BUTTE AREA ONE RESTORATION SITE

Final Draft Version
Tailings/Impacted Sediment Delineation of the Diggings East, Blacktail Creek Berm, and Northside Tailings Areas

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE OF CONTENTS</td>
<td>i</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>ii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>iii</td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>1</td>
</tr>
<tr>
<td>1.0 INTRODUCTION</td>
<td>3</td>
</tr>
<tr>
<td>1.1 Objectives</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Site Background</td>
<td>5</td>
</tr>
<tr>
<td>2.0 METHODS</td>
<td>7</td>
</tr>
<tr>
<td>2.1 Field Procedures, Sampling Protocol, and Analytical Methods</td>
<td>7</td>
</tr>
<tr>
<td>2.1.2 Deviations from the SAP</td>
<td>7</td>
</tr>
<tr>
<td>2.1.2.1 Test Pit Surveying</td>
<td>7</td>
</tr>
<tr>
<td>2.1.2.2 ICP Metals Analysis for COCs</td>
<td>8</td>
</tr>
<tr>
<td>2.1.2.3 Total Petroleum Hydrocarbon Analysis (TPH)</td>
<td>8</td>
</tr>
<tr>
<td>2.1.2.4 MBMG Access Agreements</td>
<td>8</td>
</tr>
<tr>
<td>2.2 Volume Estimates for Impacted Sediments</td>
<td>8</td>
</tr>
<tr>
<td>3.0 RESULTS</td>
<td>9</td>
</tr>
<tr>
<td>3.1 Lithology</td>
<td>9</td>
</tr>
<tr>
<td>3.2 COCs Concentrations in Sediment Samples</td>
<td>10</td>
</tr>
<tr>
<td>3.2.1 Spatial and Vertical Distribution of COCs</td>
<td>14</td>
</tr>
<tr>
<td>3.3 Volume Estimates and Thicknesses</td>
<td>25</td>
</tr>
<tr>
<td>3.3.1 Estimate of Mass of Cu and Zn within the Unsaturated Zones of</td>
<td>26</td>
</tr>
<tr>
<td>the Diggings East Tailings, Northside Tailings, and BTC Berm Areas</td>
<td>26</td>
</tr>
<tr>
<td>3.3.1.1 Mass of Cu and Zn Remaining in the Unsaturated Zone of all</td>
<td>26</td>
</tr>
<tr>
<td>Known Source Areas Associated with the Metro Storm Drain Subdrain</td>
<td>26</td>
</tr>
<tr>
<td>3.3.2 Thickness of Fill in the Diggings East Tailings</td>
<td>27</td>
</tr>
<tr>
<td>3.4 Total Petroleum Hydrocarbon Analysis</td>
<td>28</td>
</tr>
<tr>
<td>4.0 ACKNOWLEDGEMENTS</td>
<td>30</td>
</tr>
<tr>
<td>5.0 REFERENCES</td>
<td>30</td>
</tr>
<tr>
<td>APPENDIX A SAMPLING AND ANALYSIS PLAN</td>
<td>A-0</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1. Trench, test pit, and borehole locations................................................................. 4
Figure 2. A). 1921 Valley Addition Subdivision Survey showing the “bank of artificial lake” and the extent
of the Diggings East Tailings impoundment, and B). 1955 aerial image showing aerial extent of tailings
and locations of trench, test pit, and borehole......................................................................... 6
Figure 3. A). LiDAR Survey for Butte Area One Restoration corridor, and B). A portion of the 1-meter
DEM produced in the LiDAR survey showing topography of the study area(B)............................ 7
Figure 4A and 4B. Four lithologic units were observed above the water table in test pits; fill (unit 1),
tailings (unit 2), black organic silt (unit A-3), and medium gray alluvial sand (units A-4 and B-3).
Sediments were classified as fill material if they were found overlying tailings, and ranged from topsoil
and fine-medium sand (A4) to landfill material (B4). Except for a few surficial deposits, tailings material
in the Diggings East (A-2 & B-2) were typically encountered underlying 1-8 feet of fill material. The black
organic silt layer (A-3) was observed at most—but not all—of the sites, and was encountered underlying
the tailings and ranged from 0.5 feet to greater than 5 feet thick................................................. 9
Figure 5. A). A comparison of average COCs concentrations in tailings samples, and B). organic silt
samples between the Parrot Tailings (Tucci, 2010), the Diggings East, Northside Tailings, and the BTC
Berm.................................................................................................................................................. 15
Figure 6. Arsenic concentrations in sediments observed above groundwater table. Lithologic units: fill
(A), tailings (B), organic silt (C), and unsaturated alluvium (D)....................................................... 17
Figure 7. Cadmium concentrations in sediments observed above groundwater table. Lithology units: fill
(A), tailings (B), organic silt (C), and unsaturated alluvium (D)....................................................... 18
Figure 8. Copper concentrations in sediments observed above groundwater table. Lithologic units: fill
(A), tailings (B), organic silt (C), and unsaturated alluvium (D)....................................................... 19
Figure 9. Mercury concentrations in sediments observed above groundwater table. Lithologic units: fill
(A), tailings (B), organic silt (C), and unsaturated alluvium (D)....................................................... 20
Figure 10. Lead concentrations in sediments observed above groundwater table. Lithologic units: fill
(A), tailings (B), organic silt (C), and unsaturated alluvium (D)...................................................... 21
Figure 11. Zinc concentrations in sediments observed above groundwater table. Lithologic units: fill (A),
tailings (B), organic silt (C), and unsaturated alluvium (D).............................................................. 22
Figure 12. Number of COC failure criteria exceedance............................................................. 23
Figure 13. A) MBMG impacted sediment boundaries, and B) MBMG impacted sediment boundaries and failure criteria overlain on 1955 aerial photo. 

Figure 14. Isopach map showing thicknesses of impacted sediments in the BTC Berm, Diggings East, and Northside Tailings areas. Volumes (cubic yards) of wastes are given in tabular form.

Figure 15. Isopach map showing thickness of fill material in the Diggings East area.

LIST OF TABLES

Table 1. Statistical summary of COC concentration from sediment samples in the Blacktail Creek Berm.
Table 2. Statistical summary of COC concentrations from sediment samples in the Diggings East Tailings.
Table 3. Statistical summary of COC concentrations from sediment samples in the Northside Tailings.
Table 4. Mass of Cu and Zn remaining in the unsaturated zone of primary source areas.
Table 5. PID Meter Results.
Table 6. Total petroleum hydrocarbon (TPH) analysis in sediment samples.
EXECUTIVE SUMMARY

In May 2013, scientists from the Montana Bureau of Mines and Geology (MBMG) conducted trenching, test pit, and borehole investigations in known and suspected mine wastes areas of the Blacktail Creek/Silver Bow Creek Confluence area in Butte, MT. In particular, three waste areas; Blacktail Creek (BTC) Berm, Diggings East, and the Northside Tailings, were evaluated for contaminant concentrations and volumes of impacted sediments. This work was done to quantify the aerial extent and depth of tailings and impacted sediments. This work builds on previous MBMG investigations (Tucci, 2010) of wastes that have been left in place in the Butte Area One Restoration corridor. It is meant to provide an accurate, updated characterization and volume estimate of tailings and mining impacted sediments for the State of Montana.

As a result of the data and analysis presented here, the MBMG concludes:

- The BTC Berm, Diggings East, and Northside Tailings all contain tailings/impacted sediments (IS) that exceed the failure criteria for constituents of concern (COC) concentrations established for this study in the sampling and analysis plan (SAP).
- Tailings/IS in the Diggings East area are overlain by 184,000 cubic yards of fill material, that, in general, do not exceed the COC failure criteria. The bulk majority of fill material is composed of demolition debris (wood, bricks, concrete, asphalt, etc.). Tailings/IS in the BTC Berm and Northside Tailings area are not overlain by thick units of fill material, and are closer to the surface (and are surficial at times).
- The majority of sediment samples collected just above the water table in the BTC Berm, Diggings East, and Northside Tailings areas exceeded COC failure criteria. Therefore, it is recommended that any potential future removal boundaries include sediments down to the water table.
- In total, tailings/IS and potential removal volumes for the BTC Berm, Diggings East, and Northside Tailings were estimated at 14,000, 345,000, and 49,000 cubic yards respectively. Fifty-three percent (184,000 cubic yards) of the total volume in the Diggings East area are calculated to be fill material.
- The majority of organic silt samples meet the classification of impacted sediment. Subsequently, the dry alluvial sand observed above the water table in the Diggings East and Northside Tailings areas also meets the classification of impacted sediments that were established in the SAP. It is recommended that these units be included in any potential future removal boundaries.
- The average concentrations of As and Pb in tailings samples from the three waste areas are comparable to the average concentrations of As and Pb in Parrot Tailings samples (Tucci, 2010). However, concentrations of average copper concentrations in tailings
samples from the BTC Berm, as well as zinc concentrations in all three studied waste areas, were greater than the average Cu and Zn concentrations in Parrot Tailings samples.

- The mass of copper (3 million pounds) and zinc (7 million pounds) remaining above the water table in the three source areas evaluated during this investigation were found to be significant.

- When combined, the mass of copper and zinc remaining in the unsaturated zone of the three primary source areas (Parrot, Diggings East, and Northside Tailings) in the Upper Silver Bow Creek/Metro Storm Drain area was estimated to be 15.3 million and 24.5 million pounds, respectively.

- Analysis of 184 samples with a photo-ionization meter resulted in zero detectible photo-ionizable petroleum hydrocarbons. This data suggests zero detectable petroleum-based contamination in the samples collected.
1.0 INTRODUCTION

The State of Montana is proceeding with its evaluation and cost estimation for removing historic mine waste, smelter tailings and impacted sediments that have been left in place in the Butte Area One Restoration Corridor (fig. 1). The areas of focus for the current study are smelter tailings and impacted sediments (IS) located within the Blacktail Creek (BTC) Berm, Diggings East and Northside Tailings areas (fig. 1). The Montana Bureau of Mines and Geology (MBMG) was contracted by the Natural Resource Damage Program (NRDP) for the specific task of characterizing and quantifying the tailings/IS in these areas. The data collected will be used by the State to evaluate the cost of removal, and may be used to prepare designs for removal actions.

In May of 2013, in an effort to ascertain the extent and volume of mining impacted sediments (IS), scientists from the MBMG and its subcontractors conducted a trenching, test pit, and drilling investigation in the waste area commonly referred to as the Blacktail/Silver Bow Creek confluence area. Lithologic logs and chemical analysis of samples from forty-four test pits, one trench, and five boreholes (fig. 1) were used to estimate the volume and extent of tailings/IS, and quantify the concentrations of constituents of concern (COCs).

1.1 Objectives

The work proposed under this investigation concentrates on the BTC Berm, Diggings East Tailings, and Northside Tailings (fig. 1). The primary objectives were to:

- delineate the aerial and vertical extent of the tailings/IS within these areas,
- quantify the aerial and vertical distribution of COCs concentrations in all lithology units observed above the water table,
- delineate a potential excavation boundary and estimate volumes of tailings/IS,
- evaluate whether the unit known as the organic silt layer and any other unit encountered above the water table meets the IS classification established under the SAP (appendix A), and
- determine whether tailings samples have been impacted by petroleum hydrocarbon contamination.
Figure 1. Trench and Test Pit Locations

Location Summary

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<td>Northside</td>
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<td>BTC Berm</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

Legend
- Test Pit and borehole sampling locations
- Digging East Trench
- Butte Area One Boundary (MBMG, 2010)
- Digging East Tailings Boundary (EPA, 2004)
- Northside Tailings Boundary (EPA, 2004)
- BTL Berm
- MSD Subdrain

Project: DOJ TO-19 Digging East, Northside Tailings, and BTC Berm Tailings Delineation
Project Location: M:\Environmental\Nick\Butte\Butte Priority Soils\NRD\TO-19\ArcMap\Report\Figure 1
Aerial Imagery: 2011 NAIP, Silver Bow County
Projection: NAD 83 HARN Montana State Plane Meters
1.2 Site Background

The study area, referred to throughout this report as the confluence area, was the historic confluence of Blacktail Creek (BTC) and Silver Bow Creek (SBC), and is a part of the Butte Area One Restoration corridor (fig. 1). The pre-mining setting of the confluence area was described as a low-flow, low-gradient wetland environment with luxuriant growth of grass and vegetation (Meinzer, 1914).

In 1879, the first large-scale mineral processing smelter (Colorado Smelter) was built on SBC, at the west end of the valley (Smith, 1955). Between 1879 and 1888, at least three more smelters of consequence [Butte Reduction Works, Parrot Smelter, M.O.P] were constructed upstream of the Colorado, which significantly altered the morphology and hydrology of both creeks. Water demands during this period increased dramatically, and the stream channels were altered significantly to keep up with the demand. At least three dams were constructed on upper Silver Bow Creek, for tailings impoundment and water clarification. The dam at Montana Street (Weed, 1904) was constructed for tailings settlement of tailings from upstream smelters and resulted in significant ponding on both sides of the stream.

Over time, aggrandizement of waste material became a serious issue as frequent and substantial flooding began to occur (Meinzer, 1914). In an attempt to mitigate flooding issues, berms made mostly of readily available waste were constructed throughout the confluence area. The known waste area referred to as the BTC Berm (fig. 1), one of the central focal points for the current investigation, is an historic remnant of these flood control berms. Another berm, depicted in the Valley Addition land survey conducted in the 1920s, defines the southern boundary of the detention pond that encompasses the Diggings East Tailings (fig. 2A). It is hypothesized that the berm denoted in the 1921 Valley Addition land survey (fig. 2A; “Bank of artificial lake”) represents the southern boundary of the wastes known as the Diggings East Tailings.

The tailings associated with the Diggings East and Northside areas were not derived from the activities of a single smelter, but were emplaced as a result of water detention activities - attempts made by downstream smelters operations (i.e. Butte Reduction Works) to clarify Silver Bow Creek water from the suspended tailings of upstream smelters (Parrot, M.O.P, etc.). The Diggings East area underwent further alteration as a detention pond in the 1930s during a Butte storm water infrastructure improvement project (Quivik, 1998). Unfortunately, historic tailings distribution maps do not exist for the confluence area. The only evidence that exists showing the aerial extent of the tailings in the confluence area is a 1955 aerial photograph (fig. 2B). Since that time, the tailings in the low lying confluence area has been covered by two decades of dumping material and construction demolition debris.
Figure 2. A). 1921 Valley Addition Subdivision Survey showing the “bank of artificial lake” and the extent of the Diggings East Tailings impoundment, and B). 1955 aerial image showing aerial extent of tailings and locations of trench, test pit, and borehole.
2.0 METHODS

2.1 Field Procedures, Sampling Protocol, and Analytical Methods

Field procedures, sampling protocol, and analytical methods are outlined in the project’s sampling and analysis plan (SAP) (appendix A). The SAP was submitted for review to the Natural Resource Damage Program (NRDP), Montana Department of Environmental Quality (DEQ), the Environmental Protection Agency (EPA), and British Petroleum/Atlantic Richfield Company (AR). MBMG sought and received verbal or written comment on the SAP prior to the commencement of the project.

Trenching and test-pitting were conducted between 27-May-2013 and 31-May-2013. Drilling and borehole investigations were conducted by the MBMG on 6-June-2013, and were carried out using a trailer-mounted Geoprobe. During field activities, geologist Will Goldberg from Pioneer Technical Services was on-site at the request of ARCO.

2.1.2 Deviations from the SAP

The following section discusses sampling procedures and analytical methods that deviated from the project’s sampling and analysis plan.

2.1.2.1 Test Pit Surveying

While horizontal survey data (x,y) for test pit and borehole locations were obtained with a resource-grade global positioning device (GPS), elevation and topographic data were obtained with a LiDAR survey (fig. 3A). Montana LiDAR was contracted to conduct the survey, using a MD520N NOTAR turbine helicopter platform with onboard GPS guidance and a Leica ALS 50-II LiDAR Corridor Mapper. With a resolution of 35 points per square meter, the survey generated over 40 million individual data points, and produced a very accurate and precise topographic data set. One-foot contour intervals and a one-meter resolution, digital elevation map (DEM) were generated during the survey (fig. 3B).

Figure 3. A). LiDAR Survey for Butte Area One Restoration corridor, and B). A portion of the 1-meter DEM produced in the LiDAR survey showing topography of the study area(B).
2.1.2.2 ICP Metals Analysis for COCs

Even though samples were screened for COCs using a portable XRF unit, the decision was made by the NRDP to submit all sediment samples collected during this investigation to ALS Geochemistry Labs for analysis of total digestible arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) using ICP-AES (Method 200.7 CLP-M). In total, 184 samples and ten duplicate samples were submitted to ALS Labs for total digestion and ICP metals analysis. This extra step, although costly, greatly reduced experimental error associated with field XRF analysis using a portable unit, and greatly enhanced the accuracy and comparability of the data.

2.1.2.3 Total Petroleum Hydrocarbon Analysis (TPH)

Ten sediment samples (rather than five, appendix A) were submitted to the Energy Labs in Helena, MT for total petroleum hydrocarbon analysis. A background sample, composed of topsoil from an area with good vegetative cover, was submitted for comparison purposes. The nine additional samples included: five tailings samples (as per the SAP), one fill-material sample comprised of demolition debris, two organic silt samples, and one alluvial sand sample.

2.1.2.4 MBMG Access Agreements

Written access agreements had to be in place between MBMG and all property owners (Butte Silver Bow, Atlantic Richfield, and other private land owners) prior to commencement of field activities. Although this had no impact on the quality of the data collected, this process led to a considerable delay in the timeline of the project.

2.2 Volume Estimates for Impacted Sediments

Volumetric analysis was accomplished using the topographic data generated from the LiDAR survey and the GIS software program ARCMAP. The lithology records gathered during this investigation (appendix B) were combined with the ICP metals concentrations for COCs (appendix C) to depict the spatial distribution and thickness of impacted sediments in the BTC Berm, Diggings East, and Northside Tailings impoundments. A GIS database was created using the software program ARCGIS Geostatistical Analyst. A cut-and-fill model was produced to determine volumes using inverse distance weighted interpolations. The North American Datum of 1983 (NAD 83) was used for the horizontal datum, and the North American Vertical Datum of 1988 was used for the vertical datum. The 1-meter DEM produced during the LiDAR survey was used as the topographic base map for the cut-and-fill model. This topographic data has a one foot contour interval.
3.0 RESULTS

3.1 Lithology

Test pits and trenching logs are provided in appendix B. For purposes of volume estimates, sediments observed above the water table were divided into four lithologic units: fill, tailings, organic silt, and alluvium. Sediments observed overlying tailings, such as topsoil, sand and silt (fig. A-1) or landfill material (demolition debris; fig B-1), were categorically lumped as fill material. The fill thickness was highly variable (0-7 feet thick).

Figure 4A and 4B. Four lithologic units were observed above the water table in test pits; fill (unit 1), tailings (unit 2), black organic silt (unit A-3), and medium gray alluvial sand (units A-4 and B-3). Sediments were classified as fill material if they were found overlying tailings, and ranged from topsoil and fine-medium sand (A4) to landfill material (B4). Except for a few surficial deposits, tailings material in the Diggings East (A-2 & B-2) were typically encountered underlying 1-8 feet of fill material. The black organic silt layer (A-3) was observed at most-but not all-of the sites, and was encountered underlying the tailings and ranged from 0.5 feet to greater than 5 feet thick.
Tailings (fig. 4A and B, unit 2) encountered in the Diggings East varied in grain size (fine to coarse), thickness (0-3.5 feet), and color (yellow to gray); but, in general, graded from a medium-to-coarse, sand-sized material in the eastern portion to a silty-clay- to clay-sized (slickens) material in the western portion of the Diggings East. Both oxidized (tan-yellow) and gray tailings, similar in appearance to those observed by Tucci (2010), were observed in the Diggings East. Dark gray clayey tailings (slickens) were observed in the western portion (fig. 1, near Kaw Ave) of the Diggings East, this type of tail has not been reported elsewhere. The majority of tailings observed in test pits were found underlying fill material, however, surficial tailings were encountered in portions of the Diggings East. A mixed tailings/oxidized alluvial sand material, often difficult to distinguish from oxidized alluvial sand with the naked eye, were encountered in the Northside and BTC Berm areas. While the tailings in the Berm were buried, the tailings encountered in the Northside Tailings were often at or near the surface. Tailings were observed above the water table at all sites in all areas.

The organic silt unit described by Tucci (2010) was encountered in all three waste areas (fig. 4, A-3). Although a thick (3-6 feet) ubiquitous layer was observed in the BTC Berm and Northside tailings areas, the organic silt layer was not observed at all sites in the Diggings East, and ranged in thickness from 0 to 6 feet. Perched water (most likely recent precipitation) was encountered above the organic silt in the Northside Tailings area.

Medium to coarse gray alluvial sand (fig. 4, A-4 and B-3) was observed between the organic silt and the water table in the Diggings East and Northside Tailings but not in the BTC Berm. The thickness of the gray alluvial sand above the water table was between 0.5-3.5 feet thick. The organic silt layer was the underlying lithologic unit observed above the water table in the BTC Berm.

### 3.2 COCs Concentrations in Sediment Samples

Sediment samples (n=184) were analyzed for As, Cd, Cu, Hg, Pb, and Zn concentrations. Statistical summaries for sediment lithology units within each waste area are provided in tables 1 (BTC Berm), 2 (Diggings East), and 3 (Northside Tailings). Sediment concentrations of As, Cd, Cu, Pb, and Zn are given in tabular form in appendix C, while MSE lab results for Hg are given in appendix D. Average, maximum, and minimum COC concentrations are compared to the COC failure criteria and standard deviations. Number of exceedance and percent failure are given to quantify the analyte concentrations that exceeded the COC failure criteria.
<table>
<thead>
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<th>Table 1. Statistical summary of COC concentration from sediment samples in the Blacktail Creek Berm.</th>
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*Note: All concentrations given in mg/kg*
Table 2. Statistical summary of COC concentrations from sediment samples in the Diggings East Tailings.

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<tr>
<td>St Dev</td>
</tr>
<tr>
<td># of exceedance</td>
</tr>
<tr>
<td>% Failure</td>
</tr>
<tr>
<td><strong>Dry Alluvium Above Water Table (n=38)</strong></td>
</tr>
<tr>
<td>As</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Failure Criteria</td>
</tr>
<tr>
<td>Average</td>
</tr>
<tr>
<td>Max</td>
</tr>
<tr>
<td>Min</td>
</tr>
<tr>
<td>St Dev</td>
</tr>
<tr>
<td># of exceedance</td>
</tr>
<tr>
<td>% Failure</td>
</tr>
</tbody>
</table>

Note: All concentrations given in mg/kg
Table 3. Statistical summary of COC concentrations from sediment samples in the Northside Tailings.

<table>
<thead>
<tr>
<th></th>
<th>As</th>
<th>Cd</th>
<th>Cu</th>
<th>Hg</th>
<th>Pb</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fill (n=7)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Failure Criteria</td>
<td>200</td>
<td>20</td>
<td>1,000</td>
<td>10</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Average</td>
<td>608</td>
<td>10</td>
<td>5,426</td>
<td>1</td>
<td>511</td>
<td>2,936</td>
</tr>
<tr>
<td>Max</td>
<td>922</td>
<td>22</td>
<td>9,060</td>
<td>1</td>
<td>884</td>
<td>5,540</td>
</tr>
<tr>
<td>Min</td>
<td>145</td>
<td>3</td>
<td>189</td>
<td>0.21</td>
<td>173</td>
<td>950</td>
</tr>
<tr>
<td>St Dev</td>
<td>317</td>
<td>6</td>
<td>3,718</td>
<td>0.46</td>
<td>207</td>
<td>1,364</td>
</tr>
<tr>
<td># of exceedance</td>
<td>6</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>% Failure</td>
<td>86</td>
<td>14</td>
<td>86</td>
<td>0</td>
<td>0</td>
<td>86</td>
</tr>
<tr>
<td><strong>Tailings (n=6)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Criteria</td>
<td>200</td>
<td>20</td>
<td>1,000</td>
<td>10</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Average</td>
<td>390</td>
<td>18</td>
<td>1,121</td>
<td>1</td>
<td>672</td>
<td>5,390</td>
</tr>
<tr>
<td>Max</td>
<td>665</td>
<td>45</td>
<td>1,730</td>
<td>2</td>
<td>1,370</td>
<td>10,800</td>
</tr>
<tr>
<td>Min</td>
<td>193</td>
<td>4</td>
<td>465</td>
<td>0.36</td>
<td>269</td>
<td>1,760</td>
</tr>
<tr>
<td>St Dev</td>
<td>177</td>
<td>16</td>
<td>459</td>
<td>1</td>
<td>371</td>
<td>4,014</td>
</tr>
<tr>
<td># of exceedance</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>% Failure</td>
<td>83</td>
<td>33</td>
<td>50</td>
<td>0</td>
<td>17</td>
<td>100</td>
</tr>
<tr>
<td><strong>Organic Silt (n=11)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Criteria</td>
<td>200</td>
<td>20</td>
<td>1,000</td>
<td>10</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Average</td>
<td>222</td>
<td>23</td>
<td>3,027</td>
<td>5</td>
<td>868</td>
<td>3,619</td>
</tr>
<tr>
<td>Max</td>
<td>777</td>
<td>164</td>
<td>17,800</td>
<td>24</td>
<td>2,770</td>
<td>18,100</td>
</tr>
<tr>
<td>Min</td>
<td>21</td>
<td>1</td>
<td>68</td>
<td>0.04</td>
<td>248</td>
<td>456</td>
</tr>
<tr>
<td>St Dev</td>
<td>296</td>
<td>47</td>
<td>5,361</td>
<td>8</td>
<td>760</td>
<td>4,924</td>
</tr>
<tr>
<td># of exceedance</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>% Failure</td>
<td>27</td>
<td>18</td>
<td>45</td>
<td>9</td>
<td>18</td>
<td>91</td>
</tr>
<tr>
<td><strong>Dry Alluvium Above Water Table (n=6)</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Failure Criteria</td>
<td>200</td>
<td>20</td>
<td>1,000</td>
<td>10</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Average</td>
<td>91</td>
<td>3</td>
<td>259</td>
<td>0.39</td>
<td>438</td>
<td>1,419</td>
</tr>
<tr>
<td>Max</td>
<td>392</td>
<td>6</td>
<td>886</td>
<td>0.82</td>
<td>689</td>
<td>2,120</td>
</tr>
<tr>
<td>Min</td>
<td>9</td>
<td>1</td>
<td>110</td>
<td>0.03</td>
<td>65</td>
<td>271</td>
</tr>
<tr>
<td>St Dev</td>
<td>148</td>
<td>2</td>
<td>308</td>
<td>0.40</td>
<td>295</td>
<td>872</td>
</tr>
<tr>
<td># of exceedance</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>% Failure</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>67</td>
</tr>
</tbody>
</table>

Note: All concentrations given in mg/kg
Average As, Cu, Pb, and Zn concentrations in tailings samples (fig. 5A) and organic silt (fig. 5B) samples collected during the Parrot Tailings investigation (Tucci, 2010) were compared to average concentrations from the Diggings East, Northside, and BTC Berm areas. Parrot Tailings samples contained slightly higher As and Pb concentrations, but lower Cu concentrations and much lower Zn concentrations than samples from other waste areas investigated in this study (fig. 5A). On average, organic silt samples from the Parrot area contained higher As, Cu, and Pb concentrations and significantly lower Zn concentrations (fig. 5B).

3.2.1 Spatial and Vertical Distribution of COCs

Spatial and vertical distribution of As, Cd, Cu, Hg, Pb, and Zn are provided in figures 6, 7, 8, 9, 10, and 11 respectively. Average depth to, and thicknesses of lithology units are given for fill (A), tailings (B), organic silt (C), and alluvium (D). The failure criteria for each COC are given; samples with concentrations below the failure criteria level are depicted in green and yellow, while sediment concentrations that exceed the failure criteria are demonstrated in orange and red. Sites represented by blue triangles represent sites where samples were either unable to be sampled (demolition debris or landfill material) or were absent in the lithology log.

Except for the northeast section of the Northside Tailings, the majority of fill sample concentrations were below the As failure criteria level (fig. 6A), but the majority of samples exceeded As criteria in tailings (fig. 6B), organic silt (fig. 6C), and alluvial sand samples (Diggings East only) (fig. 6D). The same trend is observed for Cd (fig. 7).

The majority of Cu (fig. 8) and Zn (fig. 11) sample concentrations exceeded the COC failure criteria (1,000 mg/kg) in all lithology units in the Diggings East, but not in the BTC Berm or the Northside Tailings (majority of alluvial samples passed). Concentrations of Cu were highest (>1% Cu in many cases) in organic silt (fig. 8C) and dry alluvial (fig. 8D) samples in the Diggings East. Concentrations of Zn were most elevated in tailings (fig. 11B), organic silt (fig. 11C), and dry alluvium samples (fig. 11D; Diggings East only), exceeding concentrations of one percent in many cases.
Figure 5. A). A comparison of average COCs concentrations in tailings samples, and B). organic silt samples between the Parrot Tailings (Tucci, 2010), the Diggings East, Northside Tailings, and the BTC Berm.
The high percentage of samples that failed the Cu and Zn criteria (>1,000 mg/kg) in near-surface fill samples in the BTC Berm are notable, and may be a potential source of contamination to surface water (Blacktail Creek). Bed sediment data in samples collected in Blacktail Creek adjacent to the BTC Berm (Arco, 2013a) are comparable to the data presented in this report. Combined, this data provides strong supporting evidence that the BTC Berm may be a point source of Cu and Zn loading to Blacktail Creek during run-off conditions.

In total, only ten samples exceeded the Hg failure criteria (10 mg/kg), with the highest percentage of failures being observed in the BTC Berm area (fig. 9). The low percentage of Hg concentrations (relative to the other COCs) may be due to, in part, the exceedance of laboratory holding times for Hg (appendix D).

The largest percentage of lead concentrations that exceeded failure criteria were observed in the tailings (fig. 10B) and organic silt (fig. 10C) units, and the highest Pb concentrations were observed in the organic silt unit (fig. 10C; >2,000 mg/L in many samples). Spatially, the tailings in the western portion of the Diggings East represented the highest percentage of samples where Pb concentrations exceeded the failure criteria (fig. 10B).

According to the SAP (Appendix A), if three of the six COCs exceed the failure criteria, the sample is considered to be impacted, and will be recommended for potential removal. However, if four of the six COCs pass the COC failure criteria, the sample will be considered to be non-impacted by the primary source. Figure 13 summarizes the number of COC failure criteria exceedances, and shows both impacted and non-impacted areas within the Diggings East, Northside, and BTC Berm areas. Because designated waste areas contain sections of discernible impacted sediments and non-impacted sediments, it was necessary to differentiate between the two by recreating boundaries different from those previously established by the EPA (Fig. 13A). Although different, the new boundaries include the bulk majority of tailings visible in the 1955 DOT aerial photograph (fig. 13B), were constructed using the new data, and provide the area necessary to calculate the volumes of waste.
Figure 6. Arsenic concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic silt (C), unsaturated alluvium (D)

Project: DOJ TO-19 Diggings East, Northside Tailings, and BTC Berm Tailings Delineation
Project Location: M:\Environmental\NickT\Butte\Butte Priority Soils\WRD\TO-19\ArcMap\Report\Fig. 6
Aerial Imagery: 2011 NAIP, Silver Bow County
Projection: NAD 83 Montana State Plane Feet

Legend
[As] (mg/kg)
- < 100
- 100 - 200
- 200 - 500
- 500 - 1,000
- > 1,000

Lithologic Not Sampled
Berm Area One Boundary (MBMG, 2010)
BTC Berm
Diggings East Tailings Boundary (EPA, 2004)
Northside Tailings Boundary (EPA, 2004)

Failure Criteria = 200 mg/kg
Figure 7. Cadmium concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic Silt (C), unsaturated alluvium (D)

Failure Criteria = 20 mg/kg

Project: DOJ TO-19 Diggings East, Northside Tailings, and BTC Berm Tailings Delineation
Project Location: M:\Environmental\NickT\Butte Priority Soils\WRD\TO-19\ArcMap\Report\Fig. 7
Aerial Imagery: 2011 NAIP, Silver Bow County
Projection: NAD 83 Montana State Plane Feet
Figure 8. Copper concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic Silt (C), unsaturated alluvium (D)

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>0</td>
<td>3.3</td>
</tr>
<tr>
<td>Diggings</td>
<td>0</td>
<td>4.4</td>
</tr>
<tr>
<td>Northside</td>
<td>0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>2.04</td>
<td>0.5</td>
</tr>
<tr>
<td>Diggings</td>
<td>4.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Northside</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>5.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Diggings</td>
<td>7.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Northside</td>
<td>7.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Diggings</td>
<td>6.2</td>
<td>1.6</td>
</tr>
<tr>
<td>Northside</td>
<td>2.8</td>
<td>4.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>2.04</td>
<td>0.5</td>
</tr>
<tr>
<td>Diggings</td>
<td>4.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Northside</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Failure Criteria = 1,000 mg/kg

Legend
- [Cu] (mg/kg)
  - < 250
  - 250 - 500
  - 500 - 1,000
  - 1,000 - 10,000
  - > 10,000
  - Lithologic Not Sampled
  - Berm Area Boundary (MBMG, 2010)
  - BTC Berm
  - Diggings East Tailings Boundary (EPA, 2004)
  - Northside Tailings Boundary (EPA, 2004)

Project: DOJ TO-19 Diggings East, Northside Tailings, and BTC Berm Tailings Delineation
Project Location: M:\Environmental\NickT\Butte\Butte Priority Soils\WRD\TO-19\ArcMap\Report\Fig. 8
Aerial Imagery: 2011 NAIP, Silver Bow County
Projection: NAD 83 Montana State Plane Feet

Figure 8. Copper concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic Silt (C), unsaturated alluvium (D)
Figure 9. Mercury concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic silt (C), unsaturated alluvium (D)

Failure Criterial = 10 mg/kg

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Diggings</td>
<td>6.2</td>
<td>1.6</td>
</tr>
<tr>
<td>Northside</td>
<td>2.8</td>
<td>4.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>5.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Diggings</td>
<td>7.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Northside</td>
<td>7.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Figure 10. Lead concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic silt (C), unsaturated alluvium (D)

Failure Criteria = 1,000 mg/kg
Figure 11. Zinc concentrations in sediments observed above groundwater table
Lithologic units: fill (A), tailings (B), organic silt (C), unsaturated alluvium (D)

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>0</td>
<td>3.3</td>
</tr>
<tr>
<td>Diggings</td>
<td>0</td>
<td>4.4</td>
</tr>
<tr>
<td>Northside</td>
<td>0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>2.04</td>
<td>0.5</td>
</tr>
<tr>
<td>Diggings</td>
<td>4.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Northside</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Average Depth (ft.)</th>
<th>Average Thickness (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm</td>
<td>2.04</td>
<td>0.5</td>
</tr>
<tr>
<td>Diggings</td>
<td>7.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Northside</td>
<td>7.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Legend

[Zn] (mg/kg)

- < 250
- 250 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Criteria Failure = 1,000 mg/kg
Figure 12. Number of COC failure criteria exceedances.

Project: DOJ TO-19 Diggings East, Northside Tailings, and BTC Berm Tailings Delineation
Project Location: M:\Environmental\NickT\Butte\Butte Priority Soils\NRD\TO-19\ArcMap\Report\Figure 12
Aerial Imagery: 2011 NAIP, Silver Bow County
Projection: NAD 83 HARN Montana State Plane Meters
3.3 Volume Estimates and Thicknesses

Based on lithology, concentration of COCs, and COC failure criteria established in the SAP, data in each waste area show impacted sediment from the surface down to the water table. Impacted sediments encountered in the Northside Tailings and BTC Berm areas had thicknesses ranging between 5.0-6.0 feet, while impacted sediments in the Diggings East were between 4.5-12.1 feet thick (fig. 13). Volume calculations of total wastes for the BTC Berm, Diggings East, and Northside areas are provided in tabular form in figure 13. Because the volume of fill material comprised a much larger percentage of the total waste in the Diggings East, volumes of each lithology unit were calculated for that waste area. In total, 408,000 cubic yards of impacted sediment were calculated. Nearly half of the total waste volume (184,000 cubic yards) is estimated to be fill material that overlies the Diggings East Tailings (topsoil, sand, demolition debris, and landfill material).

<table>
<thead>
<tr>
<th>Tailings Area</th>
<th>Area (Acres)</th>
<th>Total Waste</th>
<th>Fill</th>
<th>Tailings</th>
<th>Organic Clay</th>
<th>Dry Alluvium</th>
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</thead>
<tbody>
<tr>
<td>Diggings East</td>
<td>24.0</td>
<td>345,000</td>
<td>184,000</td>
<td>75,000</td>
<td>58,000</td>
<td>28,000</td>
</tr>
<tr>
<td>Northside Tailings</td>
<td>5.5</td>
<td>49,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blacktail Creek Berm</td>
<td>1.4</td>
<td>14,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Volumes reported as cubic yards (yd³)
Figure 13. Isopach map showing thicknesses of impacted sediments in the BTC Berm, Diggings East, and Northside Tailings areas. Volumes (cubic yards) of wastes are given in tabular form.

3.3.1 Estimate of Mass of Cu and Zn within the Unsaturated Zones of the Diggings East Tailings, Northside Tailings, and BTC Berm Areas

Average Cu and Zn concentrations (section 3.2; table 2), volume estimates (section 3.4; figure 14), and assumed bulk densities for tailings (2,659 kg/m$^3$), organic silt (2,798 kg/m$^3$), and dry alluvial sand (2,655 kg/m$^3$) were used to calculate the mass of Cu and Zn in the Diggings East Tailings areas (table 4). Additionally, average Cu and Zn concentrations (section 3.2; tables 1 and 3), average bulk densities, and average volumes (section 3.4; figure 14) were used to calculate the mass of Cu and Zn remaining above the water table in the Northside Tailings and BTC Berm areas. Roughly 3 million pounds of Cu and 7 million pounds of Zn are estimated to remain in the three source areas in the unsaturated zone (table 4).

Table 4. Mass of Cu and Zn remaining in the unsaturated zone of primary source areas

<table>
<thead>
<tr>
<th>Waste Area</th>
<th>Diggings East</th>
<th>Northside Tailings</th>
<th>BTC Berm</th>
<th>Total Impacted Sediments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COC Cu Zn</td>
<td>Cu Zn Cu Zn</td>
<td>Cu Zn</td>
<td>Total Cu Zn</td>
</tr>
<tr>
<td>Tailings</td>
<td>288,000 3,035,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic Silt</td>
<td>1,369,000 2,595,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry alluvial sand</td>
<td>567,000 440,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,224,000 6,070,000</td>
<td>713,000 889,000</td>
<td>130,000 134,000</td>
<td>3,067,000 7,093,000</td>
</tr>
</tbody>
</table>

*All masses reported in pounds

3.3.1.1 Mass of Cu and Zn Remaining in the Unsaturated Zone of all Known Source Areas Associated with the Metro Storm Drain Subdrain

The Metro Storm Drain Subdrain, a 10-inch, perforated, french drain system designed to capture and deliver contaminated groundwater to the Butte Treatment Lagoons (BTL) may become the final groundwater remedy for the Upper Silver Bow Creek/Metro Storm Drain area under the Butte Priority Soils Operable Unit. The three known primary groundwater source areas for which the subdrain was designed are the Parrot Tailings, Diggings East Tailings, and Northside Tailings. The mass of Cu and Zn within the unsaturated tailings and impacted sediments of these areas provide an estimate of the load that has yet to leach into groundwater.

The mass of Cu and Zn in the unsaturated zone of the Parrot Tailings were calculated from data (average concentrations and volumes) provided in previous MBMG reports (Tucci, 2010). The amount of Cu and Zn remaining above the water table in the Parrot Tailings were combined with the mass in the Diggings East and Northside Tailings provided in this report. In total, 15.3 million pounds of Cu and 24.5 million pounds of Zn are estimated to remain in the unsaturated zones of the Parrot, Northside, and Diggings East tailings areas. It should be noted that these
estimates are conservative, because the bulk density for sediments used to make this calculation were on the low end.

Leaching experiments, using weakly acidic leachate solution, were performed on Parrot Tailings and organic silt sediment samples by Tucci (2010). This experiment was performed to determine if the tailings and impacted sediments that remained above the water table were still a primary source of contamination to groundwater. The leaching results indicate that the tailings and impacted sediments (organic silt) remaining in the primary source areas have the potential to continue to degrade groundwater.

Copper and zinc loading analysis of groundwater quality from the Metro Storm Drain Subdrain show that the subdrain delivers approximately 20 pounds of Cu and 60 pounds of Zn per day to the Butte Treatment Lagoons (AR, 2013b). Assuming the majority of the Cu and Zn captured by the subdrain is being leached from the wastes left in place and assuming the current leaching rate remains constant, Cu and Zn are likely to continue leaching into the groundwater for thousands of years. If the leaching rate decreases over time (a probable scenario), Cu and Zn are likely to continue leaching into the groundwater for tens of thousands of years.

3.3.2 Thickness of Fill in the Diggings East Tailings

More than half of the waste volume estimated for the Diggings East (53%) was comprised of fill material. Fill consisted of many different rock and sediment types, but the vast majority of fill observed in test pit lithology was demolition debris (bricks, wood, concrete, asphalt, etc.). The thickness of fill throughout the site was variable (fig. 15; 0-7.2 ft.). Isopach maps showing thickness of the fill in the Diggings East (fig. 15) indicate that the areas where fill was the thickest (northeast, southeast, and western portions) correlate to areas where demolition debris was encountered and observed in lithology logs (appendix B). Areas where fill was absent (fig. 15; < 1.1-ft thickness contours) are consistent to areas where tailings were observed at or near the surface.
3.4 Total Petroleum Hydrocarbon Analysis

Although organic contamination is not listed as a COC for BPSOU (EPA, 2004), MBMG tested 184 samples for petroleum contamination at the request of the Environmental Protection Agency. Samples from the Diggings East, Northside and BTC Berm areas were tested for volatile petroleum contamination using a calibrated Photovac Model 2020 Pro photo-ionization (PID) meter (appendix A). All sediment sample (n = 184) PID readings reported concentrations below detection levels (table 5); all PID meter readings are given in appendix E.
Table 5. PID Meter Results

<table>
<thead>
<tr>
<th>Lithologic Unit</th>
<th>Number of samples</th>
<th>PID Reading (ppm)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>28</td>
<td>0</td>
<td>Below Detection</td>
</tr>
<tr>
<td>Tailings</td>
<td>65</td>
<td>0</td>
<td>Below Detection</td>
</tr>
<tr>
<td>Organic Silt</td>
<td>43</td>
<td>0</td>
<td>Below Detection</td>
</tr>
<tr>
<td>Alluvium</td>
<td>47</td>
<td>0</td>
<td>Below Detection</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>184</strong></td>
<td><strong>0</strong></td>
<td><strong>Below Detection</strong></td>
</tr>
</tbody>
</table>

*Factory reported instrument detection limit = 0.5 ppm

Because petroleum screening criteria efforts resulted in photo-ionizable chemical concentrations below detection (table 5), ten sediment samples were randomly selected and analyzed for total petroleum hydrocarbon analysis (TPH, EPA method E418.1M). The TPH results are given in table 6. Clean topsoil (table 6, highlighted in yellow) from an area with good vegetative cover was used as a background sample (TP-2W), and reported a TPH concentration of 110 mg/L. All sediment concentrations were less than 1,000 mg/L while fifty percent of the samples had concentrations below detection (ND).

Table 6. Total petroleum hydrocarbon (TPH) analysis in sediment samples.

<table>
<thead>
<tr>
<th>Site</th>
<th>Depth</th>
<th>Lithology</th>
<th>Result (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-14W</td>
<td>9.4</td>
<td>Gray alluvial sand</td>
<td>ND</td>
</tr>
<tr>
<td>TP-2E</td>
<td>2</td>
<td>Tailings</td>
<td>ND</td>
</tr>
<tr>
<td><strong>TP-2W</strong></td>
<td><strong>0-2</strong></td>
<td><strong>Clean Top Soil</strong></td>
<td><strong>110</strong></td>
</tr>
<tr>
<td>TP-2W</td>
<td>7.2-9.4</td>
<td>Tailings</td>
<td>ND</td>
</tr>
<tr>
<td>TP-3E</td>
<td>5.0-6.8</td>
<td>Tailings</td>
<td>230</td>
</tr>
<tr>
<td>TP-8W</td>
<td>5.9-8.0</td>
<td>Organic Silt</td>
<td>25</td>
</tr>
<tr>
<td>TP-NS-02E</td>
<td>2.5-5.0</td>
<td>Organic Silt</td>
<td>ND</td>
</tr>
<tr>
<td>Trench 1</td>
<td>5</td>
<td>Tailings</td>
<td>ND</td>
</tr>
<tr>
<td>Trench 1</td>
<td>3.5</td>
<td>Fill: sand, brick, wood</td>
<td>820</td>
</tr>
<tr>
<td>Trench 3</td>
<td>4</td>
<td>Tailings</td>
<td>13</td>
</tr>
</tbody>
</table>

* ND = non-detect    *RL = 10 mg/L

TPH is defined as the measurable amount of petroleum-based hydrocarbon in an environmental media, but it does not provide information on the composition. EPA Method 418.1 is not specific to hydrocarbons and does not indicate petroleum contamination (e.g. humic acid, a non-petroleum hydrocarbon, is detected by this method), but the method is often used as an additional screening tool to determine the potential for petroleum hydrocarbons.
4.0 ACKNOWLEDGEMENTS

Funding for this work was provided by the Montana Department of Justice, Natural Resource Damage Program. The author wishes to extend gratitude to the members of the BNRC, for unanimously approving the funding for this project. Hopefully the data provided in this report was able to meet their expectations. The author wishes to thank the various landowners: Atlantic Richfield Company, Butte-Silver Bow County, and the other private land owners for giving MBMG and its contractor access to private property. A significant amount of aid was given to the author during field activities by Will Goldberg of Pioneer Technical Services, and the author wishes to thank him for his expertise.

5.0 REFERENCES

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Weed, W.H., 1904, Butte Special Map; surveyed in 1895 and revised and extended in 1903; Edition of 1904, nominal scale 1:15,000. USGS Special Publications.
APPENDIX A  SAMPLING AND ANALYSIS PLAN
BUTTE AREA ONE RESTORATION SITE

Draft Final
Tailings/Impacted Sediment Delineation of the Diggings East and Northside Tailing Areas

2013 Sampling and Analysis Plan

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28-March-2013
# CONTENTS

CONTENTS .................................................................................................................................................... iii

FIGURES ........................................................................................................................................................ iv

TABLES ........................................................................................................................................................ iv

1.0 INTRODUCTION ..................................................................................................................................... 1

1.2 Purpose .................................................................................................................................................... 1

1.2 General Scope of Work ......................................................................................................................... 4

2.0 LOCATION OF BOREHOLES, TEST PITS AND TRENCHES, SITE ACCESS AND SEQUENCING OF WORK .......................................................................................................................... 4

3.0 PROCEDURES FOR TEST PIT AND TRENCHING ACTIVITIES .......................................................... 5

3.1 General Procedures for Test pit and Trenching Activities .................................................................... 5

3.2 Sample Locations and Identification ..................................................................................................... 6

3.3 Test Pit Surveying ................................................................................................................................ 7

3.4 Sampling Equipment ............................................................................................................................. 7

3.5 Test Pit Excavations and Trenches ......................................................................................................... 8

3.6 Procedures for Alternative Methods for Sediment Sampling ............................................................... 8

3.6.1 Procedure for Auger Drilling or Geoprobe ....................................................................................... 8

3.7 Sampling Methods ................................................................................................................................ 10

3.7.1 Sample Collection ............................................................................................................................ 10

3.7.2 XRF Field Screening Protocol ....................................................................................................... 10

3.7.3 Portable Photoionization Monitor Screening Protocol ...................................................................... 11

3.7.4 Extents Boundary Location ............................................................................................................. 11

3.8 Selection of Samples for Laboratory Analysis ....................................................................................... 11

3.9 Decontamination .................................................................................................................................. 12

3.10 Field Documentation ............................................................................................................................ 12

3.11 Laboratory Analysis ............................................................................................................................. 13

3.12 Sample Handling ................................................................................................................................ 13

3.13 Field Quality Control .......................................................................................................................... 13

4 DRILLING OVERSIGHT ............................................................................................................................ 13

5 REPORTING ............................................................................................................................................. 14

6 HEALTH AND SAFETY ........................................................................................................................... 14

7 PROJECT SCHEULE ................................................................................................................................ 14
1.0 INTRODUCTION

The State of Montana is proceeding with its evaluation and cost estimation for removing historic mine waste/smelter tailings that have been left in place in the Butte Area One Restoration Corridor (fig 1.). Specifically, the areas of concern are the smelter tailings and impacted sediments located within the Diggings East and Northside Tailings areas (fig. 1). The Montana Bureau of Mines and Geology (MBMG) was contracted by the Natural Resources Damages Program (NRDP) for the specific task of characterizing the wastes in these areas. The data collected will be used by the State to evaluate the cost of removal, and may be used to prepare designs for removal actions.

The current sampling and analysis plan (SAP) has been prepared to document procedures used to characterize tailings and impacted sediments that directly underlie the primary sources within the Diggings East and Northside Tailings areas (fig. 1). The Blacktail Creek (BTC) berm will be the third area of concern that will be evaluated (fig. 2). The sediments targeted for analysis are the historic smelter tailings (primary source), as well as potential impacted sediments (possible secondary sources) which underlie the primary sources. Specifically, impacted sediment targeted for analysis is the soil horizon known as the organic silt layer, which has been shown to contain elevated concentrations of contaminants of concern (COCs) in other source areas (Tucci, 2010).

All procedures follow and are modified from those outlined in the methods and procedures identified in Clark Fork River Superfund Site Investigation (CFRSSI) Standard Operating Procedures (SOPs) (Arco, 1992). Portions of this SAP are based on procedures developed by contractors of the Montana Department of Environmental Quality (DEQ) for the Streamside Tailings Operable Unit of the Silver Bow Creek/Butte Area NPL Site (Pioneer Technical Service, 2011). Modifications are made to these procedures by MBMG to address the site-specific conditions in Butte Area One. Data collection and field activities conducted during this investigation are being conducted under the guidelines established in the Remedial Action Investigation Sampling Analysis Plan (SAP) for Subarea 4 Reach of the Stream Side Tailings Operable Unit (Pioneer, 2011). Data screening and evaluation are being conducted according to the screening criteria established for the DEQ (Pioneer, 2011). Minor modification in this SAP are added to include both x-ray florescence (XRF) field screening for contaminants of concern (COCs), laboratory analysis for total digested sediment for metal’s analysis, and a Photo-ionization Detector (PID) for field screening of total petroleum hydrocarbons concentrations (TPH).

1.2 Purpose

The work proposed under this investigation concentrates on the areas known as the Diggings East Tailings, Northside Tailings, and the BTC Berm (fig. 2). This SAP’s purpose is to define standard-field and laboratory activities necessary to;

- delineate horizontal and vertical extent of tailings within these areas, and
delineate a potential excavation boundary,
Figure 1. Diggings East and Northside Tailings Areas located within the Butte Area One boundary.
Figure 2. Location map showing potential MBMG bore hole, test-pit, and trenching sites

Preliminary MBMG borehole locations and possible trenches shown in green.
1) 35 borehole location
2) undefined number of trenches
3) maximum depth per site = 10 feet

Legend
- Butte Priority Soils OU Boundary
- AR Recommended Tailings Excavation Area (BP ARCO, 2012)
- MBMG Recommended Excavation Areas

BTC Berm
Northside East
Northside West
Diggings East

0 250 500 1,000 1,500 2,000 Feet
• determine whether tailings samples are impacted by petroleum hydrocarbon contamination, and
• evaluate whether the lithologic unit known as the organic silt layer should be characterized as an impacted sediment to be included under potential removal action.

This SAP utilizes tailings/impacted sediment investigation procedures developed previously by Maxim Technologies (Maxim, 2002) which were modified by Pioneer Technical Services (Pioneer, 2012) for the Montana Department of Environmental Quality (DEQ) during the remedial investigations under the SSTOU.

1.2 General Scope of Work

The current SAP presents procedures for sediment sampling and analysis, excavating and backfilling of trenches, test pits, drilling of boreholes, and surveying locations (including both groundwater and lithologic elevation). The following objectives will be accomplished during the investigation.

1) Identify the aerial extent, depth to, thickness, and volume of historic smelter tailings based on the visual inspection and lithology of backhoe test pit excavation, trenches, and boreholes.
2) Quantify the concentration of COCs in historic smelter tailings based on analysis and screening with a portable Niton XL3tGOLDD+ Portable XRF metals analyzer, and subsequent laboratory metals analysis.
3) Identify the thickness and volume of impacted sediments such as the lithologic unit known as the organic silt layer, the organic-rich soil horizon that directly underlies the tailings. The organic silt layer, and other lithologic units (clay, silts, sands) encountered during this investigation will be classified as an impacted sediment based on criteria and action levels that were previously established (Maxim, 2002; Pioneer, 2012) and are presented in this SAP.
4) Identify the depth to groundwater; determine if dewatering would be necessary based upon the presences of saturated impacted sediment.
5) Determine if tailings material identified for removal under this investigation contains petroleum hydrocarbon contamination.

2.0 LOCATION OF BOREHOLES, TEST PITS AND TRENCHES, SITE ACCESS AND SEQUENCING OF WORK

The locations of the proposed test pits/boreholes and trench are shown on Figure 2. The locations and the type of sampling method (test pit, trench, or borehole) are subject to change based on field conditions, site access considerations, general feasibility, and/or third party cooperation. The installation sequencing of individual sampling locations will be based on the availability of access agreements with property owners. Sequencing will generally start with sampling locations where access agreements have been finalized.
3.0 PROCEDURES FOR TEST PIT AND TRENCHING ACTIVITIES

Test pit and trenching activities are necessary due to a long-history of poor recovery of tailings material in core barrels when using conventional drilling techniques. Unfortunately, the poor recovery observed in the lithologic record of the near-surface is due, in most part, to large demolition debris material (concrete slabs) that has been placed above the tailings over the course of time. This debris has made the delineation of near-surface tailings in these areas challenging.

A modified version of the Backhoe Pit/ Trench excavation outlined in SOP-SS-1 of CFRSSI (Arco, 1992) and the SAP outlined in the SSTOU SAP (Pioneer, 2012). Prior to excavation or any disturbance of ground surface, local line utility locating service will be contacted 72 hours in advance and all utility locates will be completed to ensure locations are free from underground utilities and obstructions.

3.1 General Procedures for Test pit and Trenching Activities

The following procedures will be performed at each sampling location where test pit or trenching techniques are used to access the tailings.

1. Locate the clearly marked site that has been deemed free of underground utility and obstruction. Complete a visual inspection of the investigation area to identify potential hazards, waste materials, debris, obstacles, and other items that may affect the scope of work and health and safety.

2. Place the backhoe tractor in a safe position. This will be based on the operator’s judgment and site conditions.

3. Begin backhoe excavation. Place excavated materials a sufficient distance (at least three feet) from the excavation so as not to return excavated materials to the pit.

4. Continue excavation of the pit to the required depth. This total depth of each site shall be based upon the bottom of the organic silt layer or the top of the groundwater table, whichever comes first (water table ~9 – 10 feet below ground surface). No person shall be allowed to enter pits or trenches.

5. Sampling personnel will not be permitted to enter the pit at any time. All sampling in pits and trenches will be done from the surface, where sampling personnel will be equipped with the appropriate fall-protection.

6. Soil profile descriptions shall be made from a surface along the pit wall. Sampling of sediment samples in pits and trenches will be conducted from the surface using extended-arm sampling equipment and the appropriate fall protection.

7. Collect samples of tailings/impacted sediments (organic silt layer) from test pit excavations and trenches using an extended sampling apparatus that allows sampling from the surface.
Collect all sediment sampling in decontaminated stainless steel or plastic sampling tools and bowls from the appropriate intervals. Transfer bulk sample to properly labeled zip-lock bags and place in sampling coolers for safe transfer to MBMG labs. Ensure enough sample is collected so that a proper archive of each location is maintained.

8. Document approximate depth-to-groundwater if the water-table is encountered.

9. Survey the test pit location and elevation using survey-grade GPS unit.

10. Photograph and log all test pits.

11. Transport sample at the end of each day to MBMG labs. Screen samples using a Niton XL3tGOLDD+ Portable XRF analyzer to quantify the metal’s concentrations in tailings/impacted sediments and submit selected samples to the laboratory.

12. Screen samples using Photovac Model 2020Pro portable PID meter for photoionizable chemicals. Send selected samples that contain detectable photoionizable concentrations (as detected using PID meter) to labs for total petroleum hydrocarbon analysis. If analyzed PID samples report concentrations below instrumentation detection limits, then 5 samples will be randomly selected and sent to the lab for TPH analyses.

13. After steps 1 through 10 have been completed to the satisfaction of the lead sampler, the site pit shall be refilled with the excavated materials. Each excavation site will be filled back to original grade and seeded using EPA-approved seed mix.

14. Decontaminate all sampling equipment (SOP-G-8).

15. Move to the next site. If the previous site was the last site of the day, decontaminate the backhoe bucket, secure, and park the backhoe tractor rig for the evening. Backfill all pits and trenches to original grade before the end of each day. Open holes will not be left unattended.

### 3.2 Sample Locations and Identification

Test pits and trenches for the current investigation will be located on a north-south/east-west grid and based on preliminary walk-through surveys. Test pit points are on approximately 300-foot centers in the Diggings East and Northside Tailings areas, with a decrease in test pit density beyond the limits of the tailings deposition area clearly defined on historic 1955 aerial imagery. The actual test pit locations will be field adjusted in areas where the proposed location does not meet the objectives of the investigation. Approximate locations for test pit, borehole, and trench sites are shown on Figure 2.

Pit locations will be flagged with survey lath placed within one foot of the actual location. The lath will be clearly labeled with a unique designation number. The sample identification number will be derived from the pit number with the addition of four or more digits separated by a dash.
to represent the depth interval. The first two digits will represent depth (in feet, accurate to the
tenth of an inch) from the ground surface to the top of the interval sampled, and the second two
digits will represent the depth to the bottom of the interval. For example, a sample designated
DE-TP-01-0.8-1.2, describes a sample from the Diggings East, in Test Pit #1 from a depth of 0.8
feet to 1.2 feet below existing grade. The horizontal location and elevation of each test pit will
be surveyed with respect to the project coordinate system. The test pit and sample numbers will
be unique.

Test pit and sample identification protocol may be modified to identify horizontal extent of
tailings. Extent points will be located during the investigations and will not be staked in
advance. The approximate sample location will be determined by the field crew measuring from
the nearest staked test pit along the appropriate north-south or east-west gridline. If the sample is
not located on a gridline, the location will be estimated as close as possible measuring from the
nearest test pit. These measurements will be documented in the logbook for later surveying. The
lateral extent samples will be identified relative to the nearest test pit and its north-south or east-
west distance from the test pit. For example, the sample identifier for a test pit located 60 feet
east of Test Pit #10 in the Diggings East would be DE-LE-10-60E. The lateral extent samples
will be located and field-screened as described below. The lateral extent will be marked with a
pin flag, and the associated sample identifier will be recorded on the pin flag.

3.3 Test Pit Surveying

Test pits and lateral extent sample locations will be sited using resource-grade Global
Positioning System (GPS) methods, staked and labeled as described above. Following
completion of sampling, the location and elevation of each test pit sample will be surveyed using
survey-grade GPS methods conducted by MBMG personnel. Data collected will include test pit
designation, northing, easting, and elevation. The accuracy will be to within 1-foot horizontally
and 0.1-foot vertically. Survey data will be collected using the Montana State Plane (NAD 83)
coordinate system and North American Vertical Datum (NAVD) 1988. Surveying will be
completed MBMG personnel.

3.4 Sampling Equipment

Excavation of test pits and trenches will be performed with a track-mounted excavator.
Equipment utilized to collect soil samples will include:

- Stainless steel shovels, spoons, and sampling bowls;
- Field notebook and measuring tape;
- Sample containers (Zip-lock bags) and labels;
- Sharpie pens;
- Niton XL3tGOLDD+ Portable XRF instrument and calibration supplies;
- Photovac Model 2020 PRO Portable Photoionization meter
- Chain of custody forms;
- Coolers;
• Decontamination equipment (tap water, Alconox soap, decontamination containers, paper
towels, scrub brushes, and spray bottles);
• Camera;
• Portable pump; and
• Personal Protective Equipment (PPE): Level D with appropriate fall protection.

3.5 Test Pit Excavations and Trenches

Test pits will be excavated using a track-mounted excavator to provide access for sampling to
soils at depth. Excavations will be in a manner preserving location and designation stake
described in Section 3.2. The pits will be dug to an average depth of approximately nine (9) feet
below ground surface (existing groundwater table). One wall will be prepared for evaluation and
sampling as described in Section 3.6.1. Excavated materials will be stockpiled a minimum of
three (3) feet from the edge of the cavity. Samples will be collected from the surface using
extended arm sampling methods. Sampling personnel will be fitted with the appropriate fall
protection.

After excavation, general lithology will be evaluated from the surface. This includes a general
soil log of the sidewall, estimated rock content, color, soil horizon depths, tailings depth and
thickness, organic silt depth and thickness, and depth-to-groundwater. Visual and lithologic
information will be recorded in a field logbook for future reference. Each test pit will be
photographed for future reference.

3.6 Procedures for Alternative Methods for Sediment Sampling

In areas where trenching/pit techniques are not feasible (i.e. BTC Berm area), conventional drilling
techniques (i.e. auger drilling, geoprobe) will be employed in order to achieve the goals outlined in
section 1.1. The procedures listed below may be modified in the field by the agreement with the
lead site sampler and drill operators based on field and site conditions after appropriate annotations
have been made in the appropriate field logbook. This section is only meant in substitution of
section 3.1 in areas where necessary. All procedures outlined in sections 3.2 – 3.5 and 3.7 – 3.13
apply if this method is used in lieu of section 3.1.

3.6.1 Procedure for Auger Drilling or Geoprobe

The following procedures are designed to be used during the operation of auger type drill rigs or
Geoprobe during soil sampling operations.

1. Locate the clearly marked site that has been deemed free of underground utility and
obstruction. Complete a visual inspection of the investigation area to identify potential
hazards, waste materials, debris, obstacles, and other items that may affect the scope of work
and health and safety.
2. Drillers prepare rig for operation. This includes but is not limited to leveling the rig, preparing the downhole tool, preparing the auger "flights", and establishing the drill over the location.

3. Attach the split tube sampler to the "hammer tool" (approximately 150 pounds).


5. Place split tube sampler on the ground surface and advance sampler using the rig hammer.

6. After driving the split tube sampler its entire length (18 inches) or upon refusal of advancement, recover the split tube sampler. Refusal is defined as 50 blows with the rig hammer and less than 5 inches advancement of the sampler.

7. After recovery of the split tube sampler, open the tube and place the solid material in a core holder maintaining the intervals as sampled.

8. Repeat steps 3 to 7 until the depth of groundwater table or the bottom of the organic silt layer is encountered, whichever comes first.

9. Sampling personnel will then describe the core, subsample according to the sampling protocol outlined in section 3.6, fill out the appropriate logbooks, field profile sheets, field site sheets, and quality assurance/quality control documentation, and photographs.

10. Collect samples of tailings/impacted sediments (organic silt layer) from split-spoon sampler. Transfer bulk sample to properly labeled sample bags and place in sampling coolers for safe transfer to MBMG labs. Ensure enough sample is collected so that a proper archive of each location is maintained after all chemical analysis are performed.

11. Document approximate depth-to-groundwater in each of the test pits.

12. After items 1 through 11 have been completed to the satisfaction of the lead sampler, the borehole shall be abandoned using 3/8” bentonite chips to 1-foot below ground surface. The remainder of the hole will be filled in with native material and re-seeded using EPA-approved seed mix that will be provided by the county of Butte Silver Bow.

13. Survey the drilling location and elevation.

14. Decontaminate all sampling equipment (SOP-G-8).

15. Move to the next site. If the previous site was the last site of the day, decontaminate the drill rig tools, lower the drill mast, and secure and park the drill rig for the evening.
3.7 Sampling Methods

The following section describes the sampling protocol established for this investigation.

3.7.1 Sample Collection

Upon completion of excavation and logging, the test pit sidewall will be scraped clean of visual residue with a decontaminated shovel or trowel. Sediment samples of tailings and impacted sediments will be collected continuously in 0.5 foot vertical intervals along the scraped wall, beginning at a depth equivalent to the base of the test pit, and proceeding upward and ending at the ground surface. This methodology will prevent contamination of lower layers prior to sampling. Intervals will be measured from the ground surface. The samples will be collected in stainless steel bowls and homogenized. Soil collected from each sampling interval will be placed in sample containers according to the methods and procedures identified in *Clark Fork River Superfund Site Investigation (CFRSSI) Standard Operating Procedures (SOPs) SS-1 and SS-6* (ARCO, 1992).

3.7.2 XRF Field Screening Protocol

Field screening protocols established for the Stream Side Tailings Operable Unit by Pioneer Technical Services (2011) will be used during the current investigation to evaluate concentrations of COCs in impacted sediment (i.e. organic silt layer or samples containing a mixture of tailings and fluvial deposits) samples (Pioneer, 2012). Individual samples will be screened using a portable XRF analyzer in accordance with U. S. Environmental Protection Agency (EPA) Method 6200 (Appendix A). The Method provides procedures for both direct readings (placing the instrument on the test pit sidewall) and field-prepared sample readings. The field-prepared sample method will be used. Field-screening will occur on samples selected for laboratory analysis as well.

Results will be compared to the concentrations listed in table 1, a set of criteria that was developed for the SSTOU and are used as the screening criteria for characterizing tailings and impacted sediments (Pioneer, 2011).

**Table 1. Field XRF sample screening criteria (Pioneer, 2011).**

<table>
<thead>
<tr>
<th>COC</th>
<th>Action Level (mg/kg)</th>
</tr>
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<tr>
<td>Arsenic</td>
<td>200</td>
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<tr>
<td>Cadmium</td>
<td>20</td>
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<td>Copper</td>
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<td>Lead</td>
<td>1,000</td>
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<td>Mercury</td>
<td>10</td>
</tr>
<tr>
<td>Zinc</td>
<td>1,000</td>
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</table>
If four of the six COCs pass the field-screening criteria listed in Table 1, the sample will be considered to be non-impacted by the primary source (overlying tailings deposits). If three of the six COCs exceed the failure criteria listed in Table 1, the sample will be considered to be impacted, and recommended for potential removal. Sample screening criteria will be applied to field-identify the base and lateral extents of impacted sediments and will aid in the selection of laboratory sample selections.

3.7.3 Portable Photoionization Monitor Screening Protocol

Tailings samples will be screened for petroleum hydrocarbon contamination using a model 2020Pro portable photionization monitor in accordance with SOP A-1 of CFRSSI (Arco, 1992). Instrument specifications, calibration methods and procedures for the instrument are included in Appendix B. Samples containing detectable concentrations of photoionizable chemicals (as detected by the instrument) will be sent to a certified laboratory for Total Petroleum Hydrocarbon (TPH) analysis. If detectable concentrations of photoionizable chemicals are not observed in tailings samples, a minimum of five randomly selected samples will be prepared for analyses of TPH concentrations.

3.7.4 Extents Boundary Location

The impacted boundary will be determined by extending the gridlines perpendicularly to the general trend of the tailings deposit. A soil sample will be collected from the ground surface near the suspected edge (or boundary) of the tailings deposit (as determined by historic aerial photography). This boundary will be determined based on the positive identification of tailings material identified at each site location. The “halving the distance” method will be applied until the halved distance is equal to or less than 100 feet, and will be staked as the edge of the tailings boundary, marked in accordance with Section 3.2, and surveyed for horizontal position and elevation.

The determination of boundaries may have to account for the presence of practical boundaries; such as roads, buildings, and utility lines. For instance, the northern boundary of the Diggins East complex will most likely be dictated by the geographical orientation of George Street.

3.8 Selection of Samples for Laboratory Analysis

Upon completion of test pit evaluation, samples will be selected for laboratory analysis. The screening criteria provided in Table 1 will assist in determining the base of tailings and impacted sediments and which samples will be submitted for laboratory analyses. Identification of the 0.5-foot interval samples selected for laboratory analyses will be based on a combination of visual observation of the tailings depth and the results of the XRF field screening concentrations.
For lateral extents, there may or may not be an “order-of-magnitude” break in COC levels. Field XRF results will be used in an attempt to identify a clear break in COC concentrations; however, the criteria provided in Table 1 will be applied to laboratory analysis to determine the lateral extent of the tailings and impacted sediments wherever a clear break in concentrations cannot be identified.

Laboratory samples will be analyzed for total metal’s concentrations, as described in Section 3.11. All remaining samples, not analyzed, will be archived and will be available for laboratory analysis if the samples originally submitted for laboratory analysis do not define the “order-of-magnitude” break in total metals concentrations.

### 3.9 Decontamination

All drilling/excavation and related equipment required to complete this scope of work will be decontaminated by the contractor prior to the project. The decontamination procedure consists of clearing drilling flights and excavation equipment of all sediment, soil, and debris. The MBMG field representative will be responsible for inspecting the cleanliness of the equipment prior to commencing drilling or excavation activities. Prior to the excavation of each new sampling pit, all tooling and sampling equipment will be decontaminated according to modified procedures described in SOP G-8 of CFRSSI (Arco, 1992). Hand tools will be used to remove gross contamination from the backhoe bucket/drilling equipment before moving to the next test pit.

All non-disposable sampling equipment will be decontaminated using a soap and tap water rinse prior to collecting each sample. Gross contamination will be removed from any hand tools used to prepare the test pit sidewalls.

### 3.10 Field Documentation

All significant observations, measurements, data, and results will be clearly documented in the field logbook in indelible ink according to the methods and procedures specified in CFRSSI SOP-G-4 (ARCO, 1992). This will include the following:

- Lithologic logs of the test pit material types (e.g., sand, silt, organic silt), texture, grain-size, and color;
- Presence of visually discernible fill, tailings and other mine-waste material;
- Results of XRF field screening;
- Depths below ground surface to all soil horizons and total depth of the test pit;
- Depths to groundwater, if present;
- Sample location descriptions and designations;
- Photographs of selected sample locations; and
- Abnormal occurrences, deviations from the SAP, or other relevant observations.
3.11 Laboratory Analysis

Sample analysis parameters and the respective analysis methods are listed in table 2. Samples will be submitted to ALS Geochemistry Labs for analysis of total digestible As, Cd, Cu, Pb, and Zn. Samples will be submitted to MSE labs for total Hg. Samples will be submitted to Energy Labs for total petroleum hydrocarbon analysis.

Table 2. Parameters for Laboratory Analysis

<table>
<thead>
<tr>
<th>MATERIAL TYPE</th>
<th>PARAMETER</th>
<th>METHOD</th>
<th>LAB</th>
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</thead>
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<tr>
<td>Tailings/Impacted Soils</td>
<td>Total Digestable Metals (As, Cd, Cu, Pb, Zn)</td>
<td>200.7 CLP-M</td>
<td>ALS</td>
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<td></td>
<td>Total Mercury</td>
<td>245.5 CLP-M</td>
<td>MSE</td>
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<td></td>
<td>Total Petroleum Hydrocarbon</td>
<td>SW8015B</td>
<td>Energy Labs</td>
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3.12 Sample Handling

All samples will be packaged and handled according to the applicable CFRSSI SOPS (ARCO, 1992) provided. The technician will label each with an indelible marker, record designation in field notes, and prepare a chain of custody form as specified in CFRSSI SOP G-7 (ARCO, 1992). Labels will include sample designation, date, technician, time, and location. Samples will be transported to MBMG Labs prior to the cessation of field activities on a daily basis. Designation labels will be completed in the lab, prior to transport of the samples to the analytical facility.

A copy of the chain of custody record will accompany the shipment and serve as laboratory request forms. The chain of custody form will specify the type of analysis requested for individual samples. The original form will be maintained with the field notes and records.

3.13 Field Quality Control

Replicate XRF samples will be made every 20 samples or once a day, whichever comes first. One field duplicate every 20 samples will be collected and submitted for laboratory. The duplicate sample will be labeled in a manner not allowing the analytical laboratory to identify its location. The duplicate will be analyzed for all laboratory parameters listed in Table 1. The identification and location of the duplicate sample will be recorded in the field logbook.

Collection of field, cross-contamination, or external contamination blank samples will not be performed.

4 DRILLING OVERSIGHT

MBMG will provide the personnel to oversee all drilling, core sampling/evaluation, excavation, and abandonment activities. If third parties want a representative on-site, they will be required to
check-in and check-out with the MBMG field leader on a daily basis. The MBMG representative will be responsible for logging the borehole, collecting the appropriate samples, and management of on-site activities.

5 REPORTING

MBMG will submit a Final Report to NRDP upon the completion of sample analysis and tailings delineation.

6 HEALTH AND SAFETY

All work competed by MBMG and its contractors during execution of this SAP will be performed in accordance with all procedures outlined in MBMG’s Health and Safety Plan developed for the Butte Mine Flooding Operable Unit (MBMG, 2012; Appendix C).

7 PROJECT SCHEULE

The start date will be determined obtaining signed access agreements from the property owners and the time and availability of MBMG’s contractors. This work is anticipated to begin April 15, 2013 and continue for approximately 4 to 6 weeks. The excavation/test pit activities are anticipated to take 10 to 15 work days, and will be followed by drilling activities if necessary.

8 REFERENCES

APPENDIX B  LITHOLOGY LOGS OF TEST PITS, TRENCH, AND BOREHOLES
### A) DIGGINGS EAST TAILINGS LITHOLOGY LOGS

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### APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

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### APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

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# APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

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### APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

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<tr>
<td>6.2</td>
<td>6.4</td>
<td>Black organic silt</td>
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<td>6.4</td>
<td>10</td>
<td></td>
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<td>Groundwater @ 9.9'</td>
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<table>
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<tr>
<th>Site: TP-16W-50S Extent</th>
<th>TD = 11.7</th>
<th>From</th>
<th>To</th>
<th>Description</th>
<th>Longitude: -112.528656</th>
<th>Elevation (ft):</th>
<th>Method: Test Pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.8</td>
<td>Fill: demolition debris</td>
<td></td>
<td>NAD 83 Decimal Degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.8</td>
<td>10.3</td>
<td>Yellow tailings</td>
<td></td>
<td>NAVD 88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.3</td>
<td>11.7</td>
<td>Black organic silt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater @ 11.6'</td>
<td></td>
<td></td>
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<table>
<thead>
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<th>Site: TP-16W</th>
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<th>From</th>
<th>To</th>
<th>Description</th>
<th>Longitude: -112.52866</th>
<th>Elevation (ft):</th>
<th>Method: Test Pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.5</td>
<td>Fill: demolition debris</td>
<td></td>
<td>NAD 83 Decimal Degrees</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5.5</td>
<td>5.6</td>
<td>Yellow tailings</td>
<td></td>
<td>NAVD 88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>11.8</td>
<td>Black organic silt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater @ &gt;11.8'</td>
<td></td>
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</table>
# APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

<table>
<thead>
<tr>
<th>Site: TP-17W</th>
<th>TD = 12</th>
<th>Latitude: 45.995674</th>
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<tbody>
<tr>
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<td>To</td>
<td>Description</td>
<td>NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>5.1</td>
<td>Fill: demolition debris</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>8</td>
<td>Yellow tailings</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>11.9</td>
<td>Black organic silt</td>
<td></td>
</tr>
<tr>
<td>11.9</td>
<td>12</td>
<td>Gray alluvial sand</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater @ &gt;11.9'</td>
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<table>
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<th>Site: TP-18W</th>
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<th>Longitude: -112.526362</th>
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<tbody>
<tr>
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<td>To</td>
<td>Description</td>
<td>NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>3.5</td>
<td>Fill: demolition debris</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>5.1</td>
<td>Yellow tailings</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>6</td>
<td>Black organic silt</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3.1</td>
<td>Gray alluvial sand</td>
<td></td>
</tr>
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<td></td>
<td>Groundwater @ 6.0'</td>
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<table>
<thead>
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<th>Site: TP-19W</th>
<th>TD = 8.8</th>
<th>Latitude: 45.995474</th>
<th>Longitude: -112.526916</th>
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<td>To</td>
<td>Description</td>
<td>NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>5.2</td>
<td>Fill: demolition debris</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>7</td>
<td>Yellow tailings</td>
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</tr>
<tr>
<td>7</td>
<td>8.5</td>
<td>Black organic silt</td>
<td></td>
</tr>
<tr>
<td>8.5</td>
<td>8.8</td>
<td>Gray alluvial sand</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Groundwater @ 8.7'</td>
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### B) NORTHSIDE TAILINGS IMPOUNDMENT LITHOLOGY LOGS

<table>
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<tr>
<th>Site: TP-NS-01</th>
<th>TD = 11.5</th>
<th>Latitude : 45.995619</th>
<th>Longitude : -112.530961</th>
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<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Description</td>
<td>Longitude : NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>2.3</td>
<td>Top soil, clean</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>2.6</td>
<td>Oxidized alluvial sand and tailings</td>
<td>Elevation (ft): 5448.46</td>
</tr>
<tr>
<td>2.6</td>
<td>4.4</td>
<td>Medium brown sand</td>
<td>Method: Test Pit</td>
</tr>
<tr>
<td>4.4</td>
<td>11</td>
<td>Black organic silt</td>
<td></td>
</tr>
</tbody>
</table>

Groundwater @ 11.5'

<table>
<thead>
<tr>
<th>Site: TP-NS-01E-50S</th>
<th>TD = 7.3</th>
<th>Latitude : 45.996819</th>
<th>Longitude : -112.526155</th>
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<tbody>
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<td>From</td>
<td>To</td>
<td>Description</td>
<td>Longitude : NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>1.4</td>
<td>Yellow oxidized tailings</td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>3.3</td>
<td>Oxidised sand, no noticeable tailings</td>
<td>Elevation (ft): 5451.82</td>
</tr>
<tr>
<td>3.3</td>
<td>7.2</td>
<td>Black organic silt</td>
<td>Method: Test Pit</td>
</tr>
<tr>
<td>7.2</td>
<td>7.3</td>
<td>Olive silty sand with gravel, alluvium</td>
<td></td>
</tr>
</tbody>
</table>

Groundwater @ 7.25', possibly a perched system

<table>
<thead>
<tr>
<th>Site: TP-NS-01E</th>
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<th>Longitude : -112.526215</th>
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<tr>
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<td>To</td>
<td>Description</td>
<td>Longitude : NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>0.8</td>
<td>Top soil, clean</td>
<td></td>
</tr>
<tr>
<td>0.8</td>
<td>3.3</td>
<td>Oxidized alluvial sand</td>
<td>Elevation (ft): 5451.44</td>
</tr>
<tr>
<td>3.3</td>
<td>&gt;7.0</td>
<td>Black organic silt</td>
<td>Method: Test Pit</td>
</tr>
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Groundwater @ 3.3', perched aquifer

<table>
<thead>
<tr>
<th>Site: TP-NS-02</th>
<th>TD = 8</th>
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<th>Longitude : -112.53056</th>
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</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Description</td>
<td>Longitude : NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>1.8</td>
<td>Top soil, clean</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>6.6</td>
<td>Oxidised sand, no noticeable tailings</td>
<td>Elevation (ft): 5448.70</td>
</tr>
<tr>
<td>6.6</td>
<td>8+</td>
<td>Black organic silt</td>
<td>Method: Test Pit</td>
</tr>
</tbody>
</table>

Groundwater @ 7.4', perched aquifer

<table>
<thead>
<tr>
<th>Site: TP-NS-02E</th>
<th>TD = 5.5</th>
<th>Latitude : 45.997334</th>
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<td>To</td>
<td>Description</td>
<td>Longitude : NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>2.6</td>
<td>Medium to coarse oxidized sand, no noticeable tailings</td>
<td>Elevation (ft): 5451.82</td>
</tr>
<tr>
<td>2.6</td>
<td>5.5</td>
<td>Black organic silt</td>
<td>Method: Test Pit</td>
</tr>
</tbody>
</table>

Groundwater @ 2.6' perched system

<table>
<thead>
<tr>
<th>Site: TP-NS-03</th>
<th>TD = 10.2</th>
<th>Latitude : 45.995847</th>
<th>Longitude : -112.529821</th>
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</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Description</td>
<td>Longitude : NAD 83 Decimal Degrees</td>
</tr>
<tr>
<td>0</td>
<td>2.7</td>
<td>Top soil, clean</td>
<td></td>
</tr>
<tr>
<td>2.7</td>
<td>4.2</td>
<td>Oxidized sand, no noticeable tailings</td>
<td>Elevation (ft): 5450.53</td>
</tr>
<tr>
<td>4.2</td>
<td>10.2</td>
<td>Black organic silt</td>
<td>Method: Test Pit</td>
</tr>
</tbody>
</table>

Groundwater @ 7.4'; possibly a perched system
# APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

<table>
<thead>
<tr>
<th>Site: TP-NS-03E</th>
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</tr>
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<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Description</td>
<td>Elevation (ft): 5452.66</td>
</tr>
<tr>
<td>0</td>
<td>0.9</td>
<td>Top soil, clean</td>
<td>NAVD 88</td>
</tr>
<tr>
<td>0.9</td>
<td>1.3</td>
<td>Oxidized sand with tailings</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>1.5</td>
<td>Fine oxidized tailings</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>2</td>
<td>Fine-medium gray sand</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5.6</td>
<td>Black organic silt</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>5.7</td>
<td>Olive silty sand with gravel</td>
<td></td>
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<tr>
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<td>Groundwater @ 5.6’</td>
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<table>
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<td>To</td>
<td>Description</td>
<td>Elevation (ft): 5452.13</td>
</tr>
<tr>
<td>0</td>
<td>1.4</td>
<td>Oxidized silty sand</td>
<td>NAVD 88</td>
</tr>
<tr>
<td>1.4</td>
<td>&gt;3.0</td>
<td>Black organic silt</td>
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</tr>
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<tr>
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<td>To</td>
<td>Description</td>
<td>Elevation (ft): 5455.50</td>
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<tr>
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<td>Top soil</td>
<td>NAVD 88</td>
</tr>
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<td>0.3</td>
<td>2.2</td>
<td>Oxidized sand, SP</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>&gt;3.0</td>
<td>Black organic silt</td>
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</tr>
<tr>
<td></td>
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<td>Groundwater @ &gt;3.0’</td>
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<table>
<thead>
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<th>Site: TP-NS-04E-50N</th>
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<td>Top soil</td>
<td>NAVD 88</td>
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<td>1.4</td>
<td>Oxidized tailings and sand</td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>&gt;3.0</td>
<td>Black organic silt</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater @ &gt;3.0’</td>
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Method: Test Pit
### C) BLACKTAIL CREEK BERM LITHOLOGY LOGS

<table>
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<tr>
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<th>Description</th>
<th>Longitude:</th>
<th>Latitude:</th>
<th>Elevation (ft):</th>
<th>Method:</th>
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<tbody>
<tr>
<td>Berm 1</td>
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<td>0.5</td>
<td>Top soil</td>
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<tr>
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<td>4</td>
<td>Clayey sand, SC, brown</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4.2</td>
<td>Tailings</td>
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</tr>
<tr>
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<td>4.2</td>
<td>4.25</td>
<td>Black organic silt</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>4.25</td>
<td>4.7</td>
<td>Sand with some gravel</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>4.7</td>
<td>5.7</td>
<td>Black organic silt, wet at 5.7</td>
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<td>5.7</td>
<td>6.3</td>
<td>Silty sand, saturated</td>
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<td></td>
<td></td>
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<tr>
<td></td>
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<td>6.3</td>
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<td>No recovery</td>
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<td></td>
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<td></td>
<td>8</td>
<td>11</td>
<td>Black organic silt</td>
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<tr>
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<td></td>
<td>11</td>
<td>12</td>
<td>No recovery</td>
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<td></td>
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<td>13</td>
<td>Oxidized orange clay</td>
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<tr>
<td></td>
<td></td>
<td>12</td>
<td>16</td>
<td>Coarse gray alluvial sand and fine gravel</td>
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</tr>
<tr>
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<td></td>
<td></td>
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<td>Groundwater @ 5.7'</td>
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</table>

<table>
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<th>To</th>
<th>Description</th>
<th>Longitude:</th>
<th>Latitude:</th>
<th>Elevation (ft):</th>
<th>Method:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berm 2</td>
<td></td>
<td>0</td>
<td>0.3</td>
<td>Top soil</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td>2.3</td>
<td>Clayey sand, SC, brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.3</td>
<td>2.5</td>
<td>Tailings</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>2.5</td>
<td>4</td>
<td>No recovery</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4.25</td>
<td>Silty sand with some tailings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.25</td>
<td>6.5</td>
<td>oxidized silt with orange clay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.5</td>
<td>8</td>
<td>No recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>10.8</td>
<td>Black organic silt, entire sample wet</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
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<td>16</td>
<td>Coarse gray alluvial sand and fine gravel</td>
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### APPENDIX B. TRENCH, TEST PIT, AND BOREHOLE LITHOLOGY

**Site: Berm 3**

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<td>Black organic silt, saturated</td>
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<td>Sandy Silt grading to silty sand</td>
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Groundwater @ 5.0'

**Site: Berm 4**

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<td>No recovery, water entering</td>
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Groundwater @ ~6.4'
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<td>10.5</td>
<td>10.9</td>
<td>Black organic silt</td>
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Longitude: -112.53309

Elevation (ft): 5441.33

Method: Geoprobe

NAD 83 Decimal Degrees

NAVD 88
APPENDIX C  CONCENTRATIONS OF COCs
## APPENDIX C: ICP DATA: CONCENTRATIONS OF COCs IN SEDIMENT

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<th>Cd</th>
<th>Cu</th>
<th>Pb</th>
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## APPENDIX C: ICP DATA: CONCENTRATIONS OF COCs IN SEDIMENT

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<th>Soil Type</th>
<th>As</th>
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# APPENDIX C: ICP DATA: CONCENTRATIONS OF COCs IN SEDIMENT

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## APPENDIX C: ICP DATA: CONCENTRATIONS OF COCs IN SEDIMENT

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### APPENDIX C: ICP DATA: CONCENTRATIONS OF COCs IN SEDIMENT

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APPENDIX C: ICP DATA: CONCENTRATIONS OF COCs IN SEDIMENT

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APPENDIX D  MERCURY CONCENTRATIONS
Monday, September 30, 2013

Nick Tucci
Montana Tech
1300 W. Park Street
Butte, MT 59701

Dear Nick Tucci:

MSE Lab Services received 195 sample(s) on 8/21/2013 for the analyses presented in the following report.

Please find enclosed analytical results for the sample(s) received at the MSE Laboratory.

If you have any questions regarding these test results, please feel free to call.

Sincerely,

[Signature]

Sara Ward
Laboratory Manager
406-494-7334

Enclosure
## MERCURY IN SOIL/SEDIMENT - SW846 7471B

**Lab Order:** 1308116  
**Date Received:** 8/21/2013 4:45:00 PM  
**Matrix:** Soil

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**Qualifiers:**  
- MDL - Method Detection Limit  
- DF - Dilution Factor  
- ND - Not Detected at the Method Detection Limit (MDL)  
- RL - Reporting Limit  
- J - Detected below the Reporting Limit (RL)
### MERCURY IN SOIL/SEDIMENT - SW846 7471B
### SW7471

**CLIENT:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Analyte:** Mercury

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**Qualifiers:**  
MDL - Method Detection Limit  
DF - Dilution Factor  
ND - Not Detected at the Method Detection Limit (MDL)  
RL - Reporting Limit  
J - Detected below the Reporting Limit (RL)
### MERCURY IN SOIL/SEDIMENT - SW846 7471B

**SW7471**

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- DF - Dilution Factor
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- J - Detected below the Reporting Limit (RL)

**P.O. Box 4078**
**Butte, MT 59701**
**Lab: 406-494-7334**
**Fax: 406-494-7230**
**labinfo@mse-ta.com**

**Date:** 10/7/2013

**CLIENT:** Montana Bureau of Mines & Geology

**Project:** DIGGINGS EAST TO-19

**Analyte:** Mercury

**Lab Order:** 1308116

**Date Received:** 8/21/2013 4:45:00 PM

**Matrix:** Soil
MSE Lab Services

MERCURY IN SOIL/SEDIMENT - SW846 7471B
SW7471

CLIENT: Montana Bureau of Mines & Geology
Project: DIGGINGS EAST TO-19
Analyte: Mercury

Lab Order: 1308116
Date Received: 8/21/2013 4:45:00 PM
Matrix: Soil

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Qualifiers:
- MDL - Method Detection Limit
- DF - Dilution Factor
- ND - Not Detected at the Method Detection Limit (MDL)
- RL - Reporting Limit
- J - Detected below the Reporting Limit (RL)
### MERCURY IN SOIL/SEDIMENT - SW846 7471B
### SW7471

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**Lab Order:** 1308116  
**Project:** DIGGINGS EAST TO-19  
**Date Received:** 8/21/2013 4:45:00 PM  
**Analyte:** Mercury  
**Matrix:** Soil  
**Date:** 10/7/2013

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RL - Reporting Limit  
J - Detected below the Reporting Limit (RL)
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### MERCURY IN SOIL/SEDIMENT - SW846 7471B
#### SW7471

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**Qualifiers:**
- MDL - Method Detection Limit
- DF - Dilution Factor
- ND - Not Detected at the Method Detection Limit (MDL)
- RL - Reporting Limit
- J - Detected below the Reporting Limit (RL)
### MERCURY IN SOIL/SEDIMENT - SW846 7471B
**SW7471**

**CLIENT:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Analyte:** Mercury

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**Qualifiers:** MDL - Method Detection Limit  
DF - Dilution Factor  
ND - Not Detected at the Method Detection Limit (MDL)  
RL - Reporting Limit  
J - Detected below the Reporting Limit (RL)
MSE Lab Services

MERCURY IN SOIL/SEDIMENT - SW846 7471B
SW7471

CLIENT: Montana Bureau of Mines & Geology
Project: DIGGINGS EAST TO-19
Analyte: Mercury

Lab Order: 1308116
Date Received: 8/21/2013 4:45:00 PM
Matrix: Soil

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Qualifiers: MDL - Method Detection Limit
ND - Not Detected at the Method Detection Limit (MDL)
J - Detected below the Reporting Limit (RL)
DF - Dilution Factor
RL - Reporting Limit

Page 9 of 19
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** Diggings EAST TO-19  
**Work Order:** 1308116  
**BatchID:** 7118  

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| Sample ID: 7118-PB  
Mercury | ND | 0.100 | mg/Kg | | | | | | | |
| Method: SW7471 | Batch ID: 7118 | Analysis Date: 9/4/2013 2:24:00 PM |
| Sample ID: LCS-7118  
Mercury | 17.2 | 1.18 | mg/Kg | 21.70 | 79.4 | 80 | 120 | | S* |
| Method: SW7471 | Batch ID: 7118 | Analysis Date: 9/4/2013 2:24:00 PM |
| Sample ID: 1308116-001A-MSD  
Mercury | 20.3 | 1.52 | mg/Kg-dry | 27.94 | 69.2 | 75 | 125 | 17.9 | 35 | S*H2 |
| Method: SW7471 | Batch ID: 7118 | Analysis Date: 9/4/2013 2:24:00 PM |
| Sample ID: 1308116-001A-MS  
Mercury | 24.3 | 1.55 | mg/Kg-dry | 27.94 | 83.5 | 75 | 125 | | H2 |

---

**Qualifiers:**  
NA Sample conc. Is > 4*spike level  
S* Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** Diggings East To-19  
**Work Order:** 1308116  
**Batch ID:** 7128  
**Date:** 07-Oct-13  
**Report Date:** 30-Sep-13

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**Qualifiers:**  
NA: Sample conc. is > 4*spike level  
S*: Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** Diggings East To-19

### Analyte Results

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**Qualifiers:**  
- NA  
- Sample conc. Is > 4*spike level  
- S* Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Work Order:** 1308116  
**Batch ID:** 7132  

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<th>High Limit</th>
<th>RPD</th>
<th>RPD Limit</th>
<th>Qualifier</th>
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| **Sample ID: 7132-PB**  
Mercury | ND | 0.100 | mg/Kg | | | | | | | |
| **Sample ID: LCS-7132**  
Mercury | 12.4 | 1.22 | mg/Kg | 21.70 | 57.3 | 80 | 120 | | S* |
| **Sample ID: 1308116-061A-MS**  
Mercury | 27.6 | 2.01 | mg/Kg-dry | 37.88 | 69.4 | 75 | 125 | | S*H2 |
| **Sample ID: 1308116-061A-MSD**  
Mercury | 21.0 | 2.08 | mg/Kg-dry | 37.88 | 52.1 | 75 | 125 | 28.9 | 35 | S*H2 |

**Qualifiers:**  
NA  Sample conc. Is > 4*spike level  
S*  Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
# QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19

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Mercury       | ND     | 0.100 | mg/Kg  | 1.00      |       |           |            |     |           |           |
| Method: SW7471  
Batch ID: 7147 | Analysis Date: 9/11/2013 10:11:00 AM |
| Sample ID: LCS-7147  
Mercury       | 19.6   | 1.17  | mg/Kg  | 2.00      |       | 80        | 120        |     |           |           |
| Method: SW7471  
Batch ID: 7147 | Analysis Date: 9/11/2013 10:11:00 AM |
| Sample ID: 1308116-081A-MS  
Mercury       | 22.0   | 1.53  | mg/Kg-dry | 2.00     |       | 75        | 125        |     | H2        |           |
| Method: SW7471  
Batch ID: 7147 | Analysis Date: 9/11/2013 10:11:00 AM |
| Sample ID: 1308116-081A-MSD  
Mercury       | 22.5   | 1.52  | mg/Kg-dry | 2.00     |       | 75        | 125        |     | 2.34 35 H2 |           |

**Qualifiers:**  
NA  
Sample conc. Is > 4x spike level  
S* Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Work Order:** 1308116  
**Batch ID:** 7156  
**Date:** 07-Oct-13  
**Report Date:** 30-Sep-13

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**Qualifiers:**  
- NA  
- Sample conc. Is > 4* spike level  
- Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Work Order:** 1308116  
**BatchID:** 7162

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**Qualifiers:**  
NA  
Sample conc. is > 4*spike level  
8' Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Work Order:** 1308116  
**BatchID:** 7207

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| **Sample ID: 7207-PB**  
Mercury | ND     | 0.100 | mg/Kg     |       | 21.70     | 81.3       | 80  | 120       |           |
|         |        |       |           |       |           |            |     |           | Analysis Date: 9/23/2013 2:10:00 PM |
| **Sample ID: LCS-T207**  
Mercury | 17.6   | 1.25  | mg/Kg     | 21.70 | 81.3      | 80         | 120 |           |           |
|         |        |       |           |       |           |            |     |           | Analysis Date: 9/23/2013 2:10:00 PM |
| **Sample ID: 1308116-141A-MS**  
Mercury | 21.1   | 1.46  | mg/Kg-dry | 27.35 | 76.8      | 75         | 125 | H2        |           |
|         |        |       |           |       |           |            |     |           | Analysis Date: 9/23/2013 2:10:00 PM |
| **Sample ID: 1308116-141A-MSD**  
Mercury | 21.9   | 1.49  | mg/Kg-dry | 27.35 | 79.6      | 75         | 125 | 3.65      | 35        | H2        |
|         |        |       |           |       |           |            |     |           | Analysis Date: 9/23/2013 2:10:00 PM |

**Qualifiers:**  
- NA: Sample conc. is > 4*spike level  
- S*: Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
## QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** Diggings East To-19  
**Work Order:** 1308116  
**Batch ID:** 7211

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Mercury | ND     | 0.100 | mg/Kg |           |       |           |           |     |           |           |
| **Sample ID: LCS-7211**  
Mercury | 16.6   | 1.23  | mg/Kg | 21.70     | 76.5  | 80        | 120       |     | S*        |           |
| **Sample ID: 1308116-161A-MS**  
Mercury | 24.9   | 1.72  | mg/Kg-dry | 29.91 | 80.4  | 75        | 125       |     | H2        |           |
| **Sample ID: 1308116-161A-MSD**  
Mercury | 28.8   | 1.70  | mg/Kg-dry | 29.91 | 93.5  | 75        | 125       |     | 14.6      | 35        | H2        |

**Qualifiers:**  
NA: Sample conc. is > 4*spike level  
S*: Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
# QA/QC SUMMARY REPORT

**Client:** Montana Bureau of Mines & Geology  
**Project:** DIGGINGS EAST TO-19  
**Work Order:** 1308116  
**BatchID:** 7212  
**Date:** 07-Oct-13  
**Report Date:** 30-Sep-13

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**Qualifiers:**  
NA  Sample conc. is > 4*spike level  
S*  Spike Recovery outside limits; Manufacturer limits for mercury 11.2 - 32.3 mg/kg
# Chain of Custody

**Company Name:** MBMG  
**Address:** 1300 West Park St., Butte, MT 59701  
**Phone:** 406-496-4795  
**Fax:** 406-496-4451

**Project Manager:** Nicholas Tucci  
**Email Address:** NTucci@mttech.edu  
**Project Name and Number:** Diggs MSE EAST To-19

**Sample ID** | **LAB ID** | **DATE** | **TIME** | **Remarks**
--- | --- | --- | --- | ---
TP-IE 0-6.7 | 001A | 5/24/13 | |  
TP-IE 6.2-2.9 | 002A | 5/24/13 | |  
TP-IE 8.0+ | 003A | 5/24/13 | |  
TP-IE 6.3-8.65 | 004A | 5/29/13 | |  
TP-IE 8.9-10.0 | 005A | 5/29/13 | |  
TP-IE > 10.9 | 006A | 5/29/13 | |  
MBMG. DUP 10 | 007A | 8/21/13 | |  
MBMG. DUP 9 | 008A | 8/21/13 | |  
MBMG. DUP 8 | 009A | 8/21/13 | |  
MBMG. DUP 7 | 010A | 8/21/13 | |  
MBMG. DUP 6 | 011A | 8/21/13 | |  
MBMG. DUP 5 | 012A | 8/21/13 | |  

**Relinquished By (Signature):**  
**Date & Time:** 8/24/13 16:45  
**Received By (Signature):** Sara Ward  
**Date & Time:** 8/21/13 16:45

**Remarks:**  
- All rush order requests must have prior approval

**Inspection Checklist:**  
- Received Intact? Y N  
- Labels & Chains Agree? Y N  
- Containers Sealed? Y N  
- Cooler Sealed? Y N  
- Delivery Method: 
  - hld in sealed cooler
  - Several samples collected to interred client of 28 day H7803

**Date & Time:** __________________

**Inspected By:** __________________

---

**MSE Laboratory Services**  
200 Technology Way, P.O. Box 4078  
Butte, MT 59701  
PH: (406) 494-7334 / FAX: (406) 494-7128  
labinfo@mse-ta.com
## CHAIN OF CUSTODY

### COMPANY INFORMATION
- **Company Name:** MBMG
- **Project Manager:** Nicholas Tucci

### ADDRESS AND CONTACT INFORMATION
- **Address:** NRB 130 West Park St.
- **City:** Butte, MT 59701
- **Phone:** 406-496-4795
- **Fax:** 406-496-4451

### SAMPLE TABLE

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### REMARKS
- **Turnaround Time (TAT) / Reporting**
  - Standard
  - Next Day*
  - 2nd Day*
  - Other*

### Inspection Checklist
- **Received Intact?** Y N
- **Labels & Chains Agree?** Y N
- **Containers Sealed?** Y N
- **Cooler Sealed?** Y N

### Laboratory Services Information
- **MSE LABORATORY SERVICES**
  - 200 Technology Way, P.O. Box 4078
  - Butte, MT 59701
  - PH: (406) 494-7334 / FAX: (406) 494-7128
  - labinfo@mse-la.com
# CHAIN OF CUSTODY

**MSE Technology Applications, Inc.**
**Laboratory Services**

**Company Name:** m8mg

**Address:** 1300 West Park St
**City:** Butte
**State:** MT
**Zip:** 59701

**Phone:** 406-496-4795
**Fax:** 406-496-4451

**Project Manager:** Nicholas Tucci

**Project Name and Number:** Digging's East To-19

**Email Address:** NTucci@mitech.edu

**Turnaround Time (TAT) / Reporting**
- [ ] Standard
- [ ] Next Day*
- [ ] 2nd Day*
- [ ] Other*

**Remarks**
- [ ] All rush order requests must have prior approval

**ANALYSIS REQUESTED**

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**PRINTED NAME:**

**Company:**

**Printed Name:**

**Company:**

**Received By (Signature):**

**DATE:** 8/2/1145
**TIME:** 16:45

**PRINTED NAME:**

**Company:**

**Printed Name:**

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**PRINTED NAME:**

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**Printed Name:**

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**PRINTED NAME:**

**Company:**

**Printed Name:**

**Company:**
**CHAIN OF CUSTODY**

**MSE Technology Applications, Inc.**
Laboratory Services

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<tr>
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<td>Fax:</td>
<td>406-496-4451</td>
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**Project Manager:** Nicholas Tucci

**Project Name and Number:** Digging East To 19

**Email Address:** NTucci@MTtech.edu

**Purchase Order #:**

**Sample Name and Phone #:**

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**REMARKS**

**Turnaround Time (TAT) / Reporting**

- [ ] Standard
- [ ] Next Day* 
- [ ] 2nd Day* 
- [ ] Other* 
- [ ] All rush order requests must have prior approval

**Inspection Checklist**

- [ ] Received Intact?
- [ ] Labels & Chains Agree?
- [ ] Containers Sealed?
- [ ] Cooler Sealed?
- [ ] Delivery Method:
- [ ] Temperature (°C):
- [ ] Preservative:
- [ ] Date & Time:
- [ ] Inspected By:

**MSE LABORATORY SERVICES**
200 Technology Way, P.O. Box 4078
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7126
labinfo@mse-ta.com
## CHAIN OF CUSTODY

**Company Name:** M&MG  
**Project Manager:** Nicholas Tucci  
**Address:** NRB 1300 West Park St.  
**City:** Butte, MT  
**State:** MT  
**Zip:** 59701  
**Phone:** 406-496-4795  
**Fax:** 406-496-4451

### ANALYSIS REQUESTED

**Project Name and Number:** Deppas East Tc-19

### REMARKS

**Turnaround Time (TAT) / Reporting**

- Standard
- Next Day*
- 2nd Day*
- Other*

**All rush order requests must have prior approval**

### SAMPLE ID

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### Inspection Checklist

- Received Intact? Y N
- Labels & Chains Agree? Y N
- Containers Sealed? Y N
- Cooler Sealed? Y N

**Delivery Method:**

**Temperature (°C):**

**Preservative:**

**Date & Time:**

**Inspected By:**

---

**MSE LABORATORY SERVICES**  
200 Technology Way, P.O. Box 4078  
Butte, MT 59701  
PH: (406) 494-7334 / FAX: (406) 494-7128  
labinfo@mse-ta.com
**CHAIN OF CUSTODY**

**Company Name:** MBMG  
**Address:** 1300 West Park St  
**City:** Butte  
**State:** MT  
**Zip:** 59701  
**Phone:** 406-496-4795  
**Fax:** 406-496-4451  

**Project Manager:** Nicholas Tucci  
**Project Name and Number:** Diggs, East To-19  
**Email Address:** n.tucci.mrceh.edu  
**Purchase Order #:**  

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**Relinquished By (Signature):**  
**Printed Name:** Nick Tucci  
**Date:** 8/21/13  
**Time:** 16:35  
**Received By (Signature):** David Ward  
**Date:** 8/21/13  
**Time:** 16:45  
**Printed Name:** Sara Ward  
**Company:** MSE TA  

**Relinquished By (Signature):**  
**Printed Name:** Sara Ward  
**Company:** MSE TA  

**Remarks:**  
- Turnaround Time (TAT) / Reporting:  
  - **Standard**  
  - **Next Day**  
  - **2nd Day**  
  - **Other**  
  - *All rush order requests must have prior approval*  
  - **Phone**  
  - **Mail**  
  - **Fax**  
  - **Email**

**Inspection Checklist:**  
- Received Intact? Y N  
- Labels & Chains Agree? Y N  
- Containers Sealed? Y N  
- Cooler Sealed? Y N  
- Delivery Method:  
- Temperature (°C):  
- Preservative:  
- Date & Time:  
- Inspected By:  
  **MSE LABORATORY SERVICES**  
  **200 Technology Way, P.O. Box 4078**  
  **Butte, MT 59701**  
  **PH: (406) 494-7334 / FAX: (406) 494-7128**  
  **labinfo@mse-ls.com**
# CHAIN OF CUSTODY

**Company Name:** MBBMG  
**Address:** 300 West Park St.  
**City:** Butte  
**State:** MT  
**Zip:** 59701-8997  
**Phone:** 406-496-4795  
**Fax:** 406-496-4451  
**Project Manager:** Nicholas Tucci  
**Project Name and Number:** Diggs East PED  
**Email Address:** NTucci@mttech.edu  
**Purchase Order #:**  
**Sampler Name and Phone #:** 406-496-4795  

## ANALYSIS REQUESTED

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## REMARKS

- **Turnaround Time (TAT) / Reporting:**  
  - Standard  
  - Next Day*  
  - 2nd Day*  
  - Other*  
  - *All rush order requests must have prior approval  

## Inspection Checklist

- **Received Intact?** Y N  
- **Labels & Chains Agree?** Y N  
- **Containers Sealed?** Y N  
- **Cooler Sealed?** Y N  

## Delivery Method:

- [ ]  

## Temperature (°C):

- [ ]  

## Preservative:

- [ ]  

## Date & Time:

- [ ]  

## Inspected By:

- [ ]  

**MSE LABORATORY SERVICES**  
200 Technology Way, P.O. Box 4078  
Butte, MT 59701  
PH: (406) 494-7334 / FAX: (406) 494-7128  
labinfo@mse-ta.com
# Chain of Custody

**MSE Technology Applications, Inc.**

**Laboratory Services**

**Project Manager:** Nicholas Tucci

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**Address:**

NRB 1300 West Park St.

**City:** Butte

**State:** MT

**Zip:** 59701-8997

**Phone:** 406-496-4795

**Fax:** 406-496-4451

**Email Address:** Tucci.n@tech.edu

**Purchase Order #:**

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**RECEIVED BY (Signature):**

**Diana Ward**

**DATE:** 8/21/13

**TIME:** 16:45

**RECEIVED BY (Signature):**

**Jared Ward**

**DATE:** 8/21/13

**TIME:** 16:45

**RECEIVED BY (Signature):**

**Jared Ward**

**DATE:** 8/21/13

**TIME:** 16:45

**Delivery Method:**

**Temperature (°C):**

**Preservative:**

**Date & Time:**

**Inspected By:**

---

MSE LABORATORY SERVICES
200 Technology Way, P.O. Box 4078
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7128
labinfo@mse-la.com
# CHAIN OF CUSTODY

**Company Name:** MAME

**Address:** 1300 West Park St -

**City:** Butte  MT  59701 - 8997

**Phone:** 406-496-4795

**Fax:** 406-496-4451

**Project Manager:** Nicholas Tucci

**Project Name and Number:** Diglams East (PI)

**Email Address:** NTucci@mtech.edu

**Purchase Order #:**

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Trench Y 5.5 | 099A | 5/28/13 | | 
Trench Y 6.0 | 100A | 5/28/13 | | 
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T1 - Trench 1 - 3005 8.5+ | 104A | 5/28/13 | | 
T1 - Trench 1 - 1005 65-75 | 105A | 5/28/13 | | 
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T1 - Trench 1 - 1005 89-9.9 | 107A | 5/28/13 | | 
T1 - Trench 1 - 2W 7.2-9.4 | 108A | 5/28/13 | | 

**RELINQUISHED BY (Signature):**

**PRINTED NAME:** Nicholas Tucci

**RELINQUISHED DATE:** 5/28/13

**RECEIVED BY (Signature):** Sara Ward

**DATE:** 8/21/13

**TIME:** 10:45

**RELINQUISHED BY (Signature):**

**PRINTED NAME:** Sara Ward

**COMPANY:** MSE TA

**DATE:**

**TIME:**

**RELINQUISHED BY (Signature):**

**PRINTED NAME:**

**COMPANY:**

**DATE:**

**TIME:**

**RELINQUISHED BY (Signature):**

**PRINTED NAME:**

**COMPANY:**

**DATE:**

**TIME:**

**RELINQUISHED BY (Signature):**

**PRINTED NAME:**

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**DATE:**

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**PRINTED NAME:**

**COMPANY:**

**DATE:**

**TIME:**

**RELINQUISHED BY (Signature):**

**PRINTED NAME:**

**COMPANY:**

**_DATE & TIME:**

**Inspected By:**

MSE LABORATORY SERVICES
200 Technology Way, P.O. Box 4978
Butte, MT 59701

PH: (406) 494-7334 / FAX: (406) 494-7128
labinfo@mse-ta.com
# Chain of Custody

**Company Name:** MBE MG

**Address:** NRB 1360 West Park St

**City:** Butte

**State:** MT

**Zip:** 59701-8997

**Phone:** 406-496-4795

**Fax:** 406-496-4451

**Project Manager:** Nicholas Tucci

**Project Name and Number:** DigaJet East P5D

**Email Address:** NTucci@mtech.edu

**Purchase Order #:**

## Analysis Requested

### Turnaround Time (TAT) / Reporting

- Standard
- Next Day*
- 2nd Day*
- Other*

### Remarks
- *All rush order requests must have prior approval

## Sample ID

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**Inspection Checklist**

- Received Intact? Y N
- Labels & Chains Agree? Y N
- Containers Sealed? Y N
- Cooler Sealed? Y N

**Delivery Method:**

**Temperature (°C):**

**Preservative:**

**Date & Time:**

**MSE Laboratory Services**

200 Technology Way, P.O. Box 4078
Butte, MT 59701

PH: (406) 494-7334 / FAX: (406) 494-7128

labinfo@mse-ta.com
# CHAIN OF CUSTODY

**MSE Technology Applications, Inc.**

**Laboratory Services**

**Company Name:** MBRG

**Project Manager:** Nicholas Tucci

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**Address:** NRB 1300 West Park St.

**City:** Butte

**State:** MT

**Zip:** 59701-8997

**Phone:** 406-496-4795

**Fax:** 406-496-4451

**Email:** NTucci@mtech.edu

**Purchase Order #:**

---

**ANALYSIS REQUESTED**

**REMARKS**

- **Turnaround Time (TAT) / Reporting**
  - Standard
  - Next Day*
  - 2nd Day*
  - Other*

  *All rush order requests must have prior approval

---

**Inspection Checklist**

- Received Intact? Y N
- Labels & Chains Agree? Y N
- Containers Sealed? Y N
- Cooler Sealed? Y N

**Delivery Method:**

**Temperature (°C):**

**Preservative:**

**Date & Time:**

**Inspected By:**

---

MSE LABORATORY SERVICES
200 Technology Way, P.O. Box 4078
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7128
labinfo@mse-ta.com
# CHAIN OF CUSTODY

**Company Name:** MB MG

**Address:** NRB 1300 West Park St.

**City:** Butte

**State:** MT

**Zip:** 59701-8997

**Phone:** 406-496-4795

**Fax:** 406-496-4451

**Project Manager:** Nicholas Tucci

**Project Name and Number:** Diagnos East D55

**Email Address:** n.tucci@emtech.edu

**Purchase Order #:**

**Sampler Name and Phone #:**

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**Turnaround Time (TAT) / Reporting**

- Standard
- Next Day*
- 2nd Day*
- Other*

**All rush order requests must have prior approval**

**Phone**

**Mail**

**Fax**

**Email**

### Inspection Checklist

- Received Intact? Y N
- Labels & Chains Agree? Y N
- Containers Sealed? Y N
- Cooler Sealed? Y N
- Delivery Method:
- Temperature (°C):
- Preservative:
- Date & Time:
- Inspected By:

**MSE LABORATORY SERVICES**
200 Technology Way, P.O. Box 4076
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7128
labinfo@mse-ta.com
**CHAIN OF CUSTODY**

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**REMARKS**

- Turnaround Time (TAT) / Reporting:
  - Standard
  - Next Day*
  - 2nd Day*
  - Other*
  - *All rush order requests must have prior approval

**Inspection Checklist**

- Received Intact?: Y N
- Labels & Chains Agree?: Y N
- Containers Sealed?: Y N
- Cooler Sealed?: Y N

**Delivery Method:**

- Temperature (°C): __________

- Preservative: __________

- Date & Time: __________

**Inspected By:** __________
**CHAIN OF CUSTODY**

**Company Name:** MBMG

**Address:** NRB 1300 West Park St.

**City:** Butte, MT 59701-8997

**Phone:** 406-496-4795

**Fax:** 406-496-4451

**Project Manager:** Nicholas Tucci

**Project Name and Number:** Digimms East PED

**Email Address:** ntucci@mttech.edu

**Purchase Order #:**

**Sampler Name and Phone #:**

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**Analysis Requested:**

**Remarks:**

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*All rush order requests must have prior approval*

**Inspection Checklist**

- Received Intact? Y N
- Labels & Chains Agree? Y N
- Containers Sealed? Y N
- Cooler Sealed? Y N
- Delivery Method: 
- Temperature (°C): 
- Preservative: 
- Date & Time: 
- Inspected By: 

MSE LABORATORY SERVICES
200 Technology Way, P.O. Box 4078
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7128
labinfo@mse-la.com
## CHAIN OF CUSTODY

**Company Name:** MBMG  
**Project Manager:** Nicholas Tucci  
**Address:** NRB 1200 West Park St.  
**City:** Butte  
**State:** MT  
**Zip:** 59701-8997  
**Phone:** 406-496-4795  
**Fax:** 406-496-4451  
**Project Name and Number:** Diggs East PID  
**Email Address:** n.tucci@mttech.edu  
**Purchase Order #:**  
**Sampler Name and Phone #:**  

### SAMPLE ID | LAB ID | DATE | TIME | ANALYSIS REQUESTED |
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**Turnaround Time (TAT) / Reporting**  
- **Standard**  
- **Next Day**  
- **2nd Day**  
- **Other**  

**Remarks**  
- All rush order requests must have prior approval  
- Phone, Mail, Fax, Email  

### Inspection Checklist

- **Received Intact?**  
  - Y  
  - N  
- **Labels & Chains Agree?**  
  - Y  
  - N  
- **Containers Sealed?**  
  - Y  
  - N  
- **Cooler Sealed?**  
  - Y  
  - N  
- **Delivery Method:**  
- **Temperature (°C):**  
- **Preservative:**  
- **Date & Time:**  
- **Inspected By:**

---

**MSE LABORATORY SERVICES**  
200 Technology Way, P.O. Box 4078  
Butte, MT 59701  
PH: (406) 494-7334 / FAX: (406) 494-7128  
labinfo@mse-ta.com
**CHAIN OF CUSTODY**

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**REMARKS**

- **Standard**
- **Next Day**
- **2nd Day**
- **Other**

- *All rush order requests must have prior approval*

- **Phone**
- **Mail**
- **Fax**
- **Email**

**Analyzed by:** Sarah Ward

**Date & Time:** 8/24/13 11:45

**Temperature (°C):**

- **Preservative:**

**Received Intact?** Y N

**Labels & Chains Agree?** Y N

**Containers Sealed?** Y N

**Cooler Sealed?** Y N

**Date & Time:**

**Inspected By:**
# Chain of Custody

**Company Name:** MBMG  
**Project Manager:** Nicholas Tucci

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**Bem 3 0-9**  
**Bem 3 1-6-19**  
**TP-N5 01E**

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**Analysis Requested:** Mercury

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**Remarks:**
- **Turnaround Time (TAT) / Reporting**
  - Standard
  - Next Day
  - 2nd Day

**Inspection Checklist**

- Received Intact?  
  - Y  
  - N
- Labels & Chains Agree?  
  - Y  
  - N
- Containers Sealed?  
  - Y  
  - N
- Cooler Sealed?  
  - Y  
  - N
- Delivery Method:  
  - ____________  
- Temperature (°C):  
  - ____________  
- Preservative: ____________  
- Inspected By: ____________

---

**MSE TECHNOLOGY APPLICATIONS, INC.**
**LABORATORY SERVICES**
200 Technology Way, P.O. Box 4078
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7128
labinfo@mse-ta.com
Sample Receipt Checklist

Client Name: MBMG
Work Order Number: 1308116
RcptNo: 1
Date and Time Received: 8/21/2013 4:45:00 PM
Received by: mw

COC_ID: 1308116
CoolerID:
Checklist completed by:
Signature: [Signature]
Date: 8/21/13
Reviewed by: [Signature] Date: 8/21/2013

Matrix: Carrier name Hand-Delivered

Shipping container/cooler in good condition? Yes ☑ No ☐ Not Present ☐
Custody seals intact on shipping container/cooler? Yes ☐ No ☑ Not Present ☑
Custody seals intact on sample bottles? Yes ☐ No ☑ Not Present ☑
Chain of custody present? Yes ☑ No ☐
Chain of custody signed when relinquished and received? Yes ☑ No ☐
Chain of custody agrees with sample labels? Yes ☑ No ☐
Samples in proper container/bottle? Yes ☑ No ☐
Sample containers intact? Yes ☑ No ☐
Sufficient sample volume for indicated test? Yes ☑ No ☐
All samples received within holding time? Yes ☑ No ☐
Container.Temp Blank temperature in compliance? Yes ☑ No ☐
Water - VOA vials have zero headspace? No VOA vials submitted ☑ Yes ☐ No ☐
Water - pH acceptable upon receipt? Yes ☑ No ☐ Blank ☐

Adjusted? No ☐ Checked by: [Signature] 8/21/13

Any No and/or NA (not applicable) response must be detailed in the comments section below:

Client contacted: Yes ☑
Date contacted: 8/21/13
Person contacted: N. Tucci

Contacted by: S. Ward
Regarding: sample ID discrepancies

Comments: H/D TEMP=NA SOIL, SAMPLE019 STATES TP-2Y 4.0 ON THE COC AND TP-2E 4.0 ON THE BAG. SAMPLE058 HAS TP-15 W 6.2-7.5 ON THE BAG AND THE COC STATES TP-15W 6.2-10. SAMPLE102 STATES TP3 TRENCH1 3005 7.6-5.3 ON THE BAG AND THE COC STATES TP1 TRENCH1 3005-7.6-5.3 SAMPLE106 STSTEPT-3 TRENCH 1 3005 8.6 ON THE BAG AND COC STATES TP1-TRENCH1 3005 7.5-9.5 SAMPLE180 STATES BERM2 ON COC AND BERM 2 0.7-2.35 ON THE BAG, SAMPLE 195 STATES TP-NS-01 E ON THE COC AND THE BAG STATES TP-NS-01 E 0.75-3.3. ANY SAMPLES COLLECTED BEFORE JULY 30 ARE PASSED THE HOLDING TIME. A client was made aware of holding time @ sample delivery.

Corrective Action: [Handwritten: Adjusted for holding time @ sample delivery]
APPENDIX E  PID METER READINGS
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