APPENDIX E

CORRECTIVE ACTION FORMS AND DEVIATIONS FROM THE WORK PLAN

APPENDIX E-1

CORRECTIVE ACTION FORMS

CORRECTIVE ACTION RECORD

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Audit Report No. : 01 Date: September 7, 2017

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

We've determined that a bulk density measurement from an unconsolidated IC sample will not be a value that is meaningful for amendment application. In addition to the 0-3" bulk density sample, we would like to collect deeper in situ bulk density samples. We would collect in situ bulk density samples from each test pit area from 0-3" and 6-9".

Date and Time Problem Recognized: 8/30/17 12:20pm By: Amy Kephart

Date of Actual Occurrence: Not Applicable- no samples collected By: Not Applicable

Analyte: Bulk Density Analytical Method: ASTM E1109

Cause of Problem:

This method is not appropriate for site soils.

CORRECTIVE ACTION PLANNED:

We propose to change the 0-3" bulk density IC sample to an in situ discrete sample. This will meet data quality objectives and provide data that can be used for determining future amendment applications. In situ bulk density will no longer be ASTM E1109. It will be ASTM D 7263. HWA Geosciences Inc. will analyze the samples.

Person Responsible for Corrective Action: Amy Kephart

Date of Corrective Action: September 2017

Corrective Action Plan Approval: Amy J Kephart Date: 9/8/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Distribute corrective action form to laboratory.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity: 9/8/17

Final Corrective Action Approval: Amy J Kephart Date: 9/8/17

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Audit Report No. : 02 Date: September 7, 2017

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

The lab method specified for in-situ permeability in the work plan (ASTM D5084 - 16a) is not appropriate for the soil types at the site.

Date and Time Problem Recognized: 9/6/17 4:11pm By: Rebecca Andresen

Date of Actual Occurrence: Not Applicable- no samples collected By: Not Applicable

Analyte: In Situ permeability Analytical Method: ASTM D5084-16a

Cause of Problem:

This method is not appropriate for site soils.

CORRECTIVE ACTION PLANNED:

In situ permeability will no longer be analyzed using ASTM D5084 - 16a.
It will be analyzed using ASTM D2434.

Person Responsible for Corrective Action: Amy Kephart

Date of Corrective Action: September 2017

Corrective Action Plan Approval: Amy J Kephart Date: 9/8/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Distribute corrective action form to laboratory.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity: 9/8/17

Final Corrective Action Approval: Amy J Kephart Date: 9/8/17

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Audit Report No. : 03 Date: September 8, 2017

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

Commercial carrier lost one of the sample coolers because the airbill was attached to the cooler handle, which detached from the cooler during shipping. Samples arrived at the lab at a temperature greater than 4 degrees Celsius.

Date and Time Problem Recognized: 8/22/17 By: Arcadis Field Staff

Date of Actual Occurrence: 8/22/17 By: Commercial Shipping Carrier

Analyte: Initial screening samples-total As & Pb Analytical Method: USEPA 6010

Cause of Problem:

Airbill was separated from the cooler and only cooler handle was initially delivered to the lab.

CORRECTIVE ACTION PLANNED:

Cooler was located and arrived at the lab. Samples were intact but warm.
Update Shipping procedure in SOP-10: Sample Storage Packing and Shipping (Page 4). No longer put airbill on cooler handle.
"Fill out the airbill as required and firmly affix it to one side of the cooler within a clear adhesive-backed envelope provided by the shipper. Secure with extra tape if needed, ensuring that the tape does not obscure shipping or tracking information. Do not attach the air bill or tracking documentation to cooler handles or in any other manner that could result in the document detaching from the cooler during transport."

Person Responsible for Corrective Action: Rebecca Andresen/Amy Kephart

Date of Corrective Action: September 2017

Corrective Action Plan Approval: Amy J Kephart Date: 9/8/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Distribute appropriate information including the corrective action form to field team, laboratory, and SATES Technical team.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity: 9/8/17

Final Corrective Action Approval: Amy J Kephart Date: 9/8/17

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Audit Report No. : 04 Date: September 8, 2017

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

Based on calculations with soil weights obtained during Phase IA, two 3" diameter sample pushes will need to be collected at each of the 30 increment locations at each sub-plot to ensure we collect sufficient sample volume for the planned analyses. Additional clarification is also needed on collection of triplicates given that two pushes are now needed at each IC sample location.

Date and Time Problem Recognized: 8/28/17 By: Amy Kephart

Date of Actual Occurrence: Not Applicable- no samples collected By: N/A

Analyte: All IC samples Analytical Method: All IC samples

Cause of Problem:

The sample masses that were measured in the field during Phase IA are less than anticipated.

CORRECTIVE ACTION PLANNED:

When collecting the two pushes at an increment location, both pushes should be collected as close as possible to the planned GIS sample location and adjacent to each another (ideally one collected parallel to the test plot baseline on the left and the right of the flag sample location). The procedure for triplicates will also be updated in Section 7.3.5 Incremental Composite Soil Samples and SOP-11 Incremental Composite Sample (ICS) Surface Sample Collection.

Person Responsible for Corrective Action: Amy Kephart

Date of Corrective Action: September 2017

Corrective Action Plan Approval: Amy J Kephart Date: 9/8/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Distribute appropriate information including the corrective action form to field team, laboratory, and SATES Technical team.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity: 9/8/17

Final Corrective Action Approval: Amy J Kephart Date: 9/8/17

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CORRECTIVE ACTION RECORD

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Audit Report No. : 05 Date: October 11, 2017

Report Originator: Julie Weicheld

Person Responsible for Response: Michael Raposo

DESCRIPTION OF THE PROBLEM:

The Work Plan specified a 3 inch diameter sampler would be used to collect IC soil samples. In the field, IC samples were collected using a 2 inch diameter tool rather than a 3 inch diameter tool. It was discovered there was an overestimation in the soil volume calculations, and that 2 pushes of a 2 inch sampler produces an adequate volume for sample analysis.

Date and Time Problem Recognized: 10/10/17 - 10/11/17 By: Michael Raposo, Amy Kephart (REH) and Arcadis Field Team

Date of Actual Occurrence: 10/10/17 - 10/11/17 By: Michael Raposo, Amy Kephart (REH) and Arcadis Field Team

Analyte: N/A Analytical Method: N/A

Cause of Problem:

Different sampler (2 inch diameter) used than specified in Work Plan (3 inch diameter).

CORRECTIVE ACTION PLANNED:

Two 2 inch diameter pushes will be collected instead of two 3 inch diameter pushes as originally planned. Because the soil volume needed is less than originally planned (3,500 grams vs 7,500 grams), the 2 inch diameter sampler will continue to be used.

Person Responsible for Corrective Action: Michael Raposo and Arcadis Field Team

Date of Corrective Action: 10/11/17

Corrective Action Plan Approval:  Date: 2/13/18

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

IC samples collected using two pushes of the 2 inch diameter sampler. Note: 3 pushes of the 2 inch sampler were performed at subplots 401-1A, 401-1 B, 401-1C, and the 401-1C dup.

Person Responsible for Follow-up Activities: Michael Raposo and Arcadis Field Team

Date of Follow-up Activity:

Final Corrective Action Approval:  Date: 2/13/18

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Audit Report No. : 06 Date: November 1, 2017

Report Originator: Julie Weicheld

Person Responsible for Response:

DESCRIPTION OF THE PROBLEM:

100 2-inch interval, discrete samples originally to be processed (dried and sieved) by ALS were inadvertently sent directly to OSU.

Date and Time Problem Recognized: 10/17/17 By: Shane Whitacre (OSU)

Date of Actual Occurrence: 10/16/2017 By: Arcadis Field Team

Analyte: N/A Analytical Method: N/A

Cause of Problem:

The field team inadvertently shipped the samples to OSU when they should have been sent to ALS for processing, according to the work plan flow-chart.

CORRECTIVE ACTION PLANNED:

OSU will retain the samples and perform the drying and sieving instead of ALS. They will perform the TAL metals analysis as intended, and ship excess sample volume to ALS for retention.

Person Responsible for Corrective Action: Shane Whitacre and Amy Kephart

Date of Corrective Action: 10/17/17

Corrective Action Plan Approval: Amy J Kephart Date: 10/17/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

See above for corrective action. Sample confirmation sent by OSU 10/18/2017.

Person Responsible for Follow-up Activities: Shane Whitacre

Date of Follow-up Activity:

Final Corrective Action Approval: Date: 02/15/18

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Audit Report No. : 07 Date: November 2, 2017

Report Originator: Julie Weicheld

Person Responsible for Response: Arcadis Field Team

DESCRIPTION OF THE PROBLEM:

The GPS units used in the field to record sample locations were not recording sample locations accurately.

Date and Time Problem Recognized: 10/12/17 By: Eric Epple (Arcadis)

Date of Actual Occurrence: Phase IA Part 1 Sampling Event and Phase IA Part 2 Sampling Event through 10/12/2017 By: Arcadis Field Team

Analyte: N/A Analytical Method: N/A

Cause of Problem:

Unable to get accurate GPS reading-likely due to remoteness of Site or GPS units.

CORRECTIVE ACTION PLANNED:

Sampling locations to be manually measured from the test plot corners installed in phase IA part 1.

Person Responsible for Corrective Action: Eric Epple and Amy Kephart

Date of Corrective Action: 10/12/17

Corrective Action Plan Approval: Amy J Kephart Date: 10/12/17

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Sampling locations manually measured as indicated above.

Person Responsible for Follow-up Activities: Eric Epple

Date of Follow-up Activity: 10/13/17

Final Corrective Action Approval: Date: 02/13/18

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Audit Report No. : 08 Date: November 2, 2017

Report Originator: Julie Weicheld

Person Responsible for Response: Mark Harris, Amy Kephart, Julie Weicheld

DESCRIPTION OF THE PROBLEM:

Following the lab coordination call on 9/18/2017, it was decided that ALS would process sulfides in-stead of OSU as specified in the work plan due to the short hold times (7 days) for sulfides. ALS performed sulfides analysis as planned, however for six samples hold times were still exceeded.

Date and Time Problem Recognized: 9/18/2017 and 10/19/2017 By: Mark Harris

Date of Actual Occurrence: 10/17/17 By: Mark Harris

Analyte: Sulfide Analytical Method: SM 4500-S2D

Cause of Problem:

Relatively short hold times unable to be met by labs.

CORRECTIVE ACTION PLANNED:

Sulfide samples were to be processed by ALS instead of OSU to meet hold times. Al-though ALS did perform the analysis, they still exceeded hold times for six samples. Samples exceeding hold times will be J flagged by data validator.

Person Responsible for Corrective Action: Mark Harris, Julie Weicheld

Date of Corrective Action: 10/19/17

Corrective Action Plan Approval: Julia J Weicheld Date: 2/9/18

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Once analytical data is received, data validation will flag samples exceeding hold times as estimated (J).

Person Responsible for Follow-up Activities: Julie Weicheld

Date of Follow-up Activity: 12/28/17

Final Corrective Action Approval: Julia J Weicheld Date: 2/9/18

CORRECTIVE ACTION RECORD

Audit Report No. : 09 Date: December 20, 2017

Report Originator: Julie Weicheld

Person Responsible for Response: Shane Whitacre, Amy Kephart, Julie Weicheld

DESCRIPTION OF THE PROBLEM:

Delayed processing of IC samples at ALS resulted in shipment of processed (homogenized and sieved) IC samples that had exceeded or were about to exceed sample hold times to Ohio State University (OSU) for analysis. Samples hold times were exceeded for IC samples.

Date and Time Problem Recognized: 11/14/17 By: Shane Whitacre

Date of Actual Occurrence: Variable By: Shane Whitacre

Analyte: Total TAL metals, electrical conductivity, chloride, and sulfate Analytical Method: EPA 6010, SM2510B, EPA 300.0

Cause of Problem:

Delayed IC sample processing and relatively short hold times unable to be met by labs.

CORRECTIVE ACTION PLANNED:

TAL metals can appropriately be held for up to 180 days per USEPA January 2010 National Functional Guidelines for Inorganic Superfund Data Review. In addition, because the samples were dried within 28 days (the holding time) of collection, the electrical conductivity, chloride, and sulfate content would be fixed upon drying, thus the data would not need to be discarded.

Person Responsible for Corrective Action: Shane Whitacre, Julie Weicheld

Date of Corrective Action: TBD

Corrective Action Plan Approval: Julia J Weicheld Date: 2/9/18

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Once analytical data is received, data validation may necessitate addition of a flag to samples exceeding hold times as estimated (J).

Person Responsible for Follow-up Activities: Julie Weicheld

Date of Follow-up Activity: TBD

Final Corrective Action Approval: Julia J Weicheld Date: 2/9/18

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Audit Report No. : 10 Date: January 23, 2018

Report Originator: Revathi Muralidharan

Person Responsible for Response: Shane Whitacre and Amy Kephart

DESCRIPTION OF THE PROBLEM:

The hold time for TAL Metals in water samples was inadvertently listed for soil TAL Metals analysis.

Date and Time Problem Recognized: email from Shane Whitacre on 11/14/17 at 4:05 PM By: Shane Whitacre

Date of Actual Occurrence: Upon sample receipt and logging at Ohio State University (OSU) By: N/A

Analyte: TAL Metals in Soil Analytical Method: USEPA 6010

Cause of Problem:

The Work Plan inadvertently included an overly conservative hold time of 28 days for metals in soil.

CORRECTIVE ACTION PLANNED:

In accordance with recommendations for analysis of metals in soils in the USEPA National Contract Laboratory Program's National Functional Guidelines, the hold times were updated to 180 days.

Person Responsible for Corrective Action: Shane Whitacre and Amy Kephart

Date of Corrective Action: 11/20/17

Corrective Action Plan Approval: Amy J Kephart Date: 01/23/18

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

The hold time for TAL metals was revised to 180 days.

Person Responsible for Follow-up Activities: Amy Kephart

Date of Follow-up Activity:

Final Corrective Action Approval: Amy J Kephart Date: 01/23/18

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Audit Report No. : 11 Date: 2/13/2018

Report Originator: Julie Weicheld

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

Test Plot 258-3 was inadvertently plotted as a non-square parallelogram with equal side lengths and parallel opposite sides during the Phase IA Part 1 (Test Plot Screening) field event, instead of as a square as indicated in the Work Plan.

Date and Time Problem Recognized: 8/31/17 By: Amy Kephart

Date of Actual Occurrence: 8/15/2017 By: Arcadis Field Team

Analyte: N/A Analytical Method: N/A

Cause of Problem:

Shifting of the test plot from the original location and lack of verification of test plot corner angles on the ground resulted in an altered test plot shape.

CORRECTIVE ACTION PLANNED:

The deviation from scope was discussed during a SATES stakeholder teleconference on 9/26/2017 regarding test plot selection rationale and discussion. Additionally, a figure illustrating the shifted parallelogram was distributed to the SATES team as part of the Work Plan addendum. Because the test plot had already been characterized, all subsequent sampling activities at 258-3 required a transposition.

Person Responsible for Corrective Action: Amy Kephart and Eric Epple

Date of Corrective Action: 10/3/2017, 10/7/2017, 10/13/2017, 10/17/2017

Corrective Action Plan Approval: Amy L Kephart Date: 2/23/2018

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Sampling activities conducted during Phase IA Part 2 were transposed as described in Section 3.1.1.3 of the Data Summary Report.

Person Responsible for Follow-up Activities: Amy Kephart and Eric Epple

Date of Follow-up Activity: 10/3/2017, 10/7/2017, 10/13/2017, 10/17/2017

Final Corrective Action Approval: Amy L Kephart Date: 2/23/2018

CORRECTIVE ACTION RECORD

Audit Report No. : 12 Date: February 22, 2018

Report Originator: Amy Kephart

Person Responsible for Response: Amy Kephart

DESCRIPTION OF THE PROBLEM:

Upon quality assurance and quality control review and data validation of the Phase IA Part 1 data, it was discovered that two samples had anomalously low total solids results. The parent sample for 401-2-J04-081717 had an anomalously low percent solids result of 62.3, but the duplicate sample (401-2-J04-081717-D) was reported within normal range at 96 percent. On the cooler receipt form, ALS noted that there was insufficient ice in the cooler these samples were shipped in, and the ice that had been included melted. After it was discovered that sample 401-2-J04-081717 may have been flooded during transport, all samples for Phase IA Part 1 with total solids results below 90 percent were reviewed by ALS laboratory staff on February 9, 2018. Sample jars with total solids results below 90 percent were photographed by ALS and reviewed by Ramboll. Upon visual inspection of the photographs, it was determined that sample 441-1-B01-082217, which had a total solids results of 61.8 percent, may also have been flooded during transport. The cooler receipt form from ALS did not include a note about insufficient or melted ice in the cooler.

Date and Time Problem Recognized: 9/15/17-initial inquiry Ramboll to ALS
2/2/18- follow-up query from Ramboll to ALS
By: Julie Weicheld

Date of Actual Occurrence: Approximately late August 2017 By: ALS

Analyte: Total arsenic and lead Analytical Method: USEPA 6010

Cause of Problem:

A review of sample packing methods with the field team revealed that there may have been some inconsistencies in how samples were packaged for shipping, of which some methods deviated from the method specified in SOP-10 of the Work Plan. Individual sample jars were not consistently shipped within an individual sealable plastic bag. Thus, the samples may have been exposed to water during shipment.

CORRECTIVE ACTION PLANNED:

In future sampling events, the field team will ensure that sufficient fresh ice will be included in each cooler shipment, as was conducted for the remainder of Phase IA Part 1 and in Part 2. The field team will also confirm that sample jars will be placed in individual sealable plastic bags and that jars and sample containers are inspected to ensure a tight seal prior to shipment. Arcadis has also updated the field-QC form for packing samples to make sure they are in in individual sealable plastic bags.

In addition, Ramboll will update SOP-10 language on page 3 under the heading “To prepare samples and coolers for shipping”. A new step 3 has been added, as shown below.

To prepare samples and coolers for shipping

1. Choose the appropriate size cooler(s) and make sure that the outside and inside of the cooler is clean of gross contamination. If the cooler has an external drain, the drain should be capped and thoroughly taped shut with duct tape to ensure no leakage will occur.
2. Use bubble wrap to line the cooler and place an opened large plastic bag (preferably a bag with a thickness of 3 mil) inside the cooler.
3. Store each sample container in an individual sealable plastic bag that allows the sample label to be read. Some samples (such as the IC sample buckets and Shelby tubes) can’t be placed completely within individual sealable plastic bags. These samples should be packaged in the cooler in a manner that prevents contact of the sample with ice melt water. Field staff should ensure that all samples are well sealed and that the samples are not packed in a manner that could result in the sample contacting

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ice meltwater in the cooler during transport.

4. Individually wrap each glass container (which has already been placed in an individual sealable plastic bag) in bubble wrap using either tape or a rubber band to hold the bubble wrap in place. Ensure IC sample bags are placed inside an additional sealable plastic bag. Place the wrapped samples into the large plastic bag in the cooler, leaving sufficient room for ice to keep the samples cold (i.e., 4±2°C).

The numbers on subsequent steps for preparing samples and coolers for shipping will also be adjusted to reflect addition of a new step 3.

Person Responsible for Corrective Action: Amy Kephart and Eric Epple

Date of Corrective Action: 2/20/18

Corrective Action Plan Approval: Amy J Kephart Date: 2/23/2018

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

The arsenic and lead results for sample 401-2-J04-081717 were within control limits. However, because of the possibility of sample flooding, the total solids, arsenic, and lead results for 401-2-J04-081717 were "R" qualified (unusable).

Arsenic and lead results for sample 441-1-B01-082217 were within control limits. All other samples appeared in good condition. Because of the possibility of flooding, the total solids, arsenic, and lead results for 441-1-B01-082217 were "R" qualified (unusable).

Person Responsible for Follow-up Activities: Julie Weicheld

Date of Follow-up Activity: Approximately February 2018

Final Corrective Action Approval: Julia J Weicheld Date: 2/23/2018

APPENDIX E-2

FIELD AND LABORATORY DEVIATIONS FROM WORK PLAN

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ENVIRONMENT
& HEALTH

MEMORANDUM

Client **Teck American Incorporated**
To **Dave Enos and Denise Mills**
From **Amy Kephart**
Copy to **Kris McCaig, Teck American Incorporated; Cristy Kessel, Teck American Incorporated; Mike Arnold, Ramboll; Rosalind Schoof, Ramboll**

Subject **Deviations from Final Work Plan for the Soil Amendment Technology Evaluation Study (SATES), Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation**

Date July 18, 2018

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1. Introduction

This memorandum describes deviations from the *Final Work Plan for the Soil Amendment Technology Evaluation Study (SATES), Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation* (hereinafter the Work Plan; Ramboll 2017a). Work Plan procedures were followed to the extent practicable during implementation of Phase IA Test Plot Selection and Characterization, which is comprised of two parts: Part 1 test plot screening and selection and Part 2 test plot baseline soil characterization. Modifications and deviations implemented during this work that had the potential to impact the ability to meet the DQOs for the SATES program were communicated with EPA for approval prior to implementation. Completed corrective action records are included in Appendix E-1.

The deviations are presented according to the stage during which they occurred (Part 1 or Part 2) and are further grouped according to whether the deviation was part of the field activities, laboratory activities, or data documentation procedure.

2. Phase IA Part 1: Test Plot Screening and Selection

2.1 Deviations from Planned Field Activities

- During the relocation and delineation of test plot 258-3, the test plot was inadvertently laid out as a non-square rhombus, with equal side lengths and parallel opposite sides (see Figure 3-5). The test plot location was adjusted in the field to more effectively incorporate areas that meet the initial test plot selection criteria (see Section 4.3.1.2 of the Work Plan). Specifically, test plot 258-3 was relocated to avoid incorporating large areas of heavy brush in order to minimize resource damage during sampling and treatment activities and to ensure reasonable access for personnel and equipment for each SATES phase of work at the test plot. A hand-held GPS unit was used to shift each of the predetermined locations

(already loaded onto the GPS) an approximate distance of approximately 55 feet. The corners were confirmed to be an approximate distance of 100-feet apart, but the angles between the side lines were mistakenly not confirmed when the adjustment was made. The altered shape of test plot 258-3 was discovered after discrete soil sampling was completed when the GPS coordinates of the surveyed test plot were plotted in geographic information system (GIS). Thus, test plot 258-3 could not be replotted. As a result, all subsequent sampling activities at this test plot (Phase IA Part 2) required a transposition (See Corrective Action Form 11, Appendix E-1).

- The individual discrete sample locations at each test plot were laid out in the field using measuring tapes instead of the GPS unit specified in the Work Plan. On the first test plot, each of the proposed discrete sample locations were marked at the centers of each of the 100 sampling grid squares using the hand-held GPS unit with preloaded spatial coordinates of the mid-points. Based on visual observations within the columns and rows, the field team, Ramboll, and TAI personnel observed inconsistencies with the linearity and spacing of sample locations. Issues with the GPS unit were due to poor satellite response in the area. The remote location and/or interference from the dense trees or hillsides prevented specific locations from being accurately and precisely located at the sub-meter precision as specified in the Work Plan. Arcadis, Ramboll, and TAI field personnel agreed that surveying the test plots by measuring multiple transects would produce an accurate orthogonal sampling regime. (see Corrective Action Form 07, Appendix E-1).
- The Standard Operating Procedure for Sample Storage, Packaging, and Shipping (SOP 10 in Appendix C of the Work Plan) was updated (see Corrective Action Form 03, Appendix E-1) and implemented during Phase IA Part 1 and 2 to specify that all shipping labels and airbills be firmly affixed directly to one side of the cooler within a clear adhesive-backed envelope provided by the shipper. The label was to be secured with extra tape if needed, ensuring that the tape did not obscure shipping or tracking information. The air bill or tracking documentation was not to be attached to cooler handles or in any other manner that could result in the document detaching from the cooler during transport. This modification resulted from a shipping incident in which a sample cooler was temporarily lost by the commercial shipping company due to the detachment of a cooler handle containing shipping information during transit. The cooler was retrieved and delivered to the respective laboratory; however, the delay in transit resulted in the sample arriving at a warmer temperature than the laboratory receiving threshold of 4-degrees Celsius (°C).
- A review of sample packing methods found that sample jars were not consistently packaged in individual sealable plastic bags before being placed into the coolers with wet ice. SOP 10 and the field QC form have since been updated for future sampling events to ensure that soil samples are placed and sealed in individual plastic bags prior to placing them in coolers for storage and shipping (See Corrective Action Form 12, Appendix E-1). The update was made to the section of the SOP which specifies the procedure for sample preparation for shipment. The SOP update states that each sample container will be placed in an individual sealable plastic bag that allows the sample label to be read. It also notes that some samples (such as the IC sample buckets and Shelby tubes) can't be placed completely within individual sealable plastic bags, so these samples should be packaged in the cooler in a manner that prevents contact of the sample with ice melt water. The SOP also states that field staff should ensure that all samples are well sealed and that the samples are not packed in a manner that could result in the sample contacting ice meltwater in the cooler during transport.

2.2 Deviations from Planned Laboratory Activities

- K1708845, K1708846, K1708847, K1708848, K1708849, K1708850, K1708851, K1708852, K1708945, K1708951, K1708957 were received outside of the temperature range specified in the Work Plan for inorganic analytes (4 ± 2°C). Although these samples were received out of the specified temperature range, this does not impact the results for lead and arsenic because these are not temperature-sensitive analytes in soils. The USEPA method used to detect lead and arsenic in soil, Method 6010C, does not reference a temperature requirement or note any interferences from temperature issues (USEPA 2007). Additionally, USEPA did not require refrigeration to 4 ± 2°C for transport or storage of residential soil samples collected in 2014 (SRC Inc. 2014) or 2016 (Ramboll 2016).

2.3 Deviations from Data Documentation Procedure

The following deviations from the Work Plan were noted in the field documentation:

- The make and model of the monitoring and screening equipment used is provided, but serial numbers are not provided in the field notes.
- There are several mistakes in the field notes and field forms that were not corrected properly (i.e., crossed out with a single line followed by the correction, the author's initials, and the date).

The following deviations were noted in the chain-of-custody documentation:

- In SDG K1708846, a sample ID did not match the COC. The sample ID on the bottle was 401-2-G02-081717, while the sample ID on the COC was 401-G02-0817-D. The sample ID on the COC was confirmed to be correct.
- In SDG K1708845, a sample ID did not match the COC. The sample ID on the bottle was 401-1-C1-081817, while the sample ID on the COC was 401-1-C01-081717. The sample ID on the COC was confirmed to be correct.
- On August 29, 2017, ALS received a revised COC from Arcadis for SDG K1708984. The COC sample IDs were revised to incorporate the addition of a D. The original sample IDs were 258-1-J01-082117 and 258-1-I07-082117, and the corrected sample IDs were 258-1-J01-082117-D and 258-1-I07-082117-D.
- In SDG K1708847, a sample ID and collection date did not match the COC. The sample ID and date on the jar were 401-2-J04-081617 and August 16, 2017, while the sample ID on the COC was 401-2-J04-081717. The sample ID and date on the COC was confirmed to be correct.

3. Phase IA Part 2: Baseline Soil Characterization

3.1 Deviations from Planned Field Activities

The following deviations from the Work Plan occurred during the test pit discrete sampling:

- To evaluate bulk density of the near surface soils from each test plot, the 0 to 3-inch (in.) IC sample was changed to an in situ discrete sample collected from 0 to 3-in. and 6 to 9-in. at the 16 sub-plots. The change was implemented because IC samples involve the aggregation of several discrete samples, which creates a mechanically-disturbed-unconsolidated sample that could potentially yield a compromised bulk density unrepresentative of the near surface soils. The in situ bulk density samples were analyzed by a local geotechnical lab, HWA Geosciences, Inc. The test method for in situ bulk density was changed from ASTM E1109 to ASTM D7263 (see Corrective Action Form 01, Appendix E-1).

- Sidewall duplicate samples collected from the 2 to 4-in. interval were not homogenized in the field. Initially, the field team collected the channelized samples side-by-side and jarred separately for submittal to the lab. The samples were transported to the field handling facility in Northport, Washington, at which time, it was determined that the samples needed to be homogenized before submitting to the laboratory. In accordance with the Work Plan, the field team homogenized the samples by combining the two samples into a Ziploc bag, mechanically mixing the soils, and splitting into two new jars for individual sample analysis[1].

The following deviations from the Work Plan occurred during the test plot incremental composite (IC) sampling:

- IC samples were collected using a 2-in. diameter soil punch rather than the 3-in. diameter tool specified in the Work Plan because the 2-in. diameter soil punch and associated samplers were already in possession of the field team.
- Based on initial calculations with soil weights obtained during Phase IA, two 3-in. diameter sample cores (pushes) needed to be collected at each of the 30 IC sample increment locations in each sub-plot to ensure sufficient sample mass for the planned analyses. Since 2-in. diameter samplers were used, it was calculated that three 2-in. diameter co-located samples would need to be collected. It was later determined that, the original calculations for required sample mass inadvertently retained additional mass for an analyte that had been removed from the analytical program, and that sufficient soil mass could be obtained with two pushes using the 2-in coring tool (see Corrective Action Forms 04 and 05, Appendix E-1).
- The geometry of duplicate and triplicate increment samples was altered to ensure they were collected near the original sample location and still within the sub-plot (and test plot) boundaries. Several of the predetermined IC increment locations were near the boundary of the test plot or the transition buffer zone (i.e., areas within 4 feet of adjacent sub-plots that will be unsampled or untreated because of potential overspill of planned future remedy materials between sub-plots). For example, the eastern most IC sampling increment locations for IC-401-1B are on the sub-plot/test plot boundary, and the northern-most IC sampling increment locations for IC-401-1C are located on the sub-plot transition buffer zone (see Figure 4-1). Based on the original Work Plan "*The first duplicate sample should be collected 5 centimeters <u>north</u> of each original sample location, and the second 5 centimeters <u>east</u> of each original sample".* Instead of sampling to the north and east of the original sample location, as noted above, the duplicate co-located samples were collected in close proximity (less than approximately 4-in., or <0.1 m) to one another relative to the bottom line and left line of the test plot.

3.2 Deviations from Planned Laboratory Activities

- HWA used ASTM D2434 to measure in situ permeability instead of ASTM D5084-16a. ASTM D2434 is more appropriate to estimate the rate of infiltration of precipitation through porous vadose-zone (unsaturated or partially saturated) soils. Additionally, HWA measured in situ bulk density using ASTM D7263 instead of ASTM E1109, because ASTM D7263 is more

[1] Field duplicate samples were collected in accordance with the Work Plan. However, upon further review, the description of the field duplicate sampling process from field activities and in the Work Plan is more representative of field split sample collection rather than a co-located field duplicate. Thus, the results of these duplicate samples provide an assessment of the precision of field homogenization process and the laboratory analysis rather than and assessment of the field sample collection procedures.

appropriate for measuring the bulk density of soil. (ASTM E1109 is used measure the bulk density of waste). These changes are documented in Corrective Action Form 01, Appendix E-1.

- ALS performed sulfide analysis in order to meet the 7-day hold time (Corrective Action Record 08, Appendix E-1). OSU was designated in the Work Plan to conduct the sulfide analyses. Despite this change, the hold time was exceeded for seven sulfide samples.
- The 28-day hold time specified for metals in the Work Plan is unnecessarily short. The hold time for metals in soil was revised to 180 days following communication with Shane Whitacre at OSU, and is based on the recommendations in the *National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA 2017). See Corrective Action Record 10, Appendix E-1.
- On October 17, 2017, due to a field team shipping error, OSU received 100 2-inch discrete samples, which were meant for ALS to dry and sieve before sending to OSU. It was decided that OSU would keep these samples and perform the drying and sieving (<2 mm) themselves prior to analysis, (see Corrective Action Record 06, Appendix E-1).
- Several IC samples had sample volumes (approximately 7,000 grams) greater than the volume that could be processed in the equipment specified in ALS's SOP for sub-sampling of IC samples. Instead of using a riffle-splitter to divide the sample into two trays for sub-sampling, laboratory technicians divided the homogenized and sieved (<2mm) samples into 2 to 3 large Ziploc bags. One bag was used to sub-sample the <2mm soil fraction, and the second bag was sieved to <150 µm, homogenized again, and sub-sampled at the <150 µm fraction. The remaining soil was reserved for possible future analysis.
- The field duplicate and triplicate IC samples were supposed to be analyzed at the laboratories according to the overview in Table 2-2; however, through laboratory error it was discovered that ALS and OSU performed all analyses on all samples. Analyses that were not originally planned for the triplicate samples (IC2-401-2A-101217, IC2-401-2A-101217 and IC3-401-2A-101217) include sulfide and total organic carbon at ALS, and Mehlich III extractable lead and phosphorus, electrical conductivity, chloride, sulfate, total carbon and nitrogen, and grain size at OSU. Analyses not originally planned for the duplicate sample (IC-401-1C-101117-D) include SPLP Metals at ALS, and TAL metals at the <2 mm and <150 µm fraction, bioaccessibility for arsenic and lead at pH 1.5 and 2.5, and grain size analysis at OSU.
- OSU measured and reported pH results for IC samples as part of standard laboratory analysis procedures; however, pH measurement in Phase IA Part 2 analysis was not specified in the Work Plan.
- OSU measured and reported total phosphorus results for all discrete samples (<2 mm) and IC samples (<2 mm and <150 µm); although analysis for total phosphorus was not specified in the Work Plan.
- IC sample processing was delayed at ALS and resulted in samples being received by OSU close to or past hold times for multiple analyses, as documented in Appendix F-1. Consequently, chloride, sulfate, electrical conductivity, and total carbon and nitrogen were analyzed past hold times.

3.3 Deviations from Data Documentation Procedure

The following deviations from the Work Plan were noted in the field documentation:

- There are several mistakes in the field notes and field forms that were not corrected properly (i.e., crossed out with a single line followed by the correction, the author's initials, and the date).
- The field notes for October 18, 2017 have nothing recorded from 08:50 to 15:45.
- The station location details (i.e., latitude, longitude, positional accuracy, and elevation), where available should have been noted on both the field forms and field notes; however, they are only noted on the field notes.
- The analysis to be performed and list of field of photograph numbers were not included on the field forms; however, a reference to the appropriate COC and a photolog are included.

The following deviations were noted in the chain-of-custody documentation:

- On October 7, 2017, a revised COC for 8 discrete samples being analyzed for water storing capacity was sent to OSU from Arcadis because an incorrect sample time was listed on the original COC for sample ID D-401-2D-100517-0-6. The sample time was updated to 13:05 to match the time on the sample bottle ID.
- On October 23, 2017, the sample confirmation receipt for SDG K1711288 from ALS specified the samples would be sieved to <2 mm and analyzed for lead and arsenic only, when the full suite of SPLP TAL metals and sieving to <2mm as well as <150 µm should have been indicated. Mark Harris from ALS confirmed the appropriate analyses were being performed and an updated sample receipt was uploaded to the Exponent database.
- On November 10, 2017, it was discovered that the COC for ALS SDG K1712145 had sample D-401-2C-100517-12-30 listed twice. The COC was revised November 10, 2017 by Arcadis to indicate that the second entry should be D-401-2D-100517-12-30.