1-B, 2-B, 3-B, 4-B, 5-B	1-C, 2-C, 3-C, 4-C	-	-	-	-	-
MW-03A-MPC		10/23/2019 11/14/2019 1/30/2020	X	-	-	1-B, 2-B, 3-B, 4-B, 5-B	1-C, 2-C, 3-C, 4-C	-	-	-	-	-
MW-03-MPC		10/23/2019 11/14/2019 1/30/2020 11/19/2020	X	-	-	1-B, 2-B, 3-B, 4-B, 5-B	1-C, 2-C, 3-C, 4-C	-	-	1-D, 2-D, 3-D, 6-D	-	-

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase I and Phase II Site Investigations - Existing Surface Water Locations												
SS-04			X	X	10-A	-	-	-	-	-	-	-
SS-05			X	X	10-A	-	-	-	-	-	-	-
SS-05.6			X	-	-	-	-	-	-	-	-	-
SS-05.7			X	X	-	-	-	-	-	-	-	-
SS-05.9R			X	X	-	-	-	-	-	-	-	-
SBC Sed B-8			X	X	-	-	-		-	-	-	-
SS-05A		10/01/2020 10/06/2020 10/14/2020 10/28/2020 11/04/2020	X	X	-	-	-	-	-	-	1-D, 2-D, 3-D, 8-D	-
SS-05B	NA	10/01/2020 10/06/2020 10/14/2020 10/28/2020 11/04/2020	X	X	-	-	-	-	-	-	1-D, 2-D, 3-D, 8-D	-
SS-06A		10/01/2020 10/06/2020 10/14/2020 10/28/2020 11/04/2020	X	-	-	-	-	-	-	-	1-D, 2-D, 3-D, 8-D	-
BRW-00		-	X	X	-	-	-	-	1-D	-	-	-
Phase II Site Investigation - Borehole and Piezometer Installation												
BRW19-PZ01DR****	7/20/2020	8/12/2020 11/11/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 12-D, 13-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ01S	7/20/2020	8/12/2020 11/10/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 13-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ03D	7/23/2020	8/4/2020 11/11/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 12-D, 13-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ05S	7/22/2020	8/4/2020 11/11/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 13-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ10D	-	8/13/2020 11/12/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D	1-D	1-D, 2-D, 3-D, 6-D	-	-

*Proposed investigation point wasn't installed. Table 1 of BRW Phase I DSR (Appendix A) details these points.
**Water levels only.
***Groundwater samples were collected before and after the pumping test.

****Due to field conditions, multiple boreholes were drilled for this location. The second borehole is indicated with a "R" in the location name. The official location name is the borehole in which the piezometer was installed. Sample names reported within this report include the borehole location name that the sample was collected from.

Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
BRW19-PZ11S	-	8/13/2020 11/12/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ12D	-	8/13/2020 11/16/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ16S	7/6/2020	8/17/2020 11/13/2020	X	-	-	-	-	1-D, 2-D, 3-D, 6-D, 13-D, 11-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ26	7/23/2020	8/4/2020 11/9/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 13-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ27	7/27/2020	8/4/2020 11/9/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 13-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ28R****	7/28/2020	8/11/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 13-D, 14-D	1-D	-	-	-
BRW19-PZ29	7/28/2020	8/4/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 13-D	1-D	-	-	-
BRW19-PZ30	7/29/2020	8/12/2020 11/9/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ31	7/29/2020	8/11/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 14-D	1-D	-	-	-
BRW19-PZ32	7/30/2020	8/11/2020 11/12/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ40	7/14/2020	8/17/2020	X	-	-	-	-	1-D, 2-D, 3-D, 6-D, 11-D, 12-D, 13-D, 14-D	1-D	-	-	-

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**Water levels only.
***Groundwater samples were collected before and after the pumping test.

****Due to field conditions, multiple boreholes were drilled for this location. The second borehole is indicated with a "R" in the location name. The official location name is the borehole in which the piezometer was installed. Sample names reported within this report include the borehole location name that the sample was collected from.

Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	Transducer	Initial Phase I Site Investigation (August 2018 to 2019)	Additional Groundwater Sampling: RFC BRW-2019-01 (October to November 2019)	Hydrocarbon Investigation: RFC BRW-2019-03 (December 2019 to February 2020)	Pre-Pumping Test (August 2020)	Pumping Test (October 2020)	Post-Pumping Test (November 2020)	Silver Bow Creek Metals Load Analysis*** (October to November 2020)	Slag Investigation (September 2020 and March 2021)
BRW19-PZ41	7/8/2020	8/14/2020	X	-	-	-	-	1-D, 2-D, 3-D, 6-D, 11-D, 12-D, 13-D, 14-D	1-D	-	-	-
BRW19-PZ42	7/13/2020	8/14/2020 11/16/2020	X	-	-	-	-	1-D, 2-D, 3-D, 6-D, 11-D, 12-D, 13-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ43	7/13/2020	8/13/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 12-D, 14-D	1-D	-	-	-
BRW19-PZ44	7/7/2020	8/14/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 12-D, 13-D, 14-D	1-D	-	-	-
BRW19-PZ45	7/7/2020	8/13/2020 11/16/2020	X	-	-	-	-	1-D, 2-D, 3-D, 11-D, 12-D, 13-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ46	7/21/2020 8/19/2020	8/12/2020 10/1/2020 10/12/2020 11/4/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 13-D, 14-D	1-D	-	1-D, 2-D, 3-D, 5-D, 6-D, 7-D, 8-D	-
BRW19-PZ47	7/22/2020 8/19/2020	8/12/2020 11/11/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D, 13-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ48	8/20/2020	8/24/2020 11/17/2020	X	-	-	-	-	1-D, 2-D, 3-D, 6-D, 10-D, 11-D, 12-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ49	8/18/2020	8/24/2020 11/18/2020	X	-	-	-	-	1-D, 2-D, 3-D, 6-D, 10-D, 11-D, 12-D, 14-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
BRW19-PZ50	7/31/2020	8/13/2020 11/18/2020	X	-	-	-	-	1-D, 2-D, 3-D, 10-D, 11-D, 12-D	1-D	1-D, 2-D, 3-D, 6-D	-	-
Phase II Site Investigation - Pumping Wells												
BRW-PW-01A	-	7/16/2020 10/5/2020 10/6/2020 10/7/2020 10/8/2020	X	-	-	-	-	5-D, 7-D	1-D, 2-D, 3-D, 4-D, 5-D, 6-D, 7-D	-	-	-
BRW-PW-01B	-	7/16/2020 10/27/2020 10/28/2020 10/29/2020 10/30/2020	X	-	-	-	-	5-D, 7-D	1-D, 2-D, 3-D, 4-D, 5-D, 6-D, 7-D	-	-	-

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
Phase II Site Investigation - Installed Surface Water Locations												
B-5		7/16/2020 10/01/2020 10/06/2020 10/14/2020 10/28/2020 11/04/2020	X	-	-	-	-	-	-	-	1-D, 2-D, 3-D, 5-D, 7-D, 8-D	-
B-6	NA	7/16/2020 10/01/2020 10/06/2020 10/14/2020 10/28/2020 11/04/2020	X	-	-	-	-	-	-	1-D	1-D, 2-D, 3-D, 5-D, 7-D, 8-D	-
BRW-SS-01		10/01/2020 10/06/2020 10/14/2020 10/28/2020 11/04/2020	X	-	-	-	-	-	-	-	1-D, 2-D, 3-D, 8-D	-
Phase II Site Investigation - Slag Investigation Test Pits												
BRW20-TP33			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP34			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP35			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP36			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP37			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP38			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP39			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP40			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP41			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP42			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP43	-		-	-	-	-	-	-	-	-	-	11-D
BRW20-TP44			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP45			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP46		NA	-	-	-	-	-	-	-	-	-	11-D
BRW20-TP47			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP48			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP49			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP50			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP51			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP52			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP53			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP54			-	-	-	-	-	-	-	-	-	11-D
BRW20-TP55	9/4/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP56	9/4/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP57	9/4/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D, 14-D
BRW20-TP58	9/4/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP59	9/8/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D, 14-D

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Location	Date of Soil Sampling	Date of Groundwater Sampling	Water Level Monitoring		Phase I Site Investigation			Phase II Site Investigation				
			Monthly Manual Water Levels	**Transducer**	**Initial Phase I Site Investigation** (August 2018 to 2019)	**Additional Groundwater Sampling: RFC BRW-2019-01** (October to November 2019)	**Hydrocarbon Investigation: RFC BRW-2019-03** (December 2019 to February 2020)	**Pre-Pumping Test** (August 2020)	**Pumping Test** (October 2020)	**Post-Pumping Test** (November 2020)	**Silver Bow Creek Metals Load Analysis***** (October to November 2020)	**Slag Investigation** (September 2020 and March 2021)
BRW20-TP60	9/8/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D, 14-D
BRW20-TP61	9/8/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D
BRW20-TP62	9/9/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP63	9/9/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D
BRW20-TP64	9/9/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D
BRW20-TP65	9/9/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D
BRW20-TP66	9/10/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 13-D
BRW20-TP67	9/10/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP68	9/10/2020	NA	-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP69	9/10/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D
BRW20-TP70	9/11/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 14-D
BRW20-TP71	9/11/2020		-	-	-	-	-	-	-	-	-	11-D, 12-D, 14-D
BRW20-TP72	-		-	-	-	-	-	-	-	-	-	11-D
BRW21-TP1	-		-	-	-	-	-	-	-	-	-	11-D
BRW21-TP2	3/17/2021		-	-	-	-	-	-	-	-	-	11-D, 13-D
BRW21-TP3	-		-	-	-	-	-	-	-	-	-	11-D
BRW21-TP4	-		-	-	-	-	-	-	-	-	-	11-D
Phase II Site Investigation - Slag Investigation Boreholes												
BRW20-BH31			-	-	-	-	-	-	-	-	-	11-D
BRW20-BH32			-	-	-	-	-	-	-	-	-	11-D
BRW20-BH33	NA	NA	-	-	-	-	-	-	-	-	-	11-D
BRW20-BH34			-	-	-	-	-	-	-	-	-	11-D
BRW20-BH35			-	-	-	-	-	-	-	-	-	11-D
Previously Installed Test Pits (BRW Smelter Site Test Pit Report [NRDP, 2016a])												
BRW-TP-01			-	-	-	-	-	-	-	-	-	-
BRW-TP-02			-	-	-	-	-	-	-	-	-	-
BRW-TP-03			-	-	-	-	-	-	-	-	-	-
BRW-TP-04			-	-	-	-	-	-	-	-	-	-
BRW-TP-05			-	-	-	-	-	-	-	-	-	-
BRW-TP-06			-	-	-	-	-	-	-	-	-	-
BRW-TP-07			-	-	-	-	-	-	-	-	-	-
BRW-TP-08			-	-	-	-	-	-	-	-	-	-
BRW-TP-09			-	-	-	-	-	-	-	-	-	-
BRW-TP-10			-	-	-	-	-	-	-	-	-	-
BRW-TP-11			-	-	-	-	-	-	-	-	-	-
BRW-TP-12			-	-	-	-	-	-	-	-	-	-
BRW-TP-13			-	-	-	-	-	-	-	-	-	-
BRW-TP-14			-	-	-	-	-	-	-	-	-	-
BRW-TP-15	NA	NA	-	-	-	-	-	-	-	-	-	-
BRW-TP-16			-	-	-	-	-	-	-	-	-	-
BRW-TP-17			-	-	-	-	-	-	-	-	-	-
BRW-TP-18			-	-	-	-	-	-	-	-	-	-
BRW-TP-19			-	-	-	-	-	-	-	-	-	-
BRW-TP-20			-	-	-	-	-	-	-	-	-	-
BRW-TP-21			-	-	-	-	-	-	-	-	-	-
BRW-TP-22			-	-	-	-	-	-	-	-	-	-
BRW-TP-23			-	-	-	-	-	-	-	-	-	-
BRW-TP-24			-	-	-	-	-	-	-	-	-	-
BRW-TP-25			-	-	-	-	-	-	-	-	-	-
BRW-TP-26			-	-	-	-	-	-	-	-	-	-
BRW-TP-27			-	-	-	-	-	-	-	-	-	-
BRW-TP-28			-	-	-	-	-	-	-	-	-	-
BRW-TP-29			-	-	-	-	-	-	-	-	-	-
BRW-TP-30			-	-	-	-	-	-	-	-	-	-

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**Water levels only.
***Groundwater samples were collected before and after the pumping test.

****Due to field conditions, multiple boreholes were drilled for this location. The second borehole is indicated with a "R" in the location name. The official location name is the borehole in which the piezometer was installed. Sample names reported within this report include the borehole location name that the sample was collected from.

Table 4. Sample Collection, Preservation, and Holding Times

Analytical Group	Analytical Lab/Company	Analyte	Analytical Method	Lab Reporting Limit/CRQL	Lab Method Detection Limit[2]	Holding Time	Container Size	Preservation[1]
Initial Phase I Site Investigation (August 2018 to 2019)								
Groundwater Field Parameters								
(1-A)	Pioneer	Water level	NA	NA	NA	NA	NA	NA
		Temperature						
		Specific conductance (SC)						
		Dissolved Oxygen (DO)						
		pH						
		Oxidation Reduction Potential (ORP)						
		Ferrous iron and total iron (Chemetrics V-2000 Photometer)	NA			NA	NA	NA
Groundwater Laboratory Samples								
(2-A)	PACE	Total recoverable and dissolved arsenic (As)	EPA 200.8 (Rev 5.4)	NA	NA	6 Months	250-mL high-density polyethylene (HDPE) bottle	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Total recoverable and dissolved cadmium (Cd)						
		Total recoverable and dissolved copper (Cu)						
		Total recoverable and dissolved lead (Pb)						
		Total recoverable and dissolved zinc (Zn)						
		Total recoverable and dissolved iron (Fe)						
(3-A)	Energy Laboratories	Dissolved Calcium (Ca)	EPA 200.7 (Rev 4.4)/ EPA 200.8 (Rev 5.4)			6 Months	250-mL high-density polyethylene (HDPE) bottle	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Dissolved Potassium (K)						
		Dissolved Silica (SiO_2)						
		Dissolved Sodium (Na)						
		Dissolved Aluminum (Al)						
		Dissolved Barium (Ba)						
		Dissolved Boron (B)						
		Dissolved Cobalt (Co)						
		Dissolved Magnesium (Mg)						
		Dissolved Manganese (Mn)						
		Dissolved Molybdenum (Mo)						
		Dissolved Nickel (Ni)						
		Dissolved Strontium (Sr)						
		Dissolved Vanadium (V)						
		Dissolved Cerium (Ce)						
		Dissolved Lithium (Li)						
		Dissolved Palladium (Pd)						
		Dissolved Rubidium (Rb)						
		Dissolved Tungsten (W)						
		Dissolved Uranium (U)						
		Bicarbonate (HCO_3)	SM 2320B			14 Days	250-mL HDPE bottle	Raw
		Carbonate (CO_3)						
		Alkalinity, Total (as $CaCO_3$)						
		Bromide (Br)	EPA 300.1 (Rev 1.0)			28 Days		
		Chloride (Cl)						
		Sulfate (SO4)						
		Fluoride (F)	A4500-F C			28 Days	250-mL HDPE bottle	Raw
		Total Hardness	Calculation			None	None	None
		Total Dissolved Solids (TDS)						
(4-A)	Energy Laboratories	Dissolved Arsenic [As (III)]	EPA 1632A			28 Days	250-mL HDPE bottle	Acidified with HCl, field filtered with 0.45 µm filter (dissolved).
		Dissolved Arsenic [As (V)]						
		Total Arsenic (As)	EPA 200.8 (Rev 5.4)			6 Months	250-mL HDPE bottle	Unfiltered, acidified with HNO_3.
(5-A)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)			14 Days	3, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)			14 Days	2, 1-L amber glass	Unfiltered, acidified with H_2SO_4.
Soil Field Readings								
(6-A)	Pioneer Laboratory XRF *used to field screen, however this analytical group refers to Pioneer Laboratory XRF only.	Arsenic (As)	NA	NA	NA	NA	NA	NA
		Cadmium (Cd)						
		Calcium (Ca)						
		Chromium (Cr)						
		Copper (Cu)						
		Iron (Fe)						
		Lead (Pb)						
		Manganese (Mn)						
		Zinc (Zn)						
(6b-A)	Pioneer	Soil Nitrate Test	NA			NA	NA	NA
(6c-A)	Pioneer PID MiniRAE (PID MR) - 10.6 eV lamp UltraRAE (PID UR) - 9.8 eV lamp	Volatile Organic Compounds	NA			NA	NA	NA
Soil Laboratory Samples								
(7-A)	PACE General Parameters	pH	Method 9045D	NA	NA	15 Minutes	4 oz. amber glass container	None
		SC	Method ASA10-3.3			28 Days	8 oz. amber glass container	None
	ICP-OES	Arsenic (As)	SW-846 6010D			6 Months	4 oz. amber glass container	None
		Cadmium (Cd)						
		Calcium (Ca)						
		Chromium (Cr)						
		Copper (Cu)						
		Iron (Fe)						
		Lead (Pb)						
		Manganese (Mn)						
		Zinc (Zn)						
(8-A)	PACE	Asbestos	EPA 600			None	4 oz. amber glass container	None
(9-A)	Energy Laboratories	Polychlorinated Biphenyl (PCB)	EPA 8082A			14 Days	4 oz. amber glass container	None
(10-A)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)			7 Days	4 oz. amber glass container	None
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)			14 Days		
(11-A)	Torkelson Geochemistry	High Resolution Gas Chromatography with Flame Ionization Detector (Pristane/Phytane Ratio)	EPA 8015M			14 Days	4 oz. amber glass container	None
(12-A)	Energy Laboratories SPLP	SPLP solids to be analyzed for (7), above. SPLP leachate to be analyzed for (2) (dissolved only) and (3) (only for EPA 200.7/200.8), above. Extraction fluid #2 shall be used. Lab to use the 20:1 liquid to solid ratio. Laboratory to report final extraction pH.	SW1312			180 Days	1 Quart	None

[1] In addition to the preservation listed, all samples will be cooled to 4 ± 2°C. Not all analyses require this but because multiple containers will be collected at most sites, all samples will be cooled.

[2] ARCO, 1992. Clark Fork River Superfund Site Investigations (CFRSSI) Standard OperatingProcedures (SOPs). September 1992.

[3] Energy Laboratories' Applicable Reporting Limit

[4] DEQ, 2019. Circular DEQ-7 Montana Numeric Water Quality Standards. Montana Department of Environmental Quality. June 2019.

[4*] Energy Laboratories Applicable Reporting Limit for one analyte, Indeno (1,2,3-cd)pyrene (0.1µg/L), is higher than the Circular DEQ-7 Reporting Limit for that analyte (0.08µg/L).

[5] Pace Analytical Practical Quantitation Limit (PQL)

[6] Pace Analytical Minimum Detection Limit (MDL)

[7] MBMG detection limit

[8] LNAPL Preservation Methods:

If sample is pure LNAPL - collect 5-40mL VOAs, unpreserved, and cooled to <6˚C.

If sample is a mixture of LNAPL and water - collect all of the following: 2-4mL VOAs preserved with HCL and cooled to <6˚C, 2-1L amber glass containers preserved with H_2SO_4 and cooled to <6˚C, and 2-1L amber glass containers preserved with H_2SO_4 and cooled to <6˚C

Units:
- µg/L - Microgram per liter
- S.U. - Standard Unit
- umhos/cm or µS/cm - microsiemen per centimeter
- mg/L - milligram per liter
- mg/kg - milligram per kilogram
- pCi/L - picocurie per liter
- pg/L - picograms per liter
- TBD - To Be Determined
- CRQL - Contract Required Quantitation Limit

Additional Groundwater Sampling: RFC BRW-2019-01 (October to November 2019)								
Analytical Group	**Analytical Lab/Company**	**Analyte**	**Analytical Method**	**Lab Reporting Limit/CRQL**	**Lab Method Detection Limit[2]**	**Holding Time**	**Container Size**	**Preservation[1]**
Groundwater Field Parameters								
(1-B)	Pioneer	Water level	NA	NA	NA	NA	NA	NA
		Temperature						
		Specific conductance (SC)						
		Dissolved Oxygen (DO)						
		pH						
		Oxidation Reduction Potential (ORP)						
		Ferrous iron and total iron (Chemetrics V-2000 Photometer)	NA	NA	NA	NA	NA	NA
Groundwater Laboratory Samples								
(2-B)	PACE		EPA 200.8 (Rev 5.4)	Total / Dissolved	NA	6 Months	2, 250-mL high-density polyethylene (HDPE) bottles	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Total recoverable and dissolved arsenic (As)		0.5 µg/L / 1.0 µg/L[2]				
		Total recoverable and dissolved cadmium (Cd)		0.08 µg/L / 1.0 µg/L[2]				
		Total recoverable and dissolved copper (Cu)		1.0 µg/L / 2.0 µg/L[2]				
		Total recoverable and dissolved iron (Fe)		50.0 µg/L / 200.0 µg/L[2]				
		Total recoverable and dissolved lead (Pb)		0.1 µg/L / 1.0 µg/L[2]				
		Total recoverable and dissolved zinc (Zn)		0.2 µg/L / 0.15 µg/L[2]				
		Total recoverable and dissolved silver (Ag)		5.0 µg/L / 2.0 µg/L[2]				
		Total recoverable and dissolved mercury (Hg)	EPA 245.1	0.01 µg/L / 2.0 µg/L[2]		28 Days		
		Total recoverable Phosphate (PO4)	EPA 365.1	50 µg/L[2]	NA	29 Days	1, 250-mL high-density polyethylene (HDPE) bottle	Acidified with H2SO4.
		Nitrate (NO2) and Nitrite (NO3)	EPA 300.0	100 µg/L[2]	NA	48 hour	1, 125-mL high-density polyethylene (HDPE) bottle	Raw
(3-B)	Energy Laboratories	Dissolved Calcium (Ca)	EPA 200.7 (Rev 4.4)/ EPA 200.8 (Rev 5.4)	5000 µg/L[2]	NA	6 Months	250-mL HDPE bottle	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Dissolved Potassium (K)		5000 µg/L[2]				
		Dissolved Silica (SiO_2)		200 µg/L[3]				
		Dissolved Sodium (Na)		5000 µg/L[2]				
		Dissolved Aluminum (Al)		9.0 µg/L[4]				
		Dissolved Barium (Ba)		3.0 µg/L[4]				
		Dissolved Boron (B)		50 µg/L[3]				
		Dissolved Cobalt (Co)		50 µg/L[2]				
		Dissolved Magnesium (Mg)		5000 µg/L[2]				
		Dissolved Manganese (Mn)		15 µg/L[2]				
		Dissolved Molybdenum (Mo)		1 µg/L[3]				
		Dissolved Nickel (Ni)		2.0 µg/L[4]				
		Dissolved Strontium (Sr)		20.0 µg/L[4]				
		Dissolved Vanadium (V)		50 µg/L[2]				
		Dissolved Cerium (Ce)		1 µg/L[3]				
		Dissolved Lithium (Li)		100 µg/L[3]				
		Dissolved Palladium (Pd)		10 µg/L[3]				
		Dissolved Rubidium (Rb)		10 µg/L[3]				
		Dissolved Tungsten (W)		100 µg/L[3]				
		Dissolved Uranium (U)		0.2 µg/L[4]				
		Bicarbonate (HCO_3)	SM 2320B	4 mg/L[3]		14 Days	250-mL HDPE bottle	Raw
		Carbonate (CO_3)		4 mg/L[3]				
		Alkalinity, Total (as $CaCO_3$)		4 mg/L[3]				
		Bromide (Br)	EPA 300.1 (Rev 1.0)	0.5 mg/L[3]		28 Days		
		Chloride (Cl)		1 mg/L[3]				
		Sulfate (SO4)		1 mg/L[3]				
		Fluoride (F)	A4500-F C	0.2 mg/L[4]		28 Days	250-mL HDPE bottle	Raw
		Total Hardness	Calculation	1 mg/L[3]		None	None	None
		Total Dissolved Solids (TDS)		1 mg/L[3]				
(4-B)	Energy Laboratories	Dissolved Arsenic [As (III)]	EPA 1632A	5 µg/L[3]	NA	28 Days	250-mL HDPE bottle	Acidified with HCl, field filtered with 0.45 µm filter (dissolved).
		Dissolved Arsenic [As (V)]		5 µg/L[3]	NA			
		Total Arsenic (As)	EPA 200.8 (Rev 5.4)	1 µg/L[4]	NA	6 Months	250-mL HDPE bottle	Unfiltered, acidified with HNO_3.
(5-B)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	14 Days	3, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[3]	NA	14 Days	2, 1-L amber glass	Unfiltered, acidified with H_2SO_4.
		Lead Scavengers (1, 2 dichloroethane and 1, 2 dibromoethane)	EPA 8011, EPA 8260B	Various depending on analyte detected.[3]	NA	14 Days	6, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
Hydrocarbon Investigation: RFC BRW-2019-03 (October to November 2019)								
Analytical Group	**Analytical Lab/Company**	**Analyte**	**Analytical Method**	**Lab Reporting Limit/CRQL**	**Lab Method Detection Limit[2]**	**Holding Time**	**Container Size**	**Preservation[1]**
Groundwater Field Parameters								
(1-C)	Pioneer	Water level	NA	NA	NA	NA	NA	NA
		Temperature						
		Specific conductance (SC)						
		Dissolved Oxygen (DO)						
		pH						
		Oxidation Reduction Potential (ORP)						
Groundwater Laboratory Samples								
(2-C)	PACE		EPA 200.8 (Rev 5.4)	Total and Dissolved	NA	6 Months	2, 250-mL high-density polyethylene (HDPE) bottles	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Total recoverable and dissolved arsenic (As)		1.0 µg/L[2]				
		Total recoverable and dissolved cadmium (Cd)		0.03 µg/L[2]				
		Total recoverable and dissolved copper (Cu)		2.0 µg/L[2]				
		Total recoverable and dissolved lead (Pb)		0.3 µg/L[2]				
		Total recoverable and dissolved zinc (Zn)		8.0 µg/L[2]				
		Total recoverable and dissolved silver (Ag)		0.2 µg/L[2]				
		Total recoverable and dissolved iron (Fe)		20 µg/L[2]				
		Total recoverable and dissolved mercury (Hg)	EPA 245.1	0.01 µg/L[3]	NA	28 Days		
		Total recoverable Phosphate (PO4)	EPA 365.1	50 µg/L[3]	NA	29 Days	1, 250-mL high-density polyethylene (HDPE) bottle	Acidified with H2SO4.
		Nitrate (NO2) and Nitrite (NO3)	EPA 353.2	20 µg/L[2]	NA	28 Days	1, 250-mL high-density polyethylene (HDPE) bottle	Acidified with H2SO4.
(3-C)	Energy Laboratories	PCB	EPA 8082A	0.08 µg/L[3]	NA	7 Days	1-L amber glass	Raw
(4-C)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	14 Days	3, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[4*]	NA	14 Days	2, 1-L amber glass	Unfiltered, acidified with H_2SO_4.
		Lead Scavengers (1, 2 dichloroethane and 1, 2 dibromoethane)	EPA 8011, EPA 8260B	Various depending on analyte detected.[3]	NA	14 Days	6, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
LNAPL Laboratory Samples								
(5-C)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	14 Days	Depends on nature and purity of LNAPL sample[8]	≤6°C
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[4*]	NA	14 Days	Depends on nature and purity of LNAPL sample[8]	≤6°C
		Hydrocarbon Fingerprinting Scan	EPA8015C	Various depending on analyte detected.[3]	NA	14 Days	Depends on nature and purity of LNAPL sample[8]	≤6°C
Soil Field Readings								
(6-C)	Pioneer Laboratory XRF *used to field screen, however this analytical group refers to Pioneer Laboratory XRF only.	Arsenic (As)	NA	NA	NA	NA	NA	NA
		Cadmium (Cd)						
		Calcium (Ca)						
		Chromium (Cr)						
		Copper (Cu)						
		Iron (Fe)						
		Lead (Pb)						
		Manganese (Mn)						
		Mercury (Hg)						
		Zinc (Zn)						
(7-C)	Pioneer PID MiniRAE (PID MR) - 10.6 eV lamp UltraRAE (PID UR) - 9.8 eV lamp	Volatile Organic Compounds	NA	NA	NA	NA	NA	NA
Soil Laboratory Samples								
(8-C)	PACE General Parameters	pH	Method 9045D	0.10 S.U.[5]	NA	15 Minutes	4 oz. amber glass container	None
		SC	Method ASA10-3.3	10 umhos/cm[5]	NA	28 Days	8 oz. amber glass container	None
	ICP-OES	Arsenic (As)	SW-846 6010D	1.0 mg/kg[5]	NA	6 Months	4 oz. amber glass container	None
		Cadmium (Cd)		0.15 mg/kg[5]				
		Calcium (Ca)		25.0 mg/kg[5]				
		Chromium (Cr)		0.50 mg/kg[5]				
		Copper (Cu)		0.50 mg/kg[5]				
		Iron (Fe)		2.5 mg/kg[5]				
		Lead (Pb)		0.50 mg/kg[5]				
		Manganese (Mn)		0.25 mg/kg[6] / 0.3 mg/kg[5]				
		Silver (Ag)		0.5 mg/kg[5]				
		Zinc (Zn)		1.0 mg/kg[5]				
		Mercury (Hg)	EPA Method 7471	0.02 mg/kg[5]		28 Days		≤6°C
(9-C)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	7 Days	4-oz amber glass container	None
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[4*]	NA	14 Days		
		Lead Scavengers (1, 2 dichloroethane and 1, 2 dibromoethane)	EPA 8011, EPA 8260B	Various depending on analyte detected.[3]	NA	14 Days	2, 4-oz amber glass containers	None

[1] In addition to the preservation listed, all samples will be cooled to 4 ± 2°C. Not all analyses require this but because multiple containers will be collected at most sites, all samples will be cooled.

[2] ARCO, 1992. Clark Fork River Superfund Site Investigations (CFRSSI) Standard OperatingProcedures (SOPs). September 1992.

[3] Energy Laboratories' Applicable Reporting Limit

[4] DEQ, 2019. Circular DEQ-7 Montana Numeric Water Quality Standards. Montana Department of Environmental Quality. June 2019.

[4*] Energy Laboratories Applicable Reporting Limit for one analyte, Indeno (1,2,3-cd)pyrene (0.1µg/L), is higher than the Circular DEQ-7 Reporting Limit for that analyte (0.08µg/L).

[5] Pace Analytical Practical Quantitation Limit (PQL)

[6] Pace Analytical Minimum Detection Limit (MDL)

[7] MBMG detection limit

[8] LNAPL Preservation Methods:

If sample is pure LNAPL - collect 5-40mL VOAs, unpreserved, and cooled to <6˚C.

If sample is a mixture of LNAPL and water - collect all of the following: 2-4mL VOAs preserved with HCL and cooled to <6˚C, 2-1L amber glass containers preserved with H_2SO_4 and cooled to <6˚C, and 2-1L amber glass containers preserved with H_2SO_4 and cooled to <6˚C

Units:
- µg/L - Microgram per liter
- S.U. - Standard Unit
- umhos/cm or µS/cm - microsiemen per centimeter
- mg/L - milligram per liter
- mg/kg - milligram per kilogram
- pCi/L - picocurie per liter
- pg/L - picograms per liter
- TBD - To Be Determined
- CRQL - Contract Required Quantitation Limit

Phase II QAPP (August 2020 to April 2021)

Analytical Group	Analytical Lab/Company	Analyte	Analytical Method	Lab Reporting Limit/CRQL	Lab Method Detection Limit[2]	Holding Time	Container Size	Preservation[1]
Groundwater and Surface Water Field Parameters								
(1-D)	Pioneer	Water level	NA	NA	NA	NA	NA	NA
(2-D)	Pioneer	Temperature	NA	NA	NA	NA	NA	NA
		Specific conductance (SC)						
		Dissolved Oxygen (DO)						
		pH						
		Oxidation Reduction Potential (ORP)						
		Total recoverable copper (Chemetrics V-2000 Photometer)						
Groundwater, Surface Water, Drill Return Water Laboratory Samples								
(3-D)	PACE		EPA 200.8 (Rev 5.4)	Total / Dissolved	NA	6 Months	2, 250-mL high-density polyethylene (HDPE) bottles	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Total recoverable and dissolved arsenic (As)		0.5 µg/L / 1.0 µg/L[2]				
		Total recoverable and dissolved cadmium (Cd)		0.08 µg/L / 1.0 µg/L[2]				
		Total recoverable and dissolved copper (Cu)		1.0 µg/L / 2.0 µg/L[2]				
		Total recoverable and dissolved lead (Pb)		0.1 µg/L / 1.0 µg/L[2]				
		Total recoverable and dissolved zinc (Zn)		5.0 µg/L / 2.0 µg/L[2]				
		Total recoverable and dissolved silver (Ag)		0.2 µg/L / 0.15 µg/L[2]				
		Total recoverable and dissolved iron (Fe)		50.0 µg/L / 200.0 µg/L[2]				
		Total recoverable and dissolved mercury (Hg)	EPA 245.1	0.01 µg/L / 2.0 µg/L[2]	NA	28 Days		
		Total recoverable Phosphate (PO4)	EPA 365.1	50 µg/L[2]	NA	29 Days	1, 250-mL high-density polyethylene (HDPE) bottle	Acidified with H2SO4.
		Nitrate (NO2) and Nitrite (NO3)	EPA 353.2	100 µg/L[5]	NA	28 days	1, 250-mL high-density polyethylene (HDPE) bottle	Acidified with H2SO4.
(4-D)	Energy Laboratories	Dissolved Calcium (Ca)	EPA 200.7 (Rev 4.4)/ EPA 200.8 (Rev 5.4)	5000 µg/L[2]	NA	6 Months	250-mL HDPE bottle	Acidified with HNO_3, field filtered with 0.45 µm filter (dissolved).
		Dissolved Potassium (K)		5000 µg/L[2]				
		Dissolved Silica (SiO_2)		200 µg/L[3]				
		Dissolved Sodium (Na)		5000 µg/L[2]				
		Dissolved Aluminum (Al)		9.0 µg/L[4]				
		Dissolved Barium (Ba)		3.0 µg/L[4]				
		Dissolved Boron (B)		50 µg/L[3]				
		Dissolved Cobalt (Co)		50 µg/L[2]				
		Dissolved Magnesium (Mg)		5000 µg/L[2]				
		Dissolved Manganese (Mn)		15 µg/L[2]				
		Dissolved Molybdenum (Mo)		1 µg/L[3]				
		Dissolved Nickel (Ni)		2.0 µg/L[4]				
		Dissolved Strontium (Sr)		20.0 µg/L[4]				
		Dissolved Vanadium (V)		50 µg/L[2]				
		Dissolved Cerium (Ce)		1 µg/L[3]				
		Dissolved Lithium (Li)		100 µg/L[3]				
		Dissolved Palladium (Pd)		10 µg/L[3]				
		Dissolved Rubidium (Rb)		10 µg/L[3]				
		Dissolved Tungsten (W)		100 µg/L[3]				
		Dissolved Uranium (U)		0.2 µg/L[4]				
		Bicarbonate (HCO_3)	SM 2320B	4 mg/L[3]	NA	14 Days	250-mL HDPE bottle	Raw
		Carbonate (CO_3)		4 mg/L[3]				
		Alkalinity, Total (as $CaCO_3$)		4 mg/L[3]				
		Bromide (Br)	EPA 300.1 (Rev 1.0)	0.5 mg/L[3]	NA	28 Days		
		Chloride (Cl)		1 mg/L[3]				
		Sulfate (SO4)		1 mg/L[3]				
		Fluoride (F)	A4500-F C	0.2 mg/L[4]	NA	28 Days	250-mL HDPE bottle	Raw
		Total Hardness	Calculation	1 mg/L[3]	NA	None	None	None
		Total Dissolved Solids (TDS)		1 mg/L[3]	NA			
(5-D)	PACE	Polychlorinated biphenyls (PCB)	EPA 8082A	0.1 µg/L[5] / 0.0355 µg/L[6]	NA	1 Year	2, 1-L amber glass	≤6°C
(6-D)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	14 Days	3, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[3]	NA	14 Days	2, 1-L amber glass	Unfiltered, acidified with H_2SO_4.
		Lead Scavengers (1, 2 dichloroethane and 1, 2 dibromoethane)	EPA 8011, EPA 8260B	Various depending on analyte detected.[3]	NA	14 Days	6, 40-mL clear glass VOA vials	Unfiltered, acidified with HCl.
(7-D)	PACE	Pentachlorophenol (PCP)	EPA 8270 SIM	0.6 µg/L[5] / 0.193 µg/L[6]	NA	7 Days	2-1L amber glass	≤6°C
		2,3,7,8-TCDD	EPA 1613	10 pg/L[5] / 3.06 pg/L[6]	NA	1 Year	2-1L amber glass	≤6°C
(8-D)	MBMG	Radon	EPA 913.0	20 pCi/L[7]	NA	48 hours	125-mL glass - no headspace	None
LNAPL Laboratory Samples								
(9-D)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	14 Days	Depends on nature and purity of LNAPL sample[8]	≤6°C
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[3]	NA	14 Days		≤6°C
		Hydrocarbon Fingerprinting Scan	EPA8015C	Various depending on analyte detected.[3]	NA	14 Days		≤6°C
Soil Field Readings								
(10-D)	Pioneer Laboratory XRF *used to field screen, however this analytical group refers to Pioneer Laboratory XRF only.	Arsenic (As)	NA	NA	NA	NA	NA	NA
		Cadmium (Cd)						
		Calcium (Ca)						
		Chromium (Cr)						
		Copper (Cu)						
		Iron (Fe)						
		Lead (Pb)						
		Manganese (Mn)						
		Mercury (Hg)						
		Silver (Ag)						
		Zinc (Zn)						
(11-D)	Pioneer PIDs MiniRAE (PID MR) - 10.6 eV lamp UltraRAE (PID UR) - 9.8 eV lamp	Volatile Organic Compounds	NA	NA	NA	NA	NA	NA
Soil Laboratory Samples								
(12-D)	PACE General Parameters	pH	Method 9045D	0.10 S.U.[5]	NA	15 Minutes	4-oz. amber glass container	None
		SC	Method ASA10-3.3	10 umhos/cm[5]	NA	28 Days	8-oz. amber glass container	None
	ICP-OES	Arsenic (As)	SW-846 6010D	1.0 mg/kg[5]	NA	6 Months	4-oz. amber glass container	None
		Cadmium (Cd)		0.15 mg/kg[5]				
		Calcium (Ca)		25.0 mg/kg[5]				
		Chromium (Cr)		0.50 mg/kg[5]				
		Copper (Cu)		0.50 mg/kg[5]				
		Iron (Fe)		2.5 mg/kg[5]				
		Lead (Pb)		0.50 mg/kg[5]				
		Manganese (Mn)		0.25 mg/kg[6] / 0.3 mg/kg[5]				
		Silver (Ag)		0.5 mg/kg[5]				
		Zinc (Zn)		1.0 mg/kg[5]				
		Mercury (Hg)	EPA Method 7471	0.02 mg/kg[5]	NA	28 Days		≤6°C
(13-D)	Energy Laboratories	Volatile Petroleum Hydrocarbons (VPH)	MAVPH (Rev 1.1)	Various depending on analyte detected.[3]	NA	7 Days	4-oz. amber glass container	None
		EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs)	Montana Method EPH (PAHs: 8270C or 8270D)	Various depending on analyte detected.[3]	NA	14 Days		
		Lead Scavengers (1, 2 dichloroethane and 1, 2 dibromoethane)	EPA 8011, EPA 8260B	Various depending on analyte detected.[3]	NA	14 Days	2, 4-oz. amber glass containers	None
(14-D)	Energy Laboratories SPLP (20:1)	SPLP solids to be analyzed for (12), above. SPLP leachate to be analyzed for (3) (dissolved metals only) above. Lab to use the 20:1 liquid to solid ratio. Laboratory to report final extraction pH.	SW1312	See CRQL's listed above for applicable analytical method.	NA	180 Days	Minimum 200 grams in a ziplock bag.	None
	Modified SPLP (4:1)	SPLP solids to be analyzed for (12), above. SPLP leachate to be analyzed for (3) (dissolved metals only) above. Lab to use a 4:1 liquid to solid ratio and increase the sample size. Laboratory to report final extraction pH. Up to 8 laboratory samples will be split with the 20:1 SPLP analysis.	SW1312 (Modified to use a 4:1 liquid to solid ratio)	See CRQL's listed above for applicable analytical method.	NA	180 Days	Minimum 250 grams in an 8 oz jar.	None
Drill Return Water Field Readings								
(15-D)	Pioneer	Total Petroleum Hydrocarbons (TPH)	NA	NA		NA	NA	NA

[1] In addition to the preservation listed, all samples will be cooled to 4 ± 2°C. Not all analyses require this but because multiple containers will be collected at most sites, all samples will be cooled.
[2] ARCO, 1992. Clark Fork River Superfund Site Investigations (CFRSSI) Standard OperatingProcedures (SOPs). September 1992.
[3] Energy Laboratories' Applicable Reporting Limit
[4] DEQ, 2019. Circular DEQ-7 Montana Numeric Water Quality Standards. Montana Department of Environmental Quality. June 2019.
[4*] Energy Laboratories Applicable Reporting Limit for one analyte, Indeno (1,2,3-cd)pyrene (0.1µg/L), is higher than the Circular DEQ-7 Reporting Limit for that analyte (0.08µg/L).
[5] Pace Analytical Practical Quantitation Limit (PQL)
[6] Pace Analytical Minimum Detection Limit (MDL)
[7] MBMG detection limit
[8] LNAPL Preservation Methods:
If sample is pure LNAPL - collect 5-40mL VOAs, unpreserved, and cooled to <6˚C.
If sample is a mixture of LNAPL and water - collect all of the following: 2-4mL VOAs preserved with HCL and cooled to <6˚C, 2-1L amber glass containers preserved with H_2SO_4 and cooled to <6˚C, and 2-1L amber glass containers preserved with H_2SO_4 and cooled to <6˚C

Units:
- µg/L - Microgram per liter
- S.U. - Standard Unit
- umhos/cm or µS/cm - microsiemen per centimeter
- mg/L - milligram per liter
- mg/kg - milligram per kilogram
- pCi/L - picocurie per liter
- pg/L - picograms per liter
- TBD - To Be Determined
- CRQL - Contract Required Quantitation Limit

Table 5: SPLP Analytical Results Summary (Phase I)

Location	Sample Interval	pH of Extraction Fluid After SPLP Cycle	Initial Geologic Unit Classification	ReClassified Geologic Unit	Lithology	Additional Sample Selection Notes**	Arsenic		Cadmium		Copper		Lead		Zinc		Waste Criteria
						Groundwater Standards (2006 ROD, Table 8-1)	-	**10**	-	**5**	-	**1,300**	-	**15**	-	**2,000**	-
						Waste Criteria (mg/kg)	**200**	-	**20**	-	**1,000**	-	**1,000**	-	**1,000**	-	-
							(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	Result (Pass/Fail)
BRW18-PZ03	5.0 - 9.9	6.80	Alluvium	ATO	SP	Interval with the 2nd highest copper concentration for alluvium. Interval with highest copper concentration did not have sufficient sample volume for lab analysis [BRW18-PZ06(4.8-5.3)].	**2,010**	2	10	1.78	**18,700**	262	974	2	**4,260**	471	Fail
BRW18-BH28	5.9 - 8.6	6.90	Alluvium	ATO	SW	Interval with the 3rd highest copper concentration for alluvium.	**1,910**	3	**30**	3.81	**27,200**	295	689	8.2	**10,900**	533	Fail
BRW18-BH05	15.0 - 17.5	8.20	Alluvium	Slag	GC	Interval selected based on overall concentrations and material type.	**447**	**45**	2	0.26	**6,810**	36	**1,650**	**15.4**	**11,500**	28	Fail
BRW18-BH05	12.3 - 13.7	7.50	Alluvium	Other	ML	Interval selected based on overall concentrations and material type.	151	3	<1	<0.07	**5,000**	8	**1,350**	0.9	**6,620**	<8	Fail
BRW18-BH26	6.5 - 6.8	7.10	Alluvium	ATO	CL	Interval selected based on overall concentrations and material type.	**511**	<1	9	2.27	**3,820**	80	**21,600**	**249**	**25,300**	368	Fail
BRW18-PZ21	12.5 - 15.0	7.00	Alluvium	Slag	SM	Interval selected based on both high chromium and iron concentrations.	100	<1	7	0.66	**4,740**	46	**3,690**	**30.3**	**38,600**	133	Fail
BRW18-PZ21	31.0 - 31.7	7.00	Alluvium	ATO	SM	Interval selected based on both high chromium and iron concentrations.	9	7	<1	0.13	171	20	29	3	352	25	Pass
BRW18-BH09	36.8 - 37.4	6.80	Alluvium	ATO	SW	Interval selected based on both high chromium and iron concentrations.	26	**128**	<1	0.08	85	8	48	5	219	14	Pass
BRW18-PZ09	13.0 - 13.6	6.50	Alluvium	ATO	GM	Interval selected based on both high chromium and iron concentrations.	6	3	10	**6.86**	22	7	21	1.7	188	99	Pass
BRW18-PZ15	18.3 - 18.8	7.00	Alluvium	ATO	SP	Interval selected based on both high chromium and iron concentrations.	2	2	<1	<0.07	10	3	11	2	142	22	Pass
BRW18-PZ19	12.6 - 14.5	8.80	Demolition Debris	Slag	SW	Interval with highest copper concentration for demolition debris.	**540**	**337**	4	<0.05	**2,310**	19	405	1.7	**5,150**	<8	Fail
BRW18-PZ21	6.2 - 10.0	7.70	Demolition Debris	Demolition Debris	GM	Interval with 2nd highest copper concentration for demolition debris.	**351**	**14**	8	0.70	**4,860**	13	615	<0.3	**7,120**	34	Fail
BRW18-BH06	5.5 - 5.7	9.00	Demolition Debris	Demolition Debris	SW	Interval with highest lead concentration and no detectable nitrate for demolition debris.	**343**	**127**	11	<0.05	968	5	**1,820**	0.7	**7,850**	<8	Fail
BRW18-BH10	0.0 - 3.5	9.00	Demolition Debris	Other	SP	Interval with 3rd highest lead concentration and no detectable nitrate for demolition debris. Interval with 2nd highest lead concentration and no detectable nitrate was already collected based on copper concentration [BRW18-PZ19(12.6-14.5)].	155	**80**	5	<0.05	551	10	**1,690**	13.0	**3,860**	14	Pass
BRW18-BH11	0.0 - 10.0	9.00	Demolition Debris	Demolition Debris	ML	Interval with 4th highest lead concentration and no detectable nitrate for demolition debris.	**398**	**297**	9	<0.05	**1,010**	7	**1,450**	4.5	**4,260**	<8	Fail
BRW18-BH02	2.5 - 10.8	6.30	Demolition Debris	Other	ML	Interval with 5th highest lead concentration and no detectable nitrate for demolition debris.	**940**	**23**	7	4.47	**1,790**	394	956	1.4	**1,710**	**3,100**	Fail
BRW18-BH10	3.5 - 4.8	9.20	Demolition Debris	Demolition Debris	CL	Interval with 6th highest lead concentration and no detectable nitrate for demolition debris.	**448**	**198**	11	<0.05	**1,190**	9	**1,890**	13.1	**8,940**	16	Fail
BRW18-PZ21	0.0 - 6.2	8.10	Demolition Debris	Other	GM	Interval with 8th highest lead concentration and no detectable nitrate for demolition debris. Interval with 7th highest lead concentration and no detectable nitrate was already collected based on copper concentration [BRW18-PZ21(6.2-10.0)].	**234**	**89**	9	0.12	**1,420**	6	454	<0.3	**11,700**	<8	Fail
BRW18-BH05	2.7 - 4.7	9.40	Demolition Debris	Demolition Debris	ML/GM	Sample submitted due to unique lithology.	23	**33**	<1	<0.05	207	13	172	3.3	468	10	Pass
BRW18-TP09	3.5 - 4.5	8.00	Demolition Debris	Demolition Debris	SM	Interval with highest lead concentration, no detectable nitrate, and sufficient sample volume.	**270**	**44**	**31**	0.20	195	3	609	<0.3	**2,220**	<8	Fail
BRW18-PZ23	0.0 - 5.0	7.80	Other	Other	ML/SC	Interval with highest copper concentration for other.	**218**	3	6	1.79	**11,000**	31	255	0.5	**1,780**	51	Fail
BRW18-PZ13	0.0 - 2.7	8.80	Other	Slag	GM/SM	Interval with 2nd highest copper concentration for other.	93	**325**	<1	<0.07	**1,520**	16	115	0.6	**9,120**	13	Fail
BRW18-PZ02	1.2 - 2.0	8.10	Other	ATO	OL	Interval with highest lead concentration and no detectable nitrate for other.	185	10	8	0.08	83	3	**1,030**	6.5	**3,780**	10	Pass
BRW18-BH16	0.0 - 1.3	8.70	Other	Other	SM	Interval with 2nd highest lead concentration and no detectable nitrate for other.	136	**212**	5	0.08	312	22	542	4.7	**1,240**	10	Pass
BRW18-BH28	0.0 - 1.5	8.00	Other	ATO	OH	Interval with 4th highest lead concentration and no detectable nitrate for other. Interval with 3rd highest lead concentration and no detectable nitrate for other was already collected based on copper concentration [BRW18-PZ13(0.0-2.7)].	21	**32**	<1	<0.07	76	19	18	2.5	86	<8	Pass
BRW18-BH03	0.0 - 1.3	8.10	Other	Other	OL	Interval with 6th highest lead concentration and no detectable nitrate for other. Interval with 5th highest lead concentration and no detectable nitrate for other was already collected based on copper concentration [BRW18-PZ23(0.0-5.0)].	27	**32**	2	<0.07	315	26	214	1.9	628	<8	Pass
BRW18-PZ06	0.5 - 2.5	8.80	Other	ATO	GM	Interval with 8th highest lead concentration and no detectable nitrate for other. Interval with 7th highest lead concentration and no detectable nitrate did not have sufficient volume for lab analysis [BRW-BH26(0.0-0.9)].	26	**20**	<1	<0.07	69	7	48	2.9	124	<8	Pass
BRW18-PZ22	35.0 - 37.6	7.40	Other	ATO	SP	Interval with 9th highest lead concentration and no detectable nitrate for other.	42	**23**	3	0.24	910	25	69	4.8	**1,060**	28	Pass
BRW18-PZ23	30.7 - 31.1	6.70	Other	ATO	ML	Interval with 10th highest lead concentration and no detectable nitrate for other.	3	4	3	0.18	27	2	31	2.6	222	23	Pass
BRW18-PZ15	8.0 - 8.9	7.90	Other	ATO	SP	Sample submitted due to upgradient location to help spatial distribution of samples.	13	**55**	<1	0.24	96	30	17	10.6	112	54	Pass

<X = Value less than detection limit (value in cell (X) is the detection limit)

Above Groundwater Standards (2006 ROD, Table 8-1)

Above Waste Identification Criteria (BPSOU SOW; EPA, 2020)

Waste Identification Criteria (Pass/Fail) - If three of the six contaminant criteria listed are exceeded or any one contaminant is above 5,000 mg/kg then, then material is waste.

Table 4 contains additional information on analytical method used, including sample preparation.

****Sample Selection Criteria from Phase I QAPP:**

Criteria from Phase I QAPP:

(1) For tailings, slag, demolition debris, and other materials (not including alluvium) from boreholes, up to 8 samples from each material with the highest lead concentrations and no detectable nitrate concentrations will be sent to the laboratory for SPLP analysis. In addition, up to 8 samples (up to 2 from each material) with the highest copper concentrations will be sent to the analytical laboratory for SPLP analysis.

(2) For alluvium from boreholes, up to 8 samples with the highest chromium and iron concentrations will be sent to the analytical laboratory for SPLP analysis. In addition, up to 2 samples with the highest copper concentrations will be sent to the analytical laboratory for SPLP analysis.

(3) The lead, chromium, iron, and copper concentrations will be based on XRF or ICP-OES results.

(4) If multiple similar samples (i.e., same locations or same material) meet the criteria above for SPLP analysis, field personnel will determine the appropriate samples to be submitted to the laboratory to get results representative of a variety of materials and locations.

Additional Notes:

(1) ICP concentrations shown in table are from laboratory analysis conducted prior to SPLP analysis.

(2) To determine samples with the highest chromium and iron concentrations, the concentrations for chromium and iron were ranked numerically for each sample (with "1" representing the highest concentration). Then the rankings for chromium and iron were summed to generate a cumulative ranking value, and the lowest values were selected.

(3) The "Initial Geological Unit Classification" were based on initial field observations. After review, the geological units were reclassified to simplify the remedial design.

(4) Slag samples were not analyzed for nitrate. Due to nature of material the test could not be completed. Additionally, slag samples generally focused on larger rock materials as opposed to smaller gravel.

(5) Only seven samples were sent for demolition debris due to similar material types.

(6) No soil samples representing other material from test pits were submitted for SPLP analysis. Samples collected in the field were insufficient volume to send to the lab. [Deviations Table (Appendix A, Table 1)]

(7) Only one soil sample, representing demolition debris material from test pits, was submitted for analysis via SPLP due to insufficient sample volume. [Deviations Table (Appendix A, Table 1)]

(8) Table is organized first by "Initial Geological Unit Classification" and then by the order the samples were selected for SPLP analysis based on the criteria included in the BRW Phase I QAPP.

							Arsenic		Cadmium		Copper		Lead		Zinc		Waste Criteria
						Groundwater Standards (2006 ROD, Table 8-1)	**-**	**10**	**-**	**5**	**-**	**1,300**	**-**	**15**	**-**	**2,000**	**-**
						Waste Criteria (mg/kg)	**200**	**-**	**20**	**-**	**1,000**	**-**	**1,000**	**-**	**1,000**	**-**	**-**
Location	**Sample Interval**	**pH of Extraction Fluid After SPLP Cycle**	**Initial Geologic Unit Classification**	**ReClassified Geologic Unit**	**Lithology**	**Additional Sample Selection Notes****	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	(ICP) (mg/kg)	(D - SPLP) (µg/L)	Result (Pass/Fail)
BRW18-PZ20	7.6 - 12.5	9.00	Slag	Slag - First	GP	Interval with highest copper concentration for slag.	58	10	3	<0.07	**10,300**	33	**1,260**	**16.5**	**12,200**	63	Fail
BRW18-PZ20	7.6 - 12.5	9.00	Slag	Slag - Second	GP	-	NA	9	NA	<0.05	NA	5	NA	3.7	NA	20	-
BRW18-PZ24	9.5 - 14.5	7.20	Slag	Slag - First	GW	Interval with 2nd highest copper concentration for slag.	**263**	3	<1	<0.07	**4,240**	12	224	0.9	**8,800**	20	Fail
BRW18-PZ24	9.5 - 14.5	7.20	Slag	Slag - Second	GW	-	NA	8	NA	<0.05	NA	20	NA	1.5	NA	23	-
BRW18-BH06	7.7 - 10.0	9.10	Slag	Slag - First	GW	Interval with highest lead concentration for slag.	18	4	2	<0.07	**1,520**	8	693	7	**12,000**	27	Fail
BRW18-BH06	7.7 - 10.0	9.10	Slag	Slag - Second	GW	-	NA	2	NA	<0.05	NA	7	NA	8.8	NA	42	-
BRW18-BH06	11.1 - 15.0	6.50	Slag	Slag - First	GP	Interval with 2nd highest lead concentration for slag.	20	<1	2	0.20	**2,480**	11	593	2	**13,700**	707	Fail
BRW18-BH06	11.1 - 15.0	6.50	Slag	Slag - Second	GP	-	NA	<1	NA	0.19	NA	8	NA	0.7	NA	636	-
BRW18-PZ20	12.5 - 15.0	7.10	Slag	Slag - First	GP	Interval with 3rd highest lead concentration for slag.	67	4	2	<0.07	**4,080**	70	**1,600**	**34.2**	**5,780**	69	Fail
BRW18-PZ20	12.5 - 15.0	7.10	Slag	Slag - Second	GP	-	NA	4	NA	<0.05	NA	84	NA	**52.0**	NA	124	-
BRW18-BH01	10.1 - 16.8	9.50	Slag	Slag - First	GP/SP	Interval with 4th highest lead concentration for slag.	**267**	**31**	3	<0.07	**5,770**	21	679	6	**9,820**	14	Fail
BRW18-BH01	10.1 - 16.8	9.50	Slag	Slag - Second	GP/SP	-	NA	**33**	NA	0.08	NA	12	NA	3.6	NA	18	-
BRW18-PZ20	15.0 - 20.0	7.50	Slag	Slag - First	GP	Interval with 5th highest lead concentration for slag.	97	4	4	<0.07	**4,390**	87	**1,960**	**37.9**	**10,900**	139	Fail
BRW18-PZ20	15.0 - 20.0	7.50	Slag	Slag - Second	GP	-	NA	3	NA	0.21	NA	72	NA	**41.2**	NA	194	-
BRW18-PZ12	1.5 - 2.9	9.50	Slag	Slag - First	GW	Interval with 6th highest lead concentration for slag.	**352**	**247**	5	0.11	**4,480**	93	**4,120**	**102**	**13,700**	72	Fail
BRW18-PZ12	1.5 - 2.9	9.50	Slag	Slag - Second	GW	-	NA	**227**	NA	0.16	NA	92	NA	**141**	NA	116	-
BRW18-PZ23	10.0 - 14.2	6.90	Slag	Slag - First	GW	Interval with 8th highest lead concentration for slag. Interval with 7th highest lead concentration was already collected based on copper concentration [BRW18-PZ20(7.6-12.5)].	**498**	**16**	<1	0.24	**4,780**	20	340	2	**4,410**	48	Fail
BRW18-PZ23	10.0 - 14.2	6.90	Slag	Slag - Second	GW	-	NA	8	NA	0.08	NA	6	NA	0.6	NA	16	-
BRW18-PZ19	16.0 - 19.8	7.60	Slag	Slag - First	GM	Interval with 9th highest lead concentration for slag.	181	**15**	10	0.09	**4,260**	21	1,000	9	**20,700**	39	Fail
BRW18-PZ19	16.0 - 19.8	7.60	Slag	Slag - Second	GM	-	NA	**31**	NA	0.19	NA	102	NA	**60.7**	NA	160	-
BRW18-PZ08	6.6 - 7.2	5.50	Tailings	ATO	MH	Interval with highest copper concentration for tailings.	**801**	6	6	**9.19**	**12,200**	**37,300**	**3,640**	**547**	**2,650**	1,780	Fail
BRW18-PZ02	5.3 - 5.7	6.20	Tailings	ATO	CH	Interval with 2nd highest copper concentration for tailings.	**790**	**263**	13	4.96	**4,020**	155	803	10.8	**3,270**	**4,070**	Fail
BRW18-PZ24	25.4 - 26.3	8.00	Tailings	ATO	CH	Interval with highest lead concentration and no detectable nitrate for tailings.	**881**	**32**	**38**	0.68	**2,540**	215	**15,200**	**33.8**	**16,100**	30	Fail
BRW18-BH27	6.4 - 9.2	8.20	Tailings	ATO	OH	Interval with 3rd highest lead concentration and no detectable nitrate for tailings. Interval with 2nd highest lead concentration and no detectable nitrate was already collected based on copper concentration [BRW18-PZ02(5.3-5.7)].	106	**13**	7	0.23	364	41	**1,820**	9.0	**2,970**	13	Pass
BRW18-PZ09	3.8 - 5.1	6.60	Tailings	ATO	OL	Interval with 6th highest lead concentration and no detectable nitrate for tailings. Interval with 4th highest lead concentration and no detectable nitrate was already collected based on copper concentration [BRW18-PZ08(6.6-7.2)], and interval with 5th highest lead concentration and no detectable nitrate did not have sufficient volume for lab analysis [BRW18-BH23(6.0-6.3)].	**2,190**	7	**63**	**308**	**22,700**	**1,440**	**6,310**	**1,280**	**11,000**	**27,600**	Fail
BRW18-PZ05	6.8 - 8.8	7.80	Tailings	ATO	CL	Interval with 8th highest lead concentration and no detectable nitrate for tailings. Interval with 7th highest lead concentration did not have sufficient volume for lab analysis [BRW18-BH27(6.0-6.4)].	80	7	4	1.07	447	31	**2,720**	**28.2**	**1,310**	51	Pass
BRW18-PZ06	7.0 - 9.1	7.80	Tailings	ATO	ML/MH	Interval with 11th highest lead concentration and no detectable nitrate for tailings. Intervals with 9th and 10th highest lead concentrations and no detectable nitrates did not have sufficient volume for lab analysis [BRW18-BH11(10.0-15.0) and BRW18-PZ09(5.9-6.2)].	**750**	**26**	9	0.53	**7,340**	112	640	3.5	**2,650**	71	Fail
BRW18-PZ02	7.2 - 8.3	8.00	Tailings	ATO	OH	Interval with 12th highest lead concentration and no detectable nitrate for tailings.	**434**	**15**	**21**	0.90	**3,860**	37	**22,800**	**95.0**	**21,700**	64	Fail
BRW18-PZ19	19.8 - 20.9	7.90	Tailings	ATO	SM	Interval with 13th highest lead concentration and no detectable nitrate for tailings.	**229**	**28**	13	0.46	**3,390**	27	991	3.8	**7,220**	14	Fail
BRW18-PZ08	8.5 - 9.5	7.90	Tailings	ATO	MH	Interval with 14th highest lead concentration and no detectable nitrate for tailings.	148	10	4	0.89	819	32	**1,630**	6.0	**1,310**	27	Pass

<X = Value less than detection limit (value in cell (X) is the detection limit)

Above In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)

Above Waste Identification Criteria (BPSOU SOW; EPA, 2020)

Waste Identification Criteria (Pass/Fail) - If three of the six contaminant criteria listed are exceeded or any one contaminant is above 5,000 mg/kg then, then material is waste.

Table 4 contains additional information on analytical method used, including sample preparation.

****Sample Selection Criteria from Phase I QAPP:**

Criteria from Phase I QAPP:

(1) For tailings, slag, demolition debris, and other materials (not including alluvium) from boreholes, up to 8 samples from each material with the highest lead concentrations and no detectable nitrate concentrations will be sent to the laboratory for SPLP analysis. In addition, up to 8 samples (up to 2 from each material) with the highest copper concentrations will be sent to the analytical laboratory for SPLP analysis.

(2) For alluvium from boreholes, up to 8 samples with the highest chromium and iron concentrations will be sent to the analytical laboratory for SPLP analysis. In addition, up to 2 samples with the highest copper concentrations will be sent to the analytical laboratory for SPLP analysis.

(3) The lead, chromium, iron, and copper concentrations will be based on XRF or ICP-OES results.

(4) If multiple similar samples (i.e., same locations or same material) meet the criteria above for SPLP analysis, field personnel will determine the appropriate samples to be submitted to the laboratory to get results representative of a variety of materials and locations.

Additional Notes:

(1) ICP concentrations shown in table are from laboratory analysis conducted prior to SPLP analysis.

(2) To determine samples with the highest chromium and iron concentrations, the concentrations for chromium and iron were ranked numerically for each sample (with "1" representing the highest concentration). Then the rankings for chromium and iron were summed to generate a cumulative ranking value, and the lowest values were selected.

(3) The "Initial Geological Unit Classification" were based on initial field observations. After review, the geological units were reclassified to simplify the remedial design.

(4) Slag samples were not analyzed for nitrate. Due to nature of material the test could not be completed. Additionally, slag samples generally focused on larger rock materials as opposed to smaller gravel.

(5) Only seven samples were sent for demolition debris due to similar material types.

(6) No soil samples representing other material from test pits were submitted for SPLP analysis. Samples collected in the field were insufficient volume to send to the lab. [Deviations Table (Appendix A, Table 1)]

(7) Only one soil sample, representing demolition debris material from test pits, was submitted for analysis via SPLP due to insufficient sample volume. [Deviations Table (Appendix A, Table 1)]

(8) Table is organized first by "Initial Geological Unit Classification" and then by the order the samples were selected for SPLP analysis based on the criteria included in the BRW Phase I QAPP.

Table 6: SPLP Analytical Results Summary (Phase II)

						Arsenic		Cadmium		Copper		Lead		Mercury		Zinc		Waste Criteria
					Groundwater Standards (2006 ROD, Table 8-1)	-	**10**	-	**5**	-	**1,300**	-	**15**	-	**2**	-	**2,000**	-
					Waste Criteria (mg/kg)	**200**	-	**20**	-	**1,000**	-	**1,000**	-	**10**	-	**1,000**	-	-
Location	**Sample Interval (ft)**	**pH of Extraction Fluid After SPLP Cycle**	**Geologic Unit**	**Lithology**	Additional Sample Selection Notes**	(ICP) (mg/kg)	(SPLP) (µg/L)	(ICP) (mg/kg)	(SPLP) (µg/L)	(ICP) (mg/kg)	(SPLP) (µg/L)	(ICP) (mg/kg)	(SPLP) (µg/L)	(ICP) (mg/kg)	(SPLP) (µg/L)	(ICP) (mg/kg)	(SPLP) (µg/L)	Result (Pass/Fail)
BRW19-PZ26	13.4-14.3	6.6	ATO	SP	Located outside the removal corridor. Limited recovery, was combined with previous layer.	19	**12.6**	5.0	3.02	361	248	7	2.4	<.020	<0.5	255	140	Pass
BRW19-PZ27	10.6-12.9	7.1	ATO	SP	Similar copper concentration as following layer and sufficient recovery.	2	2.5	1.6	0.57	219	28	18	3.8	0.030	<0.1	151	100	Pass
BRW19-PZ28	7.9-8.7	6.7	ATO	CH	High lead concentration.	13	**17.4**	1.7	0.39	114	53	123	**113**	0.75	1.67	**2,500**	160	Pass
BRW19-PZ30	5.9-8.7	7.3	ATO	ML	High lead and zinc concentrations.	199	6.7	12.5	0.55	**1,040**	24	**5,600**	**52.4**	**13**	**2.01**	**9,630**	50	Fail
	10.0-14.4	6.3	ATO	SP	High copper concentration.	5	4.1	0.7	0.26	359	188	123	**43.6**	0.55	<0.5	122	60	Pass
	24.0-27.3	6.6	ATO	CH/SM	High copper and Zinc concentrations. Sufficient recovery when combined with lower layer.	13	**18.2**	1.5	0.75	135	56	52	9.4	<.020	<0.5	**1,080**	290	Pass
	28.8-30.4	7.1	ATO	GM/SM	High arsenic, cadmium and zinc concentrations.	**1,170**	**202**	4.8	0.62	6	9	11	1.6	<.020	<0.1	872	130	Pass
BRW19-PZ31	10.0-12.2	6.1	ATO	SM	High copper and zinc concentrations, limited recovery, combined with previous layer.	50	6.2	2.4	0.63	709	230	651	**181.0**	6.4	**2.73**	**1,230**	380	Pass
	25.2-30.0	6.7	ATO	ML/SM	High zinc concentration.	27	**16.6**	2.5	**5.13**	147	135	2	4.2	<.020	<0.5	**1,280**	1,050	Pass
BRW19-PZ40	**20.9-21.7**	7.3	ATO	GM/GW	Above and below intervals confirm high copper concentration.	155	9.3	2.9	0.55	**1,510**	308	292	**44.2**	0.78	<0.5	738	230	Pass
	20.9-21.7	7.3	ATO	GM/GW		34	6.8	2.9	0.15	**1,300**	43	401	5.7	0.48	<0.5	845	30	Pass
	22.4-22.8	6.4	ATO	SM	Located within removal corridor and determining the extent of lead.	5	2.7	0.9	<0.08	718	33	19	1.1	<.020	<0.5	314	20	Pass
	22.4-22.8	6.4	ATO	SM		5	6.0	2.6	0.26	611	135	19	5.9	<.020	<0.5	258	80	Pass
BRW19-PZ41	**28.5-30.0**	6.6	ATO	GP	High copper concentration and located within removal corridor.	10	**16.4**	1.5	0.27	434	92	31	7.1	<.020	<0.5	229	50	Pass
	28.5-30.0	6.6	ATO	GP		13	**67.3**	2.6	1.09	606	356	41	**17.9**	<.020	<0.5	280	230	Pass
BRW19-PZ42	**22.9-24.5**	6.5	ATO	SM/SP	Located within removal corridor.	4	5.4	3.1	<0.08	268	<4	16	<0.2	<.020	<0.5	290	<10	Pass
	22.9-24.5	6.5	ATO	SM/SP		6	**27.8**	2.6	1.25	251	139	40	6.9	<.020	<0.5	275	210	Pass
BRW19-PZ43	**10.0-11.1**	7.7	ATO	SM	High copper concentration and located within removal corridor.	41	**112**	0.9	<0.1	853	62	37	1.5	0.055	<0.5	499	30	Pass
	10.0-11.1	7.7	ATO	SM		38	**200**	0.9	0.11	**1,110**	21	30	<0.2	0.063	<0.5	461	<10	Pass
	16.7-18.3	6.7	ATO	SM	High copper concentration and located within removal corridor.	19	**22.2**	1.3	0.30	**1,250**	149	10	2.2	<.020	<0.5	244	60	Pass
	16.7-18.3	6.7	ATO	SM		18	**24.6**	1.4	1.12	**1,400**	509	12	5.2	<.020	<0.5	277	210	Pass
	26.0-27.5	6.6	ATO	SM	High copper and zinc concentrations.	36	**117**	3.0	0.70	410	62	71	2.2	<.020	<0.5	942	170	Pass
BRW19-PZ44	**22.5-25.0**	6.8	ATO	SP	Located within removal corridor.	10	9.0	1.2	0.29	347	107	37	2.7	<.020	<0.5	124	40	Pass
	22.5-25.0	6.8	ATO	SP		11	**23.5**	1.3	0.98	364	339	9	6.1	<.020	<0.5	135	130	Pass
BRW19-PZ45	21.5-24.0	6.6	ATO	SM	High cadmium concentration.	19	**14.5**	0.9	0.16	268	69	30	9.0	0.047	<0.5	165	70	Pass
	24.0-25.0	6.6	ATO	CH	High copper and zinc concentrations.	9	8.1	1.0	0.13	215	45	17	3.1	<.020	<0.5	296	80	Pass
	24.0-25.0	6.6	ATO	CH		10	**18.8**	1.2	0.69	222	184	18	11.4	<.020	<0.5	322	380	Pass
BRW19-PZ46	18.2-20.0	6.4	ATO	SP	High cadmium concentration.	2	2.5	<0.2	0.13	16	21	3	3.1	<.020	<0.5	27	20	Pass
	22.2-24.1	7.0	ATO	CH/SM	High cadmium concentration.	47	**157**	**144**	**80.9**	34	47	25	**36.6**	<.020	<0.5	**2,420**	1,870	Pass
BRW19-PZ47	8.5-13.4	6.8	ATO	SM	High copper concentration,and located within removal corridor/above bottom of waste.	**625**	3.5	**24.7**	0.71	**8,460**	198	187	5.0	0.59	<0.1	**5,460**	130	Fail
	30.2-31.3	6.9	ATO	CH	High zinc concentration.	12	**14.9**	1.3	3.70	135	329	40	**53.6**	<.020	<0.5	**1,060**	1,440	Pass
BRW19-PZ49	10.0-12.1	6.5	ATO	SP/SM	High copper concentration.	6	**14.2**	0.4	<0.08	524	75	4	<0.2	<.020	<0.5	68	<10	Pass
	23.5-25.5	6.2	ATO	SM	High copper concentration.	21	**11.5**	1.3	0.25	86	27	19	4.6	<.020	<0.5	296	100	Pass
BRW20-TP59	6.8-12.0	6.8	ATO	ML	High copper concentration and proximity to ore bin and excavation boundary.	**495**	4.0	**142**	**51.0**	**5,430**	256	**1,740**	**409**	-	-	**39,900**	1,820	Fail
BRW20-TP60	8.5-12.0	7.0	ATO	SM	High copper concentration and proximity to ore bin, excavation boundary, and groundwater table.	32	3.9	1.0	2.99	392	21	60	<2	-	-	187	480	Pass
BRW20-TP60	5.4-6.0	7.6	Demolition Debris	ML	High copper concentration, limited recovery.	**518**	4.2	**21.7**	1.86	**2,080**	<4	**1,460**	<2	-	-	**10,800**	940	Fail
	6.0-8.5	5.2		SM	High copper concentration and sufficient recovery. Similar neighboring layers.	**1,650**	**28.7**	5	**24.0**	**1,270**	857	**1,240**	**40**	-	-	**1,150**	**3,820**	Fail
BRW20-TP71	0.4-1.1	8.2	Demolition Debris	SM	High copper concentration,and located within removal corridor/above bottom of waste.	**322**	**216**	7.4	<0.2	399	5	**1,260**	2	-	-	**3,400**	20	Fail
	1.1-6.0	7.8		SM	Located within removal corridor and is above bottom of waste.	**352**	**231**	10.7	<0.2	**1,030**	24	**1,230**	9	-	-	**3,270**	50	Fail
BRW20-TP57	5.4-9.0	9.3	Slag	GP	High copper concentration and proximity to ore bin.	15	**11.5**	1.0	<1	499	33	395	**18**	-	-	**2,660**	50	Pass
	9.0-10.0	7.7		GP	High copper concentration and proximity to ore bin, excavation boundary, and groundwater table.	9	0.6	1.5	<1	**1,840**	11	249	**18**	-	-	**6,120**	70	Pass
BRW20-TP70	0.0-0.6	7.6	Other	SM	Located within removal corridor and is above bottom of waste.	13	**52.4**	2.7	<0.9	278	176	87	2	-	-	551	120	Pass

Indicates a solid:liquid ratio of 20:1 was used.

Indicates a solid:liquid ratio of 4:1 was used.

<X = Value less than detection limit (value in cell (X) is the reporting limit)

Above Standards for Groundwater (2006 ROD Amendment, Table 8-1)

Above Waste Identification Criteria (BPSOU SOW; EPA, 2020)

Waste Identification Criteria (Pass/Fail) - If three of the six contaminant criteria listed are exceeded or any one contaminant is above 5,000 mg/kg then, then material is waste.

Table 4 contains additional information on analytical method used, including sample preparation.

****Sample Selection Criteria from Phase II QAPP:**

Criteria from Phase II QAPP:

For Alluvium, Tailings, Organic soils (ATO), slag, demolition debris and other materials (not including alluvium) from test pits/boreholes the following selection criteria was used to select samples:

(1) Soil is from lithologic layers outside the removal corridor.

(2) Pioneer XRF copper concentrations exceed 367 mg/kg.

(3) Soil is located within removal corridor/above bottom of waste and pass the Waste Identification Screening Criteria (EPA, 2020).

(4) Sample selection may be altered by field personnel based on field observations or analytical results (e.g. no samples exceed threshold values). (5) Additional notes have been added to clarify why certain samples were selected.

Additional Notes:

(1) ICP concentrations shown in table are from laboratory analysis conducted prior to SPLP analysis.

(2) Table is organized first by "Initial Geological Unit Classification" and then by the order the samples were selected for SPLP analysis based on the criteria included in the BRW Phase II QAPP.

Table 7. Summary of Historic Infrastructure

Equipment (Cultural Resource Inventory Feature)	**Description**	**Remaining Equipment/Data Gaps**	**Phase I QAPP Actions and Observations**	**Additional Notes from Cultural Resource Inventory and/or Structural Assessment**
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 Phase I.	Concentrator that used two 4-stamp battery stamp mill, jigs and vanners to separate ore from gangue. Produced approximately 150 tons per day beginning in 1885.
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 Phase I.	No additional observations.
Reverberatory Furnace Foundation (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 a system of elevated flues and dust chambers that directed flow to the main stack. The settling tanks and tables were most likely part of the slime plant which were used to thicken the slimes from the concentrator. Buried brick and slag smoke flue used for furnace smoke evacuation. Oriented east-west and is approximately 300 feet long.	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. Remaining settling tanks and tables from the slime plant are based on present-day aerial imagery and previous site investigations.	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 will be included in the PDI Evaluation Report. Measurements and photographs of visible settling tanks and tables will be collected. Settling ponds, made mostly of slag, are roughly 5 feet high, 104 feet long, and 15-20 feet wide. Photos will be included in the PDI Evaluation Report.	A 40' wide slag floor extends south to Feature 14 and was thought to have housed the roasting furnace/calciner in 1904. The Structural Assessment reports the furnace foundations will be preserved for their historic value, but the public should be restricted from approaching or entering the structures, pits and basins. An area security fence should be installed to restrict access. Feature 16 has four slag walls, with three chambers. The east end chamber contains five narrow concrete chambers. There was reason to believe these were built on the ruins of reverberatory furnace house No. 2. The buried brick and slag smoke flue (Feature 15) used for furnace smoke evacuation runs between Feature 14 and Feature 17. The flume is currently blocked with chain-link fencing at the west end because it has collapsed in three place and has filled in with dirt.
Blast / Reverberatory & Smelting 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.	Unable to excavate a test pit due to current location of Butte-Silver Bow's equipment. No actions proposed for Phase I.	Multiple reverberatory smelting furnaces were installed and updated in 1888-1889.
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.	No additional observations.
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 Phase I.	No additional observations.
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 Phase I.	No additional observations.
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 Phase I.	No additional observations.
Steel Tank (Feature 21)	A 24' tall million gallon capacity tank used for storing both liquid and dry materials. It is located in the center of the BRW site	NA - Feature identified during cultural survey.	No actions proposed for Phase I.	Located in the center of the site, the tank stands 24' tall and 90' in diameter. Its age is estimated to post-date 1955.
Ore Bins (Feature 23)	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. The Storage bin is about 44 feet long, 16 feet high, and 16 feet wide. Structure, mostly concrete and rebar, is falling apart. There appears to be 4-inch channel iron running through it. Photos will be included in the PDI Evaluation Report.	This is an 8-compartment ore bin, F-23, and is considered one of the first concrete ore bins erected in Butte. The structural reports the inside surfaces in good condition however, the exterior surfaces are in poor to very poor condition. Spalling has occurred where steel reinforcement has been exposed. The southwest column is completely failed with a visible air gap through the column. The structure should be fenced off and public access restricted.
Blacktail Creek Box Flume (Figure 15a)	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 MASW seismic survey was completed. See Appendix C for additional information.	This feature, built as early as 1909, carried Blacktail Creek through the BRW site and is made of brick and poured slag. It is approximately 7'long by 9' tall.
Slag Walls, Slag Canyon, and Poured Slag Constructions (Features 28), and (Feature 44).	The network of slag walls is the main identifying structure of the Butte Reduction Works area. These walls are identified as Features 16 and 44.	Based on historical information the extensive slag piles on either side of SBC creating a "slag canyon".	No actions proposed for Phase I.	Structural observations include the "slag canyon" which lines both sides of SBC on the north side of BRWs site. According to the structural report, slag is not a natural soil material or a recognized building material. It is not recommended as a viable base for a new bridge abutment.
Slag and Concrete Culvert (Feature 35)	This slag and concrete barrier runs along the north side of Silver Bow Creek (SBC) and drew in water via a concrete intake gate, feature 47. This barrier is a 2360' concrete culvert.	NA - Feature identified during cultural survey.	No actions proposed for Phase I.	This culvert drew in water from SBC. It's concrete portion was built in 1907 and 1908 with its enclosed slag portion added in 1909.
Bridge (Feature 46)	This bridge is a 38-foot long by 13ft wide bridge with steel beams and it is resting on tall slag walls features 44 and 48.	NA - Feature identified during cultural survey.	No actions proposed for Phase I.	This is a 38’ long steel stringer bridge that abuts tall slag walls. It was built after 1955 and consists of three I-beam stringers. The deck is comprised of two wooden plank layers, approximately 3-inches thick. Structural reports show the bridge deck and superstructure could support a maximum single-vehicle weight of 20 tones and a maximum axle load of 4 tons. However, the slag wall substructures cannot be verified. Therefore, the bridge is rated for small numbers of pedestrians involved with construction activities.
Headgate for Culvert (Feature 47)	This headgate attaches to the Feature 35/36 culvert for SBC.	NA - Feature identified during cultural survey.	No actions proposed for Phase I.	This headgate controls the water entering F-35 (slag/concrete culvert). Headgate dimensions are 20' tall by 18-1/2' wide on the upstream side and at least 11’ tall by the same width on the downstream side.

Equipment (Cultural Resource Inventory Feature)	Description	Remaining Equipment/Data Gaps	Phase I QAPP Actions and Observations	Additional Notes from Cultural Resource Inventory and/or Structural Assessment
Butte Reduction Works				
Historic Silver Bow Creek Channel South Culvert	To direct SBC 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 MASW seismic survey was completed. See Appendix C for additional information.	No additional observations.
Miscellaneous 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.	No additional observations.
	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 Phase I.	No additional observations.
	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 Phase I.	No additional observations.
	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 Phase I. Unable to excavate a test pit due to location underneath a Butte Silver Bow materials storage pile.	No additional observations.
	Crusher House	Based on historical information, the crusher house was demolished sometime between 1900 and 1914.	No actions proposed for Phase I.	No additional observations.
	Blister Building: The building was a steel frame building with multiple engines, generators, and compressors (Feature 17).	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 comprised mostly of concrete, rebar, and 4-inch channel iron, appears to be about 8-10 feet tall and 30 feet long with 4 sets of pillars left that are about 7 feet wide. Photos will be included in the PDI Evaluation Report.	Photographs of Feature 17, east and west, were taken, showing slag floors poured between the concrete floors, joist pockets cast in the footings, and various machine pads on both foundations are still present at the Site. This indicates machine shafts for large equipment, a floor, and building used to be present.
	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 Phase I.	No additional observations.
Domestic Manganese				
Kilns:	The Domestic Manganese kilns and footings were built over the location of the dust chambers for BRW operations which were built of steel frames with a slag base between 1907-1908. The building contained two rotary kilns and was constructed of steel frame trusses and posts(20 feet tall) with wood, concrete footings (676 square feet), 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 and the structures original function is unknown.	**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 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 will be included in the PDI Evaluation Report.	Remnant features exist at the east end of the Site. These include: a Beam and Slab Pier/Remnant concrete footing (Feature 1), and Concrete Piers (Features 2-3) and (Features 6-7). The concrete footings and piers are located near the entrance. The piers are tall, tapered structures that were used to mount heavy machinery based on remnant cylindrical mounts and cast iron equipment bases that remain near the top of the structures. A retaining wall (Feature 14) located south of the reverberatory furnace and north of the ore bins is the only remaining structure made of dry-laid stone. It is possibly one of the oldest standing walls at the Site because structural slag replaced hand laid stone.
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.	No additional observations.
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.	No additional observations.
Miscellaneous 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 Phase I.	No additional observations.

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.

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Table 8: Summary of Surface Water and Groundwater Analytical Results

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					-	-	**10**	-	**5**	-	**1,300**	-	-	-	**15**	-	**2**	-	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	-	**1.0**	-	**12.3**	-	**1,000**	-	**4.79**	-	**0.05**	-	**157**	-
Location	**Aquifer Unit**	**SI**	**Date/Std. Dev**	**pH**															
Surface Water Analytical Results																			
B-5	-	-	10/1/2020	8.10	-	3.3	2.7	0.100	0.120	4.0	2.0	220	14	0.79	<0.043	<0.0045	<0.0045	11	7
	-	-	10/6/2020	8.33	-	3.4	2.9	0.089	0.100	3.7	1.6	160	<12	0.76	<0.043	<0.0045	<0.0045	10	7
	-	-	10/14/2020	7.74	-	3.6	2.9	0.062	0.048	6.3	3.7	230	40	0.70	0.044	<0.0045	<0.0045	16	12
	-	-	10/28/2020	7.76	-	2.7	2.2	0.055	0.044	5.9	1.8	320	30	1.2	0.055	0.0090	<0.0045	13	9
	-	-	11/4/2020	7.83	-	3.2	2.5	0.072	0.057	5.2	2.5	250	20	0.90	<0.043	<0.0045	<0.0045	14	12
	-	-	*Std.Dev*	*0.229*	-	*0.30*	*0.27*	*0.017*	*0.031*	*1.02*	*0.75*	*52*	*10*	*0.18*	*0.006*	-	-	*2*	*2*
B-6	-	-	10/1/2020	8.44	-	3.4	2.9	0.088	0.088	3.9	1.7	160	13	0.70	<0.043	<0.0045	<0.0045	11	6
	-	-	10/6/2020	8.54	-	3.7	3.2	0.140	0.096	4.0	1.6	160	<12	0.71	<0.043	<0.0045	<0.0045	11	5
	-	-	10/14/2020	8.16	-	3.6	3.0	0.078	0.045	6.5	4.1	240	52	0.71	0.061	<0.0045	<0.0045	16	17
	-	-	10/28/2020	7.99	-	2.6	1.9	0.059	0.030	5.9	2.0	330	21	1.3	<0.043	<0.0045	<0.0045	15	8
	-	-	11/4/2020	7.89	-	3.1	2.7	0.063	0.047	4.1	1.1	200	19	0.57	0.043	0.0050	<0.0045	12	8
	-	-	*Std.Dev*	*0.251*	-	*0.40*	*0.45*	*0.029*	*0.026*	*1.10*	*1.04*	*63*	*15*	*0.26*	*0.0090*	-	-	*2*	*4*
BRW-SS-01	-	-	10/1/2020	8.34	-	3.2	2.7	0.110	0.100	4.4	2.0	140	<12	0.64	<0.043	<0.0045	<0.0045	9	7
	-	-	10/6/2020	8.50	-	3.6	3.0	0.097	0.110	3.4	1.9	140	<12	0.62	<0.043	0.0045	<0.0045	9	6
	-	-	10/14/2020	8.06	-	4.0	3.2	0.088	0.051	8.6	4.3	340	57	1.4	0.054	0.0050	<0.0045	19	12
	-	-	10/28/2020	7.94	-	2.8	2.0	0.051	0.030	5.7	1.6	320	29	1.2	<0.043	0.0070	<0.0045	14	9
	-	-	11/4/2020	7.86	-	3.1	2.5	0.063	0.060	4.5	1.9	210	22	0.70	<0.043	<0.0045	<0.0045	12	11
	-	-	*Std.Dev*	*0.243*	-	*0.42*	*0.42*	*0.022*	*0.030*	*1.79*	*0.99*	*86*	*15*	*0.32*	-	*0.0011*	-	*4*	*2*

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.

All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.

<X = Value less than detection limit (value in cell (X) is the reporting limit)

(white)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					**Aluminum**	**Arsenic**		**Cadmium**		**Copper**		**Iron**		**Lead**		**Mercury**		**Zinc**	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					**-**	-	**10**	-	**5**	-	**1,300**	-	**-**	-	**15**	-	**2**	-	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	-	**1.0**	-	**12.3**	-	**1,000**	**-**	**4.79**	-	**0.05**	-	**157**	-
SS-05A	-	-	10/1/2020	8.55	-	3.7	2.8	0.150	0.140	5.7	1.6	220	<12	1.2	<0.043	<0.0045	<0.0045	15	8
	-	-	10/6/2020	8.66	-	3.6	3.1	0.059	0.088	3.8	1.7	150	<12	1.0	<0.043	<0.0045	<0.0045	12	8
	-	-	10/14/2020	8.33	-	3.4	3.0	0.080	0.051	6.4	4.2	220	38	0.76	<0.046	<0.0045	<0.0045	17	14
	-	-	10/28/2020	8.07	-	3.2	2.7	0.079	0.066	5.8	1.8	300	17	1.3	<0.043	0.0050	<0.0045	16	12
	-	-	11/4/2020	7.94	-	3.0	2.5	0.061	0.061	5.5	1.6	200	19	1.0	<0.043	0.0050	<0.0045	13	12
	-	-	*Std.Dev*	*0.274*	-	*0.26*	*0.21*	*0.033*	*0.032*	*0.87*	*1.01*	*48*	*9*	*0.19*	-	*0.00*	-	*2*	*2*
SS-05B	-	-	10/1/2020	8.46	-	3.8	3.2	0.099	0.110	3.4	1.3	170	14	0.96	<0.043	<0.0045	<0.0045	9	4
	-	-	10/6/2020	8.60	-	3.9	3.1	0.087	0.094	3.3	1.5	190	<12	0.85	<0.043	<0.0045	<0.0045	9	5
	-	-	10/14/2020	8.28	-	3.9	3.3	0.062	0.040	3.4	2.0	220	54	0.59	0.078	<0.0045	<0.0045	11	9
	-	-	10/28/2020	8.01	-	2.4	2.0	0.052	0.030	4.1	0.9	310	29	1.1	<0.043	<0.0045	<0.0045	11	6
	-	-	11/4/2020	8.00	-	3.0	2.6	0.052	0.052	2.8	1.3	170	24	0.48	0.044	0.0050	<0.0045	9	9
	-	-	*Std.Dev*	*0.239*	-	*0.60*	*0.48*	*0.019*	*0.031*	*0.41*	*0.36*	*52*	*15*	*0.23*	*0.017*	-	-	*1*	*2*
SS-06A	-	-	10/1/2020	7.75	-	3.7	2.8	0.15	0.14	5.7	1.6	220	15	1.2	<0.043	<0.0045	<0.0045	15	8
	-	-	10/6/2020	8.07	-	3.6	3.1	0.059	0.088	3.8	1.7	150	<12	1.0	<0.043	<0.0045	<0.0045	12	8
	-	-	10/14/2020	7.61	-	3.4	3.0	0.080	0.051	6.4	4.2	220	38	0.76	<0.046	<0.0045	<0.0045	17	14
	-	-	10/28/2020	7.67	-	3.2	2.7	0.079	0.066	5.8	1.8	300	17	1.3	<0.043	0.0050	<0.0045	16	12
	-	-	11/4/2020	7.77	-	3.0	2.5	0.061	0.061	5.5	1.6	200	19	1.0	<0.043	0.0050	<0.0045	13	12
	-	-	*Std.Dev*	*0.159*	-	*0.26*	*0.21*	*0.033*	*0.032*	*0.87*	*1.01*	*48*	*9*	*0.19*	-	*0.00*	-	*2*	*2*
Groundwater Analytical Results																			
BRW18-PZ01	Deep	10' - 15'	12/4/2018	5.41	**2640**	**470**	**260**	**41**	**40**	**18700**	**18900**	**108000**	110000	**150**	**130**	-	-	**15300**	**14800**
			10/22/2019	5.70	-	**440**	**280**	**19**	**18**	**7400**	**7700**	**53400**	55900	**110**	**100**	**0.86**	0.87	**7100**	**7000**
			8/24/2020	5.85	-	**480**	**240**	**12**	**13**	**4200**	**4800**	**36500**	42900	**69**	**39**	**0.17**	0.11	**4800**	**5800**
			11/10/2020	5.60	-	**320**	**190**	**7.3**	**11**	**1800**	**3800**	**22300**	33600	**29**	**17**	**0.17**	0.15	**3000**	**5200**
			Std. Dev	*0.160*	-	*64*	*33*	*13*	*12*	*6475*	*6005*	*32493*	*29600*	*45*	*45*	*0.33*	*0.35*	*4705*	*3865*
BRW19-PZ01S	Shallow	3.5'-8.5'	8/12/2020	5.60	-	**19**	10	**23**	**26**	**12100**	**12300**	**57300**	61200	**360**	**300**	**0.32**	0.10	**9300**	**9900**
			11/10/2020	5.80	-	**21**	**18**	**19**	**20**	**10000**	**10600**	**51600**	47700	**130**	**140**	**0.25**	0.29	**8000**	**7800**
			Std. Dev	*0.100*	-	*1.0*	*4.0*	*2.0*	*3.0*	*1050*	*850*	*2850*	*6750*	*115*	*80*	*0.035*	*0.096*	*650*	*1050*
BRW19-PZ01DR	Deep	19'-24'	8/12/2020	7.19	-	2.2	2.4	**2.3**	2.8	**50**	50	170	<12	0.48	0.057	<0.0045	<0.0045	**200**	210
			11/11/2020	7.06	-	2.6	2.6	**2.4**	2.6	**69**	79	150	<12	0.40	0.080	<0.0045	<0.0045	**250**	270
			Std. Dev	*0.0650*	-	*0.20*	*0.10*	*0.050*	*0.10*	*9.5*	*15*	*10*	-	*0.040*	*0.012*	-	-	*25*	*30*

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.

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	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					**-**	**-**	**10**	**-**	**5**	**-**	**1,300**	**-**	**-**	**-**	**15**	**-**	**2**	**-**	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	**-**	**1.0**	**-**	**12.3**	**-**	**1,000**	**-**	**4.79**	**-**	**0.05**	**-**	**157**	**-**
BRW18-PZ02	Deep	10' - 15'	12/5/2018	7.09	<9	3.0	2.9	**3.6**	3.6	**82**	84	150	62	1.4	0.30	-	-	**320**	350
			10/24/2019	7.24	-	2.5	2.2	**4.1**	3.9	**83**	74	180	<12	1.2	0.096	0.016	<0.0039	**370**	360
			10/1/2020	7.22	-	2.7	2.5	**4.2**	4.0	**77**	74	84	<12	0.64	0.11	0.0090	<0.0045	**390**	370
			10/12/2020	7.15	-	3.8	3.1	**4.4**	4.3	**76**	67	39	<12	0.26	0.11	0.0050	0.0060	**420**	410
			11/5/2020	6.97	-	3.1	2.8	**4.1**	3.9	**83**	74	55	<12	0.65	0.087	0.0090	0.0070	**360**	340
			Std. Dev	*0.0977*	-	*0.44*	*0.32*	*0.26*	*0.22*	*3.1*	*5.4*	*55*	-	*0.41*	*0.080*	*0.0040*	*0.00050*	*33*	*24*
BRW18-PZ03	Shallow	5' - 10'	12/4/2018	6.66	<9	**12**	**11**	**7.4**	**7.5**	**600**	630	140	140	2.8	0.46	-	-	**6000**	**6500**
			10/22/2019	6.46	-	**25**	**23**	**7.0**	**7.0**	**380**	400	**1500**	1500	1.7	0.65	0.010	<0.0039	**9800**	**9700**
			10/1/2020	6.74	-	**24**	**21**	**5.1**	4.8	**460**	460	250	210	2.5	0.39	0.0090	<0.0045	**2400**	**2900**
			10/12/2020	6.48	-	**18**	**15**	**7.2**	**6.9**	**400**	370	360	340	2.0	0.50	0.0060	<0.0045	**4200**	**4200**
			11/4/2020	6.53	-	**16**	**13**	**8.5**	**8.4**	**380**	380	300	330	1.4	0.54	0.013	0.0050	**5300**	**5200**
			Std. Dev	*0.108*	-	*4.9*	*4.6*	*1.1*	*1.2*	*83.3*	*96.2*	*500*	*504*	*0.51*	*0.087*	*0.0025*	-	*2452*	*2323*
BRW19-PZ03D	Deep	14.5'-19.5'	8/4/2020	7.30	-	3.0	2.8	**2.4**	2.4	**14**	8.3	160	<12	0.34	<0.043	<0.0045	<0.0045	130	130
			11/11/2020	7.18	-	3.7	3.4	**1.9**	1.9	**17**	17	66	<12	0.16	<0.043	<0.0045	<0.0045	120	130
			Std. Dev	*0.0600*	-	*0.35*	*0.30*	*0.25*	*0.25*	*1.5*	*4.4*	*47*	-	*0.090*	-	-	-	*5.0*	*0.0*
BRW18-PZ04	Deep	12.5' - 17.5'	12/4/2018	7.07	<9	6.0	2.4	**6.0**	**5.7**	**67**	43	620	53	3.6	<0.039	-	-	**520**	530
			10/22/2019	6.82	-	2.8	2.6	**4.9**	**5.2**	**40**	33	980	930	0.11	0.050	0.016	0.0090	**490**	530
			11/12/2020	6.78	-	1.9	2.0	**3.3**	3.5	**27**	31	220	220	0.098	0.067	0.0080	0.0060	**350**	400
			Std. Dev	*0.128*	-	*1.8*	*0.25*	*1.1*	*0.94*	*17*	*5.2*	*310*	*380*	*1.6*	*0.0085*	*0.0040*	*0.0015*	*74.1*	*61*
BRW18-PZ05	Deep	14.4' - 19.4'	12/4/2018	7.18	<9	2.8	1.1	**7.7**	**7.1**	**22**	7.6	**1600**	13	**5.0**	0.042	-	-	**570**	520
			10/18/2019	7.17	-	1.6	1.3	**6.5**	**7.0**	**16**	14	320	<12	1.1	<0.046	0.020	0.0040	**520**	530
			Std. Dev	*0.00500*	-	*0.60*	*0.10*	*0.60*	*0.050*	*3.0*	*3.2*	*640*	-	*1.9*	-	-	-	*25*	*5.0*
BRW19-PZ05S	Shallow	3'-8'	8/4/2020	6.29	-	3.9	1.5	**11**	**11**	**530**	460	**5600**	5100	3.5	1.2	**0.10**	0.079	**2600**	**2700**
			11/11/2020	5.56	-	5.3	4.5	**58**	**63**	**3100**	**3300**	**76000**	75900	**59**	56	**0.30**	0.22	**26300**	**31600**
			Std. Dev	*0.365*	-	*0.70*	*1.5*	*23*	*26*	*1285*	*1420*	*35200*	*35400*	*28*	*27*	*0.10*	*0.071*	*11850*	*14450*
BRW18-PZ06	Deep	14.7' - 19.7'	12/3/2018	7.18	<9	1.6	1.5	**8.9**	**8.6**	3.9	2.9	69	7.4	0.36	0.077	-	-	**730**	770
			10/18/2019	7.22	-	2.7	1.6	**7.8**	**7.8**	4.8	3.2	220	<12	0.76	<0.046	0.0090	<0.0039	**750**	700
			Std. Dev	*0.0200*	-	*0.55*	*0.050*	*0.55*	*0.40*	*0.45*	*0.15*	*76*	-	*0.20*	-	-	-	*10*	*35*
BRW18-PZ08	Shallow	5.3' - 10.3'	12/3/2018	6.73	**203**	2.1	2.0	0.62	0.57	5.3	3.1	61	24	0.22	0.074	-	-	38	38
			10/17/2019	5.80	-	**12**	8.2	**130**	**140**	**70900**	**55800**	**117000**	109000	3.1	0.45	**0.90**	0.66	**36700**	**36900**
			10/1/2020	5.99	-	**17**	9.0	**120**	**110**	**56000**	**50300**	**95400**	102000	**7.3**	1.2	**0.56**	0.36	**35100**	**36500**
			10/12/2020	5.16	-	**15**	**12**	**120**	**120**	**74700**	**71900**	**155000**	137000	**21**	**18**	**0.32**	0.18	**41600**	**40200**
			11/4/2020	4.95	-	**18**	**17**	**170**	**180**	**111000**	**110000**	**168000**	234000	**28**	**27**	**0.28**	0.12	**57800**	**57700**
			Std. Dev	*0.633*	-	*5.7*	*4.9*	*56.8*	*59.8*	*36110*	*35565*	*59490*	*74913*	*11*	*11*	*0.25*	*0.21*	*18899*	*18803*

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.
All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.
<X = Value less than detection limit (value in cell (X) is the reporting limit)

(white)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					-	-	**10**	-	**5**	-	**1,300**	-	-	-	**15**	-	**2**	-	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	-	**1.0**	-	**12.3**	-	**1,000**	-	**4.79**	-	**0.05**	-	**157**	-
BRW18-PZ09	Deep	12' - 17'	12/3/2018	6.85	<9	**50**	**38**	**23**	**21**	**17**	4.2	**1900**	1600	3.5	0.11	-	-	**1500**	1500
			10/17/2019	6.99	-	**110**	**95**	**9.7**	**9.4**	12	3.8	**2300**	2200	1.3	0.097	0.019	0.0070	**1500**	1300
			10/1/2020	7.08	-	**180**	**150**	**5.8**	**5.1**	4.1	2.2	**2800**	2500	0.63	0.12	0.017	0.011	**1400**	1500
			10/12/2020	6.99	-	**250**	**220**	**2.6**	2.5	4.6	3.9	**2800**	2200	0.88	0.12	0.025	0.014	**1400**	1500
			11/4/2020	7.09	-	**200**	**120**	**7.0**	**7.0**	5.8	3.0	**1900**	1700	1.2	0.11	0.020	0.011	**1500**	1500
			Std. Dev	*0.0863*	-	*70.3*	*60.2*	*7.1*	*6.4*	*5.0*	*0.73*	*403*	*338*	*1.0*	*0.0085*	*0.0029*	*0.0025*	*49*	*80*
BRW18-PZ10	Shallow	15' - 20'	11/28/2018	7.19	12	3.6	3.3	**1.4**	1.3	**16**	10	410	7.1	0.46	<0.039	-	-	74	74
			10/21/2019	7.19	-	2.5	2.5	0.96	1.1	11	9.0	190	81	0.20	<0.046	0.014	<0.0039	66	75
			Std. Dev	*0.00*	-	*0.55*	*0.40*	*0.22*	*0.10*	*2.5*	*0.50*	*110*	*37*	*0.13*	-	-	-	*4.0*	*0.50*
BRW19-PZ10D	Deep	24.5'-34.5'	8/13/2020	7.23	-	2.6	3.0	0.98	1.1	3.4	3.5	36	<12	0.085	0.043	<0.0045	<0.0045	**160**	170
			11/12/2020	7.21	-	3.2	3.2	**1.1**	1.1	4.8	3.8	83	<12	0.45	<0.043	0.0050	<0.0045	**160**	160
			Std. Dev	*0.0100*	-	*0.30*	*0.10*	*0.060*	*0*	*0.70*	*0.15*	*23*	-	*0.18*	-	-	-	*0.0*	*5.0*
BRW18-PZ11	Deep	19.5' - 24.5'	11/29/2018	7.35	3.4	4.2	4.0	0.79	0.73	**43**	30	320	13	0.52	0.069	-	-	35	31
			10/21/2019	7.33	-	3.0	2.9	0.70	0.75	**49**	47	160	<12	0.23	<0.046	<0.0039	<0.0039	40	37
			Std. Dev	*0.0100*	-	*0.60*	*0.55*	*0.045*	*0.010*	*3.0*	*8.5*	*80*	-	*0.15*	-	-	-	*2.5*	*3.0*
BRW19-PZ11S	Shallow	9'-14'	8/13/2020	7.54	-	5.2	5.7	0.48	0.57	**28**	28	32	<12	0.065	0.046	<0.0045	<0.0045	70	74
			11/12/2020	7.27	-	5.5	5.4	0.40	0.42	**33**	35	<12	18	0.078	0.076	<0.0045	<0.0045	68	68
			Std. Dev	*0.135*	-	*0.15*	*0.15*	*0.040*	*0.075*	*2.5*	*3.5*	-	-	*0.0065*	*0.015*	-	-	*1.0*	*3.0*
BRW18-PZ12	Shallow	17' - 22'	11/28/2018	7.06	<9	**20**	5.8	**19**	**19**	**1900**	**1600**	**3900**	3500	3.8	0.042	-	-	**3300**	**3200**
			10/21/2019	7.24	-	2.0	2.0	0.45	0.47	8.0	8.6	20	<12	0.094	<0.046	0.0040	<0.0039	48	49
			Std. Dev	*0.0900*	-	*9.0*	*1.9*	*9.3*	*9.3*	*946*	*796*	*1940*	-	*1.85*	-	-	-	*1626*	*1576*
BRW19-PZ12D	Deep	21.5'-26.5'	8/13/2020	7.35	-	2.6	2.1	0.64	0.65	8.8	4.7	430	16	2.0	0.11	<0.0045	<0.0045	66	44
			11/16/2020	7.20	-	2.4	2.3	0.36	0.36	4.2	4.2	58	<12	0.39	<0.043	<0.0045	<0.0045	40	39
			Std. Dev	*0.0750*	-	*0.1*	*0.1*	*0.1*	*0.1*	*2.3*	*0.3*	*186*	-	*0.81*	-	-	-	*13*	*2.5*
BRW18-PZ13	Shallow	19' - 24'	11/28/2018	7.30	<9	**61**	**59**	0.29	0.30	**16**	11	45	9.6	0.077	<0.039	-	-	17	12
			10/21/2019	7.39	-	**35**	**35**	0.32	0.36	6.1	6.1	<12	<12	0.43	<0.046	<0.0039	<0.0039	29	29
			Std. Dev	*0.0450*	-	*13*	*12*	*0.015*	*0.030*	*5.0*	*2.4*	-	-	*0.18*	-	-	-	*6.0*	*8.5*
BRW18-PZ14	Shallow	17.5' - 22.5'	11/29/2018	7.25	<9	2.7	2.2	**1.3**	1.3	2.4	0.89	320	15	0.39	<0.039	-	-	95	98
			10/15/2019	7.20	-	2.8	2.5	0.84	0.74	2.5	0.80	200	<12	0.26	<0.046	<0.0039	<0.0039	88	80
			11/16/2020	7.04	-	2.7	2.6	0.76	0.54	1.4	1.0	84	<12	0.12	<0.043	<0.0045	<0.0045	78	75
			Std. Dev	*0.0896*	-	*0.047*	*0.170*	*0.238*	*0.32*	*0.50*	*0.08*	*96*	-	*0.11*	-	-	-	*7.0*	*9.9*

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.

All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.

<X = Value less than detection limit (value in cell (X) is the reporting limit)

(white)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum D (µg/L)	Arsenic TR (µg/L)	Arsenic D (µg/L)	Cadmium TR (µg/L)	Cadmium D (µg/L)	Copper TR (µg/L)	Copper D (µg/L)	Iron TR (µg/L)	Iron D (µg/L)	Lead TR (µg/L)	Lead D (µg/L)	Mercury TR (µg/L)	Mercury D (µg/L)	Zinc TR (µg/L)	Zinc D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					-	-	10	-	5	-	1,300	-	-	-	15	-	2	-	2,000
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					87	10	-	1.0	-	12.3	-	1,000	-	4.79	-	0.05	-	157	-
BRW18-PZ15	Deep	20' - 25'	11/29/2018	7.25	<9	1.9	2.0	0.66	0.68	0.82	0.62	43	14	0.19	0.057	-	-	87	93
			10/15/2019	7.26	-	1.5	1.5	0.56	0.57	0.74	0.52	<12	<12	<0.046	<0.046	0.0040	<0.0039	94	100
			11/16/2020	7.09	-	2.4	2.4	0.82	0.80	1.2	1.2	13	<12	0.052	<0.043	<0.0045	<0.0045	120	130
			Std. Dev	*0.0779*	-	*0.37*	*0.37*	*0.11*	*0.09*	*0.20*	*0.30*	*15*	-	*0.069*	-	-	-	*13*	*15*
BRW18-PZ16	Deep	32.5' - 37.5'	11/29/2018	7.06	<9	6.0	6.0	1.2	1.1	100	100	100	6.6	0.57	0.057	-	-	120	130
			10/21/2019	6.82	-	8.2	8.1	0.52	0.48	70	64	78	<12	0.43	0.052	0.0060	<0.0039	70	66
			Std. Dev	*0.120*	-	*1.1*	*1.0*	*0.34*	*0.31*	*15*	*18*	*11*	-	*0.070*	*0.0025*	-	-	*25*	*32*
BRW19-PZ16S	Shallow	20'-25'	8/17/2020	6.59	-	1.7	1.6	14	14	120	110	4700	5000	0.96	0.52	<0.0045	<0.0045	8400	8700
			11/13/2020	6.38	-	34	29	8.3	8.5	390	500	15500	13900	1.9	1.5	0.0060	<0.0045	5000	4200
			Std. Dev	*0.105*	-	*16*	*14*	*2.9*	*2.7*	*135*	*195*	*5400*	-	*0.47*	*0.49*	-	-	*1700*	*2250*
BRW18-PZ17	Shallow	15' - 20'	11/29/2018	7.19	<9	43	43	2.9	2.8	68	68	22	6.9	<0.039	<0.039	-	-	230	260
			10/15/2019	7.06	-	41	40	3.7	3.7	120	120	<12	<12	0.17	<0.046	<0.0039	<0.0039	310	320
			11/16/2020	7.04	-	47	46	2.0	2.1	87	85	120	<12	0.16	<0.043	0.0060	<0.0045	180	190
			Std. Dev	*0.0665*	-	*2.5*	*2.4*	*0.69*	*0.65*	*21*	*22*	*49*	-	*0.0050*	-	-	-	*65*	*65*
BRW18-PZ18	Shallow	17' - 22'	11/27/2018	6.67	<9	87	89	44	37	1300	1100	27	<5.4	0.097	<0.039	-	-	15000	11900
			10/25/2019	6.63	-	97	93	53	51	1200	1100	<12	<12	<0.046	0.048	0.011	0.0090	13300	12500
			11/17/2020	6.63	-	150	150	24	23	780	750	20	<12	0.061	<0.043	0.0090	0.0080	3800	3600
			Std. Dev	*0.0189*	-	*28*	*28*	*12*	*11*	*225*	*165*	*4*	-	*0.018*	-	*0.0010*	*0.00050*	*4750*	*4450*
BRW18-PZ19	Shallow	22' - 27'	11/27/2018	7.02	<9	9.9	9.8	5.9	6.0	62	50	290	13	3.9	0.37	-	-	650	560
			10/23/2019	7.12	-	14	15	4.7	4.7	40	38	71	12	0.57	0.096	0.010	<0.0039	480	500
			Std. Dev	*0.0500*	-	*2.1*	*2.6*	*0.60*	*0.65*	*11*	*6.0*	*109*	*0.50*	*1.7*	*0.14*	-	-	*85.0*	*30.0*
BRW18-PZ20	Shallow	22.5' - 27.5'	11/30/2018	7.09	<9	5.1	4.4	2.9	3.0	93	75	400	180	2.7	0.20	-	-	250	240
			10/25/2019	7.23	-	6.9	5.8	2.7	2.6	99	81	240	34	1.3	0.16	0.013	<0.0039	230	220
			Std. Dev	*0.0700*	-	*0.90*	*0.70*	*0.10*	*0.20*	*3.0*	*3.0*	*80*	*73*	*0.70*	*0.020*	-	-	*10.0*	*10.0*
BRW18-PZ21	Shallow	25' - 30'	11/26/2018	7.17	<9	31	30	11	10.0	82	72	84	39	0.25	0.072	-	-	850	810
			10/25/2019	7.02	-	36	37	14	14	140	140	<12	<12	<0.046	<0.046	0.048	0.0080	1100	1000
			2/14/2020	7.14	-	31	30	9.5	8.8	110	100	<12	<12	0.15	0.13	0.030	0.011	800	840
			Std. Dev	*0.0648*	-	*2.4*	*3.3*	*1.9*	*2.2*	*24*	*28*	-	-	*0.050*	-	*0.0090*	*0.0015*	*150*	*80.0*
BRW18-PZ22	Shallow	24' - 29'	11/30/2018	7.12	<9	3.1	2.9	4.3	4.3	9.7	7.6	200	7.7	0.81	0.040			450	420
			10/25/2019	7.13	-	2.2	2.2	3.8	3.6	11	11	17	<12	0.11	0.11	0.0090	<0.0039	410	400
			Std. Dev	*0.00500*	-	*0.45*	*0.35*	*0.25*	*0.35*	*0.65*	*1.7*	*92*	-	*0.35*	*0.035*	-	-	*20.0*	*10.0*

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.

All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.

<X = Value less than detection limit (value in cell (X) is the reporting limit)

(white)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					**-**	-	**10**	-	**5**	-	**1,300**	-	**-**	-	**15**	-	**2**	-	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	-	**1.0**	-	**12.3**	-	**1,000**	**-**	**4.79**	-	**0.05**	-	**157**	-
BRW18-PZ23	Deep	22.5' - 27.5'	11/27/2018	6.97	<9	3.7	4.0	**8.4**	**8.7**	1.4	1.1	43	13	0.54	0.29	-	-	**1200**	1200
			10/24/2019	7.14	-	4.0	4.2	**9.0**	**8.8**	3.6	3.1	58	<12	0.49	0.075	0.010	0.0039	**1400**	1300
			Std. Dev	*0.0850*	-	*0.15*	*0.10*	*0.30*	*0.050*	*1.1*	*1.0*	*7.5*	-	*0.025*	*0.11*	-	-	*100.0*	*50.0*
BRW18-PZ24	Deep	34' - 39'	11/28/2018	6.58	<9	**11**	9.8	**1.7**	1.8	**59**	30	1300	11	**14**	0.70	-	-	**360**	290
			10/24/2019	7.03	-	10	9.0	**1.6**	1.5	**36**	14	920	<12	**9.6**	0.31	**0.11**	<0.0039	**330**	260
			11/13/2020	7.01	-	9.1	8.8	**2.1**	1.4	8.6	5.4	12	12	0.24	0.071	0.0050	<0.0045	**360**	360
			Std. Dev	*0.208*	-	*0.78*	*0.43*	*0.22*	*0.17*	*21*	*10*	*540*	*0.50*	*5.7*	*0.26*	*0.053*	-	*14*	*42*
BRW18-PZ25	Deep	14.8' - 19.8'	12/5/2018	6.89	<9	2.3	1.9	**8.4**	**8.2**	3.0	2.0	250	12	0.47	0.19	-	-	**540**	510
			10/22/2019	6.99	-	2.7	2.4	**5.3**	**5.3**	2.9	2.1	270	<12	0.56	<0.046	0.0050	<0.0039	**380**	380
			Std. Dev	*0.0500*	-	*0.20*	*0.25*	*1.5*	*1.5*	*0.050*	*0.050*	*10*	-	*0.0*	-	-	-	*80.0*	*65*
BRW19-PZ26	Deep	13.5'-18.5'	8/4/2020	7.16	-	1.6	1.4	**6.0**	**5.9**	**36**	31	170	63	0.58	0.16	0.0090	0.0050	**910**	850
			11/9/2020	7.08	-	1.8	1.8	**5.8**	**6.0**	**38**	40	16	<12	0.11	0.045	0.0080	<0.0045	**870**	830
			Std. Dev	*0.0400*	-	*0.10*	*0.20*	*0.10*	*0.050*	*1.0*	*4.5*	*77*	-	*0.23*	*0.057*	*0.00050*	-	*20.0*	*10.0*
BRW19-PZ27	Deep	15'-20'	8/4/2020	7.15	-	2.2	2.1	**3.5**	3.6	**46**	43	58	<12	0.64	<0.043	<0.045	<0.0045	**440**	430
			11/9/2020	6.96	-	2.1	2.3	**3.6**	4.0	**43**	50	<12	<12	<0.043	<0.043	0.0070	<0.0045	**420**	480
			Std. Dev	*0.0950*	-	*0.05*	*0.10*	*0.050*	*0.20*	*1.5*	*3.5*	-	-	-	-	-	-	*10.0*	*25*
BRW19-PZ28R	Deep	14.8'-19.8'	8/11/2020	7.31	-	2.6	2.8	**2.6**	3.1	**90**	91	32	<12	0.15	0.043	<0.0045	<0.0045	**170**	180
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-PZ29	Deep	19'-24'	8/4/2020	7.29	-	2.7	2.4	**2.5**	2.6	**40**	31	160	<12	1.1	0.092	0.0050	<0.0045	**180**	180
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-PZ30	Shallow	13.25'-17.25'	8/12/2020	7.21	-	2.2	2.3	**3.6**	4.0	**100**	96	44	<12	0.78	0.30	0.0060	0.0050	**340**	350
			11/9/2020	7.19	-	4.8	4.5	**3.4**	3.7	**130**	130	96	<12	1.2	0.21	0.0060	<0.0045	**320**	340
			Std. Dev	*0.0100*	-	*1.3*	*1.1*	*0.10*	*0.15*	*15*	*17*	*26*	-	*0.21*	*0.045*	*0.0*	-	*10.0*	*5.0*
BRW19-PZ31	Deep	14'-19'	8/11/2020	7.16		2.0	2.3	**3.3**	3.9	**25**	27	47	26	1.7	0.90	<0.0045	<0.0045	**290**	330
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-PZ32	Deep	17'-22'	8/11/2020	7.27	-	2.6	2.4	**2.6**	3.2	**120**	120	230	<12	2.0	0.16	<0.0045	<0.0045	**280**	310
			11/12/2020	7.10	-	3.2	3.4	**2.3**	2.7	**110**	130	37	<12	0.45	0.19	0.0050	<0.0045	**250**	280
			Std. Dev	*0.0850*	-	*0.30*	*0.50*	*0.15*	*0.25*	*5.0*	*5.0*	*97*	-	*0.78*	*0.015*	-	-	*15*	*15*
BRW19-PZ40	Shallow	22'-27'	8/17/2020	7.10	-	2.3	2.1	0.81	0.75	**39**	36	23	<12	0.26	0.072	<0.0045	<0.0045	**230**	210
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.

All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.

<X = Value less than detection limit (value in cell (X) is the reporting limit)

(white)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					**-**	-	**10**	-	**5**	-	**1,300**	-	**-**	-	**15**	-	**2**	-	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	-	**1.0**	-	**12.3**	-	**1,000**	**-**	**4.79**	-	**0.05**	-	**157**	-
BRW19-PZ41	Shallow	25'-30'	8/14/2020	7.18	-	**12**	**12**	**5.6**	**5.9**	**78**	74	35	<12	0.20	0.043	0.0080	0.0060	**530**	530
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-PZ42	Deep	20'-25'	8/14/2020	7.01	-	2.5	2.7	**5.6**	**6.9**	**31**	32	52	<12	0.57	0.091	0.0060	0.0050	**1700**	1800
			11/16/2020	7.00	-	4.7	4.6	**2.3**	2.3	**19**	18	55	<12	0.49	0.062	0.0070	0.0060	**600**	590
			Std. Dev	*0.00500*	-	*1.1*	*0.95*	*1.6*	*2.3*	*6.0*	*7.0*	*1.5*	-	*0.040*	*0.015*	-	-	*550*	*605*
BRW19-PZ43	Deep	22'-27'	8/13/2020	7.32	-	6.4	6.5	**1.4**	1.5	**62**	61	20	<12	0.045	<0.043	<0.0045	<0.0045	100	100
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-PZ44	Shallow	20'-25'	8/14/2020	7.21	-	2.6	2.8	**1.4**	1.7	**99**	88	97	<12	0.30	0.045	<0.0045	<0.0045	100	100
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-PZ45	Shallow	13'-18'	8/13/2020	7.32	-	9.6	10	0.95	1.2	**14**	14	23	<12	0.044	<0.043	<0.0045	<0.0045	100	110
			11/16/2020	7.21	-	**11**	**11**	0.83	0.87	9.7	9.3	16	<12	0.052	<0.043	0.0050	0.0050	90	84
			Std. Dev	*0.0550*	-	*0.70*	*0.50*	*0.060*	*0.17*	*2.2*	*2.4*	*3.5*	-	*0.0040*	-	-	-	*5*	*13*
BRW19-PZ46	Shallow	6'-11'	8/12/2020	2.87	-	**1300**	**1400**	**14**	**17**	**9600**	**9800**	48100	51300	**490**	590	0.044	<0.0045	**6700**	**7200**
			10/1/2020	3.14	-	**1300**	**1300**	**16**	**15**	**9500**	**9700**	57100	55900	**650**	600	0.043	0.010	**7100**	**7300**
			10/12/2020	2.90	-	**1200**	**1300**	**16**	**15**	**7800**	**8800**	44000	41900	**560**	490	**0.085**	0.012	**5900**	**6600**
			11/4/2020	2.96	-	**1300**	**1300**	**17**	**16**	**9300**	**8700**	49400	51600	**570**	540	**0.056**	0.009	**7800**	**7000**
			Std. Dev	*0.105*	-	*43*	*43*	*1.1*	*0.83*	*730*	*502*	*4741*	*5112*	*57*	*44*	*0.017*	*0.0012*	*687*	*268*
BRW19-PZ47	Shallow	3.6'-8.6'	8/12/2020	5.87	-	5.6	3.8	**38**	**45**	**4800**	**5000**	660	590	1.9	0.65	0.0090	<0.0045	**14800**	**15200**
			11/11/2020	5.80	-	**13**	**12**	**33**	**35**	**4700**	**5100**	630	210	1.3	0.85	0.0080	<0.0045	**11000**	**12200**
			Std. Dev	*0.0350*	-	*3.7*	*4.1*	*2.5*	*5.0*	*50*	*50*	*15*	*190*	*0.30*	*0.10*	*0.00050*	-	*1900*	*1500*
BRW19-PZ48	Shallow	11.4'-16.4'	8/24/2020	7.42	-	3.6	3.6	**1.1**	1.0	**65**	58	73	<12	0.12	<0.043	0.0050	<0.0045	**210**	220
			11/17/2020	6.95	-	4.8	4.9	**1.5**	1.7	**89**	92	17	<12	0.063	0.049	0.0080	0.0060	**350**	360
			Std. Dev	*0.235*	-	*0.60*	*0.65*	*0.20*	*0.35*	*12*	*17*	*28*	-	*0.028*	-	*0.0015*	-	*70.0*	*70.0*
BRW19-PZ49	Shallow	21.6'-26.6'	8/24/2020	7.32	-	3	3.2	0.78	0.76	8.8	7.0	57	<12	0.19	<0.043	<0.0045	<0.0045	70	67
			11/18/2020	7.27	-	4.2	3.8	0.85	0.83	6.7	4.9	180	<12	0.46	<0.043	<0.0045	<0.0045	87	79
			Std. Dev	*0.0250*	-	*0.60*	*0.30*	*0.035*	*0.035*	*1.1*	*1.1*	*62*	-	*0.135*	-	-	-	*8.5*	*6.0*
BRW19-PZ50	Shallow	9.5'-14.5'	8/13/2020	7.34	-	2.8	3.2	**2.8**	3.5	**97**	80	76	<12	0.10	<0.043	0.027	0.013	**180**	210
			11/18/2020	7.19	-	3.9	4.7	**3.1**	3.5	**100**	120	23	<12	0.047	<0.043	0.019	<0.008	**220**	270
			Std. Dev	*0.0750*	-	*0.55*	*0.75*	*0.15*	*0.0*	*1.5*	*20*	*26*	-	*0.026*	-	*0.0040*	-	*20.0*	*30.0*

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.
All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.
<X = Value less than detection limit (value in cell (X) is the reporting limit)

	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					**-**	-	**10**	-	**5**	-	**1,300**	-	**-**	-	**15**	-	**2**	-	**2,000**
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					**87**	**10**	-	**1.0**	-	**12.3**	-	**1,000**	**-**	**4.79**	-	**0.05**	-	**157**	-
BRW19-HCW30	Shallow	9.0'-24.0'	2/4/2020	7.13	-	**270**	**220**	0.069	<0.030	**16**	0.67	29400	25200	2.2	0.068	0.0080	<0.0039	**180**	140
			11/18/2020	7.01	-	**570**	**540**	0.14	0.12	3.4	1.6	24500	26400	0.91	0.29	0.0090	0.0070	**1500**	1500
			Std. Dev	*0.0600*	-	*150*	*160*	*0.036*	-	*6.3*	*0.46*	*2450*	-	*0.64*	*0.11*	*0.00050*	-	*660*	*680*
BRW19-HCW31	Shallow	4.5'-19.5'	1/28/2020	7.04	-	5.7	5.7	**4.2**	4.7	**1200**	1100	34	12	**15**	**16**	0.014	0.0060	**1900**	1800
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW32	Shallow	6.0'-21.0'	1/30/2020	7.22	-	**110**	**66**	**6.0**	**5.6**	**170**	92	3400	2300	2.2	0.17	0.011	<0.0039	**1100**	880
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW33R	Shallow	4.0'-19.0'	2/5/2020	6.93	-	**53**	**49**	**4.2**	4.3	**160**	140	620	460	1.3	0.75	0.010	0.0070	**390**	380
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW34	Deep	5.0'-20.0'	2/5/2020	7.01	-	**170**	**160**	0.12	<0.030	**45**	0.97	22300	21300	**7.9**	0.26	0.025	<0.0039	140	100
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW35	Shallow	4.0'-19.0'	2/4/2020	7.47	-	**52**	**48**	**1.6**	1.7	**58**	53	25	<12	0.11	<0.046	<0.0039	<0.0039	**160**	150
			11/19/2020	7.04	-	**75**	**78**	**1.4**	1.4	**86**	86	28	13	0.086	0.044	<0.046	0.0050	150	140
			Std. Dev	*0.215*	-	*12*	*15*	*0.10*	*0.15*	*14*	*17*	*1.5*	-	*0.012*	-	-	-	*5.0*	*5.0*
BRW19-HCW36	Shallow	3.0'-18.0'	2/5/2020	7.46	-	**27**	**27**	0.76	0.77	**49**	42	63	<12	0.11	<0.046	<0.0039	<0.0039	59	59
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW37	Shallow	10.0'-25.0'	2/5/2020	7.01	-	**30**	**27**	**12**	**11**	**280**	200	470	350	**30**	**23**	**0.087**	0.026	**5900**	**5200**
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW38	Shallow	6.0'-21.0'	2/6/2020	6.76	-	6.5	4.5	**15**	**16**	**820**	720	370	280	**78**	**62**	**0.051**	0.017	**5400**	**5100**
			11/18/2020	6.72	-	9.1	4.5	**17**	**17**	**1600**	**1500**	400	220	**110**	**68**	**0.065**	0.021	**4600**	**4700**
			Std. Dev	*0.0200*	-	*1.3*	*0.0*	*1.0*	*0.50*	*390*	*390*	*15*	*30*	*16*	*3.0*	*0.0070*	*0.0020*	*400*	*200*
BRW19-HCW39	Shallow	3.0'-18.0'	2/5/2020	6.85	-	**42**	**38**	**43**	**49**	**410**	430	520	420	0.52	<0.046	0.0070	0.0080	**13500**	**13300**
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW40	Shallow	2.0'-17.0'	1/28/2020	7.16	-	**14**	**11**	1.0	1.0	**74**	52	710	470	0.72	<0.046	<0.0039	<0.0039	**200**	190
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.
All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.
<X = Value less than detection limit (value in cell (X) is the reporting limit)

(white)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Phase I and Phase II Data					Aluminum	Arsenic		Cadmium		Copper		Iron		Lead		Mercury		Zinc	
					D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)	TR (µg/L)	D (µg/L)
Groundwater Remedial Goals (2006 ROD, Table 8-1)					-	-	10	-	5	-	1,300	-	-	-	15	-	2	-	2,000
In-Stream Chronic Surface Water Performance Standards (2020 ROD Amendment, Table 1)					87	10	-	1.0	-	12.3	-	1,000	-	4.79	-	0.05	-	157	-
BRW19-HCW41	Shallow	3.0'-18.0'	1/28/2020	7.34	-	15	15	2.1	2.1	62	56	110	<12	0.40	<0.046	<0.0039	<0.0039	98	95
			11/18/2020	6.99	-	33	30	1.3	1.3	130	98	400	<12	1.3	<0.043	0.0060	<0.0045	99	85
			Std. Dev	*0.175*	-	*9.0*	*7.5*	*0.40*	*0.40*	*34*	*21*	*145*	-	*0.45*	-	-	-	*0.50*	*5.0*
BRW19-HCW42	Shallow	3.0'-18.0'	1/28/2020	6.63	-	16	16	8.2	8.4	510	490	70	<12	0.21	<0.046	<0.0039	<0.0039	2500	2300
			11/13/2020	6.53	-	15	16	5.6	6.5	520	590	93	13	0.23	<0.043	0.0070	<0.0045	1300	1600
			Std. Dev	*0.0500*	-	*0.50*	*0.0*	*1.3*	*0.95*	*5.0*	*50.0*	*12*	-	*0.010*	-	-	-	*600*	*350*
MW-01-MPC	Shallow	3.0'-13.0'	10/23/2019	7.11	-	2.3	1.6	0.14	0.11	33	19	660	37	1.2	0.24	0.014	<0.0039	33	24
			11/14/2019	7.12	<9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			1/30/2020	7.30	-	4.0	2.4	0.22	0.056	26	4.4	1100	12	0.82	0.046	0.050	<0.0039	27	7.1
			Std. Dev	*0.0873*	-	*0.00*	*0.00*	*0.000*	*0.000*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.00*	*0.000*	-	*0.0*	*0.0*
MW-02-MPC	Shallow	3.0'-12.5'	10/23/2019	7.24	-	1.6	1.7	0.060	0.057	15	15	<12	<12	<0.046	<0.046	<0.0039	<0.0039	4.5	5.2
			11/14/2019	7.19	<9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			1/30/2020	6.90	<9	1.4	1.6	0.056	0.057	11	10	26	<12	0.074	<0.046	<0.0039	<0.0039	4.1	4.3
			Std. Dev	*0.150*	-	*0.00*	*0.000*	*0.0000*	*0.0*	*0.0*	*0.0*	-	-	-	-	-	-	*0.00*	*0.00*
MW-03A-MPC	Deep	22'-33'	10/23/2019	7.47	-	8.1	8.6	0.42	0.36	2.4	1.8	140	<12	0.77	<0.046	<0.0039	<0.0040	27	23
			11/14/2019	7.41	<9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			1/30/2020	7.46	-	7.6	7.8	0.33	0.38	1.2	13	<12	14	<0.046	<0.046	<0.0039	0.010	22	24
			Std. Dev	*0.0262*	-	*0.00*	*0.00*	*0.000*	*0.000*	*0.00*	*0.0*	-	-	-	-	-	-	*0.0*	*0.00*
MW-03-MPC	Shallow	3.5'-13.5'	10/23/2019	6.85	-	1400	1400	1.6	1.5	700	730	43	16	1.1	0.99	0.0090	0.0080	660	690
			11/14/2019	6.67	<9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			1/30/2020	6.81	<9	1500	1300	2.5	1.8	780	580	1200	<12	9.4	0.52	0.012	0.0040	810	570
			11/19/2020	6.46	-	1300	1200	1.3	1.4	750	740	170	<12	2.9	0.86	0.0090	0.0070	680	710
			Std. Dev	*0.153*	-	*82*	*82*	*0.51*	*0.17*	*33*	*73*	*518*	-	*3.6*	*0.20*	*0.0014*	*0.0017*	*66*	*62*
BRW-PW-01A	Deep	12'-32'	10/5/2020	7.12	<9	4.5	4.6	2.8	3.0	47	46	54	<12	0.51	0.20	<0.0045	<0.0045	290	290
			10/6/2020	7.24	<9	4.1	4.0	3.1	2.9	53	49	<12	<12	0.21	0.15	<0.0045	<0.0045	290	280
			10/7/2020	7.23	<9	4.0	3.8	2.9	2.9	51	49	<12	<12	0.19	0.14	<0.0045	<0.0045	270	270
			10/8/2020	7.25	<9	3.9	3.9	2.9	3.0	52	50	<12	<12	0.17	0.14	<0.0045	<0.0045	280	280
			Std. Dev	*0.0524*	-	*0.23*	*0.31*	*0.11*	*0.050*	*2.3*	*1.5*	-	-	*0.14*	*0.025*	-	-	*8.3*	*7.1*
BRW-PW-01B	Deep	25'-40'	10/27/2020	7.05	<9	16	16	5.3	5.5	110	110	58	20	2.5	2.1	0.014	<0.0045	510	550
			10/28/2020	7.02	<9	16	15	8.7	8.3	150	150	<12	<12	1.2	1.1	0.019	0.0050	910	890
			10/29/2020	7.04	<9	15	15	8.3	8.2	150	150	<12	<12	0.87	0.80	0.015	0.0050	900	890
			10/30/2020	7.04	<9	15	15	8.0	8.6	150	150	<12	<12	0.73	0.68	0.016	<0.0045	860	1000
			Std. Dev	*0.0109*	-	*0.50*	*0.43*	*1.3*	*1.3*	*17*	*17*	-	-	*0.70*	*0.56*	*0.0019*	*0.0*	*166*	*169*
BPS11-05A1	Shallow	6'-11'	1/27/2020	6.99	-	97	21	1.3	1.3	65	42	3300	1900	0.75	<0.046	<0.0039	<0.0039	1800	1600
			Std. Dev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: A hardness value of 138 mg/L (reported as $CaCO_3$) from USGS Station 12323240 (SS-04) on February 19, 2014 was used.
All Site COCs are listed in Table 7 except Silver. Silver only has an acute standard, which is not applicable for the Site.
<X = Value less than detection limit (value in cell (X) is the reporting limit)

(no shading)	Below Standard or Goal
(yellow)	Above In-Stream Chronic Surface Water Performance Standard
(pink)	Above Groundwater Remedial Goal

	Chronic Aquatic
Cadmium	1.0
Copper	12.3
Lead	4.79
Zinc	157

Acronyms Table	
SI	Screened Interval
TR	Total Recoverable
D	Dissolved

Chronic= exp.{mc[ln(hardness)]+bc}		
	mc	bc
Cadmium	0.7977	-3.909
Copper	0.8545	-1.702
Lead	1.273	-4.705
Zinc	0.8473	0.884

Table 9. Monthly Depths to Groundwater

Location	Measuring Point Elevation	Transducer	Aquifer Unit	Depth to Groundwater (ft) 1/4/2019 & 1/7/2019	1/24/2019	2/28/2019	3/28/2019	4/30/2019	5/29/2019	6/27/2019	7/26/2019	8/28/2019	9/27/2019	10/28/2019	11/25/2019	12/30/2019	1/29/2020	2/28/2020	5/29/2020	6/30/2020	7/30/2020	8/26/2020	9/22/2020	10/22/2020	11/24/2020	12/22/2020	1/27/2021	2/18/2021	3/30/2021	4/20/2021	5/17/2021	6/28/2021	Average	Average (Outliers Removed)	Standard Deviation	Standard Deviation (Outliers Removed)
BRW18-PZ01	5442.507		Deep	6.73[1]	5.81	5.87	5.07	4.86	4.76	5.22	5.45	5.56	5.41	5.36	5.54	5.76	5.81	5.88	5.59	4.85	5.44	5.68	5.77	5.74	5.71	5.88	6.01	6.03	5.54	5.57	5.70	5.92	5.60	5.56	0.40	0.34
BRW18-PZ02	5440.438		Deep	FROZEN	FROZEN	FROZEN	FROZEN	2.42	2.48	2.86	3.15	3.31	3.18	3.02	3.19	FROZEN	FROZEN	FROZEN	3.21	2.58	3.09	3.29	3.36	3.37	3.32	3.44	3.51	3.51	3.11	3.12	3.25	3.45	3.15	-	0.30	-
BRW18-PZ03	5441.043		Shallow	FROZEN	FROZEN	FROZEN	FROZEN	2.81	2.83	3.32	3.62	3.76	3.49	3.39	3.58	3.78	FROZEN	FROZEN	3.63	3	3.65	3.82	3.85	3.83	3.77	3.93	FROZEN	FROZEN	FROZEN	3.64	3.80	4.06	3.58	-	0.34	-
BRW18-PZ04	5441.373		Deep	4.01	FROZEN	FROZEN	FROZEN	3.20	3.24	3.61	3.85	4.05	3.81	3.71	3.87	4.05	4.08	FROZEN	3.9	3.36	3.78	4.00	4.02	4.09	4.02	4.14	FROZEN	FROZEN	FROZEN	FROZEN	4.04	4.22	3.86	-	0.28	-
BRW18-PZ05	5441.63	X	Deep	4.3	FROZEN	FROZEN	FROZEN	3.61	3.55	3.9	4.15	4.31	4.12	4.02	4.21	4.32	4.34	FROZEN	4.17	3.67	4.02	4.25	4.31	4.35	4.28	4.4	4.47	FROZEN	FROZEN	4.29	4.25	4.43	4.16	-	0.25	-
BRW18-PZ06	5441.454		Deep	4.56	4.62	4.7	4.15	8.33[1]	3.86	4.17	4.45	4.52	4.37	4.29	4.46	4.62	4.69	4.73	4.52	4.07	4.39	4.59	NO ENTRY	4.69	4.63	4.73	4.79	FROZEN	FROZEN	4.51	4.58	4.74	4.64	4.50	0.77	0.23
BRW18-PZ08	5443.765		Shallow	6.8	6.83	6.84	6.21	5.99	5.84	6.52	6.86	6.86	6.64	6.43	6.63	6.68	6.71	6.81	6.47	5.87	6.66	6.74	NO ENTRY	6.8	6.68	6.73	6.76	6.74	6.43	6.45	6.59	6.85	6.59	-	0.29	-
BRW18-PZ09	5441.701	X	Deep	5.06	5.1	5.13	4.7	4.45	4.45	4.74	4.92	5.06	4.89	4.8	4.98	5.05	5.10	5.13	4.94	4.58	4.83	4.99	5.07	4.79	5.03	5.13	5.19	5.19	4.94	4.96	5.03	5.13	4.94	-	0.20	-
BRW18-PZ10	5448.721		Shallow	9.25	9.32	9.41	8.68	8.24	8.35	8.74	9.03	6.24[1]	9.07	8.92	9.11	9.28	9.33	9.38	9.1	8.35	8.95	9.26	9.32	9.35	9.24	9.4	9.47	9.51	9.04	9.12	9.22	9.43	9.00	9.10	0.62	0.34
BRW18-PZ11	5447.874		Deep	7.93	8.02	8.08	7.37	6.96	7.06	7.45	9.70[1]	7.89	7.67	7.61	7.75	7.95	8.00	8.05	7.76	7.03	7.62	7.92	7.99	8.06	7.93	8.06	8.15	8.17	7.72	7.78	7.89	8.01	7.85	7.78	0.48	0.33
BRW18-PZ12	5448.986	X	Shallow	8.47	8.54	8.6	7.96	7.57	7.65	8.01	8.27	8.44	8.23	8.16	8.31	8.47	8.54	8.57	8.28	7.66	8.16	8.45	8.52	8.56	8.48	8.61	8.68	8.70	8.27	8.35	8.43	8.6	8.33	-	0.30	-
BRW18-PZ13	5450.491		Shallow	9.47	9.58	9.59	9	8.62	8.76	9.09	9.33	9.49	9.28	9.21	9.35	9.5	9.54	9.58	9.3	8.78	9.22	9.48	9.56	9.58	9.47	9.62	9.66	9.80	9.3	9.35	9.45	9.6	9.36	-	0.28	-
BRW18-PZ14	5448.876		Shallow	7.32	7.36	7.41	6.87	6.56	6.65	7.01	7.22	7.39	7.14	7.06	7.21	7.29	7.36	7.39	7.12	6.7	7.11	7.30	7.33	7.35	7.29	7.41	7.46	7.48	7.12	7.19	7.27	7.4	7.20	-	0.24	-
BRW18-PZ15	5448.239	X	Deep	9.85[1]	6.89	6.95	6.39	6.07	6.15	6.5	8.71[1]	6.60	6.63	7.51[1]	6.68	6.8	6.88	6.91	6.6	6.13	6.57	6.80	6.82	6.83	6.77	6.92	6.97	6.89	6.59	6.68	6.76	6.87	6.89	6.68	0.72	0.25
BRW18-PZ16	5461.915		Deep	21.08	21.14	21.19	20.6	20.30	20.35	20.68	19.93[1]	21.09	20.85	20.74	20.96	21.05	21.10	21.16	20.83	20.33	20.8	21.01	21.02	21.12	21.00	21.15	21.65[1]	21.23	20.82	20.92	20.98	21.11	20.90	20.91	0.34	0.26
BRW18-PZ17	5448.562		Shallow	7.48	7.54	7.59	7	6.67	6.83	7.13	7.35	7.49	7.3	7.21	7.37	7.49	7.55	7.58	7.31	6.84	7.26	7.48	7.54	7.58	7.48	7.61	7.65	7.67	7.31	7.38	7.45	7.59	7.37	-	0.25	-
BRW18-PZ18	5449.737		Shallow	9.68	9.76	9.8	6.22[1]	8.77	8.91	9.23	9.48	9.64	9.54	9.35	9.52	9.67	9.75	9.78	9.5	8.9	9.38	9.65	11.71[1]	9.76	9.66	9.8	9.88	9.91	9.5	9.56	9.65	9.8	9.51	9.55	0.79	0.29
BRW18-PZ19	5454.818		Shallow	15.06	15.13	15.18	14.66	14.22	14.34	14.65	14.93	15.06	14.84	14.76	14.91	15.05	15.12	15.16	14.89	14.35	14.79	15.03	15.08	15.14	15.02	15.15	15.22	15.25	14.89	14.94	15.03	15.17	14.93	-	0.26	-
BRW18-PZ20	5451.467		Shallow	11.83	11.89	11.97	11.34	10.91	11.03	11.37	11.62	11.80	NO ENTRY	11.49	11.64	11.83	11.88	11.93	11.66	11.02	11.52	11.79	11.86	11.9	11.79	11.94	12.03	12.05	11.64	11.7	11.79	11.96	11.69	-	0.30	-
BRW18-PZ21	5455.079		Shallow	15.37	15.44	15.51	14.88	14.42	14.57	14.87	15.14	15.32	15.12	15.04	15.19	15.38	15.43	15.47	15.2	14.51	15.04	15.34	15.41	15.44	15.35	15.5	15.57	15.62	15.18	15.25	15.33	15.51	15.22	-	0.31	-
BRW18-PZ22	5453.88		Shallow	15.58	15.63	15.68	15.14	14.77	14.84	15.19	15.43	15.59	15.38	15.28	14.46[1]	15.58	15.62	15.67	15.44	14.9	15.3	15.58	15.63	15.66	15.55	15.68	15.73	15.76	15.4	15.45	15.55	15.72	15.42	15.45	0.32	0.27
BRW18-PZ23	5450.547		Deep	11.93	12.01	12.50[1]	11.54	11.15	11.23	11.55	11.8	11.94	11.74	11.64	11.81	11.94	11.97	12.01	11.77	11.28	11.66	11.90	11.95	12	11.89	12.01	12.07	12.09	11.76	11.8	11.88	12.02	11.82	11.80	0.27	0.25
BRW18-PZ24	5460.152		Deep	21.74	21.86	21.83	21.37	21.01	21.02	21.37	21.58	21.72	21.51	20.42[1]	21.79	21.71	21.75	21.80	21.53	21.05	21.45	21.67	21.72	21.78	21.65	21.78	21.84	21.85	21.54	21.59	21.66	21.77	21.56	21.61	0.32	0.24
BRW18-PZ25	5440.455		Deep	5.05	5.15	5.19	4.76	4.52	4.51	4.77	4.94	5.01	4.85	4.81	4.97	5.19	5.30	5.34	5.17	4.71	4.97	5.14	5.2	5.21	5.22	5.36	5.52	5.55	5.28	5.25	5.34	5.46	5.09	-	0.27	-
BRW19-PZ26	5439.548		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.70	3.8	3.77	3.75	3.95	4.11	4.15	FROZEN	3.75	3.86	4.03	3.89	-	0.15	-
BRW19-PZ27	5440.637		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.28	4.35	4.35	4.32	4.45	4.56	FROZEN	FROZEN	4.23	4.34	4.5	4.38	-	0.10	-
BRW19-PZ28R	5441.411		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.49	3.57	3.56	3.50	3.61	FROZEN	FROZEN	FROZEN	3.42	3.55	3.76	3.56	-	0.09	-
BRW19-PZ29	5448.17		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.48	9.54	9.53	9.48	9.6	9.69	9.71	9.26	9.31	11.45[1]	9.66	9.70	9.53	0.57	0.14
BRW19-PZ30	5440.568		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.34	3.42	3.41	3.38	FROZEN	FROZEN	FROZEN	FROZEN	3.43	3.59	3.80	3.48	-	0.15	-
BRW19-PZ31	5440.939		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.53	3.61	3.62	3.56	3.66	FROZEN	FROZEN	FROZEN	FROZEN	3.58	3.80	3.62	-	0.08	-
BRW19-PZ32	5443.225		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.07	6.13	6.14	6.10	6.21	6.28	6.27	5.88	5.91	6.04	6.2	6.11	-	0.13	-
BRW19-PZ40	5449.868		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.21	11.28	11.31	11.22	11.32	11.41	11.43	11.00	11.07	11.18	11.38	11.26	-	0.13	-
BRW19-PZ41	5453.49		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.94	14	14.05	13.94	14.08	14.18	14.20	13.75	13.83	13.93	14.12	14.00	-	0.13	-
BRW19-PZ42	5451.137		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.69	11.75	11.78	11.69	11.81	11.89	11.92	11.56	11.58	11.67	11.84	11.74	-	0.11	-
BRW19-PZ43	5448.782		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.76	8.83	8.87	8.76	8.91	8.99	9.02	8.59	8.65	8.74	8.92	8.82	-	0.13	-
BRW19-PZ44	5449.189		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.25	9.32	9.36	9.24	9.4	9.47	9.51	9.06	9.12	9.23	9.42	9.31	-	0.14	-
BRW19-PZ45	5449.304		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.89	8.96	9	8.90	9.03	9.1	9.14	8.72	8.78	8.87	9.03	8.95	-	0.12	-
BRW19-PZ46	5444.403		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.70	7.7	7.73	7.63	7.75	7.89	7.89	7.38	7.42	7.59	7.9	7.69	-	0.17	-
BRW19-PZ47	5446.458		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.71	8.76	8.78	8.70	8.82	8.90	8.89	8.42	8.50	8.63	8.87	8.73	-	0.15	-
BRW19-PZ48	5448.787		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.45	8.52	8.51	8.48	8.61	8.69	8.70	8.28	8.34	8.43	8.61	8.51	-	0.13	-
BRW19-PZ49	5450.523		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.70	9.78	10.98[1]	10.72[1]	9.88	9.93	9.94	9.53	9.59	9.70	9.85	9.96	9.77	0.44	0.14
BRW19-PZ50	5449.235		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.81	8.88	8.94	8.81	8.96	9.04	9.05	8.62	8.69	8.78	8.96	8.87	-	0.13	-
BRW19-PZ01S	5442.481		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.36	5.39	5.42	5.33	5.55	5.78	5.79	5.26	5.24	5.42	5.69	5.48	-	0.19	-
BRW19-PZ01DR	5441.748		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.89	4.99	4.97	4.95	5.06	5.18	5.23	4.70	4.74	4.86	5.06	4.97	-	0.16	-
BRW19-PZ03D	5440.976		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.54	NO ENTRY	3.63	3.56	3.64	FROZEN	FROZEN	FROZEN	FROZEN	3.59	3.76	3.62	-	0.07	-
BRW19-PZ05S	5441.439		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.98	NO ENTRY	3.99	3.90	4	FROZEN	FROZEN	FROZEN	3.73	3.90	4.19	3.96	-	0.13	-
BRW19-PZ10D	5448.695		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.36	9.42	9.43	9.34	9.5	9.58	9.58	9.12	9.19	9.31	9.54	9.40	-	0.15	-
BRW19-PZ11S	5448.395		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.47	8.54	8.59	8.49	8.62	8.71	8.73	8.28	8.33	8.46	8.65	8.53	-	0.14	-
BRW19-PZ12D	5449.777		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.21	9.3	9.33	9.22	9.38	9.43	9.46	9.03	9.12	9.19	9.36	9.28	-	0.13	-
BRW19-PZ16S	5461.697		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.52	21.48	21.59	21.46	21.63	21.2	21.69	21.34	21.41	21.47	21.56	21.49	-	0.13	-

[1] Data point does not fit with the overall behavior of the local groundwater. The point has been identified as an outlier and has not been used to generate contours in any figures.

[2] Groundwater in this location does not match the behavior of any other location. This is likely due to the influence of the nearby Hydraulic Control Channel (HCC). The data from this location has not been used to generate contours in any figures.

[3] Datapoint does not appear to fit with the overall behavior of the local groundwater. However, it has not been identified as an outlier. It has been used to generate contours in figures.

[4] Groundwater in this location does not match the behavior of any other location. **[REASON UNKNOWN]**. The data from this location has not been used to generate contours in any figures.

[5] **Access agreements at the Northwestern Energy property were obtained in July 2019.**

[6] Highlighted values were used to generate shading (kriging) shown in Figures 11 and 12. These values are within the Site boundary and do not have data set outliers.

Blue Text Lowest groundwater elevation for this well (highest DTW measurement).

Red Text Highest groundwater elevation for this well (lowest DTW measurement).

Data isn't present for March (3/2020) and April 2020 (4/2020) due to the COVID Pandemic.

*Depth to Water is measured in feet from the top of PVC or top of steel casing (if no PVC casing is present).
The measuring point elevations have been surveyed and are listed in the indicated column.

Table 9. Monthly Depths to Groundwater (cont.)

Depth to Groundwater (ft)

Location	Measuring Point Elevation	Transducer	Aquifer Unit	1/4/2019 & 1/7/2019	1/24/2019	2/28/2019	3/28/2019	4/30/2019	5/29/2019	6/27/2019	7/26/2019	8/28/2019	9/27/2019	10/28/2019	11/25/2019	12/30/2019
BRW-PW-01A	5443.341		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW-PW-01B	5454.994		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-
AMW-02	5452.535		Shallow	10.58	10.61	10.72	10.11	9.66	9.64	10.01	10.27	10.67	10.11	10.02	10.33	10.44
BPS07-08A	5450.465		Shallow	10.2	10.29	10.35	9.7	9.32	9.26	9.68	9.91	10.09	9.83	9.74	9.97	10.13
BPS07-13A	5463.576	X	Shallow	24.65[1]	23.69	23.75	23.17	23.10	23.82[1]	23.29	23.53	23.65	23.42	24.13[1]	24.30[1]	24.41[1]
BPS07-13B	5464.695	X	Deep	24.44	24.47	24.52	23.98	23.66	23.63	23.99	24.25	24.37	24.18	24.05	24.25	24.36
BPS07-14A	5459.521	X	Deep	FROZEN	FROZEN	FROZEN	FROZEN	21.38	21.48	21.79	22.1	20.75[1]	22.05	20.32[1]	22.13	FROZEN
BPS07-15A	5459.327	X	Shallow	19.56	19.64	19.67	19.25	18.79	18.83	19.16	19.39	19.57	19.38	19.24	19.41	19.54
BPS07-25[2]	5449.082	X	Shallow	11.64[2]	10.81[2]	10.84[2]	10.35[2]	10.88[2]	10.88[2]	10.36[2]	11.45[2]	10.69[2]	11.36[2]	10.39[2]	10.62[2]	10.03[2]
BPS11-01	5450.083		Shallow	FROZEN	FROZEN	9.43[1]	FROZEN	8.26	8.24	8.63	8.89	9.08	8.76	8.72	8.98	FROZEN
BPS11-02	5447.272		Shallow	FROZEN	FROZEN	NO ENTRY	FROZEN	5.41	5.44	5.79	6.03	6.22	5.95	5.8	6.02	FROZEN
BPS11-05A1	5449.384	X	Shallow	7.93	7.98	8.02	7.45	7.14	7.34	7.6	7.81	7.97	7.76	7.67	7.81	7.92
BPS11-05A2	5449.463	X	Deep	7.95	7.97	8.05	7.46	7.16	7.32	7.62	7.83	7.98	7.75	7.67	7.83	7.96
BPS11-06	5452.047	X	Shallow	11.4	11.45	11.59	10.96	10.53	10.66	10.98	11.21	11.37	11.16	11.08	11.24	11.38
BPS11-07	5455.461		Shallow	16.35	16.44	16.48	15.91	15.51	15.55	15.86	16.13	16.27	16.02	15.94	16.15	16.31
BPS11-08	5456.821		Shallow	FROZEN	15.02	15.13	FLOODED	12.94	13.17	13.67	14.06	14.40	14.02	14.06	14.45	14.8
BPS11-09	5448.202		Shallow	5.22	5.27	5.31	4.67	4.49	4.59	4.88	5.09	5.33	4.67	4.92	5.15	5.16
BPS11-12A	5452.35		Shallow	8.58	8.62	8.65	BURIED	BURIED	7.95	8.23	8.5	8.63	8.38	8.33	8.46	8.53
FP98-01B	5461.322	X	Deep	23.85	23.88	23.94	23.49	23.14	23.13	23.48	23.71	23.87	23.67	23.58	23.73	21.86[1]
FP98-1	5443.134	X	Shallow	FROZEN	7.86[1]	6.41	5.68	5.50	5.30	6.07	6.43	6.45	6.98[1]	6.01	6.34	6.4
FP98-2	5441.485		Deep	5.94	6.01	6.02	5.64	5.40	5.36	5.62	5.68	5.87	5.72	5.69	5.86	6.02
GS-13A	5443.808		Shallow	7.08	7.09	7.05	6.54	6.77[1]	6.35	6.79	6.86	6.87	6.62	6.64	6.96	6.99
GS-13B	5441.888		Deep	4.76	4.85	4.85	4.45	4.17	4.10	4.45	4.62	4.72	4.5	4.46	4.63	4.91
HCA-MG3[3]	5460.346		Shallow	21.15	21.43	21.7	20.83	17.07	15.76	16.79	17.16	18.79	16.61[3]	17.51	20.18	20.99
FP98-3	5445.89		Shallow	NO ENTRY	FROZEN	FROZEN	FROZEN	FROZEN	DRY	DRY	DRY	DRY	DRY	DRY	DRY	FROZEN
FP98-5	5439.444		Shallow	5.66	5.74	5.79	5.42	5.18	5.15	5.38	5.55	5.62	5.49	5.46	5.61	5.78
GS-29SR	5448.852		Shallow	6.66	6.69	6.74	5.62[1]	5.65	5.91	6.29	6.55	7.01	6.33	6.27	6.54	6.56
BRW19-HCW30	5454.297		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW31	5450.836		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW32	5454.067		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW33R	5452.006		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW34	5451.967		Deep	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW35	5452.421		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW36	5450.607		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW37	5454.672		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW38	5450.956		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW39	5450.088		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW40	5449.347		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW42	5448.002		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
BRW19-HCW41	5449.674		Shallow	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-01-MPC[4,5]	5449.474		Shallow	-	-	-	-	-	-	-	8.82[4]	6.35[1]	6.17[1]	7.54[4]	8.67[4]	9.15[4]
MW-02-MPC[5]	5447.228		Shallow	-	-	-	-	-	-	-	6.16	7.92[1]	7.59[1]	6.11	6.25	6.47
MW-03-MPC[5]	5447.219		Shallow	-	-	-	-	-	-	-	5.67	5.76	5.60	5.56	5.73	5.85
MW-03A-MPC[5]	5447.32		Deep	-	-	-	-	-	-	-	5.65	5.83	5.64	5.56	5.71	5.54

Location	1/29/2020	2/28/2020	5/29/2020	6/30/2020	7/30/2020	8/26/2020	9/22/2020	10/22/2020	11/24/2020	12/22/2020	1/27/2021	2/18/2021	3/30/2021	4/20/2021	5/17/2021	6/28/2021	Average	Average (Outliers Removed)	Standard Deviation	Standard Deviation (Outliers Removed)
BRW-PW-01A	-	-	-	-	-	7.35[1]	5.56	5.56	5.50	5.63	5.70	5.69	5.30	5.32	5.46	9.64[1]	6.06	5.95	1.25	0.14
BRW-PW-01B	-	-	-	-	-	15.28	15.35	16.89[1]	15.27	15.45	15.55	15.56	15.12	15.18	15.28	15.46	15.49	15.35	0.46	0.14
AMW-02	10.53	10.60	10.13	9.57	10.00	10.26	10.24	10.42	10.38	10.6	NO ENTRY	NO ENTRY	10.18	10.26	10.36	10.44	10.26	-	0.30	-
BPS07-08A	10.23	10.26	9.86	9.18	9.74	9.95	9.97	10.09	10.77[1]	10.26	10.32	10.36	9.74	9.97	10.06	10.15	9.98	9.95	0.34	0.32
BPS07-13A	23.63	23.71	23.36	22.98	23.34	23.53	23.51	23.57	23.50	23.63	23.7	23.79	23.36	23.43	23.53	23.62	23.62	23.49	0.36	0.20
BPS07-13B	24.42	24.48	24.12	23.61	24.11	24.3	24.32	24.43	24.31	24.48	24.49	24.52	24.11	24.22	24.29	24.45	24.23	-	0.26	-
BPS07-14A	FROZEN	FROZEN	20.51	19.99	20.34	20.67	20.73	20.83	22.22	22.37	22.40	FROZEN	22.09	22.13	22.21	22.33	21.47	21.53	0.80	0.78
BPS07-15A	19.60	19.65	19.36	18.68	19.26	19.5	19.55	19.56	19.50	19.63	19.68	FROZEN	19.37	20.41	19.51	19.62	19.44	-	0.32	-
BPS07-25[2]	10.79[2]	10.83[2]	10.54[2]	10.02[2]	10.43[2]	10.61[2]	10.64[2]	10.73[2]	11.56[2]	11.64[2]	11.72[2]	10.87[2]	11.41[2]	11.47[2]	10.67[2]	11.64[2]	10.89	-	0.49	-
BPS11-01	BURIED	BURIED	8.86	FLOODED	8.65	8.92	8.98	9.11	FROZEN	FROZEN	FROZEN	NO ENTRY	8.64	9.02	9.11	9.14	8.86	8.82	0.29	0.27
BPS11-02	6.25	FROZEN	5.95	5.41	5.84	6	6.05	6.11	FROZEN	FROZEN	FROZEN	NO ENTRY	5.86	6.04	6.13	6.2	5.92	-	0.25	-
BPS11-05A1	7.98	8.01	7.73	7.33	7.72	7.92	7.97	7.99	7.90	8.03	8.06	8.09	7.73	7.72	7.87	8	7.81	-	0.24	-
BPS11-05A2	8.03	8.07	7.77	7.36	7.78	7.96	7.99	8.05	7.95	8.11	8.17	8.21	7.84	7.86	7.96	8.1	7.85	-	0.26	-
BPS11-06	11.44	11.49	11.19	10.67	11.01	11.34	11.41	11.46	11.38	11.5	11.57	11.58	11.21	11.26	9.40[1]	11.48	11.19	-	0.44	-
BPS11-07	16.38	16.43	16.07	15.47	NO ENTRY	16.16	16.2	16.3	16.24	16.37	16.46	16.47	16.06	16.17	16.25	16.3	16.15	-	0.28	-
BPS11-08	15.03	FROZEN	14.24	13.35	NO ENTRY	14.33	14.52	14.63	14.68	14.95	15.19	NO ENTRY	14.68	15.62	14.65	NO ENTRY	14.42	-	0.65	-
BPS11-09	5.23	5.25	5.02	4.55	4.94	5.2	5.22	5.25	5.18	5.29	5.38	5.34	5.01	5.03	5.13	5.35	5.07	-	0.25	-
BPS11-12A	8.60	8.60	8.43	7.98	8.42	8.65	8.69	8.61	8.58	8.67	8.71	8.72	8.4	8.43	8.54	8.79	8.51	-	0.20	-
FP98-01B	23.89	23.92	23.72	23.27	23.61	23.85	23.9	23.92	23.82	23.95	23.99	24.01	23.68	23.72	23.81	23.95	23.67	23.73	0.41	0.24
FP98-1	6.34	6.45	6.23	5.51	6.3	6.51	6.41	6.43	6.28	FROZEN	6.5	FROZEN	6.15	6.18	6.35	6.64	6.30	6.20	0.48	0.35
FP98-2	6.03	6.05	5.9	5.49	5.7	5.87	5.92	5.96	5.94	6.04	6.09	6.11	5.86	5.87	5.95	6.06	5.85	-	0.20	-
GS-13A	6.98	7.08	4.61[1]	6.52	6.75	6.78	6.87	6.88	6.86	6.89	7.10	6.99	6.8	6.89	6.97	7.04	6.78	6.86	0.45	0.19
GS-13B	4.81	4.83	6.99[1]	4.19	4.48	4.65	4.7	4.73	4.70	4.79	4.89	4.88	4.61	4.67	4.72	4.8	4.72	4.66	0.48	0.20
HCA-MG3[3]	21.43	21.76	20.48	15.25[1]	16.71	19.46	20.44	20.33	20.55	21.01	21.56	21.80	20.46	20.41	21.21	21.12	19.65	19.72	2.02	2.02
FP98-3	FROZEN	6.88[1]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	6.88	-	0.00	-
FP98-5	5.80	5.83	5.7	5.23	5.54	5.64	5.7	5.71	5.70	5.77	5.84	5.84	5.59	5.62	5.70	5.82	5.62	-	0.19	-
GS-29SR	6.59	6.70	6.31	5.83	6.28	6.57	6.45	6.62	6.52	6.66	6.76	6.67	6.33	6.38	6.46	6.6	6.43	6.46	0.32	0.29
BRW19-HCW30	16.01	16.03	15.8	15.23[1]	15.64	15.95	15.99	16.07	15.90	16.06	16.12	16.15	15.76	15.81	15.90	16.07	15.91	15.89	0.22	0.22
BRW19-HCW31	11.86	11.90	11.6	11.16[1]	11.46	11.73	11.82	11.91	11.76	11.92	11.97	11.99	11.65	11.67	11.76	11.8	11.75	11.73	0.21	0.20
BRW19-HCW32	15.02	15.05	14.79	14.36[1]	14.66	14.91	14.99	15.08	14.93	15.07	15.12	15.14	14.84	14.86	14.94	15.05	14.93	14.91	0.19	0.19
BRW19-HCW33R	12.28	12.14	11.87	11.36[1]	11.75	11.99	12.05	12.07	11.95	12.11	12.14	12.17	11.82	11.88	12.00	12.09	11.98	11.97	0.21	0.21
BRW19-HCW34	11.46	11.52	10.78	9.53[3]	10.28	10.51	11.03	11.31	11.26	11.40	11.52	11.59	10.64	10.85	11.04	11.06	10.99	-	0.53	-
BRW19-HCW35	11.85	11.88	11.61	11.07[1]	11.51	11.76	11.82	11.87	11.74	11.93	11.96	11.99	11.62	11.68	11.76	11.89	11.75	11.73	0.22	0.22
BRW19-HCW36	9.65	9.68	9.41	8.90[3]	9.33	9.59	9.65	9.68	9.62	9.72	9.77	11.69[1]	9.41	9.46	9.56	9.71	9.68	9.54	0.56	0.21
BRW19-HCW37	14.96	15.00	14.71	14.01[1]	14.56	14.84	14.91	14.96	14.84	15.01	15.09	15.12	14.69	14.73	14.85	15.02	14.83	14.81	0.26	0.26
BRW19-HCW38	10.99	11.04	10.74	10.11[1]	10.61	10.91	10.98	11.05	10.90	11.06	11.12	11.16	10.74	10.8	10.89	11.04	10.88	10.87	0.25	0.25
BRW19-HCW39	9.47	9.50	9.22	8.62[1]	9.10	9.37	9.44	9.5	9.36	9.54	9.59	9.64	9.23	9.29	9.37	9.52	9.36	9.34	0.24	0.23
BRW19-HCW40	8.90	8.93	8.26	8.01[3]	8.52	11.21	11.28	11.31	11.22	11.32	9.04	9.06	8.62	8.69	8.79	8.96	9.51	-	1.22	-
BRW19-HCW42	8.10	8.14	7.86	7.13[3]	7.72	11.69	11.75	11.78	11.69	11.81	8.25	8.27	7.82	7.89	8.00	8.19	9.13	-	1.78	-
BRW19-HCW41	8.49	8.52	8.64	7.82[1]	8.23	8.41	8.49	8.63	8.43	8.57	8.59	8.62	8.25	8.32	8.41	8.55	8.44	8.42	0.20	0.20
MW-01-MPC[4,5]	7.97[4]	9.23[4]	7.75[4]	8.43[4]	7.64[4]	7.92[4]	8.16[4]	7.97[4]	9.19	9.32	9.38	9.39	9.00	9.02	9.14	9.31	8.43	-	0.92	-
MW-02-MPC[5]	6.54	6.60	3.81[1]	3.15[1]	3.71[1]	3.25[1]	4.16[1]	6.51	6.45	6.61	6.70	6.73	6.23	6.28	6.45	6.60	5.92	6.45	1.33	0.19
MW-03-MPC[5]	5.90	5.91	5.64	5.16[3]	5.58	6.78	9.20[1]	5.88	9.90[1]	5.95	6.00	NO ENTRY	5.65	5.68	5.79	5.95	6.15	5.80	1.14	0.30
MW-03A-MPC[5]	5.88	5.96	5.66	5.19[3]	5.54	9.44[1]	5.83	5.61	12.82[1]	5.96	6.02	NO ENTRY	5.67	5.70	5.79	5.92	6.23	5.72	1.68	0.19

[1] Data point does not fit with the overall behavior of the local groundwater. The point has been identified as an outlier and has not been used to generate contours in any figures.

[2] Groundwater in this location does not match the behavior of any other location. This is likely due to the influence of the nearby Hydraulic Control Channel (HCC). The data from this location has not been used to generate contours in any figures.

[3] Datapoint does not appear to fit with the overall behavior of the local groundwater. However, it has not been identified as an outlier. It has been used to generate contours in figures.

[4] Groundwater in this location does not match the behavior of any other location. [REASON UNKNOWN]. The data from this location has not been used to generate contours in any figures.

[5] Access agreements at the Northwestern Energy property were obtained in July 2019.

[6] Highlighted values were used to generate shading (kriging) shown in Figures 11 and 12. These values are within the Site boundary and do not have data set outliers.

Blue Text Lowest groundwater elevation for this well (highest DTW measurement).

Red Text Highest groundwater elevation for this well (lowest DTW measurement).

Data isn't present for March (3/2020) and April 2020 (4/2020) due to the COVID Pandemic.

*Depth to Water is measured in feet from the top of PVC or top of steel casing (if no PVC casing is present).
The measuring point elevations have been surveyed and are listed in the indicated column.

Table 10. Summary of Groundwater and Surface Water PCB, PCP, and Dioxin Analytical Results

Phase I and Phase II Data			PCB* (µg/L)									PCP (µg/L)	Dioxins** (µg/L)
Chronic Aquatic Life Standard (DEQ-7, 2019)			0.014									4	NE
Groundwater Standard (DEQ-7, 2019)			0.5									1	0.000002
Surface Water Standard (DEQ-7, 2019)			0.00064									0.3	0.00000005
Required Reporting Value (DEQ-7, 2019)			0.08									0.1	0.00001
Field Sample ID	**Aquifer Unit**	**Sample Date**	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1262	Aroclor 1268	Pentachlorophenol	2,3,7,8-TCDD
Surface Water Samples													
BRW19-B5	-	7/16/2020	<0.040	<0.041	<0.035	<0.036	<0.038	<0.040	<0.034	<0.035	<0.043	<0.19	<0.00001
BRW19-B6	-	7/16/2020	<0.040	<0.042	<0.035	<0.036	<0.039	<0.041	<0.034	<0.035	<0.044	<0.20	<0.00001
Groundwater Samples													
BRW19-HCW36	Shallow	2/5/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
BRW19-HCW40	Shallow	1/28/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
BRW19-HCW41	Shallow	1/28/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
BRW19-HCW42	Shallow	1/28/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
MW-01-MPC	Shallow	1/30/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
MW-02-MPC	Shallow	1/30/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
MW-03A-MPC	Deep	1/30/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
MW-03-MPC	Shallow	1/30/2020	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
BRW18-PZ01	Deep	7/16/2020	<0.042	<0.043	<0.036	<0.038	<0.040	<0.042	<0.036	<0.036	<0.046	<0.19	<0.00001
		11/10/2020	<0.041	<0.042	<0.036	<0.037	<0.040	<0.042	<0.035	<0.036	<0.045	<0.19	<0.00001
BRW19-PZ46	Shallow	10/1/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.040	<0.034	<0.035	<0.044	<0.19	<0.00001
		10/12/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.040	<0.034	<0.035	<0.044	<0.18	<0.00001
		11/4/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.040	<0.034	<0.035	<0.044	<0.18	<0.00001
BRW20-PW01A	Shallow	7/16/2020	<0.042	<0.043	<0.037	<0.038	<0.041	<0.043	<0.036	<0.037	<0.046	<0.20	<0.00001
		10/5/2020	<0.041	<0.042	<0.036	<0.037	<0.040	<0.041	<0.035	<0.036	<0.045	<0.19	<0.00001
		10/6/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.041	<0.034	<0.035	<0.044	<0.19	<0.00001
		10/7/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.041	<0.034	<0.035	<0.044	<0.19	<0.00001
		10/8/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.041	<0.034	<0.035	<0.044	<0.19	<0.00001
BRW20-PW01B	Deep	7/16/2020	<0.041	<0.042	<0.036	<0.037	<0.040	<0.041	<0.035	<0.036	<0.045	<0.19	<0.00001
		10/27/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.040	<0.034	<0.035	<0.044	<0.19	<0.00001
		10/28/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.040	<0.034	<0.035	<0.044	<0.18	<0.00001
		10/29/2020	<0.040	<0.041	<0.035	<0.036	<0.039	<0.040	<0.034	<0.035	<0.044	<0.18	<0.00001
		10/30/2020	<0.040	<0.041	<0.035	<0.036	<0.038	<0.040	<0.034	<0.035	<0.043	<0.19	<0.00001

<X = Value less than detection limit (value in cell (X) is the method detection limit or reporting limit). BRW19-HCW36 to MW-03-MPC display the reporting limit (<0.20). All remaining values are method detection limits.

*Polychlorinated Biphenyl (PCB) Aroclors are summed together before determining exceedances, except for Aroclor 1262 (not regulated by DEQ-7, 2019).

**Only 2,3,7,8-TCDD was analyzed. Additional data will be provided after the completion of additional site investigations.

Table 11. Hydrocarbon Impacted Soil Treatment Results

Sample ID			BRW18-LFCHK-11022018	BRW19-LFBK(0-0.162)-03212019	BRW19-LFS(0-0.25)-03212019	BRW19-HCC-071119	BRW19-HCCBCK-071119	BRW19-BCKUG-080119	BRW19-BCKDG-080119	BRW19-HCC-10282019	BRW19-BCK-10282019	BRW20-LFCHK-05292020	BRW20-HCS-05292020
Date of Collection			11/2/2018	3/12/2019	3/12/2019	7/11/2019	7/11/2019	8/1/2019	8/1/2019	10/28/2019	10/28/2019	5/29/2020	5/29/2020
Sample Type			Landfarm Soil Sample (Initial Laboratory Analysis)	Background Soil Sample	Landfarm Soil Sample	Landfarm Soil Sample *(Additional soil was added to landfarm on July 11, 2019.)*	Background Soil Sample	Background Soil Sample - Upgradient	Background Soil Sample - Downgradient	Landfarm Soil Sample	Background Soil Sample	Background Soil Sample	Landfarm Soil Sample
Method of Collection			5-point composite	5-point composite	5-point composite	5-point composite	5-point composite	5-point composite	5-point composite	5-point composite	5-point composite	5-point composite	5-point composite
Sample Depth			0-2" bgs	0-2" bgs	0-3" bgs	0-6" bgs	0-6" bgs	0-6" bgs	0-6" bgs	See Logbook	See Logbook	See Logbook	See Logbook
Analyte		**Method**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**	**Result (mg/kg-dry)**
Arsenic (As)		EPA 6010.20	199	211	162	160	105	N/A	N/A	142	141	242	168
Barium (Ba)		EPA 6010.20	N/A	145	173	141	193	N/A	N/A	140	156	161	173
Cadmium (Cd)		EPA 6010.20	3	5	3	3	6	N/A	N/A	3.4	4.5	5	5
Chromium (Cr)		EPA 6010.20	N/A	13	18	31	31	N/A	N/A	45	22	17	38
Lead (Pb)		EPA 6010.20	243	3170	215	N/A	N/A	N/A	N/A	461	2850	3690	498
Selenium (Se)		EPA 6010.20	N/A	<0.4	<0.4	<0.4	<0.4	N/A	N/A	<0.8	<0.9	ND	ND
Silver (Ag)		EPA 6010.20	N/A	12	5	7	8	N/A	N/A	6.3	10.8	10	6
Mercury (Hg)		SW-7471B	N/A	1.3	0.69	0.71	0.69	N/A	N/A	0.65	1.1	1.3	0.7
Butte MWR O&M Manual Threshold[1]													
Total Hydrocarbons (TEH plus TPH)	100 ppm	Calculation	919.6	17	70.3	220	152	N/A	N/A	193.6	86	54	8.3
Montana Risk-Based Screening Levels (RBSL)[2]													
Volatile Petroleum Hydrocarbons (VPH)													
C5-C8 Aliphatics	52 ppm	MA-VPH	<1.1	<1.1	<1.1	<0.99	<0.98	N/A	N/A	0.84	<0.36	ND	ND
C9-C12 Aliphatics	77 ppm	MA-VPH	1.5	<0.78	3.6	<0.71	<0.70	N/A	N/A	0.67	<0.22	ND	ND
C9-C10 Aromatics	130 ppm	MA-VPH	<0.16	<0.16	<0.16	<0.14	<0.14	N/A	N/A	<0.11	<0.11	ND	ND
Total Purgeable Hydrocarbons	N/A	MA-VPH	1.6	<0.93	4.3	<0.84	<0.83	N/A	N/A	1.6	<0.43	ND	1.2
MTBE	0.078* ppm	MA-VPH	<0.0097	<0.015	<0.015	<0.013	<0.013	N/A	N/A	<0.012	<0.012	ND	ND
Benzene	0.07 ppm	MA-VPH	<0.0051	<0.024	<0.025	<0.022	<0.022	N/A	N/A	<0.0073	<0.0075	ND	ND
Toluene	21 ppm	MA-VPH	<0.0051	<0.018	<0.029	<0.017	<0.016	N/A	N/A	<0.0048	<0.0049	ND	ND
Ethylbenzene	6.4 ppm	MA-VPH	<0.0034	<0.029	<0.030	<0.010	<0.0099	N/A	N/A	<0.011	<0.012	ND	ND
Xylenes	72 ppm	MA-VPH	<0.0082	<0.034	<0.0082	<0.0092	<0.0092	N/A	N/A	0.094	<0.0042	ND	ND
Naphthalene	4.3 ppm	MA-VPH	<0.011	<0.062	0.079	<0.016	<0.016	N/A	N/A	<0.021	<0.021	ND	ND
Lead Scavengers													
1, 2-Dibromoethane (EBD)	0.000086* ppm	SW-8011	N/A	<0.000062	<0.00006	<0.00011	<0.00011	N/A	N/A	<0.00011	<0.00011	ND	ND
1, 2-Dichloroethane (DCA)	0.019 ppm	SW-8260B	N/A	<0.0027	<0.0027	<0.0024	<0.0024	N/A	N/A	<0.0025	<0.0025	ND	ND
Extractable Petroleum Hydrocarbons (EPH)													
EPH Screen, Fractionate	200 ppm	SW-8015M	1070	17	233	494	222	94	242	--	--	205	244
C9-C18 Aliphatics	110 ppm	MA-EPH	55	N/A	<1.4	<1.2	<1.1	N/A	<1.1	<1.2	<1.2	ND	ND
C19-C36 Aliphatics	24000 ppm	MA-EPH	393	N/A	27	87	89	N/A	29	60	26	ND	ND
C11-C22 Aromatics	370 ppm	MA-EPH	457	N/A	32	94	53	N/A	31	79	39	43	ND
Total Extractable Hydrocarbons	N/A	MA-EPH	918	N/A	66	220	152	N/A	67	192	86	54	7.1
Acenaphthene	27 ppm	MA-EPH	N/A	N/A	N/A	0.016	0.032	N/A	<0.0025	<0.0050	<0.0053	0.013	ND
Anthracene	2200 ppm	MA-EPH	N/A	N/A	N/A	0.064	0.092	N/A	0.0092	0.054	0.032	0.15	0.032
Benz(a)anthracene	1.3 ppm	MA-EPH	N/A	N/A	N/A	0.24	0.34	N/A	0.037	0.14	0.092	0.36	0.058
Benzo(a)pyrene	0.13** ppm	MA-EPH	N/A	N/A	N/A	0.27	0.44	N/A	0.055	0.19	0.12	0.34	0.089
Benzo(b)fluoranthene	1.3 ppm	MA-EPH	N/A	N/A	N/A	0.35	0.51	N/A	0.059	0.22	0.13	0.35	0.11
Benzo(k)fluoranthene	13 ppm	MA-EPH	N/A	N/A	N/A	0.11	0.17	N/A	0.029	0.084	0.058	0.15	0.037
Chrysene	130 ppm	MA-EPH	N/A	N/A	N/A	0.28	0.4	N/A	0.051	0.16	0.12	0.45	0.058
Dibenzo(a,h)anthracene	0.13** ppm	MA-EPH	N/A	N/A	N/A	0.054	0.091	N/A	0.013	0.055	0.028	0.059	0.02
Fluoranthene	85 ppm	MA-EPH	N/A	N/A	N/A	0.53	0.69	N/A	0.078	0.32	0.19	0.71	0.12
Fluorene	35 ppm	MA-EPH	N/A	N/A	N/A	0.021	0.038	N/A	<0.0028	0.027	0.015	0.053	0.0092
Indenol(1, 2, 3-cd)pyrene	1.3 ppm	MA-EPH	N/A	N/A	N/A	0.23	0.38	N/A	0.045	0.19	0.11	0.19	0.08
Naphthalene	4.3 ppm	MA-EPH	N/A	N/A	N/A	0.013	0.021	N/A	0.0074	<0.0055	<0.0057	0.021	0.015
Pyrene	83 ppm	MA-EPH	N/A	N/A	N/A	0.41	0.61	N/A	0.075	0.28	0.19	0.63	0.12
1-Methylnaphthalene	2.1 ppm	MA-EPH	N/A	N/A	N/A	<0.0024	0.014	N/A	<0.0024	<0.0048	<0.0050	0.014	0.012
2-Methynaphthalene	6.9 ppm	MA-EPH	N/A	N/A	N/A	0.0077	0.012	N/A	<0.0069	<0.0052	<0.0054	0.014	0.021

Red text - analytical result above applicable Butte MWR O&M Manual Threshold or RBSL.

<X = Value less than approximate detection limit (value in cell (X) is the approximate detection limit). Method detection limits vary slightly between each sample event.

N/A - Analysis not performed.

[1]Source: *Butte Mine Waste Repository (MWR) Operations and Maintenance (O&M) Manual (Atlantic Richfield, 2015)*

[2]Source: *Montana Risk-Based Corrective Action Guidance for Petroleum Releases, Table 1 - Residential RBSLs with Less Than 10-feet to Groundwater (DEQ, 2018)*

*The best achievable practical quantitation limit (0.20) is greater than the RBSL; therefore, if the compound is detected, an additional evaluation may be necessary.

**The best achievable practical quantitation limit (0.33) is greater than the RBSL; therefore, if the compound is detected, an additional evaluation may be necessary.

Table 12: Approximate Volumes of Materials Within the Site

Material Type	Volume[1] within the Site Boundary	Volume[1] within the Preliminary Waste Removal Corridor (Figure 3)[3]
	Cubic Yards	Cubic Yards
Alluvium, Tailings, and Organic Soil (ATO) - All	831,000	468,000
Waste[2]	598,000	220,000
Slag	304,000	62,000
Demolition Debris	57,000	34,000
Other (e.g., general fill from BSB Operations)	79,000	33,000
ATO - Waste	157,000	90,000
Material to Be Removed During Remedial Action[4]	NA	239,000

Notes:

(1) The volumes depicted in this table are approximate and are based on the modeling done in the Leapfrog Works software.

(2) The waste material volume includes the volume of slag, demolition debris, other, and ATO-Waste. Additionally, the upper 95% regression is used to adjust the XRF data.

(3) The excavated material is preliminary. The removal corridor and excavation surface will be refined further during the remedial design and will be submitted for Agencies' review and approval.

(4) The material to be removed during the remedial action includes only the material captured by the preliminary waste excavation surface, which captures waste in the removal corridor and incorporates construction feasible side slopes and grade along the deepest parts of the surface. The preliminary waste excavation surface does not include the material to be removed to accommodate the stream design or to accommodate end land use features. Some unimpacted material will be removed to capture the waste underneath. Additional details on the surface and its evaluation in Leapfrog can be found in Appendix C.

Table 13. Depth for Bottom of Waste in Each Investigation Point

Location	Borehole Data Regression Bottom of Waste Depth	Borehole Data Upper 95% Bottom of Waste Depth	Modeled COC Waste Depth	Excavation Depth	Added Waste Depth Comparing Regression and Upper 95%	Added Waste Depth Comparing Upper 95% and Model	Excavation Depth Below Upper 95%	Excavation Depth Below Modeled COC Waste	On the Edge of the Excavation?
BRW18-BH01	25	25.8	26.1	26.8	0.8	0.3	1.0	0.7	NO
BRW18-BH02	23.4	23.4	24.2	24.6	0	0.8	1.2	0.4	NO
BRW18-BH03	25.4	25.4	25.0	26.0	0	**-0.4**	0.6	1.0	NO
BRW18-BH05	21.9	21.9	22.6	26.7	0	0.7	4.8	4.1	NO
BRW18-BH06	20	20	20.0	20.1	0	0.0	0.1	0.1	NO
BRW18-BH07	5.7	5.9	7.6	8.0	0.2	1.7	2.1	0.4	NO
BRW18-BH16	6.2	6.2	6.2	6.7	0	0.0	0.5	0.5	NO
BRW18-BH18	6.1	6.1	6.8	7.0	0	0.7	0.9	0.2	NO
BRW18-BH20	7.7	7.7	8.5	9.3	0	0.8	1.6	0.8	NO
BRW18-BH21	10	10	10.4	10.7	0	0.4	0.7	0.3	NO
BRW18-BH22	8.6	8.6	9.2	9.7	0	0.6	1.1	0.5	NO
BRW18-BH23	7.3	7.3	9.5	10.2	0	2.2	2.9	0.7	NO
BRW18-BH24	7.9	7.9	9.1	9.3	0	1.2	1.4	0.2	NO
BRW18-BH25	10.8	10.8	11.1	11.3	0	0.3	0.5	0.2	NO
BRW18-BH26	7.2	7.2	9.1	9.6	0	1.9	2.4	0.5	NO
BRW18-BH27	9.2	9.2	8.8	9.5	0	**-0.4**	0.3	0.7	NO
BRW18-BH28	8.6	8.6	9.6	9.6	0	1.0	1.0	0.0	NO
BRW18-BH29	11.1	11.1	11.8	11.9	0	0.7	0.8	0.1	NO
BRW21-TP4	BOW ND	BOW ND	13.0	13.0	N/A	N/A	N/A	0.0	NO
BRW19-HCW41	4.5	4.5	4.5	4.9	0	0.0	0.4	0.4	NO
BRW18-PZ01	8.7	8.7	10.4	11.3	0	1.7	2.6	0.9	NO
BRW18-PZ02	8.3	8.3	8.9	9.3	0	0.6	1.0	0.4	NO
BRW18-PZ03	9.9	9.9	10.3	10.7	0	0.4	0.8	0.4	NO
BRW18-PZ04	7.5	8.3	9.6	10.4	0.8	1.3	2.1	0.8	NO
BRW18-PZ05	6.8	6.8	8.9	9.4	0	2.1	2.6	0.5	NO
BRW18-PZ06	9.1	9.1	9.6	10.1	0	0.5	1.0	0.5	NO
BRW18-PZ08	8.5	8.5	9.5	9.8	0	1.0	1.3	0.3	NO
BRW18-PZ10	No Waste	No Waste	6.5	11.3	N/A	N/A	11.3	4.8	NO
BRW18-PZ12	2.9	2.9	2.9	3.8	0	0.0	0.9	0.9	NO
BRW18-PZ13	2.7	2.7	2.7	3.2	0	0.0	0.5	0.5	NO
BRW18-PZ14	No Waste	No Waste	8.3	12.8	N/A	N/A	12.8	4.5	NO
BRW18-PZ17	7	7	7.0	7.4	0	0.0	0.4	0.4	NO
BRW18-PZ21	27.2	27.2	27.1	27.9	0	**-0.1**	0.7	0.8	NO
BRW18-PZ22	26.2	26.2	22.2	26.7	0	**-4.0**	0.5	4.5	NO
BRW19-PZ27	8.4	8.4	8.3	9.3	0	**-0.1**	0.9	1.0	NO
BRW19-PZ28R	8.7	8.7	9.3	10.0	0	0.6	1.3	0.7	NO
BRW19-PZ29	15	15	15.4	16.0	0	0.4	1.0	0.6	NO
BRW19-PZ30	8.7	8.7	9.3	10.1	0	0.6	1.4	0.8	NO
BRW19-PZ31	10	10	10.0	10.6	0	0.0	0.6	0.6	NO
BRW19-PZ32	11.3	11.3	11.5	12.0	0	0.2	0.7	0.5	NO
BRW19-PZ40	18.2	18.2	19.4	19.8	0	1.2	1.6	0.4	NO
BRW19-PZ41	16	16	16.0	16.8	0	0.0	0.8	0.8	NO
BRW19-PZ42	16.9	16.9	16.9	18.3	0	0.0	1.4	1.4	NO
BRW19-PZ43	10	10	10.0	10.7	0	0.0	0.7	0.7	NO
BRW19-PZ44	10	10	10.0	10.6	0	0.0	0.6	0.6	NO
BRW19-PZ45	7.8	7.8	7.8	8.2	0	0.0	0.4	0.4	NO
BRW19-PZ47	15	15	15.2	15.7	0	0.2	0.7	0.5	NO
BRW19-PZ49	No Waste	No Waste	2.8	3.3	N/A	N/A	3.3	0.5	NO
BRW19-PZ50	No Waste	No Waste	4.1	4.7	N/A	N/A	4.7	0.6	NO
BRW18-TP01	BOW ND	BOW ND	6.3	6.3	N/A	N/A	N/A	0.0	NO
BRW18-TP05	3.7	3.7	3.7	3.6	0	0.0	**-0.1**	**-0.1**	NO
BRW18-TP08	BOW ND	BOW ND	4.8	5.2	N/A	N/A	N/A	0.4	NO
BRW18-TP14	2.5	2.9	3.1	4.3	0.4	0.2	1.4	1.2	NO
BRW18-TP15	BOW ND	BOW ND	4.9	6.0	N/A	N/A	N/A	1.1	NO
BRW20-TP51	BOW ND	BOW ND	23.4	24.1	N/A	N/A	N/A	0.7	NO
BRW20-TP57	BOW ND	BOW ND	10.0	10.0	N/A	N/A	N/A	0.0	NO
BRW20-TP58	BOW ND	BOW ND	5.9	8.7	N/A	N/A	N/A	2.8	NO
BRW20-TP59	BOW ND	BOW ND	12.0	12.0	N/A	N/A	N/A	0.0	NO
BRW20-TP60	BOW ND	BOW ND	8.5	11.5	N/A	N/A	N/A	3.0	NO
BRW20-TP62	2.9	2.9	2.9	3.4	0	0.0	0.5	0.5	NO
BRW20-TP64	BOW ND	BOW ND	5.3	9.5	N/A	N/A	N/A	4.2	NO
BRW20-TP66	5	5	5.3	5.5	0	0.3	0.5	0.2	NO
BRW20-TP68	BOW ND	BOW ND	5.0	8.3	N/A	N/A	N/A	3.3	NO
BRW20-TP69	BOW ND	BOW ND	26.5	26.8	N/A	N/A	N/A	0.3	NO
BRW20-TP70	BOW ND	BOW ND	13.0	13.0	N/A	N/A	N/A	0.0	NO
BRW20-TP71	BOW ND	BOW ND	6.0	6.0	N/A	N/A	N/A	0.0	NO
BRW20-TP72	BOW ND	BOW ND	6.0	6.0	N/A	N/A	N/A	0.0	NO
BRW18-BH30	6.7	6.7	8.5	1.4	0	1.8	**-5.3**	**-7.1**	**YES**
BRW18-PZ09	6.2	6.2	7.2	4.8	0	1.0	**-1.4**	**-2.4**	**YES**
BRW18-PZ15	16	16	11.2	15.3	0	-4.8	**-0.7**	**4.1**	**YES**
BRW18-PZ20	21.7	21.7	21.7	19.1	0	0.0	**-2.6**	**-2.6**	**YES**
BRW19-PZ48	No Waste	No Waste	5.0	4.6	N/A	N/A	**4.6**	**-0.4**	**YES**
BRW18-TP09	BOW ND	BOW ND	4.5	1.3	N/A	N/A	**N/A**	**-3.2**	**YES**

Definitions and Color Coding

BOW ND - Bottom of Waste Not Determined.

No Waste - The borehole contained only soil samples that passed the Waste Identification Criteria.

Point of Concern for the Borehole Data Waste Geological Model (Leapfrog Model) - Modeled Waste Depth is less than Upper 95% Bottom of Waste Depth.

Point of Concern for Excavation Design - Excavation Depth is Less than Upper 95% Bottom of Waste Depth or Less than Modeled Waste Depth.

Points on the Edge of the Excavation have an Excavation Depth less than the Modeled Waste Depth or Upper 95% Bottom of Waste Depth due to excavation slope constraints.

Modeled COC Waste Depth - Depth of Waste as Modeled in Leapfrog using the COC concentrations to determine waste extents. See Appendix C for more information on the Leapfrog Model.

Statistics on Points within Removal Corridor (Excludes those on Edge of the Excavation)

Including Areas with no identified Waste

1.6 **Average Excavation Depth Below Upper 95% Bottom of Waste**

0.9 **Average Excavation Depth Below Modeled COC Waste**

Removing Areas with no identified Waste

1.1 **Average Excavation Depth Below Upper 95% Bottom of Waste**

0.8 **Average Excavation Depth Below Modeled COC Waste**

APPENDICES

(Provided electronically with this document)

Appendix A Data Summary Reports for the Phase I and Phase II Site Investigations

Appendix B Lithology Logs for Phase I and Phase II Site Investigation Locations

Appendix C Leapfrog Model Results

Appendix D Butte Reduction Works Multichannel Analysis of Surface Waves Survey Final Report

Appendix E 2019 Butte Reduction Works Waters of the U.S. Delineation Report

Appendix F Risk-Based Corrective Action Guidance Evaluation for Hydrocarbon-Impacted Material at Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site

Appendix G Butte Reduction Works (BRW) Pumping Tests Interpretation Technical Memorandum

Appendix H BRW Hydraulic Control and Construction Dewatering Technical Report

Appendix I Hydrologic Evaluation of Landfill Performance at Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site

Appendix J Further Remedial Elements Scope of Work Remedial Design/Remedial Action, Butte Priority Soils Operable Unit Cultural Resource Inventory, Evaluation, and Recommendations

Appendix K Structural Assessment of Existing Bridge and Historic Structures, Butte Reduction Works Smelter Site, Butte, Montana