STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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FILE COPY

Technical Memorandum

To: File

From: Chuck Gruenenfelder, Jeremy Schmidt / Ecology

Cc: Mike Hibbler, John Roland / Ecology

Date: January 26, 2011

Re: Black Sand Beach: Summary of Limit-of-Excavation Sample Collection and Analysis

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Introduction

Teck American Incorporated (TAI) completed slag removal activities at the Black Sand Beach in late October 2010. As discussed in Section 1.2 of the August 2010 *Final Work Plan for Black Sand Beach Project (Work Plan),* the intent of this work was to remove granulated slag from the Trail, B.C. smelter facility that had accumulated over time at the Black Sand Beach. For purposes of design and assessment, the beach was subdivided into three primary subareas: upstream beach, downstream beach, and bedrock outcrop area. The purpose of this memorandum is to document the collection, storage, processing, and analytical testing results for a series of limit-of-excavation sediment samples collected from the Black Sand Beach in October 2010 as slag removal activities were being performed.

Black, granular slag, the dominant component of the sand-sized sediment at the beach, was intermixed (to varying degrees) with native riverine sediment. The slag-impacted sediment was visually distinct and identifiable from the local native sediments and accessible using conventional excavation equipment (e.g., excavator, loader, and vacuum equipment). The vertical and horizontal extent of the excavation was jointly determined by the Engineer, Construction Manager, and Ecology based on four main criteria:

- Visual observations of areal slag distribution during preconstruction reconnaissance.
- Test pit observations of slag thickness just prior to starting construction.
- Findings from a TAI-initiated 2009 assessment of apparent slag thickness.
- The anticipated shoreline position at the time of construction.

As noted in Section 3.1 of the Work Plan, both "wet" and "dry" excavation methods were employed to complete the removal action. "Dry" excavation was defined by removal actions that occurred at elevations lying above the level (stage) of the adjacent Upper Columbia River; "wet" excavation included slag removal from below the standing water level in the excavation pit which corresponded to the elevation of the adjacent river. During construction, river levels were found to fluctuate as much as 2-3 feet over the course of a day.

Except for some limited below-water slag removal immediately adjacent to the river, most of the excavation work in upland portions of the upstream beach was performed without encountering the underlying zone of saturation. The removal actions in this area were strongly guided by visual indications of granular slag to establish the effective vertical limits of excavation.

Granular slag also was present in the central bedrock outcrop area and the cobbled shoreline area immediately south of the downstream beach. In these two areas, the construction contractor used a vacuum extraction method to remove the relatively thin and discontinuous pockets of granular slag that were present. Visual indications of granular slag were used to guide the vacuum extraction removal efforts in these areas. No limit-of-excavation samples were collected from the areas where vacuum extraction work was conducted. Detailed photographic documentation (before and after vacuum extraction) was conducted to confirm the effectiveness of the removal efforts in these areas.

At the downstream beach, a significant amount of the excavation work involved removal of saturated granular slag from below the water line. The work plan anticipated the need for wet excavation to achieve the removal goals for the project. The agreed-upon excavation approach left open the possibility that a small quantity of residual granulated slag would unavoidably remain at the bottom of the "wet" excavation pit once the effective limits of excavation had been reached. The final design included appropriate fill-placement provisions to address this situation, including physical safeguards (coarse, cobble armoring) to minimize the potential for future erosion of any slag residuals.

As discussed in Sections 3.1 and 7.0 of the August 2010 Work Plan, Ecology planned to collect sediment samples from the limits of excavation as the slag removal process proceeded. The purpose of this sample collection effort was to document the chemical composition of residual beach sediment at several limit-of-excavation locations. As stated in the Work Plan, the vertical limit of excavation was based primarily on visual evidence of slag (e.g., color). As noted above, removal actions that necessarily occurred below the water line were not expected to result in complete slag removal due to equipment and methodological considerations.

Spatial variations in slag removal effectiveness, based on laboratory analytical results and Ecology's visual observations during construction, are described in this memorandum. At large, the excavation efforts effectively removed the vast majority of slag-impacted sediment from the Black Sand Beach, consistent with the original project objectives and as achievable with the construction methods employed. Ecology believes that the project objectives and expectations related to the removal of granular slag from the targeted area of excavation, as described in the August 2010 Work Plan, were satisfied by the Phase II construction activities performed in the fall of 2010.

Methods

Sediment samples were collected from 16 separate locations within the upstream and downstream beach areas for the primary purpose of characterizing the concentrations of metals at the limits of excavation. One sample, composed of a laminated sandy silt, was collected several feet above the bottom of the excavation. Though not collected at the actual vertical "limit-of-excavation", the grain size, visual appearance and depositional significance of this material prompted the decision to evaluate its chemical composition along with the other sand-dominated samples. Seven samples were collected from the upstream beach and nine samples were collected from the downstream beach. Samples were collected judgmentally and opportunistically based on site construction conditions, the desire to provide samples from multiple locations within each beach area, and staff availability. Samples were collected from either:

- The exposed bottom of the excavation area (except as noted above).
- From the stockpile area where the excavated material at or near the vertical limits of excavation was temporarily staged.
- From the bucket of the track hoe excavator.

Generally, samples were collected by Ecology staff during construction oversight. When Ecology staff were not present on-site, the URS field representatives obtained sediment samples on Ecology's behalf, as requested by Ecology. For some samples, GPS coordinates were used to identify the approximate location of each sample. When GPS was not available, sample locations were referenced to readily identifiable geologic landmarks and tied to URS's construction stationing coordinate system. The estimated elevation of each sample was provided by the field representatives and tied to the local vertical datum (NAVD 88). See Figure 1 and Table 1 for sample locations and descriptions.

Each sediment sample was placed into a one-quart plastic sample bag using direct hand grab methods or a clean shovel. Most samples were single point grabs; however, some samples represented a composite of 2 to 3 separate subsamples collected from a localized area. Samples were labeled with a unique identifier. They were transported to Ecology's ERO office where they were temporarily stored in a refrigerator (at or below 4 degrees C) pending further examination and processing.

Sample Description and Preparation

The limit-of-excavation sediment samples from the downstream beach typically consisted of gravelly sand. One sandy silt sample (BSB-2) was collected from a deeper horizon within the downstream beach, 1-2 feet above the inferred vertical limit of excavation. Larger quantities of residual slag were present in samples collected from areas where excavation occurred below standing water, particularly at the downstream beach. Several limit-of-excavation samples from the downstream beach were collected from below the standing water level in the excavation pit. Given how these "below water" samples were collected, some quantity of original sediment fines may have been lost through unavoidable washing or winnowing. All samples, whether collected above or below the water table, likely involved some level of disturbance due to the construction methods employed. Regardless, the sediment samples collected as part of this sampling effort are believed to provide a reasonable representation of conditions at the limits of excavation – including both above water and below water sampling stations.

Samples from the upstream beach generally consisted of gravelly sand with little to no visual indication of slag. The majority of the upstream beach samples were collected from depth horizons that were located above the level of the river. These samples were not affected by potential water washing or winnowing effects ascribed above to selected downstream beach limit-of-excavation samples.

The sediment samples were examined by the Ecology project coordinator, and 11 of the 16 original samples were selected for subsequent sample preparation (i.e., sieving to <2mm). Samples were sieved at the Ecology ERO sample preparation room using a Standard Stainless Steel Test Sieve No. 10 (ASTM E-11 Specification) manufactured by Hogentogler & Co., Inc. The sieve was thoroughly cleaned and dried between the processing of each successive sample. The <2mm sample fraction was placed into a pre-labeled 4 oz. glass sample jar. Most or all of the >2mm retained fraction included native gravelly material of mixed mineralogy. For some samples, enough material was available to allow a portion of the original parent sample to be archived. For others, the entire parent sample was used to prepare the sieved sample.

Analysis and Quality Control

Ten of the limit-of-excavation samples and one additional sample were analyzed at Ecology's Manchester Lab, four from the upstream beach, and seven from the downstream beach. Analysis was limited to target analyte list (TAL) metals, minus mercury. The laboratory followed EPA 3050B for the preparation and EPA 200.8 for the analysis of trace metals. Quality control information is located within the first three pages of the laboratory report (Attachment A). Minor quality control deviations were noted, but they do not impact the overall representativeness of the limit-of-excavation analytical results or the conclusions of this memorandum.

Results

Table 2 provides a summary of the laboratory results and Attachment A includes the raw analytical laboratory data sheets. Overall, metals concentrations at the limits of excavation in the upstream beach were comparatively lower than those at the downstream beach. All maximum metals concentrations were found in downstream beach samples and but for one exception, maximum metal concentrations were found in samples 1, 2, and 3. Arsenic, copper, lead and zinc were the four trace metals with the highest degree of concentration variation between samples. The 11 samples have been assigned to three categories based on visual characteristics (inferred percentage of granular slag) and laboratory analytical results:

Higher Percentage of Residual Slag	Lower Percentage of Residual Slag	Trace or No Evident Residual Slag
BSB-1 (DS)	BSB-2 (DS)	BSB-6 (US)
BSB-3 (DS)	BSB-8 (US)	BSB-7 (US)
BSB-11 (DS)	BSB-12 (DS)	BSB-10 (US)
BSB-13 (DS)		
BSB-14 (DS)		

DS = downstream beach
US= upstream beach

Conclusions

The laboratory analysis results, along with post-excavation visual observations, demonstrate that essentially all the granular slag was removed down to the limits of the underlying native sediment horizon in the *upstream beach* area. In this subarea of the Black Sand Beach most of the excavation work occurred above the water line.

Higher concentrations of trace metals (i.e., arsenic, copper, lead and zinc) were found in limit-of-excavation samples collected from the *downstream beach* area. Most of these samples were collected from below the water line (i.e., standing water in the excavation pit). Visual examination of these samples confirmed that some contained residual granular slag. The visual observations, coupled with the laboratory analytical results, demonstrate that a limited quantity of granulated slag remained at the vertical limits of the excavation. We believe that only a relatively thin veneer of slag-enriched sediment was present beneath most of the downstream beach area when the removal action was completed. Small, localized "pockets" of slag may have been left in limited areas where the bottom of excavation interface was more irregular due to bedrock obstructions or topography.

Despite there being a small quantity of residual slag beneath portions of the downstream beach, the removal action goals and objectives were met.

While some finite quantity of residual slag was unavoidably left behind at the base of the downstream beach excavation area, this material has been covered and buried by a considerable thickness of clean fill material. Specifically, the clean fill in the downstream beach area includes (from top to bottom):

- Three-plus feet of beach sand.
- Approximately 3 to 5 feet of coarse gravel (up to 1.5-inch diameter).
- Approximately 3-5 feet of large cobble (8-inch to 12-inch diameter).

This thick sequence of clean fill material effectively caps and armors any residual slag at depth. The fill material and associated erosion protection pads (i.e., large cobbles strategically placed to reduce potential beach erosion) are expected to minimize the potential for erosion of any slag residuals during large, seasonal discharge events on the Upper Columbia River.

It is therefore unlikely that the public and/or ecological receptors will be exposed to residual slag under the beach in the future.

Black Sand Beach - Limit of Excavation Samples

Date Collected	Sample Number	Beach Area	Coordinates or Station Location	Approx Elev. (ft)	Sample Description	Limit of Excavation?
9/29/2010	BSB-LOE-1	Downstream	N48.97092 W-117.64830 STA 0+135, ~25 from river's edge	1294	Grey gravelly sand	yes
9/29/2010	BSB-LOE-2	Downstream	STA 0+180, ~25' from BOC, ~25' from river's edge	1295-1296	Grey sandy silt with iron oxide banding/staining	No. ~2' above bottom of excavation
9/29/2010	BSB-LOE-3	Downstream	STA 0+175 ~30' from river's edge	1293-1294	Grey gravelly sand	yes
9/30/2010	BSB-LOE-4	Upstream	~20' from BOC and 20' from river's edge	1298	Grey gravelly sand/sandy gravel	yes
9/30/2010	BSB-LOE-5	Upstream	~50' from BOC and 20' from river's edge	1298	Grey rounded gravel with sand	yes
9/30/2010	BSB-LOE-6	Upstream	~25' from east edge of beach ~25' from river's edge	1298	Grey poorly graded sand	yes
10/12/2010	BSB-LOE-7	Upstream	~30' from BOC and 50' from river's edge	1304	Grey-tan gravelly sand	yes
10/12/2010	BSB-LOE-8	Upstream	~50' from BOC and 50' from river's edge	1305	Grey-tan gravelly sand	yes
10/12/2010	BSB-LOE-9	Upstream	~80' from BOC and 50' from river's edge	1304	Grey-tan gravelly sand	yes
10/12/2010	BSB-LOE-10	Upstream	~30' from BOC and 100' from river's edge	1307	Grey-brown sandy gravel	yes
10/18/2010	BSB-LOE-11	Downstream	STA 0+50; ~50' from river's edge	1294	Grey sandy gravel	yes
10/19/2010	BSB-LOE-12	Downstream	STA 0+125; ~60' from river's edge	1293	Poorly graded grey-tan sand looks well washed	yes
10/21/2010	BSB-LOE-13	Downstream	N48.97071 W-117.64825	N/R	Grey to dk olive brown poorly graded fine to med sand	yes
10/21/2010	BSB-LOE-14	Downstream	STA 0+75; ~100' from river's edge	1294	Grey gravelly sand	yes
10/22/2010	BSB-LOE-15	Downstream	N48.97064 W-117.64826	N/R	Grey gravelly sand	yes
10/22/2010	BSB-LOE-16	Downstream	N48.97062 W-117.64850	N/R	Grey-tan sandy gravel	yes

Table 1

Black Sand Beach Limit of Excavation Results - Metals Analysis

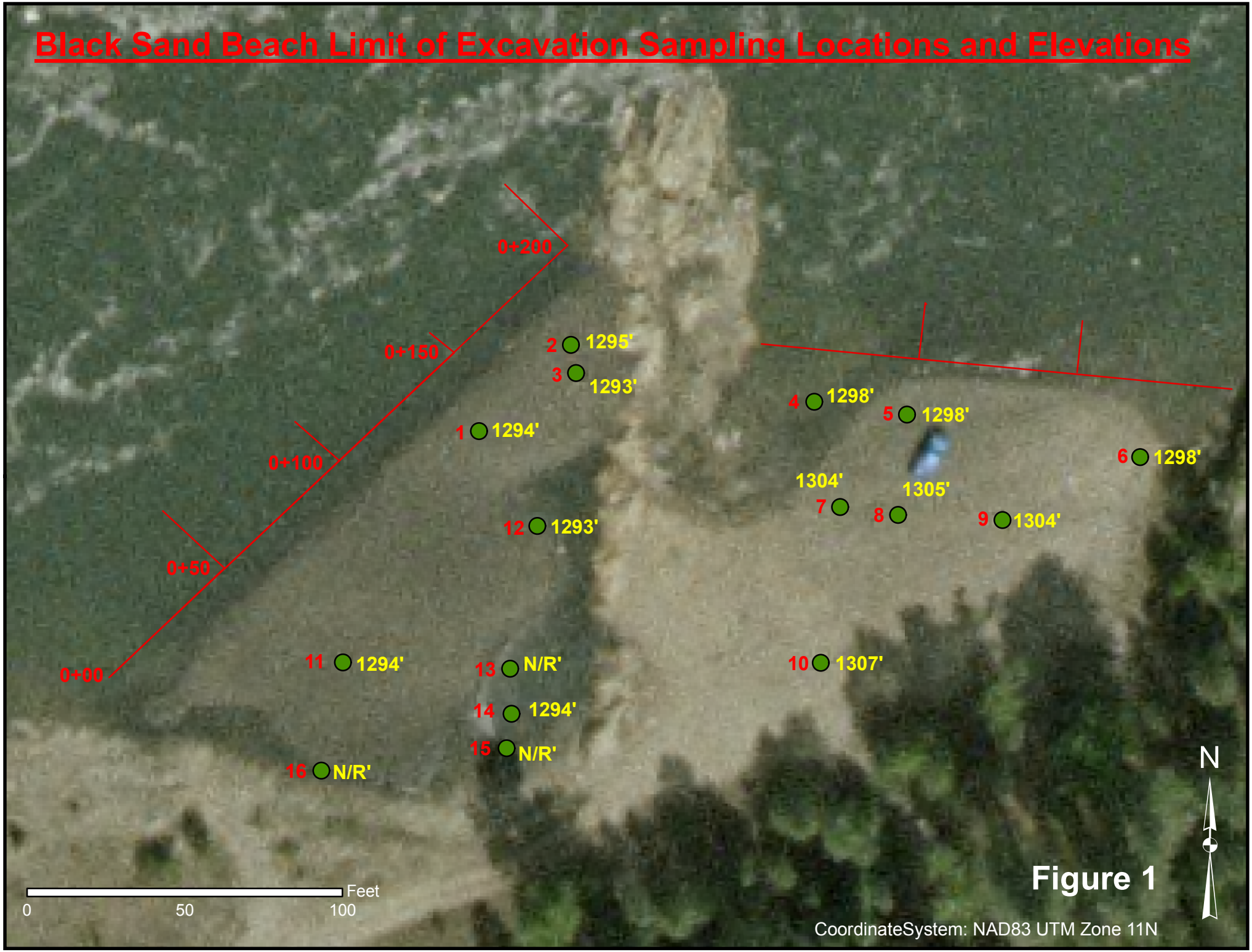
Sampling Station	Date Collected	Beach*	Antimony	Selenium	Lead	Nickel	Copper	Chromium
BSB-LOE-1	9/29/2010	DS	6.4	5.00 UJ	1320.0	9.5	***1080.0***	38.5
BSB-LOE-2	9/29/2010	DS	5.6	***1.51*** J	765.0	***22.7***	86.3	20.1
BSB-LOE-3	9/29/2010	DS	***7.6***	0.50 UJ	***1560.0***	9.3	932.0	31.2
BSB-LOE-6	9/30/2010	US	0.2 U	0.50 U	9.4	8.0	8.3	7.9
BSB-LOE-7	10/12/2010	US	0.5	0.50 UJ	15.5	8.9	28.4	11.8
BSB-LOE-8	10/12/2010	US	2.0 U	0.50 UJ	62.5	11.9	50.2	18.1
BSB-LOE-10	10/12/2010	US	0.2 UJ	0.50 UJ	14.8 J	13.8	20.7	20.6 J
BSB-LOE-11	10/18/2010	DS	2.7	0.50 U	138.0	11.6	547.0	48.1
BSB-LOE-12	10/19/2010	DS	0.3	0.50 U	24.1	9.2	42.8	11.5
BSB-LOE-13	10/21/2010	DS	7.2	0.50 U	184.0	10.9	670.0	***50.8***
BSB-LOE-14	10/21/2010	DS	2.9	0.50 U	94.8	9.3	408.0	28.7

Sampling Station	Date Collected	Beach*	Cadmium	Beryllium	Arsenic	Silver	Thallium	Zinc
BSB-LOE-1	9/29/2010	DS	3.76	1.00 UJ	***29.90***	1.75	1.00 U	17800
BSB-LOE-2	9/29/2010	DS	***10.50***	1.00 UJ	19.30	1.08	1.00 U	2810
BSB-LOE-3	9/29/2010	DS	1.83	1.00 UJ	21.00	***1.94***	1.00 U	***18300***
BSB-LOE-6	9/30/2010	US	0.23	1.00 UJ	2.32	1.00 U	1.00 U	235
BSB-LOE-7	10/12/2010	US	0.15	1.00 UJ	2.68	1.00 U	1.00 U	126
BSB-LOE-8	10/12/2010	US	1.00 U	1.00 UJ	3.45	1.00 U	1.00 U	1130
BSB-LOE-10	10/12/2010	US	0.18	1.00 UJ	3.61	1.00 U	1.00 U	143 J
BSB-LOE-11	10/18/2010	DS	1.29	1.00 UJ	4.42	1.00 U	1.00 U	9510
BSB-LOE-12	10/19/2010	DS	0.54	1.00 UJ	3.11	1.00 U	1.00 U	441
BSB-LOE-13	10/21/2010	DS	2.36	1.00 UJ	6.30	1.00 U	1.00 U	6990
BSB-LOE-14	10/21/2010	DS	1.00 U	1.00 UJ	3.74	1.00 U	1.00 U	6110

Max Value

*US = Upstream Beach; DS = Downstream Beach

Table 2


Black Sand Beach Limit of Excavation Sampling Locations and Elevations
0+200
0+150
0+100
0+50
0+00
2 1295'
3 1293'
1 1294'
4 1298'
5 1298'
6 1298'
1304'
7
1305'
8
9 1304'
12 1293'
11 1294'
13 N/R'
14 1294'
15 N/R'
16 N/R'
10 1307'
N
Feet
0
50
100
Figure 1
CoordinateSystem: NAD83 UTM Zone 11N

Attachment A

Laboratory Analytical Report

Manchester Environmental Laboratory

7411 Beach Drive E, Port Orchard, Washington 98366

Case Narrative

December 13, 2010

Project: Metals Black Sand Beach

Work Order: 1012035

Project Manager: Gruenenfelder, Charles

By: Dean Momohara DM

Summary

The laboratory followed EPA 3050B for the preparation and EPA 200.8 for the analysis of trace metals.

All analyses requested were evaluated by established regulatory quality assurance guidelines.

Sample Information

The samples were received at the Manchester Laboratory on 12/2/2010. The cooler was received within the proper temperature range of 0°C - 6°C. The samples were received in good condition. Eleven samples were received and assigned laboratory identification numbers 1012035-01 to 1012035-11.

Holding Times

The laboratory performed all analyses within their hold times.

Calibration

The instrument was calibrated following the appropriate method. All initial and continuing calibration verification checks were within the acceptance limits. The initial calibration blank check was within the acceptance limits.

All continuing calibration blank checks were within the acceptance limits except for selenium and beryllium.

The results for samples 1012035-01 to 1012035-03 and 1012035-05 to 1012035-07 for selenium and samples 1012035-01 to 1012035-11 for beryllium were qualified as estimates.

All standard residuals were within acceptance limits. All r-values were within acceptance limits. The instrument was calibrated with a NIST traceable standard and verified to be in calibration with a second source NIST traceable standard. Oven drying temperatures were monitored before and after drying.

Method Blanks

No analytically significant level of analyte was detected in the method blank associated with these samples.

Laboratory Control Samples

All laboratory control sample recoveries were within the acceptance limits.

Replicates

All duplicate relative percent differences (RPD) of samples with concentrations greater than 5 times the reporting limit were within the acceptance limit except for lead and zinc. The duplicate RPDs for sample 1012035-07 for lead and zinc were greater than the acceptance limit. The samples were qualified as estimates.

Matrix Spikes

All matrix spike (MS) recoveries were within the acceptance limits except for antimony, zinc, chromium and lead.

One of the MS/MSD recoveries for sample 1012035-07 for zinc, chromium and lead was outside of the acceptance limits due to sample inhomogeneity. The source samples were qualified as estimates.

Both MS/MSD recoveries for sample 1012035-07 for antimony were outside of the acceptance limits due to matrix interference. The source sample was qualified as an estimate.

Internal Standards

All internal standard recoveries were within the acceptance limits.

Other Quality Assurance Measures and Issues

U - The analyte was not detected at or above the reported result.

J - The analyte was positively identified. The associated numerical result is an estimate.

UJ - The analyte was not detected at or above the reported estimated result.

bold - The analyte was present in the sample. (Visual Aid to locate detected compounds on report sheet.)

Please call Deans Momohara at (360) 871-8808 to further discuss this project.

cc: Project File

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Antimony

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/09/2010

Analyte: Antimony
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	**BSB-LOE-1**	**6.39**		2.00	0.075	09/29/10	12/09/10	B10L032
1012035-02	**BSB-LOE-2**	**5.55**		2.00	0.075	09/29/10	12/09/10	B10L032
1012035-03	**BSB-LOE-3**	**7.59**		2.00	0.075	09/29/10	12/09/10	B10L032
1012035-04	BSB-LOE-6	0.200	U	0.200	0.008	09/30/10	12/09/10	B10L032
1012035-05	**BSB-LOE-7**	**0.466**		0.200	0.008	10/12/10	12/09/10	B10L032
1012035-06	BSB-LOE-8	2.00	U	2.00	0.075	10/12/10	12/09/10	B10L032
1012035-07	BSB-LOE-10	0.200	UJ	0.200	0.008	10/12/10	12/09/10	B10L032
1012035-08	**BSB-LOE-11**	**2.74**		2.00	0.075	10/18/10	12/09/10	B10L032
1012035-09	**BSB-LOE-12**	**0.302**		0.200	0.008	10/19/10	12/09/10	B10L032
1012035-10	**BSB-LOE-13**	**7.23**		2.00	0.075	10/21/10	12/09/10	B10L032
1012035-11	**BSB-LOE-14**	**2.91**		2.00	0.075	10/21/10	12/09/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.200	U	0.200	12/09/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	40.3	40			101	85-115		
B10L032-MS1	Matrix Spike	14.9	40	1012035-07	0.159	37	75-125		
B10L032-MSD1	Matrix Spike Dup	13.2	40	1012035-07	0.159	33	75-125	12	20

Authorized by: DM **Release Date:** 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Selenium

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/08/2010

Analyte: Selenium
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	5.00	UJ	5.00	3.03	09/29/10	12/08/10	B10L032
1012035-02	**BSB-LOE-2**	**1.51**	**J**	0.500	0.303	09/29/10	12/08/10	B10L032
1012035-03	BSB-LOE-3	0.500	UJ	0.500	0.303	09/29/10	12/08/10	B10L032
1012035-04	BSB-LOE-6	0.500	U	0.500	0.303	09/30/10	12/08/10	B10L032
1012035-05	BSB-LOE-7	0.500	UJ	0.500	0.303	10/12/10	12/08/10	B10L032
1012035-06	BSB-LOE-8	0.500	UJ	0.500	0.303	10/12/10	12/08/10	B10L032
1012035-07	BSB-LOE-10	0.500	UJ	0.500	0.303	10/12/10	12/08/10	B10L032
1012035-08	BSB-LOE-11	0.500	U	0.500	0.303	10/18/10	12/08/10	B10L032
1012035-09	BSB-LOE-12	0.500	U	0.500	0.303	10/19/10	12/08/10	B10L032
1012035-10	BSB-LOE-13	0.500	U	0.500	0.303	10/21/10	12/08/10	B10L032
1012035-11	BSB-LOE-14	0.500	U	0.500	0.303	10/21/10	12/08/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.500	U	0.500	12/08/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	44.9	40			112	85-115		
B10L032-MS1	Matrix Spike	41.7	40	1012035-07	0.500 U	104	75-125		
B10L032-MSD1	Matrix Spike Dup	41.9	40	1012035-07	0.500 U	105	75-125	0.5	20

Authorized by: DM **Release Date:** 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Lead

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/08/2010

Analyte: Lead
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	1320		10.0	0.664	09/29/10	12/08/10	B10L032
1012035-02	BSB-LOE-2	765		1.00	0.066	09/29/10	12/08/10	B10L032
1012035-03	BSB-LOE-3	1560		10.0	0.664	09/29/10	12/08/10	B10L032
1012035-04	BSB-LOE-6	9.44		0.100	0.007	09/30/10	12/08/10	B10L032
1012035-05	BSB-LOE-7	15.5		0.100	0.007	10/12/10	12/08/10	B10L032
1012035-06	BSB-LOE-8	62.5		0.100	0.007	10/12/10	12/08/10	B10L032
1012035-07	BSB-LOE-10	14.8	J	0.100	0.007	10/12/10	12/08/10	B10L032
1012035-08	BSB-LOE-11	138		1.00	0.066	10/18/10	12/08/10	B10L032
1012035-09	BSB-LOE-12	24.1		0.100	0.007	10/19/10	12/08/10	B10L032
1012035-10	BSB-LOE-13	184		10.0	0.664	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	94.8		0.100	0.007	10/21/10	12/08/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/08/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	36.4	40			91	85-115		
B10L032-MS1	Matrix Spike	70.8	40	1012035-07	14.8	140	75-125		
B10L032-MSD1	Matrix Spike Dup	51.5	40	1012035-07	14.8	92	75-125	32	20

Authorized by: DM

Release Date: 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Nickel

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/09/2010

Analyte: Nickel
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	9.49		1.00	0.060	09/29/10	12/09/10	B10L032
1012035-02	BSB-LOE-2	22.7		1.00	0.060	09/29/10	12/09/10	B10L032
1012035-03	BSB-LOE-3	9.33		1.00	0.060	09/29/10	12/09/10	B10L032
1012035-04	BSB-LOE-6	7.97		1.00	0.060	09/30/10	12/09/10	B10L032
1012035-05	BSB-LOE-7	8.89		1.00	0.060	10/12/10	12/09/10	B10L032
1012035-06	BSB-LOE-8	11.9		1.00	0.060	10/12/10	12/09/10	B10L032
1012035-07	BSB-LOE-10	13.8		1.00	0.060	10/12/10	12/09/10	B10L032
1012035-08	BSB-LOE-11	11.6		1.00	0.060	10/18/10	12/09/10	B10L032
1012035-09	BSB-LOE-12	9.23		1.00	0.060	10/19/10	12/09/10	B10L032
1012035-10	BSB-LOE-13	10.9		1.00	0.060	10/21/10	12/09/10	B10L032
1012035-11	BSB-LOE-14	9.34		1.00	0.060	10/21/10	12/09/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/09/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	37.9	40			95	85-115		
B10L032-MS1	Matrix Spike	48.7	40	1012035-07	13.8	87	75-125		
B10L032-MSD1	Matrix Spike Dup	51.2	40	1012035-07	13.8	93	75-125	5	20

Authorized by: DM **Release Date:** 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for

Copper

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/08/2010

Analyte: Copper
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	1080		10.0	1.16	09/29/10	12/08/10	B10L032
1012035-02	BSB-LOE-2	86.3		0.100	0.012	09/29/10	12/08/10	B10L032
1012035-03	BSB-LOE-3	932		10.0	1.16	09/29/10	12/08/10	B10L032
1012035-04	BSB-LOE-6	8.25		0.100	0.012	09/30/10	12/08/10	B10L032
1012035-05	BSB-LOE-7	28.4		0.100	0.012	10/12/10	12/08/10	B10L032
1012035-06	BSB-LOE-8	50.2		0.100	0.012	10/12/10	12/08/10	B10L032
1012035-07	BSB-LOE-10	20.7		0.100	0.012	10/12/10	12/08/10	B10L032
1012035-08	BSB-LOE-11	547		1.00	0.116	10/18/10	12/08/10	B10L032
1012035-09	BSB-LOE-12	42.8		0.100	0.012	10/19/10	12/08/10	B10L032
1012035-10	BSB-LOE-13	670		10.0	1.16	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	408		10.0	1.16	10/21/10	12/10/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/08/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	39.2	40			98	85-115		
B10L032-MS1	Matrix Spike	61.7	40	1012035-07	20.7	103	75-125		
B10L032-MSD1	Matrix Spike Dup	60.4	40	1012035-07	20.7	99	75-125	2	20

Authorized by: DM

Release Date: 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Chromium

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/10/2010

Analyte: Chromium
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	38.5		5.00	0.112	09/29/10	12/10/10	B10L032
1012035-02	BSB-LOE-2	20.1		5.00	0.112	09/29/10	12/10/10	B10L032
1012035-03	BSB-LOE-3	31.2		5.00	0.112	09/29/10	12/10/10	B10L032
1012035-04	BSB-LOE-6	7.89		5.00	0.112	09/30/10	12/10/10	B10L032
1012035-05	BSB-LOE-7	11.8		5.00	0.112	10/12/10	12/10/10	B10L032
1012035-06	BSB-LOE-8	18.1		5.00	0.112	10/12/10	12/10/10	B10L032
1012035-07	BSB-LOE-10	20.6	J	5.00	0.112	10/12/10	12/10/10	B10L032
1012035-08	BSB-LOE-11	48.1		5.00	0.112	10/18/10	12/10/10	B10L032
1012035-09	BSB-LOE-12	11.5		5.00	0.112	10/19/10	12/10/10	B10L032
1012035-10	BSB-LOE-13	50.8		5.00	0.112	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	28.7		5.00	0.112	10/21/10	12/10/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.500	U	0.500	12/10/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	39.9	40			100	85-115		
B10L032-MS1	Matrix Spike	48.0	40	1012035-07	20.6	68	75-125		
B10L032-MSD1	Matrix Spike Dup	53.9	40	1012035-07	20.6	83	75-125	12	20

Authorized by: DM

Release Date: 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Cadmium

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/09/2010

Analyte: Cadmium
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	**BSB-LOE-1**	**3.76**		1.00	0.057	09/29/10	12/09/10	B10L032
1012035-02	**BSB-LOE-2**	**10.5**		1.00	0.057	09/29/10	12/09/10	B10L032
1012035-03	**BSB-LOE-3**	**1.83**		1.00	0.057	09/29/10	12/09/10	B10L032
1012035-04	**BSB-LOE-6**	**0.232**		0.100	0.006	09/30/10	12/09/10	B10L032
1012035-05	**BSB-LOE-7**	**0.147**		0.100	0.006	10/12/10	12/09/10	B10L032
1012035-06	BSB-LOE-8	1.00	U	1.00	0.057	10/12/10	12/09/10	B10L032
1012035-07	**BSB-LOE-10**	**0.178**		0.100	0.006	10/12/10	12/09/10	B10L032
1012035-08	**BSB-LOE-11**	**1.29**		1.00	0.057	10/18/10	12/09/10	B10L032
1012035-09	**BSB-LOE-12**	**0.540**		0.100	0.006	10/19/10	12/09/10	B10L032
1012035-10	**BSB-LOE-13**	**2.36**		1.00	0.057	10/21/10	12/09/10	B10L032
1012035-11	BSB-LOE-14	1.00	U	1.00	0.057	10/21/10	12/09/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/09/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	39.6	40			99	85-115		
B10L032-MS1	Matrix Spike	36.7	40	1012035-07	0.178	91	75-125		
B10L032-MSD1	Matrix Spike Dup	36.9	40	1012035-07	0.178	92	75-125	0.7	20

Authorized by: DR **Release Date:** 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Beryllium

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/10/2010

Analyte: Beryllium
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	1.00	UJ	1.00	0.059	09/29/10	12/10/10	B10L032
1012035-02	BSB-LOE-2	1.00	UJ	1.00	0.059	09/29/10	12/10/10	B10L032
1012035-03	BSB-LOE-3	1.00	UJ	1.00	0.059	09/29/10	12/10/10	B10L032
1012035-04	BSB-LOE-6	1.00	UJ	1.00	0.059	09/30/10	12/10/10	B10L032
1012035-05	BSB-LOE-7	1.00	UJ	1.00	0.059	10/12/10	12/10/10	B10L032
1012035-06	BSB-LOE-8	1.00	UJ	1.00	0.059	10/12/10	12/10/10	B10L032
1012035-07	BSB-LOE-10	1.00	UJ	1.00	0.059	10/12/10	12/10/10	B10L032
1012035-08	BSB-LOE-11	1.00	UJ	1.00	0.059	10/18/10	12/10/10	B10L032
1012035-09	BSB-LOE-12	1.00	UJ	1.00	0.059	10/19/10	12/10/10	B10L032
1012035-10	BSB-LOE-13	1.00	UJ	1.00	0.059	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	1.00	UJ	1.00	0.059	10/21/10	12/10/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/10/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	40.1	40			100	85-115		
B10L032-MS1	Matrix Spike	43.1	40	1012035-07	1.00 U	108	75-125		
B10L032-MSD1	Matrix Spike Dup	42.7	40	1012035-07	1.00 U	107	75-125	0.8	20

Authorized by: DM

Release Date: 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Arsenic

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/08/2010

Analyte: Arsenic
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	29.9		1.00	0.163	09/29/10	12/08/10	B10L032
1012035-02	BSB-LOE-2	19.3		0.100	0.016	09/29/10	12/08/10	B10L032
1012035-03	BSB-LOE-3	21.0		0.100	0.016	09/29/10	12/08/10	B10L032
1012035-04	BSB-LOE-6	2.32		0.100	0.016	09/30/10	12/08/10	B10L032
1012035-05	BSB-LOE-7	2.68		0.100	0.016	10/12/10	12/08/10	B10L032
1012035-06	BSB-LOE-8	3.45		0.100	0.016	10/12/10	12/08/10	B10L032
1012035-07	BSB-LOE-10	3.61		0.100	0.016	10/12/10	12/08/10	B10L032
1012035-08	BSB-LOE-11	4.42		0.100	0.016	10/18/10	12/08/10	B10L032
1012035-09	BSB-LOE-12	3.11		0.100	0.016	10/19/10	12/08/10	B10L032
1012035-10	BSB-LOE-13	6.30		0.100	0.016	10/21/10	12/08/10	B10L032
1012035-11	BSB-LOE-14	3.74		0.100	0.016	10/21/10	12/08/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.146		0.100	12/08/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	42.1	40			105	85-115		
B10L032-MS1	Matrix Spike	42.5	40	1012035-07	3.61	97	75-125		
B10L032-MSD1	Matrix Spike Dup	42.0	40	1012035-07	3.61	96	75-125	1	20

Authorized by: DM

Release Date: 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Silver

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/10/2010

Analyte: Silver
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	**BSB-LOE-1**	**1.75**		1.00	0.035	09/29/10	12/10/10	B10L032
1012035-02	**BSB-LOE-2**	**1.08**		1.00	0.035	09/29/10	12/10/10	B10L032
1012035-03	**BSB-LOE-3**	**1.94**		1.00	0.035	09/29/10	12/10/10	B10L032
1012035-04	BSB-LOE-6	1.00	U	1.00	0.035	09/30/10	12/10/10	B10L032
1012035-05	BSB-LOE-7	1.00	U	1.00	0.035	10/12/10	12/10/10	B10L032
1012035-06	BSB-LOE-8	1.00	U	1.00	0.035	10/12/10	12/10/10	B10L032
1012035-07	BSB-LOE-10	1.00	U	1.00	0.035	10/12/10	12/10/10	B10L032
1012035-08	BSB-LOE-11	1.00	U	1.00	0.035	10/18/10	12/10/10	B10L032
1012035-09	BSB-LOE-12	1.00	U	1.00	0.035	10/19/10	12/10/10	B10L032
1012035-10	BSB-LOE-13	1.00	U	1.00	0.035	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	1.00	U	1.00	0.035	10/21/10	12/10/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/10/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	40.9	40			102	85-115		
B10L032-MS1	Matrix Spike	37.8	40	1012035-07	0.054	94	75-125		
B10L032-MSD1	Matrix Spike Dup	37.6	40	1012035-07	0.054	94	75-125	0.5	20

Authorized by: DM **Release Date:** 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for
Thallium

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/10/2010

Analyte: Thallium
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	1.00	U	1.00	0.163	09/29/10	12/10/10	B10L032
1012035-02	BSB-LOE-2	1.00	U	1.00	0.163	09/29/10	12/10/10	B10L032
1012035-03	BSB-LOE-3	1.00	U	1.00	0.163	09/29/10	12/10/10	B10L032
1012035-04	BSB-LOE-6	1.00	U	1.00	0.163	09/30/10	12/10/10	B10L032
1012035-05	BSB-LOE-7	1.00	U	1.00	0.163	10/12/10	12/10/10	B10L032
1012035-06	BSB-LOE-8	1.00	U	1.00	0.163	10/12/10	12/10/10	B10L032
1012035-07	BSB-LOE-10	1.00	U	1.00	0.163	10/12/10	12/10/10	B10L032
1012035-08	BSB-LOE-11	1.00	U	1.00	0.163	10/18/10	12/10/10	B10L032
1012035-09	BSB-LOE-12	1.00	U	1.00	0.163	10/19/10	12/10/10	B10L032
1012035-10	BSB-LOE-13	1.00	U	1.00	0.163	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	1.00	U	1.00	0.163	10/21/10	12/10/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	0.100	U	0.100	12/10/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	39.3	40			98	85-115		
B10L032-MS1	Matrix Spike	38.4	40	1012035-07	1.00 U	96	75-125		
B10L032-MSD1	Matrix Spike Dup	39.2	40	1012035-07	1.00 U	98	75-125	2	20

Authorized by: DM **Release Date:** 12/13/10

Washington State Department of Ecology
Manchester Environmental Laboratory
Final Analysis Report for

Zinc

Project Name: Black Sand Beach
Work Order: 1012035
Project Officer: Gruenenfelder, Charles

Date Collected: 09/29/2010
Date Analyzed: 12/08/2010

Analyte: Zinc
Method: EPA200.8
Matrix: Sediment/Soil
Units: mg/kg dw

Sample #	Sample ID	Result	Qualifier	RL	MDL	Collected	Analyzed	Batch ID
1012035-01	BSB-LOE-1	17800		500	21.8	09/29/10	12/08/10	B10L032
1012035-02	BSB-LOE-2	2810		500	21.8	09/29/10	12/08/10	B10L032
1012035-03	BSB-LOE-3	18300		500	21.8	09/29/10	12/08/10	B10L032
1012035-04	BSB-LOE-6	235		50.0	2.18	09/30/10	12/08/10	B10L032
1012035-05	BSB-LOE-7	126		5.00	0.218	10/12/10	12/08/10	B10L032
1012035-06	BSB-LOE-8	1130		50.0	2.18	10/12/10	12/08/10	B10L032
1012035-07	BSB-LOE-10	143	J	5.00	0.218	10/12/10	12/08/10	B10L032
1012035-08	BSB-LOE-11	9510		500	21.8	10/18/10	12/10/10	B10L032
1012035-09	BSB-LOE-12	441		50.0	2.18	10/19/10	12/10/10	B10L032
1012035-10	BSB-LOE-13	6990		500	21.8	10/21/10	12/10/10	B10L032
1012035-11	BSB-LOE-14	6110		500	21.8	10/21/10	12/10/10	B10L032

QC Results for Batch ID: B10L032

Method Blank	Sample ID	Result	Qualifer	RL	Analyzed
B10L032-BLK1	Blank	5.00	U	5.00	12/08/10

Sample #	QC Sample	Result	Spike Level	Source Sample	Source Result	%Rec	%Rec Limits	RPD	RPD Limit
B10L032-BS1	LCS	40.1	40			100	85-115		
B10L032-MS1	Matrix Spike	237	40	1012035-07	143	235	75-125		
B10L032-MSD1	Matrix Spike Dup	190	40	1012035-07	143	116	75-125	22	20

Authorized by: DM **Release Date:** 12/13/10