Pre-Remedial Design Investigation Data Report – Marine Unit

R.G. Haley Site
Bellingham, Washington

for
City of Bellingham

October 25, 2022

GeoEngineers
Earth Science + Technology

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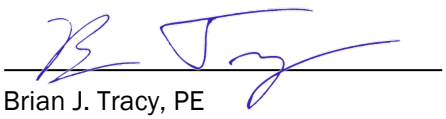

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1.0 INTRODUCTION

This Pre-remedial Design Investigation (PRDI) Data Report has been prepared to summarize the results of additional sampling and analysis completed in the Marine Unit of the R.G. Haley International Corp Site (Haley Site or Site) to support remedial design. The work was completed in accordance with the Ecology-approved PRDI Project Plans – Marine Unit (Project Plans; GeoEngineers 2022b).

The Haley Site is located south of the downtown business district in Bellingham, Washington (Figure 1). Wood products were treated with pentachlorophenol at the Site between approximately 1948 and 1985. Remedial actions will be completed at the Site pursuant to requirements of the Washington State Model Toxics Control Act (MTCA) (Chapter 173-340 of the Washington State Administrative Code [WAC]) and Sediment Management Standards (SMS) (Chapter 173-204 WAC). Design and permitting activities supporting Site cleanup are being conducted under Agreed Order (AO) No. DE 15776, (Ecology 2018) between the Washington State Department of Ecology (Ecology) and the City of Bellingham (City).

This PRDI Data Report describes field activities performed to characterize the following:

- Intertidal sediment and porewater at the base of the excavation in Zone 1a to refine the depth of excavation and to provide information to support design of the amended sand cap within the sediment excavation area.
- Intertidal sediment and porewater at the base of the amended sand cap in Zone 1b to provide information to support design of the amended sand cap.
- Conditions within the existing organoclay cap placed during the 2013 interim action and estimate the organoclay usage rate within the existing cap to inform the design of the amended sand caps to be placed in Zones 1a and 1b.

The field activities and laboratory analyses completed for the characterization tasks identified above were performed in accordance with the Ecology-approved PRDI Project Plans – Marine Unit including the Sampling and Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP).

1.1. Cleanup Action Summary

The R.G. Haley International Corp wood treatment facility was formerly located in the upland portion of the Haley Site. Operations at the facility resulted in contamination to the upland and adjacent marine area that is part of Bellingham Bay. The Site is subdivided into two units that are separated by the ordinary high water mark (OHWM) that include the Upland Unit and the Marine Unit as shown on Figure 2.

The components of the Haley Site cleanup action are summarized below and shown on Figure 3:

- In-situ soil solidification (ISS) will be performed within the area of potentially mobile light non-aqueous phase liquid (LNAPL) near the shoreline.
- A low-permeability cap will be constructed throughout the upland unit where soil exceeds cleanup levels. The cap will include a gas collection layer to prevent build-up of landfill gas and pressure below the low-permeability layer. The upland cap will also be designed to reduce stormwater infiltration and convey runoff to surface water.

- LNAPL-impacted sediment in the intertidal area adjacent to the shoreline will be excavated. Sediment remaining at the base of the excavation will be capped with clean sand and armored to prevent erosion. The cap design will include the use of amendments added to the sand cap material to enhance chemical containment. The excavated sediment will be consolidated under the upland cap.
- An amended sand cap will be placed and armored in the intertidal and shallow subtidal areas outside of the sediment removal area. This includes areas where sediment concentrations exceed benthic criteria and locations where bioaccumulative constituents are present at concentrations that are not anticipated to naturally recover within 10 years of implementation of the remedial actions.
- Thin layer capping will be completed farther offshore of the sediment excavation and amended cap areas. Thin layer capping includes placement of a 1-foot layer of gravelly sand to isolate underlying contaminated sediment and protect from potential erosion.
- Monitored natural recovery (MNR) will be used in areas where contaminant concentrations in surface sediment exceed cleanup levels but are expected to achieve cleanup levels within 10 years as a result of the natural deposition of sediment. MNR will be implemented predominantly in the subtidal portion of the Marine Unit.

Additional details about the cleanup action are presented in the Engineering Design Report (EDR) (GeoEngineers 2022a). The elements of the cleanup action for which the ongoing design will be supported by the PRDI data include the upper intertidal sediment excavation in Zone 1a and amended sand capping within Zone 1a and Zone 1b. These areas are presented on Figure 4. The following sections describe the results of the PRDI and how the results will be used to support the ongoing remedial design process.

2.0 PRDI FIELD ACTIVITIES

This section describes the sampling activities conducted to support the PRDI. Additional description of sampling procedures is presented in the PRDI Project Plans (GeoEngineers 2022b). Two separate mobilizations to the Site were required to complete the PRDI investigation activities that included the following:

- Manual Sediment and Porewater Sampling
- Sonic Drilling Sediment and Porewater Sampling

The following sections provide additional detail on the sediment and porewater sampling activities.

2.1. Manual Sediment and Porewater Sampling

Manual sediment and porewater sampling of near surface (0 to 2 feet below ground surface [bgs]) sediment and porewater was completed June 14 and 15, 2022 in dry conditions during low tides. Sediment and porewater samples were collected from four locations in Zone 1a (Z1A-3, Z1A-6, Z1A-9 and Z1A-12) and four locations in Zone 1b (Z1B-1 through Z1B-4) (Figure 4). Sediment samples comprised of material from the surface to a depth of 2 feet bgs were collected using hand tools (hand auger and trowel). Porewater samples were collected by inserting a PushPoint sampler into the sediment to a depth of approximately 1 foot bgs. The PushPoint sampler was connected to a peristaltic pump to extract porewater. Manual sediment and porewater samples collected from locations in Zone 1a (Z1A-3, Z1A-6, Z1A-9 and Z1A-12) were completed within approximately 5 to 10 feet of the proposed locations. Manual sediment and

porewater sample locations in Zone 1b (Z1B-1 through Z1B-4) were moved approximately 15 to 20 feet waterward due to the presence of debris in the upper shoreline. Sediment sampling logs documenting the sediment encountered at each manual sampling location are provided in Appendix A. NAPL was not encountered at the manual sediment sampling locations.

Sediment and porewater samples were collected in laboratory provided bottles and placed in coolers with ice for transport to the laboratory. The sediment sample locations were backfilled with bentonite and clean sand was placed on the surface of the boring in accordance with the Project Plans. Upon completion of sampling activities, the sediment and porewater samples were transported to Analytical Resources Laboratory, Inc (ARI) in Tukwila, Washington for the following analyses:

- Sediment samples
    - Diesel- and heavy oil-range total petroleum hydrocarbons by NWTPH-Dx with and without using silica gel cleanup.
    - Polycyclic aromatic hydrocarbons (PAHs) by United States Environmental Protection Agency (EPA) 8270.
    - Pentachlorophenol by EPA 8270.
    - Total organic carbon by EPA 9060A.
- Porewater samples
    - Diesel- and heavy oil-range total petroleum hydrocarbons by NWTPH-Dx.
    - PAHs by EPA 8270.
    - Pentachlorophenol by EPA 8041A.
    - Total organic carbon by EPA 9060A.

Manual sampling was also completed within the 2013 Interim Action area to collect samples from the organoclay amended sand cap and beneath the cap at locations OCM-1 and OCM-2 (Figure 4) on June 29, 2022. At each location samples were collected from a 6-inch interval within the amended cap material and from a 1-foot sample interval immediately below the cap. After sample collection the boring was backfilled with bentonite, covered with geotextile and then the existing quarry spalls were placed over the geotextile. The samples from the interim action cap were submitted to the laboratory for analysis of total organic carbon by EPA 9060A and the sediment samples collected from below the cap were analyzed for the following:

- Sediment samples
    - Diesel- and heavy oil-range total petroleum hydrocarbons by NWTPH-Dx with and without using silica gel cleanup.
    - PAHs by EPA 8270.
    - Pentachlorophenol by EPA 8270.
    - Total organic carbon by EPA 9060A.

Sediment sampling logs documenting the material encountered in the interim action sampling locations are provided in Appendix A. NAPL was not encountered at the interim action sample locations.

2.2. Sonic Drilling Sediment and Porewater Sampling

Sonic drilling and sediment sampling was completed June 27 through 29, 2022. Sonic drilling was completed in dry conditions during low tides and a crane set up in the upland was used to place the drill rig at the sampling locations. Sediment cores were completed at seven locations within Zone 1a (Z1A-1, Z1A-2, Z1A-4, Z1A-5, Z1A-7, Z1A-10 and Z1A-11). The sediment cores were advanced to depths ranging from 5 to 9.5 feet bgs.

Sample locations were modified in the field to avoid debris and allow a stable and safe surface for drilling. In general, samples were completed near the proposed sample locations identified in the Project Plans except for Z1A-7 and Z1A-8. At proposed location Z1A-8 concrete debris obstructed the proposed location and the only potential location was further shoreward. At proposed location ZA1-7 debris obstructed the location and the only potential location was further waterward. Therefore, the sampling locations converged and only one sediment core was collected and was named Z1A-7 and a separate sediment core was not performed for Z1A-8.

Sediment cores collected from the sample locations were transferred to the upland using the crane where the cores were logged and sampled. After sample collection, the excess sediment from the cores was placed in drums. Sediment core logs are presented in Appendix A. The logs identify the elevations where NAPL was observed during field screening of the sediment cores. Sediment samples were collected at intervals that generally represent the future pre-cap sediment surfaces following sediment excavation in Zone 1a. Figures 5 and 6 provide cross sections that show the minimum and maximum excavation limits along with the PRDI sediment and porewater sample locations.

Sediment was collected in laboratory provided bottles and placed in coolers with ice for transport to the laboratory for analysis. Sediment borings were backfilled with bentonite and clean sand was placed on the surface of the boring in accordance with the Project Plans. Upon completion of sampling activities, the sediment samples were transported to ARI for the following analyses:

- Diesel- and heavy oil-range total petroleum hydrocarbons by NWTPH-Dx with and without using silica gel cleanup.
- Polycyclic aromatic hydrocarbons (PAHs) by EPA 8270.
- Pentachlorophenol by EPA 8270.
- Total organic carbon by EPA 9060A.

In accordance with the Project Plans, additional sediment (approximately 15 liters) was collected at each of the highest elevation sample core locations (Z1A-1, Z1A-4, Z1A-7 and Z1A-10) for extraction of porewater. To the extent possible, sediment for porewater extraction was collected from below observed NAPL or approximately at the post-excavation surface. Poor sediment recovery and presence of larger wood debris (chunks, dimensional lumber, etc.) in the cores necessitated utilizing sediment from outside the target sample intervals to acquire the sediment for porewater extraction. The sediment collected for porewater analysis was transported to EcoAnalysts, Inc. (EcoAnalysts) in Port Gamble, Washington for porewater extraction by centrifuge. Due to characteristics of the sediment samples that were collected, the extracted porewater volume was less than the expected 1.5 liters needed to complete all of the porewater analyses identified in the Project Plans. Samples collected from locations Z1A-4 and Z1A-7 produced approximately 750 milliliters (mL) and 500 mL, respectively. Samples collected from location Z1A-1 and Z1A-10 only

produced approximately 75 mL of porewater. Therefore, selected analyses were performed on samples collected from each location. Based on discussions with ARI regarding the analyses that could be performed on the volume of porewater collected from Z1A-4 and Z1A-7, the porewater samples were analyzed for the following:

- Diesel- and heavy oil-range total petroleum hydrocarbons by NWTPH-Dx.
- PAHs and pentachlorophenol by EPA 8270.
- Total organic carbon by EPA 9060A.

Based on discussions with ARI regarding the analyses that could be performed on the volume of porewater collected from Z1A-1 and Z1A-10, the porewater samples were analyzed for the following:

- Diesel- and heavy oil-range total petroleum hydrocarbons by NWTPH-Dx.

Deviations from the Project Plans for the porewater samples extracted from sediment include the following:

- Pentachlorophenol was planned to be analyzed by EPA Method 8041A to achieve a lower detection limit but was not completed at the four locations. Pentachlorophenol was performed using EPA 8270, but with a higher detection limit than anticipated in the Project Plans.
- PAHs, pentachlorophenol, and total organic carbon could not be analyzed at Z1A-1 and Z1A-10 due to low porewater recovery.

3.0 ANALYTICAL RESULTS

The purpose of this PRDI was to collect analytical data that will inform the design of the amended caps for Zones 1a and 1b. During the FS, indicator hazardous substances (IHS) were selected for further evaluation to identify those contaminants requiring the most robust cap design to achieve cleanup standards. Based on this analysis, pentachlorophenol and 2-methylnaphthalene were selected for cap modeling, in part because of their higher dissolved-phase mobility in groundwater relative to other Site contaminants. The FS cap modeling also included total petroleum hydrocarbons for nearshore locations where sediment contains residual LNAPL.

PRDI sediment and porewater samples were also analyzed for carcinogenic PAHs (cPAHs), but these results were not expected to be used to modify the design of the cap or excavation elements of the cleanup action. cPAHs were detected above cleanup levels in most sediment samples collected from Zone 1a, but were not detected above cleanup levels in samples collected from Zone 1b. In addition, porewater samples did not have detectable cPAHs, with one exception. Because of their low mobility, as indicated by the lack of porewater detections in the PRDI samples, cPAHs are not a driver for the amended capping and were not considered in earlier cap modeling. The cPAH results are presented in Tables 1 and 2, but are not planned to be used for further cap modeling or to inform any modifications to the cap design.

The following sections further discuss the analytical data results for the PRDI focusing on analytical results for 2-methylnaphthalene, pentachlorophenol, and total TPH[1]. The analytical results for sediment and porewater samples are presented compared to Site cleanup levels in Tables 1 and 2, respectively.

3.1. Zone 1a

Sediment investigation was performed along four transects within Zone 1a as shown on Figure 4 and represented by cross-sections A-A' through D-D' in Figures 5 and 6. The cross-sections show each sample location and where each sediment sample interval was collected relative to the existing ground surface and minimum and maximum limits of the sediment excavation. Sediment samples in Zone 1a, particularly the subsurface samples collected by sonic drilling, contained multiple PAHs, total cPAH TEQ, total TPH, and pentachlorophenol at concentrations greater than the sediment cleanup levels. The elevated concentrations in sediment were expected based on previous site investigations identifying the area as a known source and the results of field screening observations during the PRDI. Field screening was performed during sediment coring along each transect to document the sediment conditions and identify the presence or absence of NAPL. As previously stated, this PRDI data report focuses on the contaminants that are the primary IHSs for cap design (2-methynaphthalene, pentachlorophenol, and total TPH). The following sections describe field screening observations and analytical results along each cross-section in Zone 1a.

3.1.1. Section A-A'

Sediment cores were advanced at locations Z1A-1, Z1A-2 and Z1A-3 in Section A-A' in the southern portion of Zone 1a (Figures 4 and 5).

NAPL was observed at location Z1A-1 from approximately 1 to 8 feet bgs (Figure 5). The sediment sample collected from Z1A-1 from 5.5 to 7.5 feet bgs had elevated concentrations of total TPH (up to 62,400 mg/kg) and pentachlorophenol (8,140 µg/kg) that represent NAPL-impacted sediment (Table 1). 2-methylnaphthalene was detected at a concentration below the cleanup level in the sample collected from 5.5 to 7.5 feet bgs. A second sediment sample was collected directly below the observed NAPL from 7.5 to 9.5 feet bgs at Z1A-1. The sample collected from 7.5 to 9.5 feet bgs had a significantly lower total TPH concentration (2,917 mg/kg). The concentration of pentachlorophenol was also significantly lower as pentachlorophenol was not detected. The pentachlorophenol reporting limit (222 µg/kg) was greater than the cleanup level (100 µg/kg) in the sediment sample likely due to interference from the presence of other contaminants in the sample. 2-methylnaphthalene was detected at a concentration below the cleanup level in the sample collected from 7.5 to 9.5 feet bgs (Table 1).

NAPL was not observed in the sediment core collected at Z1A-2 (waterward of Z1A-1) (Figure 5). One sample was collected and analyzed from Z1A-2 from 3.5 to 5.5 feet bgs. The TPH concentration (2,014 mg/kg) was greater than the cleanup level but less than concentrations indicating the presence of NAPL. 2-methylnaphthalene was detected at a concentration below the cleanup level in the sample collected from

[1] Sediment samples were analyzed for diesel-range TPH with and without silica gel cleanup preparation for comparison to previous investigation data. For the purposes of discussions in this report and to be conservative the total TPH concentration refers to the highest concentration between results with and without silica gel cleanup.

Z1A-2. Pentachlorophenol was not detected at a reporting limit (187 µg/kg) greater than the cleanup level (100 µg/kg) likely due to interference from the presence of other contaminants in the sample. (Table 1).

NAPL was also not observed in sediment collected at Z1A-3 (waterward of Z1A-2) at the waterward boundary of the sediment excavation area in Section A-A'. One sample was collected and analyzed from Z1A-3 from 0 to 2 feet bgs. The TPH concentration (498 mg/kg) was greater than the cleanup level but less than concentrations indicating the presence of NAPL. 2-methylnaphthalene was detected at a concentration below the cleanup level in the sample collected from Z1A-3 and pentachlorophenol was not detected at a reporting limit (99 µg/kg) below the cleanup level (100 µg/kg) (Table 1).

Field observations and the analytical results for the sediment sample collected from 5.5 to 7.5 feet bgs at location Z1A-1 indicate the presence of NAPL in sediment below the minimum limit of excavation (Figure 5).

Porewater samples were collected from Z1A-1 and Z1A-3. As described in Section 2.2, only TPH analysis was performed on the sample collected from Z1A-1 due to the limited volume of porewater that was able to be extracted from the sample. The total TPH concentration in porewater from Z1A-1 was 3.14 mg/L. TPH and 2-methylnaphthalene were not detected in porewater collected from Z1A-3 at the boundary of the sediment excavation area in Section A-A' at reporting limits below cleanup levels. Pentachlorophenol was not detected at a reporting limit (0.25 µg/L) above the cleanup level (0.04 µg/L) in the porewater sample collected from Z1A-3 due to matrix interference in the sample (Table 2).

3.1.2. Section B-B'

Sediment cores were advanced at locations Z1A-4, Z1A-5 and Z1A-6 in Section B-B' near the southern extent of the existing sheet pile wall in Zone 1a (Figures 4 and 5).

NAPL was observed at location Z1A-4 from approximately 1 to 5.5 feet bgs. The sediment sample at Z1A-4 collected from 3.5 to 5.5 feet bgs had concentrations of total TPH (up to 32,650 mg/kg), 2-methylnaphthalene (157,000 µg/kg), and pentachlorophenol (1,610 µg/kg) that represent NAPL-impacted sediment. A second sample collected from 6.5 to 8.5 feet bgs and below the observed NAPL had significantly lower total TPH (470 mg/kg) and 2-methylnaphthalene (2,180 µg/kg) concentrations. The concentration of pentachlorophenol was also lower as pentachlorophenol was not detected. The pentachlorophenol reporting limit (996 µg/kg) was greater than the cleanup level (100 µg/kg) in the sediment sample likely due to interference from the presence of other contaminants in the sample.(Table 1).

NAPL was not observed in the sediment core collected at Z1A-5 (waterward of Z1A-4). One sample was collected and analyzed from Z1A-5 from 2.5 to 4.5 feet bgs. The total TPH concentration (5,410 mg/kg) was greater than cleanup level but less than concentrations indicative of the presence of NAPL. 2-methylnaphthalene was detected at a concentration below the cleanup level in the sample collected from Z1A-5. Pentachlorophenol was not detected at a reporting limit (187 µg/kg) greater than the cleanup level(100 µg/kg) likely due to interference from the presence of other contaminants in the sample (Table 1).

NAPL was not observed in sediment collected at Z1A-6 (waterward of Z1A-5) at the waterward boundary of the sediment excavation area in Section B-B'. One sample was collected at Z1A-6 from 0 to 2 feet bgs. The TPH concentration (4,410 mg/kg) was greater than the cleanup level but less than concentrations

indicating the presence of NAPL. 2-methylnaphthalene was detected at a concentration below the cleanup level in the sample collected from Z1A-6 and pentachlorophenol was not detected at a reporting limit (99.9 µg/kg) below the cleanup level (100 µg/kg) (Table 1).

Field observations and the analytical results for the sediment sample collected from 3.5 to 5.5 feet bgs at location Z1A-4 indicate the presence of NAPL in sediment below the minimum limit of excavation (Figure 5).

Porewater samples were collected from Z1A-4 and Z1A-6. The porewater from sample location Z1A-4 was extracted from sediment with and without observed NAPL because sediment recovery was limited due to wood debris being present at the core location. TPH and PAH analysis and analysis of pentachlorophenol using EPA Method 8270 was performed on the sample collected from Z1A-4. The total TPH concentration in porewater from Z1A-4 was 23.77 mg/L and 2-methylnaphthalene was detected in porewater at 82.6 µg/L exceeding the cleanup level of 15 µg/L. Pentachlorophenol was not detected but at an elevated detection limit (14.3 µg/L) due to low sample volume and use of EPA Method 8270 and matrix interference. The elevated results for TPH and 2-methylnaphthalene in the porewater sample from Z1A-4 corresponds to the portion of the sample that had residual NAPL.

The total TPH concentration in porewater at Z1A-6 was 0.386 mg/L and 2-methylnaphthalene was not detected above the cleanup level. Pentachlorophenol was not detected at a reporting limit (0.25 µg/L) above the cleanup level (0.04 µg/L) in Z1A-6 due to matrix interference (Table 2).

3.1.3. Section C-C'

Sediment cores were advanced at locations Z1A-7 and Z1A-9 in Section C-C' near the middle of the existing sheet pile wall within Zone 1a (Figures 4 and 6).

NAPL was observed at location Z1A-7 from 1 to 3 feet bgs. The sediment sample at Z1A-7 that was collected from 2.5 to 4.5 feet bgs had concentrations of total TPH (2,621 mg/kg) greater than the cleanup level but less than concentrations indicating NAPL. 2-methylnaphthalene was detected at a concentration below the cleanup level. Pentachlorophenol was not detected at a reporting limit (300 µg/kg) greater than the cleanup level (100 µg/kg) likely due to interference from the presence of other contaminants in the sample. A second sample collected from 4.5 to 6.5 feet bgs and below the observed NAPL had total TPH (1,971 mg/kg) and 2-methylnaphthalene (745 µg/kg) concentrations greater than the cleanup level but lower than concentrations indicative of NAPL. Pentachlorophenol was not detected at a reporting limit (299 µg/kg) greater than the cleanup level (100 µg/kg) likely due to interference from the presence of other contaminants in the sample collected from 4.5 to 6.5 feet bgs (Table 1).

NAPL was not observed in sediment collected at Z1A-9 (waterward of Z1A-7) at the waterward boundary of the sediment excavation area. One sample was collected from Z1A-9 from 0 to 2 feet bgs. The total TPH concentration (266 mg/kg) was slightly greater than the cleanup level but less than concentrations indicating the presence of NAPL. Pentachlorophenol was detected at a concentration (113 µg/kg) slightly greater than the cleanup level (100 µg/kg) and 2-methylnaphthalene was detected at a concentration less than the cleanup level in the sample collected from Z1A-9 (Table 1).

Field observations at location Z1A-7 indicate the presence of NAPL in sediment below the minimum limit of excavation (Figure 6).

Porewater samples were collected from Z1A-7 and Z1A-9. TPH and PAH analysis and analysis of pentachlorophenol using EPA Method 8270 were performed on the sample collected from Z1A-7. The total TPH concentration in porewater from Z1A-7 was 3.41 mg/L. 2-methynaphthalene was not detected in the porewater sample collected from Z1A-7 and pentachlorophenol was not detected but at an elevated detection limit (18.2 µg/L) due to low sample volume and use of EPA Method 8270 and matrix interference. In the porewater sample collected from Z1A-9, TPH and 2-methylnaphthalene were not detected at reporting limits below cleanup levels. Pentachlorophenol was also not detected in porewater collected from Z1A-9 at a reporting limit (0.05 µg/L) slightly above the cleanup level (0.04 µg/L) (Table 2).

3.1.4. Section D-D'

Sediment cores were advanced at locations Z1A-10, Z1A-11 and Z1A-12 in Section D-D' in the northern portion of Zone 1a (Figures 4 and 6).

NAPL was observed in location Z1A-10 from approximately 0.5 to 6 feet bgs. The sediment sample at Z1A-10 collected from 3.5 to 5.5 feet bgs had elevated concentrations of total TPH (8,202 mg/kg) and 2-methylnaphthalene (137,000 µg/kg) that represent NAPL impacted sediment (Table 1). Pentachlorophenol was not detected at a reporting equivalent to the cleanup level (100 µg/kg) in the sample collected from 3.5 to 5.5 feet bgs. A second sample collected from 6.5 to 8.5 feet bgs and below the observed NAPL had detected concentrations of total TPH and 2-methylnaphthatlene less than cleanup levels and pentachlorophenol was not detected at reporting limit less than the cleanup level(Table 1).

NAPL was observed in the sediment core collected at Z1A-11 (waterward of Z1A-10) from 1.5 to 5 feet bgs. One sample was collected from Z1A-11 from 4 to 6 feet bgs. The total TPH (632 mg/kg) in the sample from Z1A-11 was greater than the cleanup level but less than concentrations that indicate the presence of NAPL. 2-methylnaphthatlene was detected at a concentration less than the cleanup level and pentachlorophenol was not detected at a reporting limit (99.8 µg/kg) below the cleanup level (100 µg/kg) (Table 1).

NAPL was not observed in sediment collected at Z1A-12 (waterward of Z1A-11) at the waterward boundary of the sediment excavation area in Section D-D'. One sample was collected at Z1A-12 from 0 to 2 feet bgs. The TPH concentration (543 mg/kg) was greater than the cleanup level but less than concentrations indicating the presence of NAPL. Pentachlorophenol (205 µg/kg) was detected at a concentration greater than the cleanup level and 2-methylnaphthalene was detected at a concentration less than the cleanup level in the sample collected from Z1A-12 (Table 1).

Field observations and the analytical results for the sediment sample collected from 4 to 6 feet bgs at location Z1A-10 indicate the presence of NAPL in sediment below the minimum limit of excavation. Field observations at location Z1A-11 also indicate the presence of NAPL in sediment below the minimum limit of excavation (Figure 6).

Porewater samples were collected from Z1A-10 and Z1A-12. The porewater from sample location Z1A-10 was extracted from sediment with and without observed NAPL because sediment recovery was limited due to wood debris being present at the core location. As described in Section 2.2, only TPH analysis was performed on the sample collected from Z1A-10 due to the limited volume of porewater that was able to be extracted from the sample. The total TPH concentration in porewater from Z1A-10 was 13.8 mg/L. The elevated results for TPH in the porewater sample from Z1A-10 corresponds to a portion of the sample that had residual NAPL. In the porewater sample collected from Z1A-12 total TPH was detected at a

concentration of 0.331 mg/L. Pentachlorophenol was detected at a concentration (0.14 µg/L) exceeding the cleanup level of 0.04 µg/L and 2-methylnaphthalene was not detected at a concentration below the cleanup level (Table 2).

3.2. Zone 1b

Near surface sediment and porewater samples were collected from 0 to 2 feet bgs at locations Z1B-1 through Z1B-4 in Zone 1b using hand tools. NAPL was not observed in sediment at locations Z1B-1 through Z1B-4. The analytical results for sediment and porewater samples are presented in Tables 1 and 2, respectively.

TPH, 2-methylnaphthalene and pentachlorophenol were not detected at concentrations greater than the cleanup levels in sediment samples collected from Zone 1b. TPH, 2-methylnaphthalene and pentachlorophenol were not detected at reporting limits below the cleanup levels in porewater samples collected at Z1B-1, Z1B-3 and Z1B-4 in Zone 1b. TPH was detected in porewater at Z1B-2 at a concentration of 0.58 mg/L. 2-methylnaphthalene and pentachlorophenol were not detected at reporting limits below the cleanup levels in porewater at Z1B-2.

3.3. Interim Action Cap

Samples were collected at locations OCM-1 and OCM-2 within the area of amended sand cap placed as an Interim Action in 2013. Two samples were collected of the amended sand cap material and the sediment immediately underlying the amended sand cap.

The amended sand cap material samples collected at OCM-1 and OCM-2 from 0 to 0.5 feet bgs had total organic carbon concentrations of 4.33 and 8.41 percent, respectively. The samples of sediment collected from beneath the amended sand cap at OCM-1 and OCM-2 had total TPH concentrations of 1,231 and 5,640 mg/kg, respectively. The sediment sample collected at OCM-2 also had 2-methylnaphthalene at a concentration of 1,890 µg/kg and pentachlorophenol at a concentration of 563 µg/kg. Pentachlorophenol was not detected and 2-methylnaphthalene was detected at a concentration less than the cleanup level in the sediment sample collected from OCM-1.

The data collected from sediment beneath the interim action cap will be used in conjunction with the other sediment data collected within Zone 1a to evaluate the need to modify the current cap design. In addition, this sediment data will be evaluated in the context of the TOC values from the overlying cap material to provide additional information on interim action cap performance.

4.0 USE OF PRDI RESULTS FOR DESIGN OF THE SEDIMENT EXCAVATION AND AMENDED SEDIMENT SAND CAPS

The overall objective of the PRDI was to collect sediment and porewater data to provide information to support design of the sediment excavation in Zone 1a and amended sand caps in Zone 1a and 1b. Specifically, the results will be used to determine the depth of sediment excavation to be performed in Zone 1a and to revise the inputs into the sediment cap model to determine the type and quantities of amendment that will be used in the caps to be placed in Zone 1a and 1b. Sufficient data was collected to meet the PRDI objectives and support the remedial design for Zone 1a and 1b.

The sediment and porewater analytical results will be evaluated to determine the limit of excavation to remove NAPL impacted sediment in Zone 1a. The results from the PRDI indicate that NAPL impacted sediment extends deeper than the minimum limit of excavation.

The data collected as part of the PRDI will also be evaluated and utilized to determine the concentrations in sediment and porewater that represent the post-excavation conditions in Zone 1a and pre-cap conditions in Zone 1b. The analytical data, including the reporting limits, will be used to update the cap modeling completed as part of the feasibility study (FS) and EDR. The sediment cap modeling performed to support design of the sediment caps in Zone 1a and 1b is provided in Appendix C of the EDR (GeoEngineers 2022a). A one-dimensional transient model was used to evaluate contaminant transport within cap material under selected cap design scenarios. Analyses were performed using the transient numerical modeling program CAPSIM© (Version 3.6) developed by Dr. Danny Reible and associates (Reible 2018). The CAPSIM program is a well-accepted model that is commonly used to evaluate the contaminant isolation capability of sediment caps. Additional sediment cap modeling will be completed prior to the 90% design to modify input parameters to the CAPSIM model for Zones 1a and 1b based on the results of the PRDI. The following general steps will be completed to refine the CAPSIM model for sediment caps in Zones 1a and 1b:

- Modify the contaminant-specific input parameters for the model based on the PRDI data. Specifically, the porewater concentration input values for 2-methylnaphthalene, pentachlorophenol, and TPH, representing conditions entering the cap, will be revised for Zone 1a and 1b.
- Complete model sensitivity analyses to address the range of concentrations in sediment and porewater from the PRDI. Identify factors of safety to achieve containment of contamination as required for the cleanup action.
- Identify constructable cap design parameters that can be incorporated into the 90% cleanup action design.

Additionally, the results from samples collected from the organoclay cap installed as part of the interim action performed in 2013 will be evaluated to determine an approximate adsorption rate of contaminants to the organoclay amendment used in the cap. The evaluation of the organoclay adsorption rate is anticipated to provide a line of empirical evidence to compare to the cap modeling results.

The revisions to the Zone 1a sediment excavation depth and modifications to the CAPSIM model used as the basis for the amended sand cap material will be documented in a technical memorandum and submitted to Ecology for review prior to the 90% design.

5.0 REFERENCES

Ecology 2018. Agreed Order No. DE 15776 between the Washington State Department of Ecology and the City of Bellingham, for the R.G. Haley Site. June 1, 2018.

GeoEngineers 2022a. Final Engineering Design Report, R.G. Haley International Corporation Site; Bellingham, Washington. May 13, 2022.

GeoEngineers 2022b. Pre-Remedial Design Investigation Project Plans – Marine Unit, R.G. Haley Site; Bellingham, Washington. March 18, 2022.

Reible, D., 2018. CapSim v. 3.6. Accessed online at: https://www.depts.ttu.edu/ceweb/groups/reiblesgroup/CapSim.html.

Table 1

Sediment Analytical Results

R.G Haley Site

Bellingham, Washington

Parameter	Sediment Cleanup Level [1]	Sample Location	Z1A-1	Z1A-1	Z1A-2	Z1A-3	Z1A-4	Z1A-4	Z1A-5	Z1A-6
		Sample ID	Z1A-1-SC_5.5-7.5	Z1A-1-SC_7.5-9.5	Z1A-2-SC_3.5-5.5	Z1A-3-MS	Z1A-4-SC_3.5-5.5	Z1A-4-SC_6.5-8.5	Z1A-5-SC_2.5-4.5	Z1A-6-MS
		Date Sampled	6/27/2022	6/27/2022	6/27/2022	6/14/2022	6/28/2022	6/28/2022	6/28/2022	6/14/2022
		Depth Interval (ft bgs)	5.5-7.5	7.5-9.5	3.5-5.5	0-2	3.5-5.5	6.5-8.5	2.5-4.5	0-2
Conventionals (percent)										
Total Organic Carbon	0.5		46.3	55.0	55.8	9.41 J	38.5	17.3	47.8	12.7
Parameter	NE		23.77	24.38	25.96	56.24	34.85	39.86	23.57	44.47
PAHs (µg/kg)										
1-Methylnaphthalene	NE		**574 J**	**85.8**	**310**	**13.1 J**	**145,000**	**1,540**	**375**	**62.3**
2-Methylnaphthalene	670		**211 J**	**120**	**471**	**18.4 J**	**157,000**	**2,180**	**527**	**98.1**
Acenaphthene	500		211 U	**109**	**221**	**5.6 J**	**38,000 J**	**13,000**	**563**	**163**
Benzo(a)anthracene	1,300		**168 J**	**563**	**639**	**32.9**	**784 J**	**12,200**	**2,120 J**	**919**
Benzo(a)pyrene	NE		**220**	**811**	**1,120**	**37.7**	**760**	**11,100**	**2,640**	**1,350**
Benzo(b)fluoranthene	NE		**134 J**	**562**	**674**	**32.6**	**668**	**6,120**	**3,120**	**923**
Benzo(k)fluoranthene	NE		**90.1 J**	**632**	**865**	**28.6**	**489**	**7,820**	**2,800**	**1,000**
Chrysene	NE		**383 J**	**904**	**961 J**	**51.3**	**1,410 J**	**14,600 J**	**2,990 J**	**1,230**
Dibenzo(a,h)anthracene	NE		211 U	**52.2**	**55.7**	20.0 U	100 U	**2,090**	**57.3**	**80.6**
Fluoranthene	1,700		**316 J**	**1,130 J**	**8,380 J**	**115**	**3,310 J**	**37,000 J**	**3,590 J**	**1,320**
Indeno(1,2,3-c,d)pyrene	NE		**164 J**	**174**	**388**	**20.0 J**	**238**	**4,930**	**193**	**209**
Naphthalene	2,100		**299**	**1,530**	**11,100**	**67.1**	**9,060**	**3,780**	**5,260**	**639**
Phenanthrene	1,500		**522 J**	**1,660**	**6,770**	**69.7**	**71,600 J**	**53,900**	**9,390 J**	**1,410**
Total cPAH TEQ (ND=0.5RL)	229		**290 J**	**1,018**	**1,392**	**50.6**	**997**	**14,562**	**3,499**	**1,675**
Petroleum Hydrocarbons (mg/kg) [2]										
Diesel Fuel	NE		**44,400**	**977**	**764**	**123**	**25,600**	**160**	**2,070**	**1,630**
Heavy Oil	NE		**8,290**	**1,940**	**1,250**	**365**	**7,050**	**310**	**3,340**	**2,780**
Petroleum Hydrocarbons (Total)	260		**52,690**	**2,917**	**2,014**	**488**	**32,650**	**470**	**5,410**	**4,410**
Petroleum Hydrocarbons (mg/kg) [3]										
Diesel Fuel	NE		**51,400**	**691**	**501**	**91.4**	**24,900**	**112**	**1,890**	**937**
Motor Oil	NE		**11,000**	**1,960**	**929**	**407**	**6,390**	**184**	**2,900**	**1,840**
Petroleum Hydrocarbons (Total)	260		**62,400**	**2,651**	**1,430**	**498**	**31,290**	**296**	**4,790**	**2,777**
Phenols (µg/kg)										
Pentachlorophenol	100		**8,140 J**	222 U	187 U	99.9 U	**1,610 J**	996 U	187 U	99.9 U

Notes:

[1] Sediment cleanup levels based on dry weight as provided in the Final Engineering Design Report (EDR).

[2] Petroleum hydrocarbons analyzed by Northwest Method Dx.

[3] Petroleum hydrocarbons analyzed by Northwest Method Dx with silica gel cleanup.

Value is greater than the cleanup level.

Detection limit is greater than cleanup level.

Bold indicates that the analyte was detected.

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

J = Estimated value

U = Not detected at or above identified detection limit

-- = Sample was not submitted for the identified chemical analysis

NE = A criterion has not been established for the identified analyte

Parameter	Sediment Cleanup Level [1]	Sample Location	Z1A-7	Z1A-7	Z1A-9	Z1A-10	Z1A-10	Z1A-11	Z1A-12	Z1B-1
		Sample ID	Z1A-7-SC_2.5-4.5	Z1A-7-SC_4.5-6.5	Z1A-9-MS	Z1A-10-SC_3.5-5.5	Z1A-10-SC_6.5-8.5	Z1A-11-SC_4.0-6.0	Z1A-12-MS	Z1B-1-MS
		Date Sampled	6/28/2022	6/28/2022	6/15/2022	6/29/2022	6/29/2022	6/29/2022	6/15/2022	6/14/2022
		Depth Interval (ft bgs)	2.5-4.5	4.5-6.5	0-2	3.5-5.5	6.5-8.5	4.0-6.0	0-2	0-2
Conventionals (percent)										
Total Organic Carbon	0.5		5.23	7.17	2.28	5.83	6.33	9.44	0.37	1.08
Parameter	NE		61.72	63.12	79.31	77.01	69.89	70.44	76.93	82.32
PAHs (µg/kg)										
1-Methylnaphthalene	NE		**785 J**	**583 J**	**29.3**	**75,300 J**	**387**	**8,280**	**157**	**7.0 J**
2-Methylnaphthalene	670		**527**	**745**	**46.2**	**137,000 J**	**320**	**389**	**49**	**7.9 J**
Acenaphthene	500		**2,140**	**3,020**	**10.1 J**	**7420 J**	**57.2**	**1,690**	**86.5**	**6.2 J**
Benzo(a)anthracene	1,300		**5,130**	**14,500**	**60.5**	**534 J**	**21.1**	**1,570**	**73.7**	**147**
Benzo(a)pyrene	NE		**5,170 J**	**14,400**	**70.0**	**539**	**30.3**	**1,780**	**162**	**176**
Benzo(b)fluoranthene	NE		**5,250 J**	**8,360**	**48.7**	**334**	**16.6 J**	**1,040**	**132**	**135**
Benzo(k)fluoranthene	NE		**3,570 J**	**9,520**	**67.1**	**429**	**20.3**	**1,450**	**117**	**120**
Chrysene	NE		**7,070 J**	**15,200 J**	**90.1**	**788**	**34.4**	**1,750**	**107**	**177**
Dibenzo(a,h)anthracene	NE		**497 J**	**1,360 J**	19.9 U	**68.9 J**	19.9 U	**157**	**22.2**	**19.2 J**
Fluoranthene	1,700		**16,300 J**	**38100 J**	**161**	**814 J**	**75.3 J**	**7,380 J**	**226**	**427**
Indeno(1,2,3-c,d)pyrene	NE		**1,290 J**	**3,630 J**	**30.2**	**195 J**	**17.1 J**	**368**	**52**	**57.5**
Naphthalene	2,100		**1,250**	**4,080**	**70.8**	**4,410 J**	**250**	**1,310**	**36.2**	**11.5 J**
Phenanthrene	1,500		**17,400**	**26,900**	**129**	**19,400 J**	**118**	**4,750**	**124**	**124**
Total cPAH TEQ (ND=0.5RL)	229		**6,810**	**18,300**	**92.5**	**703**	**39.2 J**	**2,256 J**	**203**	**226 J**
Petroleum Hydrocarbons (mg/kg) [2]										
Diesel Fuel	NE		**911**	**881**	**35.5**	**7,140 J**	**37.8**	**259**	**293 J**	**31.8**
Heavy Oil	NE		**1,710**	**1,090**	**85.9**	**609 J**	**64**	**373**	**72.5 J**	**124**
Petroleum Hydrocarbons (Total)	260		**2,621**	**1,971**	**121**	**7,749 J**	**102**	**632**	**366 J**	**156**
Petroleum Hydrocarbons (mg/kg) [3]										
Diesel Fuel	NE		**748**	**632**	**56.8**	**7,580 J**	**23.0**	**235**	**443 J**	**27.4**
Motor Oil	NE		**1,410**	**699**	**209**	**622**	**36.5**	**325**	**100 J**	**173**
Petroleum Hydrocarbons (Total)	260		**2,158**	**1,331**	**266**	**8,202 J**	**59.5**	**560**	**543 J**	**200**
Phenols (µg/kg)										
Pentachlorophenol	100		300 U	299 U	**113 J**	100 UJ	99.7 U	99.8 U	**205 J**	99.9 U

Notes:

[1] Sediment cleanup levels based on dry weight as provided in the Final Engineering Desi

[2] Petroleum hydrocarbons analyzed by Northwest Method Dx.

[3] Petroleum hydrocarbons analyzed by Northwest Method Dx with silica gel cleanup.

Value is greater than the cleanup level.

Detection limit is greater than cleanup level.

Bold indicates that the analyte was detected.

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

J = Estimated value

U = Not detected at or above identified detection limit

-- = Sample was not submitted for the identified chemical analysis

NE = A criterion has not been established for the identified analyte

Parameter	Sediment Cleanup Level [1]								
Sample Location		Z1B-2	Z1B-2-MS	Z1B-3	Z1B-4	OCM-1	OCM-1	OCM-2	OCM-2
Sample ID		Z1B-2-MS	DUP-1-MS	Z1B-3-MS	Z1B-4-MS	OCM-1-CAP	OCM-1-MS	OCM-2-CAP	OCM-2-MS
Date Sampled		6/14/2022	6/14/2022	6/14/2022	6/15/2022	6/29/2022	6/29/2022	6/29/2022	6/29/2022
Depth Interval (ft bgs)		0-2		0-2	0-2	0-0.5	0.5-2.5	0-0.5	0.5-2.5
Conventionals (percent)									
Total Organic Carbon	0.5	0.47	0.91	0.14	0.95	4.33	5.64	8.41	11.3
Parameter	NE	85.83	85.13	86.19	80.36	76.52	70.89	79.10	47.39
PAHs (µg/kg)									
1-Methylnaphthalene	NE	20.0 U	20.0 U	**7.7 J**	**20.3**	--	**71.0**	--	**957**
2-Methylnaphthalene	670	20.0 U	**5.6 J**	**9.3 J**	**21.4**	--	**111**	--	**1,890**
Acenaphthene	500	20.0 U	**5.3 J**	20.0 U	19.9 U	--	**11.8 J**	--	**150 J**
Benzo(a)anthracene	1,300	**14.0 J**	**128 J**	**9.7 J**	**8.0 J**	--	**15.9 J**	--	**180 J**
Benzo(a)pyrene	NE	**15.7 J**	**143 J**	**11.4 J**	**6.3 J**	--	**33.7**	--	**128**
Benzo(b)fluoranthene	NE	**12.3 J**	**126 J**	**9.3 J**	19.9 U	--	**40.5**	--	**113**
Benzo(k)fluoranthene	NE	**9.9 J**	**113 J**	**8.6 J**	**9.8 J**	--	**13.6 J**	--	**100**
Chrysene	NE	**17.6 J**	**150 J**	**14.3 J**	**11.3 J**	--	**26.8**	--	**347 J**
Dibenzo(a,h)anthracene	NE	20.0 U	**20.9**	20.0 U	19.9 U	--	20.0 U	--	99.9 U
Fluoranthene	1,700	**33.8 J**	**366 J**	**37.5**	**27.3**	--	**26.2 J**	--	**467 J**
Indeno(1,2,3-c,d)pyrene	NE	20.0 U	**55.1**	20.0 U	19.9 U	--	20.0 U	--	99.9 U
Naphthalene	2,100	20.0 U	**10.8 J**	**8.6 J**	**16.2 J**	--	**22.6**	--	**475**
Phenanthrene	1,500	**14.6 J**	**84.3 J**	**15.8 J**	**12.5 J**	--	**60.5**	--	**669 J**
Total cPAH TEQ (ND=0.5RL)	229	**21.5 J**	**188 J**	**16.3 J**	**11.2 J**	--	**43.0 J**	--	**181**
Petroleum Hydrocarbons (mg/kg) [2]									
Diesel Fuel	NE	**12.8 J**	**31.3 J**	5.79 U	**32.5**	--	**526**	--	**3,350**
Heavy Oil	NE	**52.2 J**	**120 J**	**12.6**	**103**	--	**705**	--	**2,290**
Petroleum Hydrocarbons (Total)	260	**65 J**	**151 J**	**12.6**	**136**	--	**1,231**	--	**5,640**
Petroleum Hydrocarbons (mg/kg) [3]									
Diesel Fuel	NE	**7.97 J**	**22.9 J**	**5.81**	**10.3**	--	**207**	--	**2,740**
Motor Oil	NE	**45.3 J**	**107 J**	**14.9**	**65.1**	--	**167**	--	**1,850**
Petroleum Hydrocarbons (Total)	260	**53.3 J**	**130 J**	**20.7**	**75.4**	--	**374**	--	**4,590**
Phenols (µg/kg)									
Pentachlorophenol	100	**32.4 J**	99.9 U	99.9 U	99.5 U	--	99.8 U	--	**563 J**

Notes:

[1] Sediment cleanup levels based on dry weight as provided in the Final Engineering Desi

[2] Petroleum hydrocarbons analyzed by Northwest Method Dx.

[3] Petroleum hydrocarbons analyzed by Northwest Method Dx with silica gel cleanup.

Value is greater than the cleanup level.

Detection limit is greater than cleanup level.

Bold indicates that the analyte was detected.

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

J = Estimated value

U = Not detected at or above identified detection limit

-- = Sample was not submitted for the identified chemical analysis

NE = A criterion has not been established for the identified analyte

Table 2

Porewater Analytical Results

R.G Haley Site

Bellingham, Washington

Parameter	Groundwater Cleanup Level[1]	Sample Location	Z1A-1	Z1A-3	Z1A-4	Z1A-6	Z1A-7	Z1A-9	Z1A-10	Z1A-12	Z1B-1	Z1B-2	Z1B-2	Z1B-3	Z1B-4
		Sample ID	Z1A-1-PW	Z1A-3-PW	Z1A-4-PW	Z1A-6-PW	Z1A-7-PW	Z1A-9-PW	Z1A-10-PW	Z1A-12-PW	Z1B-1-PW	Z1B-2-PW	DUP-1-PW	Z1B-3-PW	Z1B-4-PW
		Date Sampled	7/6/2022	6/14/2022	7/6/2022	6/14/2022	7/6/2022	6/15/2022	7/6/2022	6/15/2022	6/14/2022	6/14/2022	6/14/2022	6/15/2022	6/15/2022
Conventionals (percent)															
Total Organic Carbon	NE		--	6.72	29.86	4.36	23.43	2.93	--	1.63	3.99	7.44	4.22	3.67	2.08
PAHs (µg/L)															
1-Methylnaphthalene	15		--	1.0 U	**239**	1.0 U	**3.3**	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Methylnaphthalene	15		--	1.0 U	**82.6**	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Acenaphthene	5.3		--	1.0 U	**20.4**	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Naphthalene	NE		--	1.0 U	**26**	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Phenanthrene	NE		--	1.0 U	**45.9**	1.0 U	**0.8 J**	1.0 U	--	1.0 U	1.0 U	1.0 UJ	**2.1 J**	1.0 U	1.0 U
Benzo(a)anthracene	0.01		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	**1.4**	1.0 U	1.0 U
Benzo(a)pyrene	NE		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	**1.2**	1.0 U	1.0 U
Benzo(b)flouranthene	NE		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	**0.9 J**	1.0 U	1.0 U
Benzo(k)flouranthene	NE		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	**1.2**	1.0 U	1.0 U
Chrysene	NE		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	**1.8**	1.0 U	1.0 U
Dibenzo(a,h)anthracene	NE		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Fluoranthene	NE		--	1.0 U	**1.3 J**	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 UJ	**3.1 J**	1.0 U	1.0 U
Indeno(1,2,3-c,d)pyrene	NE		--	1.0 U	1.4 U	1.0 U	1.8 U	1.0 U	--	1.0 U	1.0 U	1.0 U	**0.5 J**	1.0 U	1.0 U
Total cPAHs	0.02		--	0.755 U	1.057 U	0.755 U	1.359 U	0.755 U	--	0.755 U	0.755 U	0.755 U	**1.668 J**	0.755 U	0.755 U
Petroleum Hydrocarbons (mg/L)															
Diesel Fuel	NE		**1.72**	0.100 U	**19.6**	**0.116**	**1.32**	0.100 U	**13.8**	**0.331**	0.100 U	**0.256**	**0.212**	0.100 U	0.100 U
Heavy Oil	NE		**1.42**	0.200 U	**4.17**	**0.27**	**2.09**	0.200 U	1.33 U	0.200 U	0.200 U	**0.328**	**0.367**	0.200 U	0.200 U
Petroleum Hydrocarbons (Total)[2]	NE		**3.14**	0.200 U	**23.77**	**0.386**	**3.41**	0.200 U	**13.8**	**0.331**	0.200 U	**0.584**	**0.579**	0.200 U	0.200 U
Phenols (µg/L)															
Pentachlorophenol (by EPA Method 8041)	0.04		--	0.25 U[4]	--	0.25 U[4]	--	0.05 U[5]	--	**0.14**[6]	0.05 U[5]	0.05 U[5]	0.25 U[4]	0.05 U[5]	0.05 U[5]
Pentachlorophenol (by EPA Method 8270)[2]	0.04		--	--	14.3 U	--	18.2 U	--	--	--	--	--		--	--

Notes:

[1] Groundwater cleanup levels are those identified in the R.G. Haley Engineering Design Report (EDR).

[2] Highest detection limit concentration used for total if diesel and heavy oil are not detected.

[3] Pentachlorophenol analysis completed by EPA 8270 due to low porewater extraction volume. Combined with other PAH analysis.

[4] Initial pentachlorophenol analysis completed by EPA 8041 resulted in no detection at an elevated reporting limit of 0.25 µg/L. Sample was reanalyzed but reporting limit increased due to matrix interference.

[5] Initial pentachlorophenol analysis completed by EPA 8041 resulted in no detection at an elevated reporting limit of 0.25 µg/L. Sample was reanalyzed and the reporting limit was decreased to 0.05 µg/L.

[6] Initial pentachlorophenol analysis completed by EPA 8041 resulted in no detection at an elevated reporting limit of 0.25 µg/L. Sample was reanalyzed and pentachlorophenol was detected below the initial reporting limit.

Value is greater than the cleanup level.

Detection limit is greater than cleanup level.

Bold indicates that the analyte was detected.

mg/L = milligrams per liter

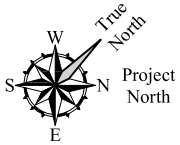
µg/L = micrograms per liter

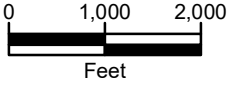
J = Estimated value

U = Not detected at or above identified detection limit

-- = Sample was not submitted for the identified chemical analysis

NE = A cleanup has not been established for the identified analyte





Reference: Whatcom County GIS, City of Bellingham GIS, Aerial from Esri, 2017.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
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Projection: NAD 1983 UTM Zone 10N

Vicinity Map

R.G. Haley Site
Bellingham, Washington

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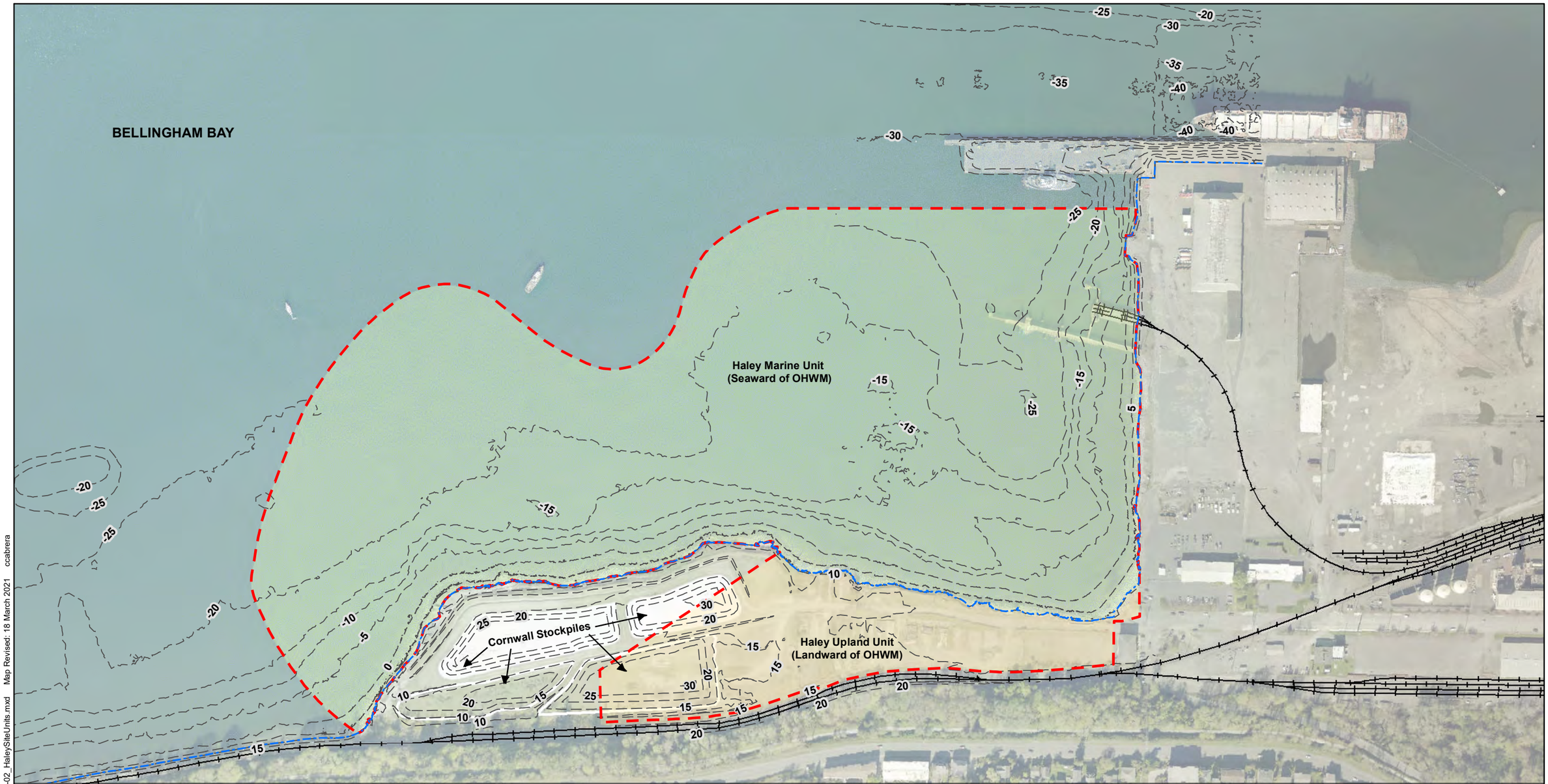
Figure 1

Path: P:\0\00356114\GIS\MXDs\2018_EDRFigures\Fig_1-01_VicinityMap.mxd Map Revised: 11 July 2019 glohrmeyer



W True North S N E Project North

0 150 300 Feet

Haley Cleanup Area Boundary
OHWM
BNSF Railroad
Elevation Contour (5ft-Interval)
Haley Marine Unit
Haley Upland Unit

Data Source: Aerial from City of Bellingham, 2016.
NAVD88 vertical datum.
Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Notes:
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3. Base survey by Wilson Engineering & Surveying 10/28/15, updated along north shoreline 5/8/2019
4. 2016 Hilton Avenue Stockpile topography provided from April 30, 2018 Cornwall Site EDR

Haley Site Units

R.G. Haley Site
Bellingham, Washington

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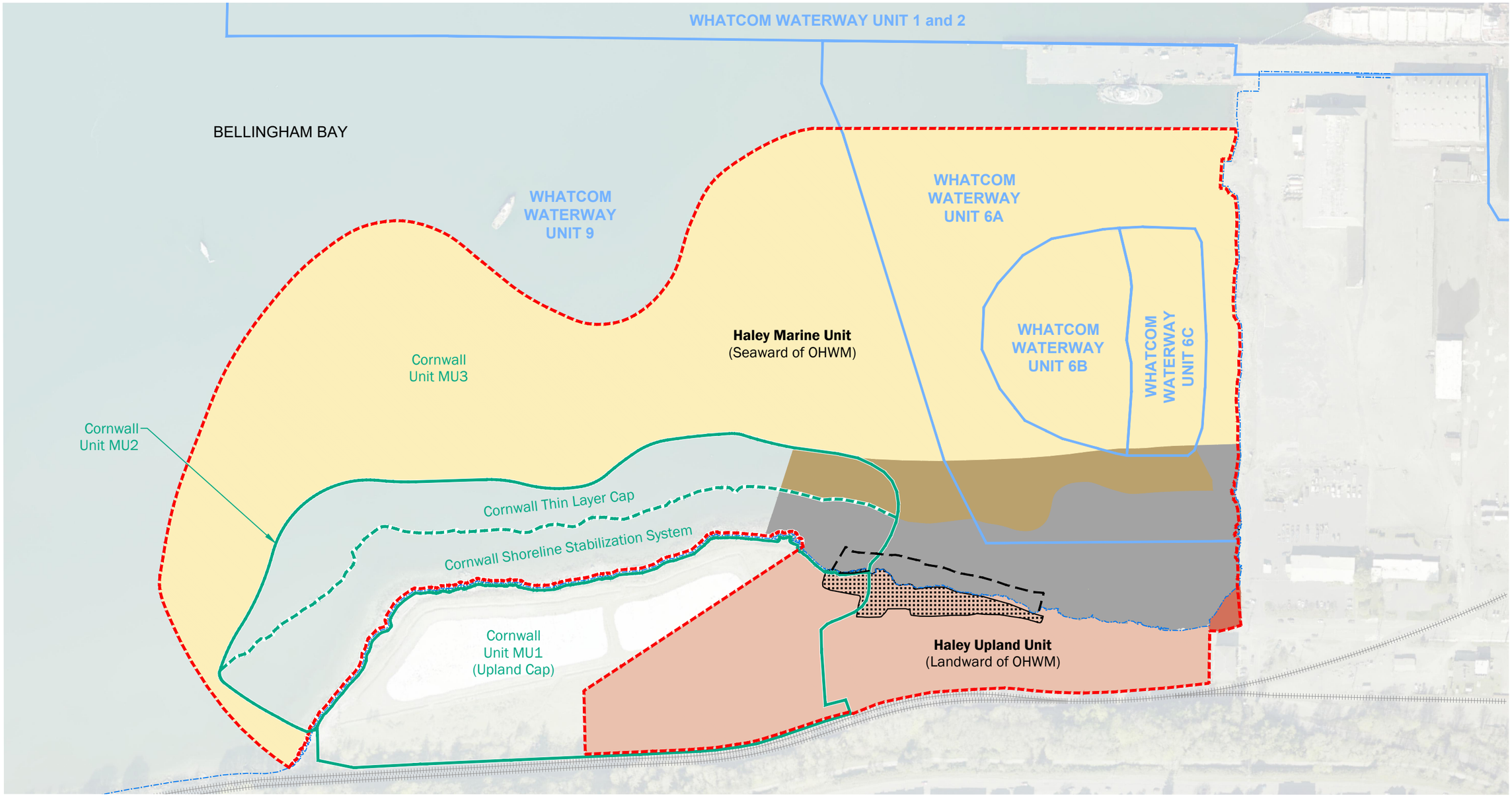
Figure 2

Path: P:\0\0356114\GIS\MXDs\2018_EDRFigures\Fig_1-02_HaleySiteUnits.mxd Map Revised: 18 March 2021 ccabrera



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Data Source: Aerial Photo from City of Bellingham, 2016.

Projection: WA State Plane, N Zone, NAD83, US Foot
Vertical Datum: NAVD88

Legend

- Haley Cleanup Area Boundary
- OHWM
- Low-Permeability Upland Cap
- Upland Pavement Cap
- Organoclay and Activated Carbon Amended Sand Caps
- Gravelly Sand Thin Layer Sediment Cap
- Monitored Natural Recovery
- Approximate ISS Area
- Sediment Excavation Area

W, True North, S, N, Project North, E

250 0 250
Feet

Cleanup Action Components

R.G. Haley Site
Bellingham, Washington

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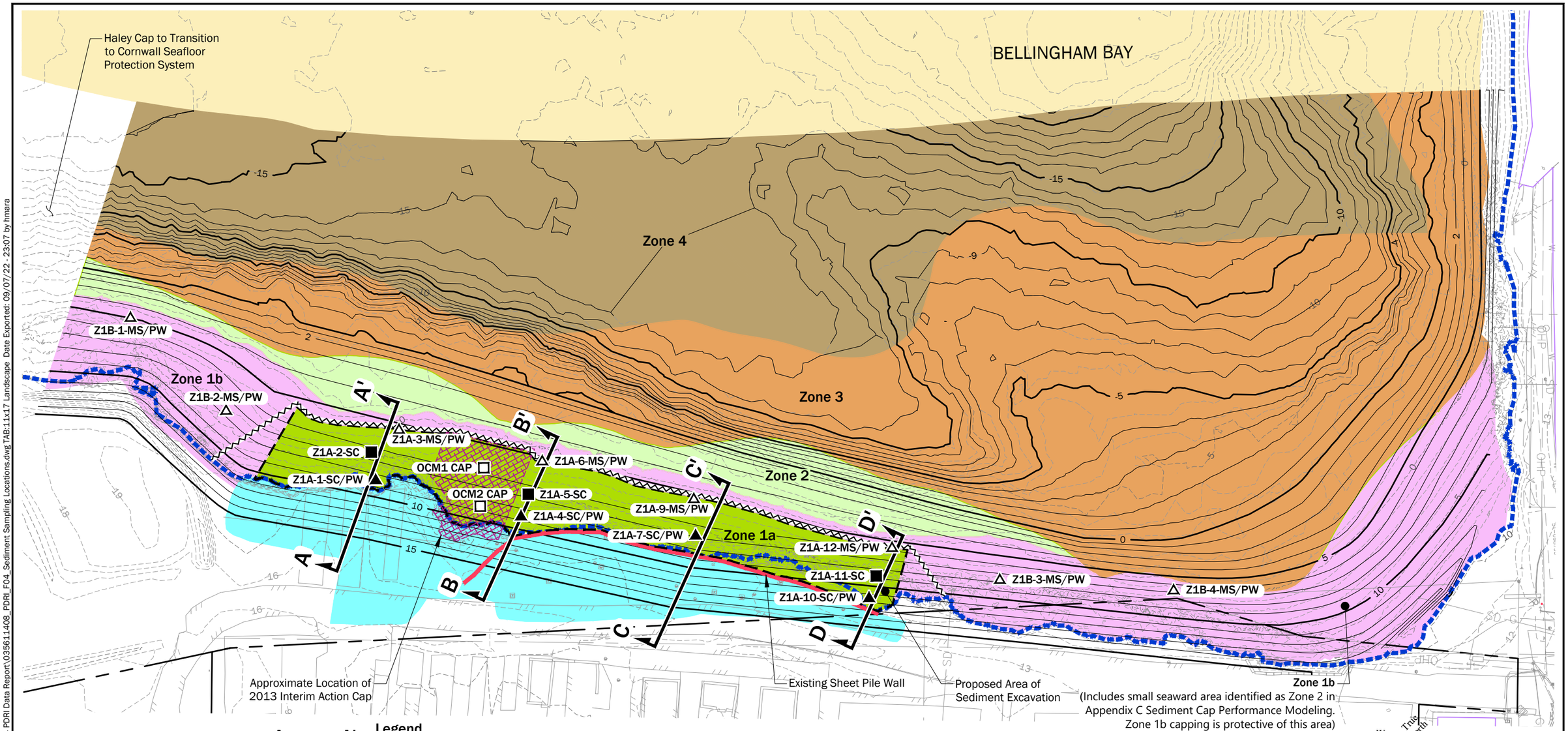
Figure 3



Legend

A — A' Typical Cross-Section

Haley Marine Unit Boundary (OHWM)

Sediment Excavation Area

10 Proposed Top of Cap Chemical Containment Layer Elevation Contour in Feet (NAVD88)

Approximate Location of Temporary Cofferdam during Sediment Excavation

Existing Sheet Pile Wall

Approximate Location of 2013 Interim Action Cap

Sediment and Porewater Sampling by Sonic Drilling Methods

Sediment Sampling by Sonic Drilling Methods

Sediment and Porewater Sampling by Manual Collection Methods

Organoclay/Sediment Sampling by Manual Collection Methods

Sediment Cap Zones

Zone 1a - High-Content Organoclay Amended Sand Cap

Zone 1b - Organoclay and Activated Carbon Amended Sand Cap

Zone 2 - Organoclay Amended Sand Cap

Zone 3 - Activated Carbon Amended Sand Cap

Zone 4 - Combined Gravelly Sand Thin-Layer Containment Cap and Seafloor Erosion Protection

Monitored Natural Recovery

Approximate Maximum Potential Extent of Upland ISS

Notes:

1. Generalized contours shown for discussion purposes; they will be refined including in transition to bank and railroad areas.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Base survey by Wilson Engineering & Surveying 10/28/15.

Projection: WA State Plane, N Zone, NAD83, US Foot
Vertical Datum: NAVD88

True North / Project North

80 0 80
Feet

Sediment and Porewater Sampling Locations

R.G. Haley Site
Bellingham, Washington

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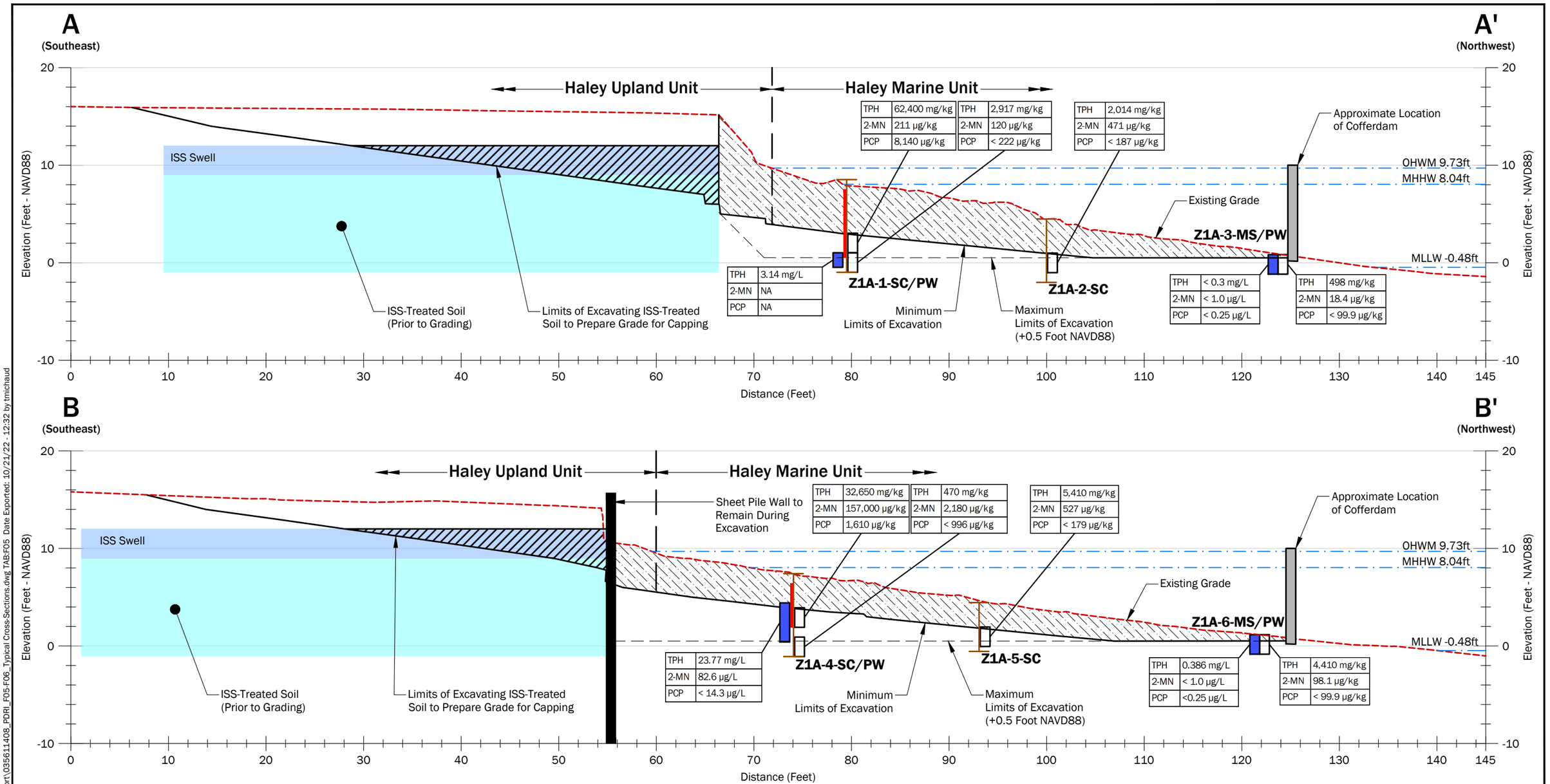
Figure 4



Analyte — Sediment or Porewater Analytical Result

TPH	2,014 mg/kg
2-MN	471 µg/kg
PCP	< 187 µg/kg

Notes:

< indicates the analyte was not detected above the value shown
TPH = total petroleum hydrocarbons
2-MN = 2-methylnaphthalene
PCP = pentachlorophenol
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
mg/L = milligrams per liter
µg/L = micrograms per liter

Legend

- Sonic Sediment Core
- Z1A–PW — Sediment Sample Interval for Porewater
- Z1A-1-SC — Sediment Sample Interval
- NAPL Observed in Field
- Existing Grade
- Debris Removal and Contaminated Sediment Excavation
- Potential Additional NAPL Excavation
- Excavation of ISS-Treated Soil
- Extent of ISS-Treated Soil, to be Completed Prior to Grading
- Estimated ISS-Swell

10 0 10
Horizontal Scale in Feet
10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 1X

NAPL Observations and Analytical Results Sections A-A' and B-B'

R.G. Haley Site
Bellingham, Washington

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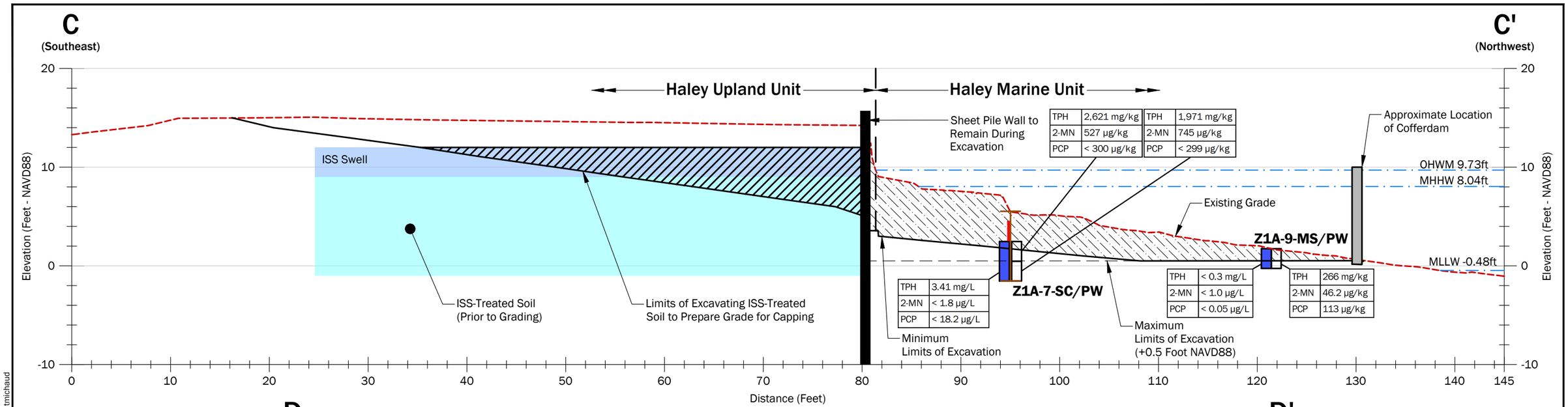
Figure 5



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Legend

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- Excavation of ISS-Treated Soil
- Extent of ISS-Treated Soil, to be Completed Prior to Grading
- Estimated ISS-Swell

10 0 10
Horizontal Scale in Feet
10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 1X

NAPL Observations and Analytical Results Sections C-C' and D-D'

R.G. Haley Site
Bellingham, Washington

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Figure 6