Sediment Remedial Investigation Report

Ecology Site Name: BNSF Wishram Track Switching Facility
Ecology Facility/ Site ID: 1625461
Cleanup Site ID: 230

BNSF Railway Company
BNSF Wishram Railyard, Wishram, Washington

Wishram Sediment Remedial Investigation Report
June 10, 2024

Sediment Remedial Investigation Report

Client name:	BNSF Railway Company		
Project name:	Wishram Sediment Remedial Investigation Report		
Client reference:	BNSF Wishram Railyard, Wishram, Washington	**Project no:**	D3711800
Document no:	240606113622_bc20f074	**Project manager:**	Kris Ivarson
Revision no:	4	**Prepared by:**	Jacobs
Date:	June 10, 2024		
Doc status:	Final		

Jacobs Engineering Group Inc.

2020 SW Fourth Avenue
3rd Floor
Portland, OR 97201
United States

T +1.503.235.5000

Contents

Acronyms and abbreviations ..... **v**
Executive Summary ..... **vii**
1 Introduction **1-1**
1.1 General Site Information 1-1
1.2 Regulatory Framework and Chronology 1-2
1.3 Site History and Use 1-2
2 Field Investigations **2-1**
2.1 Previous Investigations 2-1
2.2 Initial Investigation of 2018 2-1
2.3 Remedial Investigation and Site Characterization Activities 2-2
2.3.1 Step 1 Field Investigation 2-3
2.3.2 Step 2 Field Investigation 2-5
3 Field and Analytical Results **3-1**
3.1 Step 1 Results 3-1
3.1.1 SPI Camera 3-1
3.1.2 Surface Sediment Grab Sampling 3-1
3.1.3 Background Evaluation 3-1
3.2 Step 2 Results 3-2
3.2.1 TarGOST and Sediment Coring Results 3-2
3.2.2 Subsurface Sediment Sample Analytical Results 3-4
3.3 Estimated Extent of NAPL and Surface Sediment Conditions 3-5
3.3.1 Estimated Extent of NAPL 3-5
3.3.2 Surface Sediment Conditions 3-6
3.4 Analytical Data Quality Evaluation 3-6
4 Conceptual Site Model **4-1**
4.1 Site Setting and Physical Characteristics 4-1
4.1.1 General Hydrology 4-1
4.1.2 Geologic and Hydrogeologic Conditions 4-1
4.1.3 Bathymetry 4-2
4.2 Ecological Resources 4-3
4.2.1 Vegetation 4-3
4.2.2 Aquatic Life 4-3
4.2.3 Avian and Mammalian Receptors 4-4
4.3 Potential Sources of Site-related Contaminants 4-4
4.4 NAPL Conceptual Site Model 4-4
4.4.1 Initial NAPL Release and Transport Mechanisms 4-4
4.4.2 Current NAPL Mobility 4-5

4.5 Transport of COCs in Sediment 4-6
4.6 Potential Exposure Pathways and Receptors 4-7
4.6.1 Transport Pathways and Exposure Media 4-7
4.6.2 Ecological Exposure Pathways and Routes 4-8
4.6.3 Human Health Exposure Scenarios and Pathways 4-8
5 Risk Summary and Standards Comparison 5-1
5.1 Ecological Risk Screening 5-1
5.1.1 Identifying Cleanup Sites Based on Benthic Criteria 5-1
5.1.2 Identifying Cleanup Sites Based on Bioaccumulative Criteria 5-1
5.2 Human Health Risk Screening 5-2
5.3 Standards Comparison 5-2
6 Summary and Conclusions 6-1
7 References 7-1

Appendices

A Step 1 SPI Camera Field Documentation
B Step 1 Grab Sampling Documentation
C TarGOST Investigation Documentation
D Step 2 Core Sampling Documentation
E SPI Camera Report
F Preliminary Natural Background Values
G TarGOST Report
H Data Quality Evaluation Reports
I Analytical Data Reports – Step 1 and Step 2
J Summary of Columbia River Fisheries
K Ecological Screening Results
L Human Health Risk-Based Screening Evaluation
M Initial Investigation Data from 2018 – Statistical Analysis of Surface Samples

Attachments

1 Inundated Lands Initial Investigation Report Final, BNSF Wishram Railyard

Tables

2-1 Summary of Upland Investigations at the BNSF Wishram Railyard
2-2 Summary of Shoreline and Sediment Investigations through 2021
2-3 Attempted and Retained Surface Grab Sample Locations and Details
2-4 Attempted TarGOST Locations Summary
2-5 Sediment Core and TarGOST Penetration Depth Comparison
2-6 Accepted Sediment Core Sample Summary

3-1 Step 1 Polychlorinated Biphenyl Dioxin-like Congener Results
3-2 Step 1 Ammonia, Sulfide and Metals Results
3-3 Step 1 Polycyclic Aromatic Hydrocarbons and Bulk Petroleum Hydrocarbon Results
3-4 Step 1 Dioxins and Furans Results
3-5 Step 1 Total Organic Carbon, Total Solids, and Grain Size Results
3-6 Preliminary Natural Background Values
3-7 Summary and Evaluation of TarGOST Profiling Responses and Confirmatory Data
3-8 Step 2 Polycyclic Aromatic Hydrocarbons and Bulk Petroleum Hydrocarbon Results
3-9 Step 2 Total Organic Carbon, Total Solids, and Grain Size Results
4-1 Columbia River Designated Uses
5-1 Step 1 Standards Comparison
5-2 Step 2 Standards Comparison

Figures

1-1 Site Location Map
1-2 Area Features
1-3 Current Site Features
1-4 Historic Site Features
2-1 SPI Camera and Oxygen Profiling Locations
2-2 Grab Sample Locations with Analytical Results Exceeding one or more Screening Levels or Cleanup Objectives
2-3 Background Grab Sample Locations with Analytical Results Exceeding one or more Screening Levels or Cleanup Objectives
2-4 TarGOST Profiling Locations
2-5 Subsurface Sediment Characterization
3-1 Site Grab Sample, TarGOST and Sediment Core Locations
3-2 Extent of NAPL Impacts with Analytical Results Exceeding one or more Screening Levels or Cleanup Objectives
3-3 A-A′ Cross Section
3-4 B-B′ Cross Section
3-5 Site Bathymetry with Cross Sections
4-1 Areas of Exposed Bedrock
4-2 NAPL Conceptual Site Model – Cross Section A to A′
4-3 NAPL Conceptual Site Model - Cross Section B to B′
4-3 Conceptual Site Model for Sediment and Surface Water

Acronyms and abbreviations

µg/kg	microgram(s) per kilogram
%RE	percent of the reference emitted
AO	Agreed Order
AST	aboveground storage tank
BAZ	biologically active zone
bgs	below ground surface
BNSF	BNSF Railway Company
bss	below sediment surface
COC	constituent of concern
COPC	constituent of potential concern
CSL	cleanup screening level
CSM	conceptual site model
CUL	cleanup level
DPT	direct-push technology
DQO	data quality objective
EC	Electrical Conductivity Dipole Array
Ecology	Washington State Department of Ecology
FS	feasibility study
LIF	laser-induced fluorescence
LNAPL	light nonaqueous phase liquid
mg/kg	milligram(s) per kilogram
MTCA	*Model Toxics Control Act*
NAPL	nonaqueous phase liquid
NAVD88	North American Vertical Datum of 1988
NNLS	non-negative least squares
OWS	oil water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCC	State of Washington Pollution Control Commission

PQL	Practical quantitation limit
QC	quality control
RBC	risk-based concentrations
RI	remedial investigation
SAP	sampling and analysis plan
SCO	sediment cleanup objective
SCUM	Sediment Cleanup User's Manual
SMS	Sediment Management Standards
SP&S	Spokane, Portland, and Seattle Railway
SPI	Sediment Profile Imaging
SVOCs	semi-volatile organic compounds
TarGOST	Tar-specific Green Optical Screening Tool
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-DRO	total petroleum hydrocarbons as diesel range organics
TPH-RRO	total petroleum hydrocarbons as residual range organics (synonymous with motor oil range organics)
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
WAC	Washington Administrative Code
YNF	Yakama Nation Fisheries

Executive Summary

This Sediment Remedial Investigation (RI) Report was prepared by Jacobs on behalf of BNSF Railway Company (BNSF) for the BNSF Wishram Railyard (aka BNSF Track Switching Facility) in Wishram, Washington (Figure ES-1). Initial investigations were conducted in 2018 to investigate the potential presence of non-aqueous phase liquid (NAPL) in sediment in the nearshore area, characterize the nature and extent of NAPL if present, and evaluate nearshore sediment against applicable sediment cleanup standards (CH2M 2018). The initial investigation work plan was approved by the Washington State Department of Ecology (Ecology) on February 7, 2018, and field work was performed in June and August 2018. Following the initial work, the *Sediment Remedial Investigation Work Plan* (Work Plan) (Jacobs 2021) was developed to further characterize and delineate the area of impacted sediment. The Work Plan was approved by Ecology in 2021, and the RI field effort was conducted in two mobilizations between April and November 2022. A revision to the Work Plan was requested by Ecology on October 3, 2022, and BNSF submitted the *Sediment Remedial Investigation Work Plan Revision 1* (Jacobs 2022) on October 25, which was subsequently approved by Ecology on October 27, 2022.

The RI was conducted in two steps:

> Step 1 included determining the biologically active zone (BAZ), surface sediment sampling in areas of known and potential sources, and background surface sediment sampling. Step 1 surface sediment samples were analyzed for ammonia, total sulfides, metals, semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, select dioxin-like polychlorinated biphenyl (PCB) congeners, total petroleum hydrocarbons - diesel range (TPH-DRO), TPH- residual range organics (TPH-RRO), grain size, and total organic carbon. Analytical results from Step 1 were evaluated and results discussed with Ecology prior to starting Step 2.
>
> Step 2 included laser-induced fluorescence (LIF) sediment profiling using the Tar-specific Green Optical Screening Tool (TarGOST) to measure the depth and thickness of the NAPL-impacted materials and subsurface sediment cores to confirm the TarGOST profiling results and characterize sediment lithology. Different types of materials fluoresce differently, so samples of various types of materials (e.g., shells, grasses, woody debris) were analyzed by TarGost ex-situ to assess the non-NAPL-related fluorescence responses or “false positives” in the cores. Sediment samples collected and submitted for laboratory analysis were analyzed for TPH- DRO, TPH- RRO, SVOCs including PAHs, and grain size.

Step 1 included determining the BAZ. This effort used a Sediment Profile Imaging (SPI) camera to photograph shallow sediment to document the BAZ depth. Grab samples were collected to profile oxygen content; this information helped determine the depth of the BAZ. Due to the hard riverbed and lack of soft sediment, the SPI camera was unable to penetrate the river bottom to take an image of the riverbed in profile. As a result, Ecology determined that the BAZ was the top 10 centimeters (cm) of the river bottom consisting of rocks and gravel, with some sediment present; Ecology determined this during the April 18, 2022 call between Ecology and BNSF (Email from John Mefford on April 18, 2022).

Where sediment was available for sampling, analytical results indicated the presence of total sulfides above the Freshwater Benthic dry weight sediment cleanup objective (SCO) in both site and background samples. In addition, 3 & 4-Methylphenol (m&p-Cresols), was identified above the SCO in one background sample (BG17). TPH-DRO and TPH-RRO were not detected above the SCO in any Step 1 samples.

The Step 2 approach included TarGOST profiling, confirmatory sediment core logging, and sediment sample collection with laboratory analysis to further evaluate the nature and extent of impacts. The purpose of Step 2 was to identify intervals of NAPL and impacted and unimpacted sediment. Each of the 58 successful TarGOST profile waveforms were evaluated to determine the presence or absence of NAPL. Sediment cores were collected to confirm the TarGOST readings, determine if natural organic matter was present in the core causing a TarGOST response, and to further refine the extent of impacted sediment.

Step 1 and Step 2 field work resulted in a total of 176 attempted surface sediment grabs from 64 stations (both offshore near the railyard and at select background locations), 46 attempted subsurface sediment cores from 16 stations, and 58 TarGOST profiles from 60 stations. Of the attempted sediment grabs and cores, 32 surface sediment grab samples and 14 subsurface sediment core samples were collected and submitted for laboratory analysis. Additionally, 20 sediment samples from 7 stations were collected and submitted for TarGOST ex-situ analysis. Figure ES-2 presents the locations of the site grab samples, TarGOST, and sediment cores.

NAPL impacts were observed within approximately 140 feet of the shoreline and consisted of localized saturated or coated sediments and NAPL-coated woody debris with odors. No bedding structure was visible, and the abundance of mixed organic debris in the NAPL-impacted intervals suggest that these materials represent a layer of material that was in place before the land was inundated by the filling of Lake Celilo.

The NAPL impacts extend approximately 650 feet east-to-west. The majority of the NAPL was identified in the vicinity of locations G200, G320, I200, I280, J260 between approximately 40 and 120 feet south of the shoreline as shown on Figure ES-3. The NAPL is present at thicknesses of up to 6 feet in this area and is found at depths ranging from 0.5 ft below sediment surface (bss) to the south at J260 and 9.5 ft bss to the north at G320. Because this area is adjacent to where intermittent sheens have been observed along the shoreline, and because this area had the highest peak TarGOST responses and consistent observations of saturated NAPL conditions, this area of NAPL is considered the source area for the intermittent sheens.

NAPL impacts diminish to the north and east towards the shoreline and are found at lesser thicknesses and relatively lower peak and average TarGOST responses. To the south, the NAPL-impacted interval thins and is closer to the sediment surface (J260, K200 and K280) as the sediment slopes downward. When the sediment surface drops below the base of the impacted interval to the south (~141 ft AMSL), NAPL is no longer found. This observed distribution of NAPL impacts is consistent with a surface release that was controlled by the topography before Lake Celilo was filled.

The lateral extent of NAPL-related impacts extends towards the west where average TarGOST response readings decline with distance away from the main source area, and where the impacted interval thins to 1 foot or less west of HN100 and deepens to between 7 and 8 feet bss. Unimpacted TarGOST profiles at HN280, KN280, KN220, and MN160 bound the western and southern extents in this area.

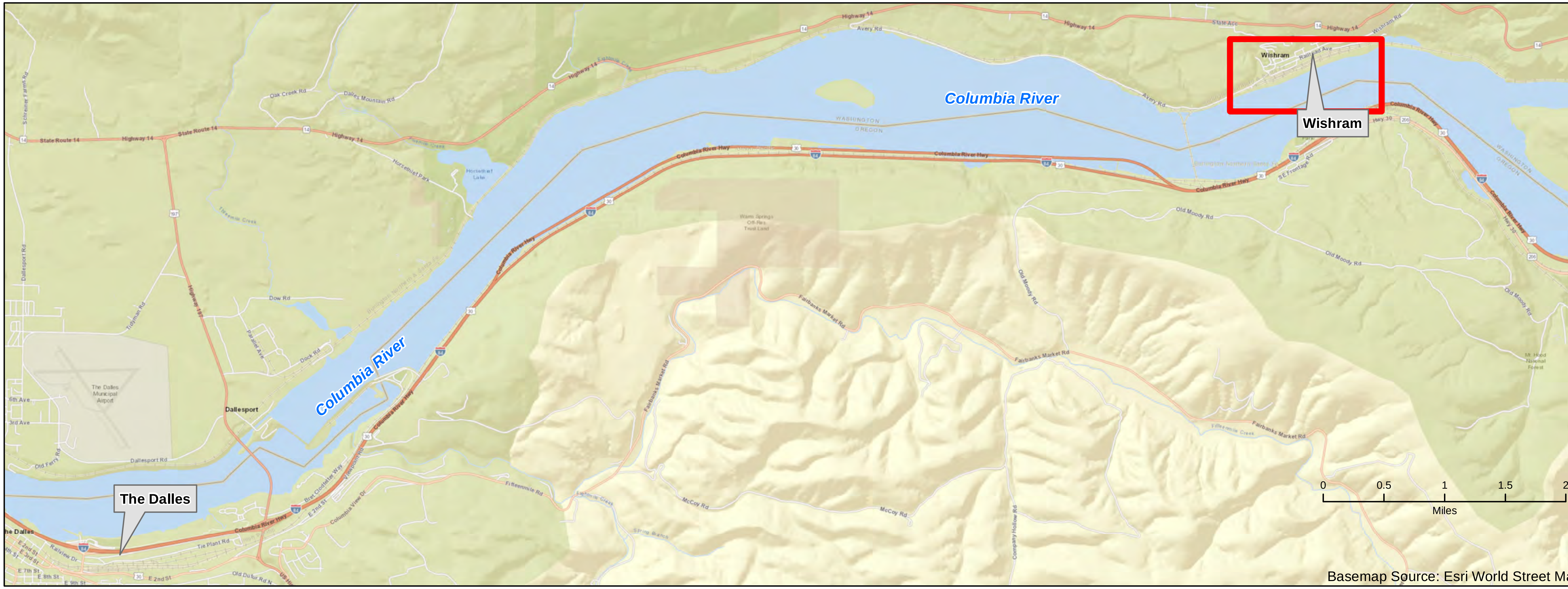
The analytical data from the14 subsurface sediment cores are consistent with the lateral and vertical extents of NAPL as shown in Figures ES-3 through ES-5. Fourteen samples were collected to confirm the absence of NAPL (above, below, and beyond the NAPL impacts seen in the TarGOST responses and core observations). Each of these 14 samples had relatively low levels of TPH-DRO, confirming that NAPL was not present. TPH-DRO, TPH-RRO and PAH results were below their respective SCOs, except for one sample collected from directly below the NAPL-impacted interval at F390 (8.7 to 9.7 ft bss); TPH-DRO were detected at 676 mg/kg, above the SCO of 340 mg/kg. As a comparison, the sample collected from within the NAPL-impacted interval at G200 (5.5 to 6.5 ft bss) was reported to contain TPH-DRO (91,100 mg/kg) and TPH-RRO (102,000 mg/kg) concentrations that exceed their respective SCO levels of 340 mg/kg and 3,600 mg/kg.

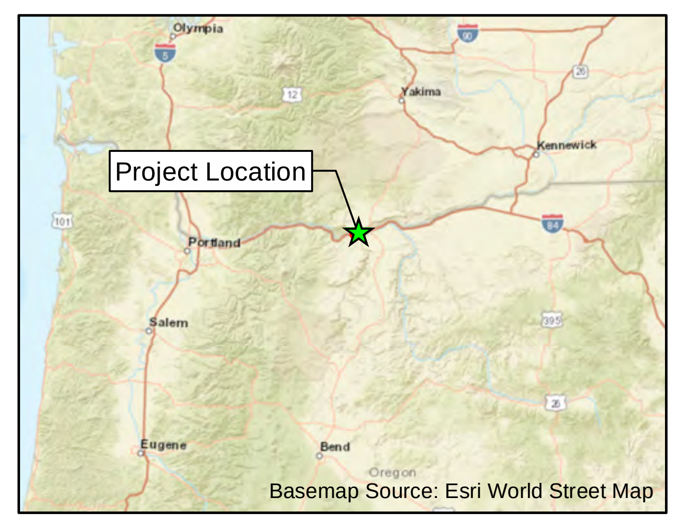
Ecological screening indicates that constituents found in site surface sediment (driven by two 2018 samples with TPH-DRO exceedances) pose risk to the benthic community. Bioaccumulative compounds were also evaluated for potential risk; this evaluation indicated that low concentrations of PAHs and TPH-DRO in 3 of 13 samples exceeded preliminary natural background values. However, when considering the concentration and detection frequency of PAHs and TPH-DRO in NAPL-affected site sediment and the low potential for bioaccumulation (neither TPH-DRO nor total PAHs exceeded conservative benthic screening criteria), further ecological risk evaluation of these compounds is not warranted. Rather than conducting further risk assessment, a remedy to address the areas of NAPL will be evaluated in the feasibility study.

Human health screening results were similar to ecological screening with some exceedances of risk criteria at a few sampling stations associated with the fish/shellfish consumption exposure scenario.

The NAPL impacts in the inundated lands were delineated during the RI. The area of investigation was expanded away from the shoreline and to the west beyond the initial RI study area to delineate the impacted area. The historical information and RI data indicate that the NAPL within the inundated lands was in place prior to filling Lake Celilo (as a result of The Dalles Dam) and is physically separate from the upland NAPL impacts. Sometime after deposition, the NAPL-affected layer was buried under up to 7 feet of sediment. While the data have confirmed that the NAPL body is not moving, ebullition (gas release from natural organic decay in sediment) is resulting in the release of NAPL and sheens to the surface water in areas where the NAPL impacts are closer to the current sediment surface.

The RI results show that sediment contaminant concentrations do not exceed SMS criteria outside of the NAPL impacted area. NAPL delineations performed during this RI established the sediment cleanup unit. The RI is complete, and a feasibility study to evaluate remedial alternatives and identify the design studies needed for implementation can be performed with the information collected.



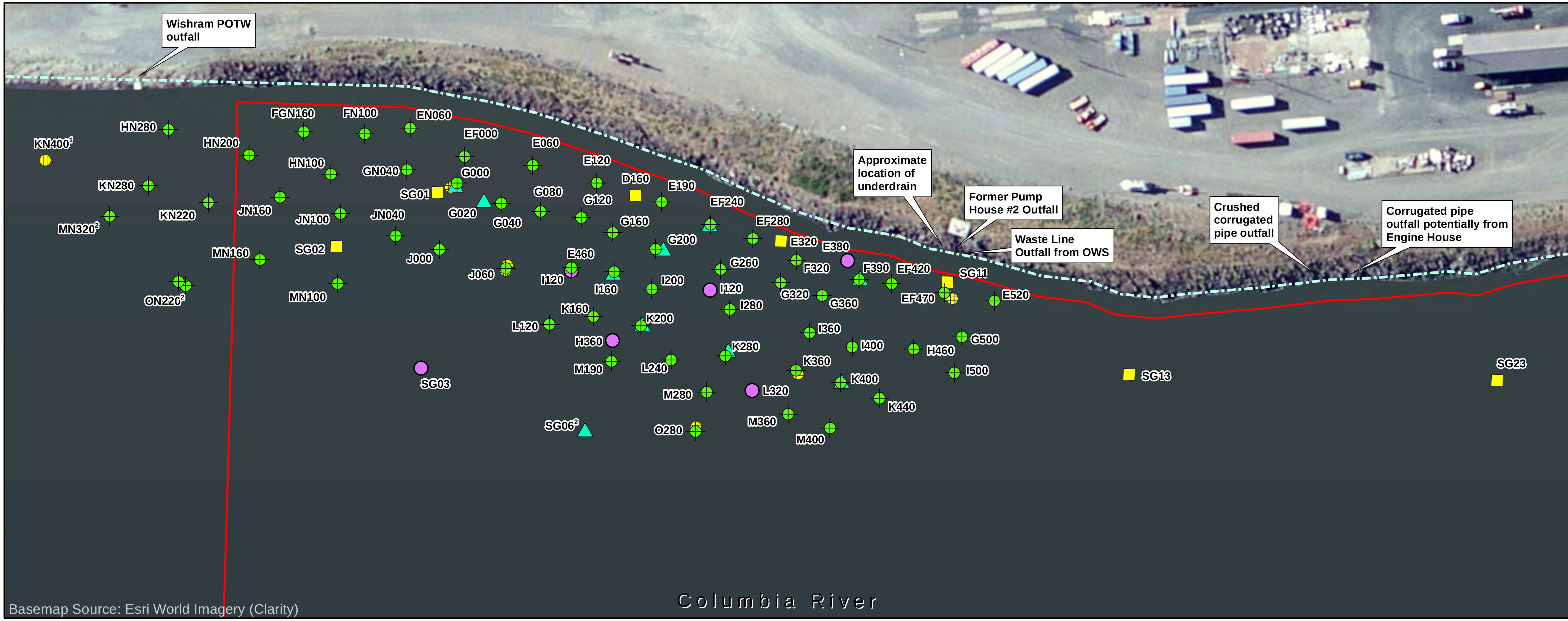


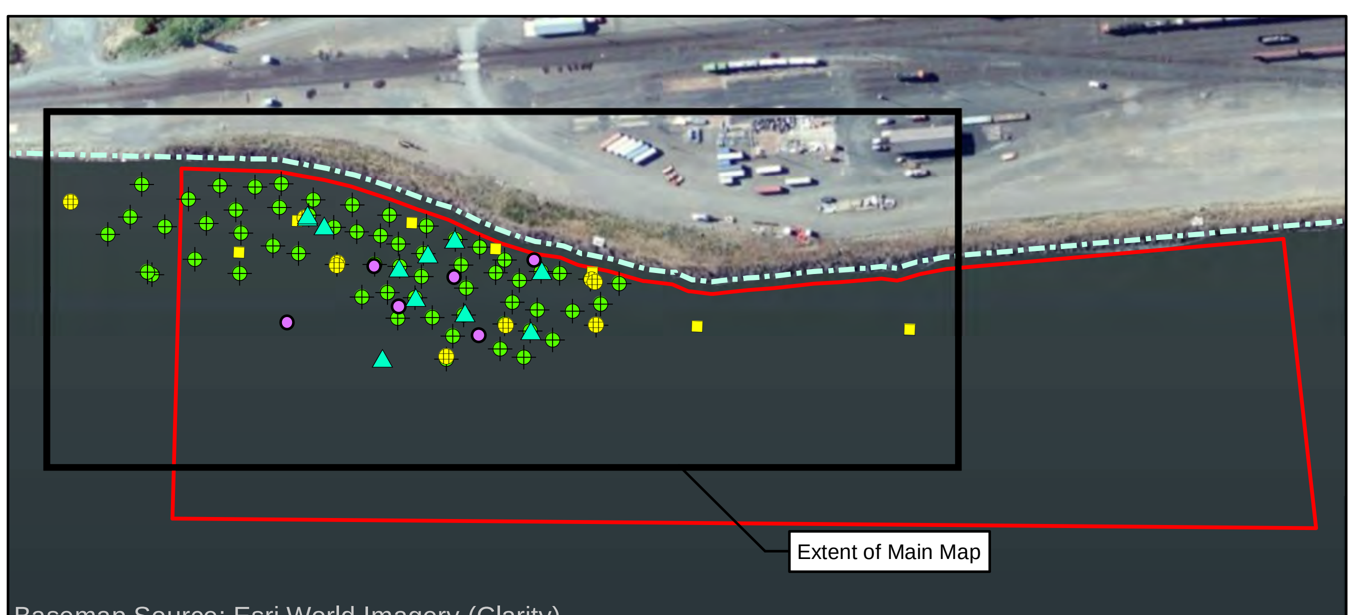
0 375 750 1,500
Feet

Figure ES-1. Site Location Map BNSF Track Switching Facility Wishram, Washington

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE1-1_SITEMAP.MXD GGEE 4/7/2023 09:52:35

Jacobs





LEGEND

Remedial Investigation Location

- Geoprobe (DPT)
- Vibracore
- Grab Composite Sample
- Grab Sample
- TarGOST
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

Notes:
OWS = oil/water separator; POTW = publicly owned treatment works
[1]Changed station name from HN300 to KN400 post sample collection based on actual X,Y. (No target X,Y available at the time of collection. Station was estimated.)
[2]Refusal at surface.

N

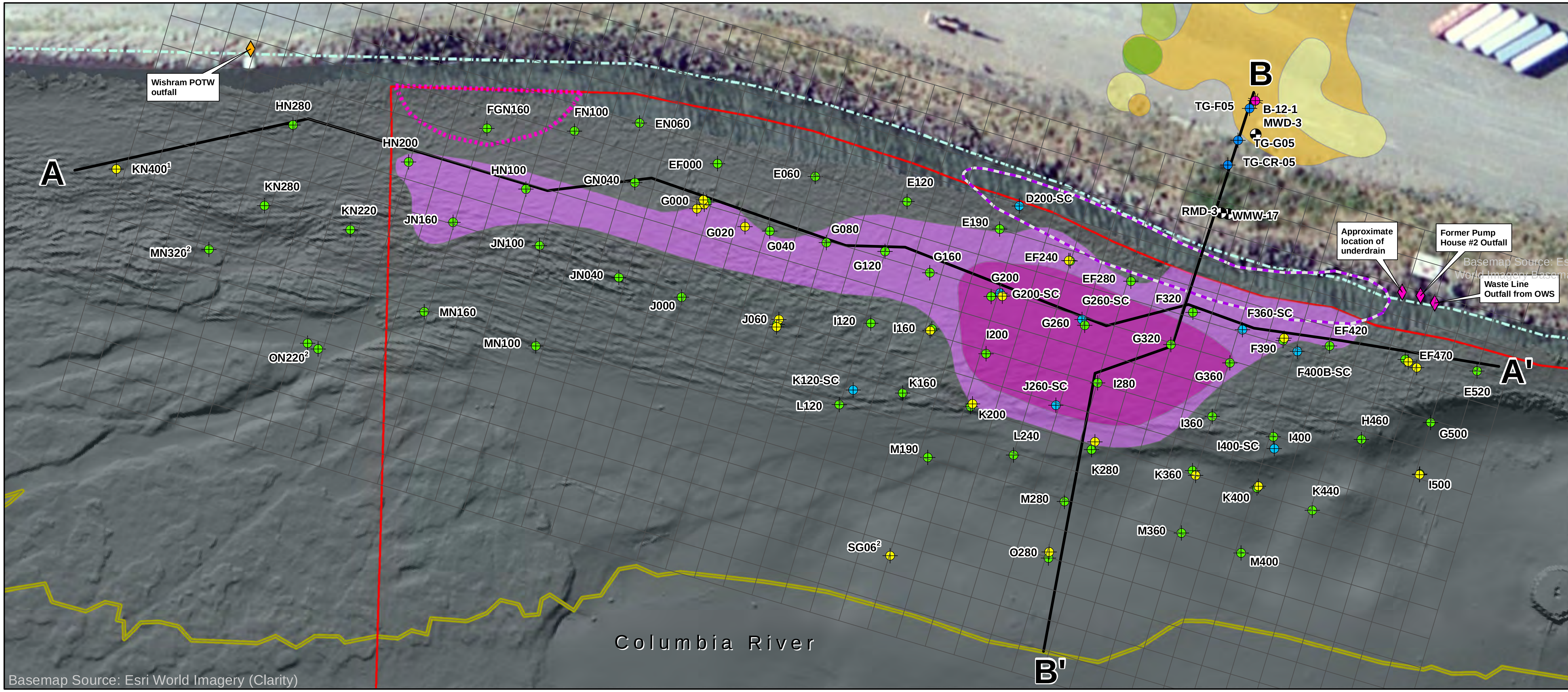
0 25 50 100
Feet

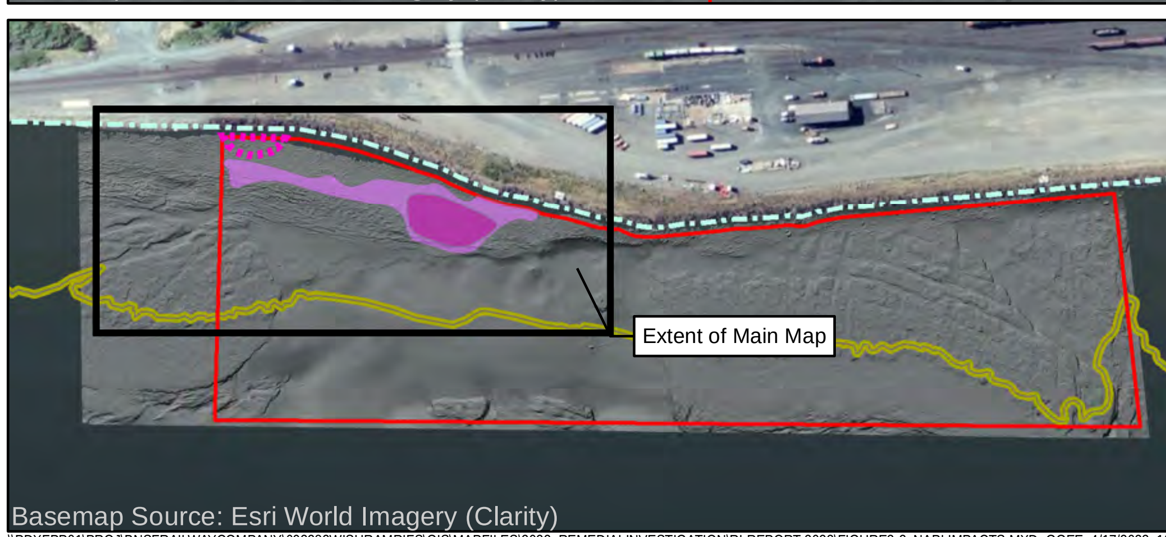
Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

Figure **ES-2**. Site Grab Sample, TarGOST, and Sediment Core Locations
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE3-1_ALLSAMPLESB.MXD GGEE 4/17/2023 12:02:12





LEGEND

- 2022 TarGOST Location
- 2022 Sediment Core
- 2018 Sediment Core
- Upland RI TarGOST Location
- Upland Boring
- Groundwater Monitoring Well
- Extent of NAPL Impacts
- Approximate Extent of Sheen-Generating NAPL Impacts
- Area of Shallower, Thin Zone of Elevated TarGOST Responses
- Area of Intermittent NAPL Sheening
- Small-extent NAPL Sheens Observed (Ecology, 2017)
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline
- Cross Section Location
- Inferred Lateral Extent of Smear Zone Diesel Impacts
- Inferred Lateral Extent of Submerged Diesel Impacts
- Inferred Lateral Extent of Smear Zone Oil Impacts
- Inferred Lateral Extent of Submerged Oil Impacts

0 25 50 100
Feet

N

Notes:
OWS = oil/water separator; POTW = publicly owned treatment works
[1]Changed station name from HN300 to KN400 post sample collection based on actual X,Y. (No target X,Y available at the time of collection. Station was estimated.)
[2]Refusal at surface.

Figure **ES-3**. Extent of NAPL Impacts
BNSF Track Switching Facility Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE3-2_NAPLIMPACTS.MXD GGEE 4/17/2023 12:08:52

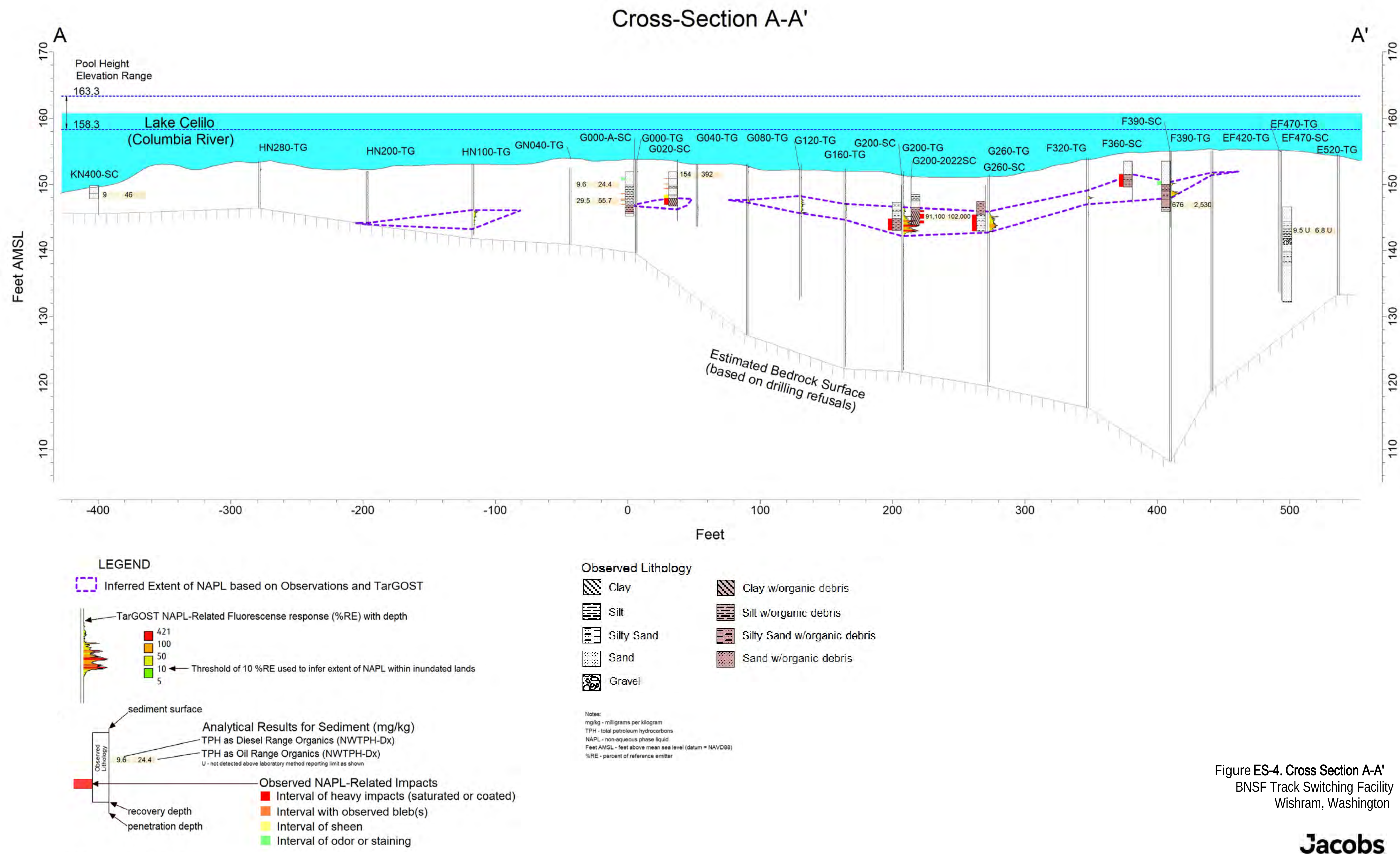


Figure **ES-4. Cross Section A-A'**
BNSF Track Switching Facility
Wishram, Washington

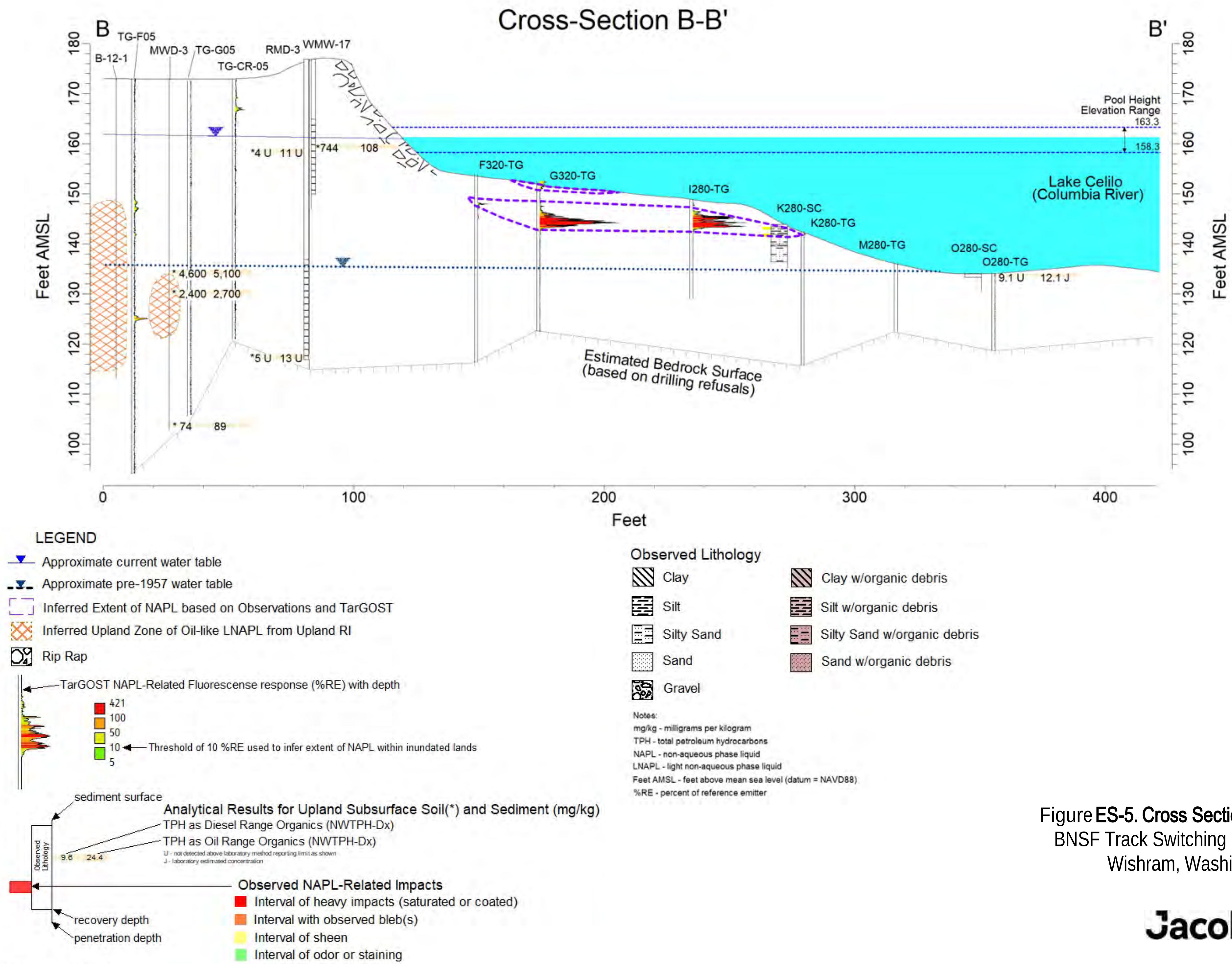


Figure **ES-5. Cross Section B-B'**
BNSF Track Switching Facility
Wishram, Washington

1 Introduction

This Sediment Remedial Investigation (RI) Report was prepared by Jacobs on behalf of BNSF Railway Company (BNSF) for the BNSF Wishram Railyard (aka BNSF Track Switching Facility) in Wishram, Washington (Figure 1-1).

Petroleum sheening and nonaqueous phase liquid (NAPL) droplets have been observed occasionally along an approximately 350-foot stretch of the Columbia River adjacent to the site (Washington State Department of Ecology [Ecology] 2017a). This stretch of the Columbia River is separated from the uplands area by a berm armored with riprap. The area where the sheening has been observed was inundated when the area behind The Dalles Dam was flooded in 1957, creating Lake Celilo. Initial investigation activities in the vicinity of the observed sheen identified a NAPL -impacted organic-rich fill layer between 0.5 and 2.5 feet below the sediment surface (bss) between 40 and 130 feet south (offshore) of the current riprap shoreline (Jacobs 2019). The sheen intermittently observed along the shoreline is believed to be the result of ebullition-driven transport of NAPL (bubbles) from the NAPL body to the water column, as discussed in the initial investigation. Selected sample results from the overlying surface sediments in the initial investigation were found to exceed the Sediment Management Standards (SMS) Sediment Cleanup Objectives (SCOs) (Washington Administrative Code [WAC] 173-204-563). Figure 1-2 shows the area of the 2018 initial investigation, the railyard features, current and former shorelines, and the toe of exposed riprap observed within the 2018 sampling investigation area.

As required by the Washington State Department of Ecology (Ecology) in its letter dated August 13, 2020, BNSF collected additional data to meet the requirements of an RI during 2022. Activities proposed for the sediment RI are described in the Sediment Remedial Investigation Work Plan (Work Plan) (Jacobs 2021). The Work Plan describes the additional data needed to identify constituents of potential concern (COPCs), characterize the nature and extent of constituents of concern (COCs) (including NAPL) in sediment adjacent to the railyard, evaluate fate and transport mechanisms, establish sediment cleanup standards, and develop cleanup alternatives. The preliminary conceptual site model (CSM) developed during the Work Plan was refined based on the data collected during this RI. The updated CSM will be used to evaluate potential exposures to site-related constituents and support development of the feasibility study (FS).

The final Work Plan was submitted to Ecology on November 19, 2021, incorporating Ecology comments on the draft Work Plan. On November 30, 2021, Ecology's letter approving the Work Plan (dated November 19, 2021) was received by BNSF. Field work for Step 1 was conducted in April 2022, results were discussed with Ecology and presented to Ecology and Yakama Nation Fisheries (YNF) in September 2022. Ecology and the YNF requested modification to the approved Work Plan related to Step 2 on October 3, 2022. In response, the Work Plan was revised on October 25, 2022, and the revision (Work Plan Revision 1) was approved by Ecology via email on October 27, 2022. Step 2 was conducted in November 2022. The RI for the sediments adjacent to the railyard was conducted in accordance with the Ecology *Model Toxics Control Act* (MTCA) regulations in WAC 173-340 (found at https://apps.leg.wa.gov/wac/default.aspx?cite=173-340), the SMS in WAC 173-204 (found at https://app.leg.wa.gov/wac/default.aspx?cite=173-204), and the SMS guidance described in the *Sediment Cleanup User's Manual* (SCUM) (Ecology 2021). Fieldwork was conducted under the oversight of a qualified archeologist and the Washington State Department of Archaeology and Historic Preservation (DAHP) permit (Permit Number 2022-10).

1.1 General Site Information

The BNSF railyard is in the town of Wishram in Klickitat County, Washington, approximately 13 miles northeast of The Dalles, Oregon, and 0.75 mile south of Washington State Route 14, within the southwestern quarter of Section 17, Township 2 north, Range 15, east of the Willamette Meridian (Figure 1-1).

The railyard is approximately 5,000 feet long (from northeast to southwest) and ranges from 150 to 720 feet wide (from northwest to southeast). The portion of the railyard where historical industrial activities (e.g., fuel storage, engine refueling, engine maintenance) occurred and the focus of the upland investigation is at the western end (approximately 1,100 feet) of the yard, covering an area of approximately 6 to 10 acres (KJ 2020). Existing structures on the railyard include storage buildings, a maintenance shop (office and tool storage), two mainline tracks, and active yard tracks (Figure 1-3). Current railyard operations of the uplands include Amtrak passenger service at the depot and railcar switching on track spurs located just south of the Depot. Railcar fueling and maintenance activities are no longer performed at the railyard. The former Signal Office (former Store House) was removed in 2018.

The railyard is located on the shore of the Columbia River within a treaty and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation. Tribal members still exercise treaty reserved fishing rights on the shores of and in the Columbia River in the vicinity of the railyard. This fishing activity is regulated under tribal laws through off-reservation enforcement authority. The Celilo Treaty Fishing Access Site, a tribal fishing boat launch area regulated by the Bureau of Indian Affairs, is situated across the Columbia River on the Oregon shore. The Columbia River adjacent to the railyard is also used for vessel traffic, sailing, fishing, and various recreational uses.

1.2 Regulatory Framework and Chronology

Corrective action activities on the uplands portion of the railyard are being performed pursuant to an Agreed Order (AO) (No. DE 12897) between Ecology and BNSF, dated October 7, 2015. The scope of work in the AO includes an upland RI, an FS, and a Draft Cleanup Action Plan, and is mainly focused on the upland area, with limited requirements related to shoreline conditions.

On March 3, 2017, Ecology directed BNSF to complete an investigation of the inundated lands area. In response to Ecology's 2017 letter, BNSF developed an initial investigation work plan to investigate the potential presence of NAPL in the identified nearshore area, characterize the nature and extent of NAPL if present, and evaluate nearshore sediment against applicable sediment cleanup standards (CH2M 2018). The initial investigation work plan was approved by Ecology on February 7, 2018, and field work was performed in June and August 2018. Subsequent work related to the sediment investigation and development of the Work Plan took place from 2018 until the RI field effort was completed in November 2022. Details of the timeline for the Work Plan development, various reporting on the sediment investigation and correspondence related to the Work Plan are presented in Table 1-1.

1.3 Site History and Use

The BNSF railyard occupies a flat bench along the northern side of the Columbia River at the eastern edge of the Columbia River Gorge. The railyard was developed by the Spokane, Portland, and Seattle Railway between 1910 and 1912. The Spokane, Portland, and Seattle Railway merged with other railroads in 1970 to become the Burlington Northern Railroad, which merged with the Santa Fe Railroad in 1995 to become what is now BNSF. Historically, locomotive operations involving fueling/watering and repairs also occurred within the western portion of the Wishram Railyard. Oil and diesel were the primary fuels historically used to fuel locomotives at this yard. Most track spurs, early structures, and infrastructure no longer remain. Prominent historical railyard features present during some portion of the time between 1910 and the present, include the pump house, various storage tanks (above and below ground), and an oil water separator (OWS), are shown on Figure 1-4.

Operations at the Wishram railyard began between 1910 and 1912, and the southern portion of the railyard, now under water, was inundated during the filling of Lake Celilo in 1957. Reported locations and uses of former buildings and structures, former fueling areas, and former fuel storage in aboveground storage tanks (ASTs) and underground storage tanks (USTs) were identified using past reports, historical maps and aerial photographs, and historical documents including a summary of the Wishram Railyard presented in The Northwest's Own Railway Fall 2014 publication (NWOR 2014) and correspondences between Spokane, Portland, and Seattle Railway (SP&S) Railway personnel including design plans and drawings for former railyard features. The historical documents were transmitted from BNSF to Ecology on September 27, 2017 (BNSF 2017).

Based on historical photos and plans, areas to the south of the current railyard consisted of vegetated areas and bedrock outcrops with some areas of sandy beachfront. Structures included a former pump house and a feature identified on historical maps as a 24-foot-diameter structure with a manhole that was associated with former processes for obtaining railyard and drinking water from the Columbia River in the early 1900s (Figure 1-4). Water use from the Columbia River was discontinued after installation of water supply wells within the railyard. The river water supply piping, which extended from a pump shaft on the railyard to the pump house, well, and river intake lines, was removed or abandoned in place in 1920. According to correspondence between SP&S personnel in the 1950s (SP&S 1950), numerous small shacks occupied by employees of SP&S were also located south of the current railyard. The Store House is visible in the aerial photograph circa 1951 (obtained by Kennedy Jenks from USACE in 2017). It is unknown if the structure was present when this area was inundated by the construction of The Dalles Dam in March 1957.

At the time the railyard was constructed, the Columbia River was free-flowing and occupied a channel approximately 300 feet south of and 40 to 50 feet lower than the current railyard. Construction of The Dalles Dam in 1957 impounded the Columbia River to create Lake Celilo. As a result, the lands along the southern portion of the railyard were inundated and remain submerged today. The main area for the sediment RI is the inundated lands adjacent to the railyard operational areas and associated outfalls.

The sediment RI study area consists of the aquatic lands that are adjacent to past industrial activities and discharges (spills and releases) associated with the railyard. This aquatic area extends approximately 1,850 feet along, and approximately 500 feet south of, the riprap shoreline. It covers the lands inundated during the filling of Lake Celilo in this area and extends beyond the historic shoreline to include the former nearshore area. The former and current shorelines are shown relative to the RI Study Area on Figure 1-2.

2 Field Investigations

Investigation activities started in the upland areas in 2002, with sediment investigations starting in 2018. Table 2-1 provides a high-level summary of the past investigations and remedial actions that have been conducted in the upland areas of the railyard. Additional details are available in the referenced documents. Table 2-2 provides a summary of the sediment investigation efforts through 2022. Section 2.1 provides a summary of the COPCs for the uplands and the in-water areas of the site. Section 2.2 discusses the investigations performed in accordance with the Work Plan and Work Plan Revision 1 (Jacobs 2021, 2022).

2.1 Previous Investigations

BNSF performed a series of voluntary and AO-directed investigations to characterize the nature and extent of constituents in soil and groundwater in the uplands portion of the railyard. In addition, BNSF voluntarily implemented independent remediation activities in the uplands portion of the railyard.

Results from past investigations indicate the COCs for the uplands are total petroleum hydrocarbons (TPH), specifically diesel (TPH-DRO)- and motor oil (residual)-range hydrocarbons (TPH-RRO), with gasoline-range hydrocarbons in localized areas, polycyclic aromatic hydrocarbons (PAHs), and select metals. PAHs, related to the TPH, have been reported in a small subset of samples above applicable MTCA cleanup levels (CULs). Reported concentrations of metals in soil were less than applicable MTCA CULs in 126 of 127 samples. Metals reported in groundwater samples above applicable MTCA CULs were limited to total and dissolved arsenic, total barium (in 1 of 73 groundwater samples), dissolved iron, and dissolved manganese. Per Ecology's letter dated December 10, 2020, geochemical conditions influencing metals concentrations in groundwater will be further evaluated as part of future groundwater monitoring efforts once the draft Cleanup Action Plan is approved.

2.2 Initial Investigation of 2018

The Initial Investigation of the Wishram Inundated Lands was completed in 2018 (Jacobs 2019). The purpose of the 2018 sampling was to characterize the nature and extent of potential NAPL occurrence and to evaluate surface sediment quality. The investigation included advancing 30 Dart samplers, which are passive sampling devices that consist of a rod coated with a sorptive material (solid phase extraction media), that were deployed to span from the sediment surface to a maximum depth of 6 feet bss. PAHs are attracted to and absorb into the solid-phase extraction media which, following removal from the sediment, were analyzed in the laboratory using laser-induced fluorescence (LIF) for the presence of NAPL (*Draft Initial Sediment Investigation Report, rev. 1*, Jacobs 2019). Results from the LIF analysis were then used to target sediment sampling in locations where NAPL was indicated.

A total of 10 surface sediment samples from the near shore and off shore areas were collected for laboratory analysis. A sample was also collected from a background location, as shown in the table below. Samples were analyzed for PAHs, TPH-DRO and TPH-RRO, extractable petroleum hydrocarbons (EPH), and volatile petroleum hydrocarbons (VPH). TPH-DRO and TPH-RRO were analyzed using both silica gel treatment and without treatment.

2018 Samples with Laboratory Analysis for Select Constituents

Station ID	Sample Method	Coordinates		Sample Depth (ft bss)	Sample Date	Sample ID	Laboratory Analysis Conducted for TPH, PAH, EPH, VPH
		Easting- X	Northing- Y				
BG-US01	Grab	1529652.49	119071.54	0.0 to 0.5	8/7/2018	BG-US01-080718	Yes
D150	Grab	1520502.10	117996.33	0.0 to 0.5	8/7/2018	D150-GS-080718	Yes

D220	Grab	1520563.61	117997.21	0.0 to 0.5	8/7/2018	D220-GS-080718	Yes
D240	Grab	1520594.91	117998.50	0.0 to 0.5	8/6/2018	D240-GS-080618	Yes
D260	Grab	1520611.39	117996.78	0.0 to 0.5	8/6/2018	D260-GS-080618	Yes
D420	Grab	1520770.20	118013.17	0.0 to 0.5	8/6/2018	D420-GS-080618	Yes
						D420-GS-080618-1	Yes
D200	Vibracore	1520546.37	118008.00	0.0 to 0.5	8/7/2018	D200-GS-080718	Yes
				3.5	8/7/2018	D200-GS-080718-A	No
F360	Vibracore	1520713.94	117981.30	1	8/8/2018	F360-SC-080818-A	No
				4	8/8/2018	F360-SC-080818-A	No
F400	Vibracore	1520753.13	117980.18	1	8/8/2018	F400B-SC-080818-A	No
				5	8/8/2018	F400B-SC-080818-B	No
G200	Vibracore	1520554.09	117949.19	0.0 to 0.5	8/7/2018	G200-GS-080718	Yes
				3.5	8/7/2018	G200-SC-080718-A	No
G260	Vibracore	1520611.41	117951.16	0.0 to 0.5	8/7/2018	G260-GS-080718	Yes
				3.5	8/7/2018	G260-SC-080718-A	No
				3.5	8/7/2018	G260-SC-080718-A-1	No
				4	8/7/2018	G260-SC-080718-B	No
I400	Vibracore	1520760.93	117914.32	0.0 to 0.5	8/9/2018	I400-GS-080918	Yes
				2.5	8/9/2018	I400-SC-080918-A	No
				5.5	8/9/2018	I400-SC-080918-B	No
J260	Vibracore	1520614.66	117891.71	0.0 to 0.5	8/8/2018	J260-GS-080818	Yes
				2.5	8/8/2018	J260-SC-080818-A	No
K120	Vibracore	1520484.45	117855.27	0.0 to 0.5	8/8/2018	K120-GS-080818	Yes
				3.4	8/8/2018	K120-SC-080818-A	No

Notes:

bss = below sediment surface

EPH = extractable petroleum hydrocarbons

PAH = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

VPH = volatile petroleum hydrocarbons

Samples that were not analyzed for selected COCs were analyzed for chemical oxygen demand and/or total organic carbon, as per Table 2-3 in the *Inundated Lands Initial Investigation Report, BNSF Wishram Railyard, Wishram Washington, May 2019* (Jacobs)

The 2018 Inundated lands initial investigation results identified TPH- DRO and TPH-RRO as COPCs in study area sediment (Jacobs 2019).

2.3 Remedial Investigation and Site Characterization Activities

The sediment RI was initiated in response to the identification of submerged NAPL in the offshore sediment during the 2018 initial investigation. The sediment RI was conducted to collect and evaluate sufficient data and information to characterize the inundated lands portion of the site. The general objectives of the RI were to develop the CSM, evaluate the nature and extent of COPCs, establish cleanup standards, and develop cleanup alternatives.

The specific objectives of the sediment RI included the following:

- Determine the depth of the biologically active zone (BAZ).
- Characterize the sediment and COPCs within the BAZ in areas of potential historical discharges, historical activities in the uplands and inundated land, and activities along the historical shoreline.

- Assess the lateral distribution of COPCs in surface sediments, and whether constituents represent an adverse risk to benthic organisms or human health.
- Characterize the sediment lithology and the lateral and vertical extent of NAPL-impacted materials below the sediment surface and refine the understanding of the source of observed sheens.
- Evaluate whether the NAPL in sediment is isolated from the NAPL in the upland areas.
- Evaluate sediment cleanup unit boundaries and appropriate cleanup standards (which may include CULs and points of compliance), as applicable.

The RI was conducted in two steps:

Step 1 included determination of the BAZ, surface sediment sampling in areas of known and potential sources, and background surface sediment collection. Step 1 surface sediment samples were analyzed for ammonia, total sulfides, metals, SVOCs including PAHs, dioxins/furans, select dioxin-like polychlorinated biphenyl (PCB) congeners, total petroleum hydrocarbons (TPH) - DRO, TPH- RRO, grain size, and total organic carbon. Analytical results from Step 1 were evaluated and results discussed with Ecology prior to starting Step 2.

Step 2 included the use of LIF profiling using Tar-specific Green Optical Screening Tool (TarGOST) to measure the depth and thickness of the NAPL-impacted materials, along with subsurface sediment cores to confirm the TarGOST profiling results and characterize sediment lithology. Sediment samples were analyzed for TPH- DRO, TPH – RRO, SVOCs including PAHs, and grain size.

2.3.1 Step 1 Field Investigation

Step 1 of the field investigation included a Sediment Profile Imaging (SPI) Camera investigation, and oxygen profiling to define depth of the BAZ, followed by collection of surface sediment grab samples for chemical analysis. Details are provided in Sections 2.2.1.1 and 2.2.1.2. The bathymetry of the area was updated in preparation for the RI and is discussed in Section 4.1.3.

2.3.1.1 Sediment Profile Imaging Camera and Oxygen Profiling

SPI camera and oxygen profiling were conducted on April 12, 2022, by Gravity Marine Services (Gravity). Field documentation is provided in Appendix A. Figure 2-1 shows the locations where the SPI camera and associated oxygen profiling were attempted, along with the bathymetry of the area.

In Step 1, the SPI camera system collected photographs of the in-situ sediment near the site. This system uses a specially designed camera that is inserted into the sediment up to a depth of 12 inches. The camera head includes a clear plastic viewing plate with the camera behind the plate. Once inserted into the sediment, the camera takes a picture as a cross section of the sediment profile.

Under typical soft sediment conditions, the cross-section photographs provide visual information used to establish the BAZ including:

- The Redox Potential Discontinuity or the zone where the sediment changes from oxic to anoxic, which can be observed as a color change from brown to black.
- Sediment texture, grain type and size, and color allowing identification of sediment as sand, gravel, silt, or clay.
- Evidence of biological activity by depth and the type of benthic infauna community present.
- Evidence of strongly reducing conditions such as pockets of methane gas.

The camera was deployed at six locations: SG04, SG11, SG19, SG21, SG29, and SG31 per the approved Work Plan. Multiple attempts were made at each location. The camera was also attempted at two upstream background locations (BG01 and BG04), not specified in the Work Plan, to confirm conditions found in the investigation area and to provide some indication of whether grab samples would be successful in that area. Windy conditions at BG04 prohibited deployment of equipment.

The camera head could not penetrate the river bottom as it encountered a hard substrate at each of the eight locations. The images collected by the camera identify a bed surface that is predominantly gravel, with gravel and/or cobble observed at some locations. Similar conditions were found at the background location BG01. Appendix A presents the field notes and representative images from the SPI investigation.

A Salish grab sampler was deployed in each site location where the SPI camera was deployed to collect sediment samples for oxygen profiling. The sampler was not deployed at the background locations. At the attempted grab sample locations, riverbed material retrieved using the grab sampler consisted primarily of gravel, with small amounts of sand and shells. Cobbles were also retrieved in the grab sampler and submerged aquatic vegetation was present at numerous locations. The grab sampler was unable to adequately penetrate the river bottom except at one location (SG11). At SG11, the grab produced a small amount of sandy material, but less than the minimum thickness needed for the Unisense Microrespiration System sediment oxygen sensor (5 centimeters (cm)). An oxygen reading was attempted, but the oxygen sensor was unable to obtain a reading.

2.3.1.2 Biologically Active Zone Determination from Step 1

The depth of the BAZ and the observed riverbed substrate were discussed with Ecology staff on April 18, 2022, following completion of the SPI camera field investigation. The SCUM guidance (Ecology 2021, Chapter 3) states that the BAZ should be assessed by using the redox layer. Per Section 3.4.1.2 of the SCUM guidance, if the redox layer cannot be measured using appropriate methods such as SPI and oxygen measurements (described in Section 2.2.1.1), then the default depth for the BAZ is 10 cm. Ecology agreed that 10 cm was appropriate for this area on April 18, 2022.

2.3.1.3 Grab Sampling

Step 1 sediment grab sampling was conducted in accordance with the approved Work Plan (Jacobs 2021) between April 19 and April 29, 2022. Gravity provided vessel-based sampling platforms and equipment. Sediment grab samples were logged and processed on the sampling vessel and samples were collected following the procedures detailed in the Sampling and Analysis Plan (SAP) (Appendix A of the Work Plan (Jacobs 2021)). Sampling logs and representative photographs of the sediment grab samples are provided in Appendix B. Table B-1, in Appendix B, summarizes the grab attempts and samples retained for each location. The samples were analyzed and/or archived based on the analytical schedule presented in the Work Plan (Jacobs 2021).

The Work Plan (Jacobs 2021) specified a total of 44 site locations and 12 background locations for sediment grab sampling (Figures 2-2 and 2-3). Collection of surface sediment grab samples for laboratory analysis were attempted at each of the planned locations. The grab samples were comprised of either multi-point composites from up to three individual grab samples, where possible, or single-point grabs in areas where sufficient surface sediment (10 cm) was captured within the grab sampler to represent the BAZ. Each grab sample was collected within 25 feet of the target location.

At the site areas, a total of 130 attempts were made to collect grab samples. A total of 46 attempts were made in background areas. A summary of the attempts to collect sediment grab samples is shown below.

Location	Number of attempts	Result of attempt
Site Area	64	Refusal
	45	Less than 10 cm of material
	21	Successful grab samples (13 unique stations)

Location	Number of attempts	Result of attempt
Background	25	Refusal
	11	Less than 10 cm of material
	10	Successful grab samples (8 unique stations)

Notes:
cm = centimeter

The locations of attempted and retained surface sediment grab samples at the site and in the background areas are shown on Figures 2-2 and 2-3, respectively. These figures include analytical results where one or more SCO or CSL is exceeded, for both the 2018 and 2022 data. The centroids of the composite samples are also shown. The centroid values were used to represent the sample location. A summary of the surface sediment samples is provided in Table 2-3. A list of the attempted grab samples, recovery depth, and whether the attempt resulted in a sample included in the composite is provided in Appendix B, Table B-1.

As a result of hard bottom conditions and a lack of sampleable material, BNSF met with Ecology on April 22, 2022, to discuss collecting additional background samples from the upstream area. The parties agreed with the need for additional attempts, and eight more background locations were attempted, focusing on areas where sampleable material was likely to be encountered, such as areas where sand bars were noted and areas of lower flow velocities. Ecology requested that the bottom conditions be well documented during the field activities. Due to the potential for a limited sample volume, Ecology also agreed that it would be acceptable to composite material from multiple grabs at a single station. Figures 2-2 and 2-3 indicate which locations were single point or composite samples.

The eight new locations selected in coordination with Ecology were:

- BG13 – southeast corner of Miller Island
- BG14 – northeast corner of Miller Island
- BG15 – east side of mouth of the Deschutes River
- BG16 – west side of mouth of the Deschutes River
- BG17 – approximately 2,300 west side of mouth of the Deschutes River
- BG18 – west end of sand deposit from the mouth of the Deschutes River
- BG19 – west end of Miller Island
- BG20 – northeast side of Miller Island

An alternate location was selected for BG10 (named BG10A) due to the challenging field conditions at the planned station of BG10. The depth finder and bathymetry both suggested a highly irregular surface which combined with the high current could have potentially damaged the sampling equipment. BG10A is approximately 550 feet east of BG10.

Samples of the riverbed collected with a power grab sampler confirmed the SPI camera findings, which indicated that the substrate consisted of gravel with some shells and small stones at most of the locations. Where sediment was present, samples were collected from the 0 to 10 cm depth interval (as discussed with Ecology on April 18, 2022, see Section 2.2.2).

2.3.2 Step 2 Field Investigation

Revisions to the Sediment RI Work Plan were requested by Ecology via email on October 3, 2022, following Jacob's presentation of the Step 1 results to Ecology and YNF. In response, Sediment RI Work Plan Revision 1 (Work Plan Revision 1), dated October 27, 2022 (Jacobs 2022) was prepared to address Ecology and YNF's comments. Work Plan Revision 1 modified the number of core locations to be advanced within the suspected NAPL impact area from 6 to 8, and the number of cores to the south of the impacted area from 3 to 1. In addition, the revisions clarified that locations of cores within the site area were to be selected in collaboration with Ecology, and TarGOST step-out locations would be added as needed to delineate the extent of submerged NAPL.

Step 2 of the field investigation was conducted from November 1 through 15, 2022, with TarGOST starting on November 1, and sediment coring starting on November 3, 2022. Field work was conducted in accordance with the approved Work Plan (Jacobs 2021) and the approved Work Plan Revision 1 (Jacobs 2022).

TarGOST and associated sampling field activities were conducted from a barge operated by Mark Marine Services. A tug and support vessel provided support and transportation to and from shore. Sediment cores were collected from a marine vessel operated by Gravity using a Vibracore system. Direct -push technology (DPT) cores were also collected from the barge using a drill rig operated by Western States Soil Conservation Services, Inc. (Western States).

The barge was approximately 130 feet long by 40 feet wide, with resting elevation of approximately 25 feet above the water's surface. Sampling crews were transported by support vessel (launched daily to and from Celilo Park) to a smaller secondary barge that was approximately 35 feet long by 15 feet wide, with a resting elevation of approximately 5 feet above water surface. Staff moved from the smaller barge to the working barge by climbing a secured ladder. Two separate temporary workstations were constructed on the working barge: one for the TarGOST drill rig and real-time data analysis and the other for sediment core processing and cultural monitoring (discussed in Section 2.2.2.4). Each of the two work areas were equipped with a secondary containment structure (4-millimeter-thick polyethylene liner, bermed on all sides) placed underneath the working area of the respective exclusion zones. Each workstation had its own independent field office and storage facility.

2.3.2.1 TarGOST

TarGOST is an LIF tool developed specifically for the detection of higher molecular weight NAPL. The TarGOST system is used as an in-situ evaluation tool that is advanced using a DPT drilling rig and provides real-time, semi-quantitative graphical data of the vertical distribution of NAPL saturation in the subsurface. Fluorescence responses are recorded as a percentage of a fixed calibration standard or reference emitter.

TarGOST was successfully used in uplands portions of the railyard for identifying NAPL (Dakota 2013). NAPL-containing sediment cores collected from within the inundated lands area during the initial sediment investigation in 2018 (Jacobs 2019) were scanned at the Dakota Technologies facility using TarGOST. The scans generated approximately 100 readings per core, with peak TarGOST fluorescence responses ranging from 55 and 229 percent of the reference emitted (%RE). NAPL saturations were measured in the same cores between 3 and 42 percent pore volume (%PV) (CH2M 2018). For samples where NAPL saturations were less than 0.1 %PV, the maximum TarGOST responses ranged from 30.6 to 39.2 %RE. This work demonstrated the effectiveness of TarGOST for identifying the NAPL in the materials found in the sediment RI study area.

During the RI, a Geoprobe® drilling rig equipped with DPT was employed to advance the TarGOST. While the Work Plan called for between 18 and 35 locations, TarGOST was attempted at a total of 60 unique locations during Step 2, as listed in Table C-1 of Appendix C and shown on Figure 2-4. The drill rig was positioned on the barge over a moonpool (an approximately 8-inch diameter hole intentionally positioned on the barge for drilling). The tugboat captain and field lead communicated via radio to position the barge's moonpool over the intended station. Positioning was conducted using the ArcGIS Collector application and a Trimble R1 Global Positioning System Receiver to achieve sub-meter accuracy. At 58 locations, TarGOST was successfully advanced into the subsurface. TarGOST could not be advanced at two locations (ON220 and MN320) due to the presence of bedrock (Table 2-4).

Upon arrival at each station, depth to "mudline" (i.e., riverbed material, regardless of type, and is referred to herein as "sediment surface") measurements were collected using a weighted water level indicator from the surface of the barge. Depth to riverbed surface measurements were added to target-specific penetration depths to calculate the total length of TarGOST rod required for each station. The length of rod required also accounted for an additional 6-inches, which is the distance from the tip of the TarGOST profiling tool (used as a solid drive point attached to the first section of drilling rod) to the optical viewing window (where the TarGOST profiling data are collected). The TarGOST was coupled with an Electrical Conductivity Dipole Array (EC) to provide general stratigraphic information. EC emits a current through the subsurface formation in between the two probe contacts. This current and the resulting voltage is measured, and the general sediment type or changes in sediment type are inferred by the material's measured conductivity.

Prior to advancing the TarGOST and drilling rod assembly, a 4–inch diameter casing was set at least several inches (depending on where firm material was encountered) into the riverbed surface to protect the TarGOST tooling from being bent or broken by the river currents. Once the drilling rod and TarGOST profiler were set in place, the tooling was advanced from riverbed surface to depth, collecting nearly continuous measurements of fluorescence response and EC to establish the vertical extent of submerged NAPL and sediment type. A summary of the TarGOST profiling is as follows:

- TarGOST profiling was attempted at a total of 60 locations, of which 58 locations were successful. Refusal was encountered at the surface at ON220 and MN320.
- LIF response measurements were collected at an average frequency of one reading every 0.03 foot. In total, more than 38,500 LIF response data points were collected.
- At 49 locations (which includes the two locations with refusal at the surface), the TarGOST tool was advanced to refusal. Refusal was encountered between a depth of 0 feet bss at MN320 and ON220 (2 attempts at each location) and 46.87 feet bss at F390 (Table 2-4).
- Of the locations where refusal was encountered, 41 were noted as a hard refusal at depth, which was interpreted as encountering the bedrock surface.
- At 11 locations, TarGOST profiling stopped prior to reaching refusal. The maximum depth reached with TarGOST was 46.87 feet bss (F390).

Drilling information at each location, including TarGOST fluorescence responses and refusal types (gradual vs hard) were reviewed by the TarGOST operator (a Dakota Technologies, Inc. employee) and Jacobs staff and communicated to the project team to evaluate follow-on actions. These data were also reviewed in detail by off-site Jacobs' subject matter experts.

Observations and results of the TarGOST profiling informed the locations of the sediment cores (see Section 2.2.3.2), which were conducted at 16 locations. TarGOST profiling results are discussed in Section 3.1.3. The locations of TarGOST stations are shown on Figure 2-4 and summarized in Appendix C, Table C-1. TarGOST documentation (such as field logbooks and activity-specific forms) is provided in Appendix C.

2.3.2.2 Sediment Cores

The revised Work Plan (Jacobs 2022) proposed a total of nine sediment core locations: eight pending TarGOST results within the NAPL footprint and one south of the NAPL footprint for background data. The number of cores was increased during the field effort based on observations from both the TarGOST real-time readings and sediment cores (see Section 3.2.1).

In total, sediment cores were attempted at 16 stations (10 with Vibracore and 6 with DPT) with one station (G000) being advanced with both drilling methods (as described below), between November 3 and November 15, 2022. Sediment cores were used to either (1) confirm TarGOST results with co-located cores or (2) refine the extent of NAPL. Sediment core stations co-located with TarGOST results were generally selected based on the following rationale:

TarGOST Reading	Co-located Core Rationale
Interval of relatively elevated fluorescence with waveform consistent with NAPL	Confirm presence of NAPL Assess effectiveness of TarGOST
Interval of relatively elevated fluorescence with unique waveform inconsistent with NAPL	Evaluate source of unique LIF waveforms, Evaluate potential false positive
No intervals of elevated fluorescence; NAPL not suspected	Confirm "clean" location; evaluate potential for false negative response

Coring was initially conducted using a vessel mounted Vibracore. However, coring conditions proved challenging at some locations where shallow refusals (as compared to the TarGOST depths, due to the larger diameter core) were encountered and limited recovery was achieved. In response, BNSF consulted with Ecology to obtain authorization for use of the barge mounted DPT rig to attempt advancing sediment cores to deeper depths in data gap areas. Verbal authorization from Ecology for this Work Plan deviation was provided on November 4, 2022. Multiple cores were attempted at locations as presented in Table 2-5.

The core with the best recovery percentage (drive depth/recovery) of the attempts made at a single location was decanted, split open longitudinally, sectioned and logged onboard the working barge and inspected by the Cultural Monitor (these are referred to, herein, as "accepted cores"). Based on the professional judgement of the Cultural Monitor, some of the rejected cores were opened and visually inspected. Maximum penetrations of the accepted cores ranged from 3.2 to 22.6 feet bss with recoveries ranging from 0.7 to 13.8 feet. The materials within each accepted core were processed in accordance with Appendix A of the sediment RI SAP. Table 2-5 presents the core locations, drilling methods, number of attempts, and the penetration for both sediment cores and TarGOST profiling locations. Where possible, sample collection was focused above and/or below NAPL impacts, as per the Work Plan. A summary of samples collected during the 2022 sampling event is presented in Table 2-6. Appendix D provides the field documentation for sediment coring activities, with Table D-1 providing details on sampling depths and recoveries at each location.

Upon splitting the core liner, olfactory, and visual observations were recorded, and photoionization detector measurements were collected via direct reading on a continuous basis along the core. The cores were photographed and logged according to the standard operating procedure (Appendix A of the Work Plan, [Jacobs 2021]). Logs and sample depths used the as-recovered depths (or lengths) along the recovered core. In general, the recovered interval was assumed to begin from the top of the sediment surface as estimated using the bathymetric surface elevation at the coordinates from each location. However, at select locations the elevation of the top of the recovered interval was adjusted downward (from the estimated bathymetric surface) by approximately 0.5 to 2 feet to account for the presence of a fibrous soft vegetative mat present at the sediment surface, in areas nearer to the shoreline (typically north of the grid J-line); the vegetative mat could not be recovered using the DPT or Vibracore samplers (Tables 2-4 and 2-5). The elevation adjustments were based on prior observations at each location during the advancement of the outer casing for the co-located TarGOST.

Sediment was collected from 1-foot as-recovered intervals, placed in single-use aluminum pans, thoroughly homogenized with new single-use stainless-steel spoons, and transferred into the appropriate laboratory-supplied sample jars. Samples were stored in coolers with ice until reaching the laboratory for analysis. To assess anomalies and confirm the fluorescence response and waveforms observed with TarGOST in the field, 14 samples were also collected prior to homogenization from select cores for ex situ TarGOST scanning by Dakota Technologies at their laboratory in Fargo, North Dakota (Appendix D, Table D-2). Twenty-eight samples were scanned ex situ in the field by placing materials of interest (shells, woody debris, grasses, and sediments with and without visual evidence of NAPL) directly onto the TarGOST optical viewing window. The wavelength signatures of these specific materials were recorded, as discussed in Section 3.1.3 and presented in Appendix D, Table D-2. Five locations were scanned both in the field and in the lab.

The locations of attempted and accepted sediment cores are shown on Figure 2-5 and discussed in detail below, noting that multiple attempts were made in many of the locations. A summary of field activities, including sediment sampling documentation (such as field logbooks and activity -specific forms) and sediment core attempt details (Tables D-1 and D-2) is provided in Appendix D. A summary of the number of locations for each type of penetration is presented on the following page.

Type of Penetration	Action	Number of Stations Attempted	Result of Attempts
TarGOST	TarGOST Profiling	60	60 attempts; surface refusal at 2 stations (MN320 and ON220)
Vibracore	Drilling	10	35 attempts; surface refusal at 1 station (SG06)
	Core Processing	10	9 accepted cores; 2 cores collected from station G000
	Sampling	6	8 laboratory analytical samples collected (2 samples collected from G000) 19 TarGOST ex-situ samples collected
Direct Push Technology	Drilling	7[a]	11 attempts; surface refusal at 1 station (SG06).
	Core Processing	7[a]	8 accepted cores; 2 cores collected from station J060
	Sampling	5	6 laboratory analytical samples collected (2 samples collected from J060) 1 TarGOST ex-situ sample collected

a. There were a total of 16 Stations drilled, using either DPT or Vibracore drilling methods. Station G000 was drilled using both methods and is included in the number of stations attempted for both drilling types.

Vibracore Core Sample Collection

The Vibracore sampler was used to collect sediment cores at 10 stations, with each station receiving three or more attempts (Table 2-5) to achieve the best depth and/or recovery. Of the 10 stations, eight were co-located with TarGOST results. Stations SG06 (located south of the area of impacts, as per the approved Work Plan) and G020 were placed to confirm site conditions and delineate the extent of NAPL. Table 2-6 summarizes the samples collected and analyses performed from the accepted cores.

The Vibracore sampler consisted of a vibrating drive head attached to various lengths of 4-inch diameter aluminum core barrels lined with clear polyvinyl chloride (PVC) tubes. The core barrels were driven from the riverbed surface, or just below the riverbed surface where the vegetative mat was present, to the maximum depth that could be achieved with the Vibracore at each station (Appendix D). Once retrieved, sediment cores were labeled with total penetration and recovery depths (as measured onboard after suspended sediments were allowed to settle [between 1 and 15 minutes]) and transported to the working barge for processing. Of the eight co-located Vibracore stations, none were able to penetrate greater than 50 percent of the total depth achieved using TarGOST at these same stations (Table 2-5). The reduced penetration depth was not unexpected as the outer diameter (OD) of the TarGOST tooling (1.75-inch OD) is significantly less than that of the Vibracore (4-inches OD) and can more easily navigate between large cobbles, boulders, and riprap prevalent in the area. No more than three attempts were conducted at any station with the exception of station G000. Station G000 is located near the shoreline on the western edge of the sample grid provided in the Work Plan (Jacobs 2021). To confirm the presence of suspected NAPL in this area, a total of nine attempts were made at G000; six with Vibracore, two with a combined Vibracore and water "jetting" technique used to increase recovery, and one with DPT.

Vibracore samples were also attempted at two stations where TarGOST was not employed; stations SG06 and G020 (Table 2-5). Three attempts were made to collect cores at each station. Hard refusal, indicative of bedrock, was encountered with each attempt at SG06 and therefore, no samples were collected (Appendix D). A successful core was collected at G020.

A total of eight subsurface sediment samples were collected for laboratory analysis using Vibracore from various stations and intervals (Table 2-6). Samples collected using Vibracore were submitted to Pace Analytical Laboratory for analysis of semi-volatile organic compounds (SVOCs) including PAHs, TPH-DRO and TPH-RRO (by NWTPH-Dx), total organic carbon (TOC), and grain size (Table 2-6). Nineteen additional subsurface sediment samples were collected and submitted for ex-situ TarGOST analysis (Table D-2).

DPT Core Sample Collection

A Geoprobe rig with DPT tooling was used to collect sediment cores at seven stations: six co-located with TarGOST results (including G000) and one (station KN400) placed farther west to confirm site conditions and delineate the extent of NAPL. Cores were collected by advancing 5-foot sections of 1.75-inch OD steel core barrel lined with clear PVC from riverbed surface to total depth (Appendix D). Of the six co-located DPT stations attempted, two (EF470 and G000) were successfully advanced to within 1-foot (±) of the depth achieved by TarGOST at these same stations (Table 2-5). However, recovery was less than 50 percent at both stations (5.8-feet out of a 13-foot penetration at G000 and no recovery from 0-7.5 feet bss at EF470) (Appendix D). Station EF470 is located close to the shoreline where large pieces of concrete and riprap are prevalent. The lack of sediment collected from 0-7.75 feet is due to the drilling rod pushing past a concrete slab and advancing through a void space within the rip rap, based on the lead driller's observation of casing "slipping and falling" once casing was set and they had begun advancing. The remaining four co-located stations had less than 10 feet of penetration and provided minimal volumes of sediment for sample collection (Table 2-6).

DPT cores were also attempted twice at station KN400 where TarGOST was not employed (Table 2-5). At the time of collection, station KN400 was named HN300, which was based on field estimates as no target coordinates were available, and the station was outside of the originally planned sample grid The station name was later changed from HN300 to KN400 based on where the actual coordinates placed the station on an expanded sample grid. Hard refusal (approximately 4.5 feet bss) was encountered at KN400 during each attempt and less than 50 percent recovery was achieved in either core (Table 2-5 and Appendix D, Table D-1).

A total of six subsurface sediment samples were collected using DPT from various stations and intervals (Table 2-6). Samples collected using DPT were submitted to Pace Analytical Laboratory for analysis of SVOCs including PAHs, TPH – DRO, and TPH- RRO. One sample from J060 was also submitted for TOC (Table 2-6). One additional subsurface sediment sample was collected and submitted for ex-situ TarGOST analysis (Table D-2).

2.3.2.3 Investigative Derived Waste

Investigative derived waste (IDW) generated during the field activities was collected in United States Department of Transportation-approved 55-gallon drums and labeled appropriately for its contents. IDW was transported to a staging area following completion of the field work and later disposed of by U.S. Ecology on behalf of BNSF. Waste manifests are included in Appendix D.

2.3.2.4 Cultural Resource Monitoring

An archaeological resource monitor (Cultural Monitor) was present during the subsurface investigation work. The updated archaeological site information and archaeological report was submitted to the Washington State's Department of Archaeology and Historic Preservation, the Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes of Warm Springs.

3 Field and Analytical Results

This section presents the results of the RI.

3.1 Step 1 Results

A summary of the Step 1 results is presented in the following subsections.

3.1.1 SPI Camera

As discussed in Section 2.2.1, the SPI camera was unable to penetrate the substrate but was able to confirm the presence of a hard gravel and rock substrate. No analytical samples were collected, and oxygen profiling was unsuccessful as there was no sampleable material. A report detailing the results of the investigation is presented in Appendix E.

3.1.2 Surface Sediment Grab Sampling

In total, 13 site locations and 8 background locations were sampled, as shown on Figures 2-2 and 2-3. Sediment samples from grabs were submitted to Pace Analytical Laboratory in Mount Juliet, Tennessee and analyzed for the following:

- Ammonia
- Total sulfides
- Metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc
- Organic chemicals: 4-Methylphenol, Benzoic acid, Bis(2-ethylhexyl) phthalate, Carbazole, Dibenzofuran, Di-n-butyl phthalate, Di-n-octyl phthalate, Pentachlorophenol, Phenol, Total PAHs, Carcinogenic PAHs
- Dioxins/Furans congeners
- Select dioxin-like PCB congeners
- Bulk petroleum hydrocarbons: TPH -DRO and TPH-RRO by NWTPH-Dx

Step 1 analytical results indicated the presence of total sulfides above the Freshwater Benthic dry weight SCO in both site and background samples. In addition, 3 & 4-Methylphenol (m&p-Cresols) was identified above the SCO in one background sample (BG17). TPH-DRO and TPH-RRO were not detected above the SCO. Tables 3-1 through 3-5 present the analytical results from Step 1 of the investigation.

3.1.3 Background Evaluation

Data from eight background locations was available for establishing preliminary natural background values. The result from the single field duplicate sample was averaged with its parent when both analytes were detected or undetected. If one analyte was detected and the corresponding result was not detected, the detected value was selected to represent the preliminary natural background value. Based on discussion with Ecology on August 16, 2023, preliminary natural background values were established as either the maximum detected background concentrations or the maximum practical quantitation limit (PQL) if all concentrations were non-detect. Data manipulation, visualization, and analysis were performed using R statistical software (R version 4.2.1, 2022). Table 3-6 includes a summary of the preliminary natural background values. The detailed background analysis is documented in Appendix F.

3.2 Step 2 Results

As described in the following sub-sections, a 'multiple lines of evidence' approach was conducted for this RI. The approach included TarGOST profiling, confirmatory sediment core logging, and sediment sample collection with laboratory analysis to further evaluate the nature and extent of impacts, including identifying intervals of NAPL and impacted and unimpacted sediment. NAPL was observed at several locations during the RI. Figure 3-1 shows the Step 1 grab sample and Step 2 TarGOST and sediment core sample locations.

3.2.1 TarGOST and Sediment Coring Results

The TarGOST and sediment core sampling is discussed in the following subsections.

3.2.1.1 TarGOST Profiling

The peak raw subsurface TarGOST fluorescence responses measured at each of the 58 TarGOST borings advanced below the sediment surface ranged from 1.5 %RE at M190-TG to 421 %RE at G320-TG. The depth of each TarGOST profile and the peak observed raw TarGOST response and corresponding depth is summarized in Table 3-7. Copies of each TarGOST log showing %RE responses over depth are provided in Appendix G. A copy of Dakota Technologies' TarGOST log reference guide is also included in Appendix G.

Different NAPLs will have a unique waveform fingerprint due to the relative amplitude of the four channels that comprise the tools fluorescence response and/or broadening of one or more of those channels. TarGOST can also respond to natural organic matter such as peat or wood or fluorescent minerals; these waveforms can also be distinguishable from those associated with NAPL. The variability in the fluorescence signatures observed at the site is illustrated in the cluster plots generated by Dakota for each boring and provided in the upper right hand-side of each log provided in Appendix G. In addition to waveforms that were consistent with NAPL-containing sediment (based on ex situ sediment scans from the initial sediment investigation) several unique fluorescence waveform patterns were also observed in the logs generated for the site that indicated strong non-NAPL-related fluorescence responses or 'false positives.' Additional details on waveform analysis and interpretation of TarGOST fluorescence responses can be found in Dakota Technologies' High Resolution Site Characterization Report provided in Appendix G. Confirmatory coring with visual observations and ex situ scanning was performed to assess the different fluorescence responses and benchmark the conditions indicative of NAPL in sediment at the site.

3.2.1.2 Visual Observations and Lithology

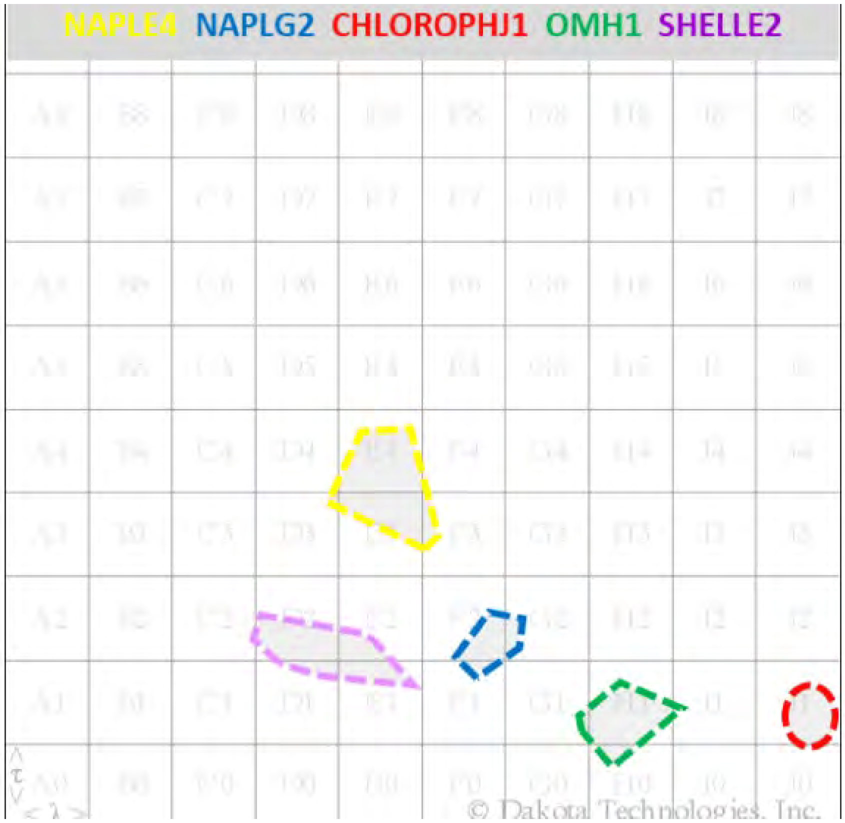
Within approximately 100 to 150 feet of the shoreline the sediment surface is covered with a dense mat of vegetation that can be observed from the surface of the water and that has been evidenced in the surface grab samples. Beneath and beyond areas where this vegetative mat is present the sediment samples obtained through core sampling indicated the presence of layers of fine sand and silty fine sand that extend to depths of between 0.5 foot (E240) and almost 7 feet bss (G000). Some limited NAPL-related impacts consisting isolated blebs, odors and sheen were observed in these materials along the edge of the sleep slope in the sediment surface around the grid K-line (K200 and K280) and towards the west in the vicinity of G000 and G020. The bulk of the observed NAPL impacts are present beneath the fine sands and silts within a 1- to 5-foot interval of disturbed silty sand, silt, and clay with no apparent bedding structure and an abundance of organic debris, consisting of wood and roots. NAPL impacts were observed within approximately 140 feet of the shoreline and consisted of saturated or coated sediments and NAPL-coated woody debris with odors and occasionally elevated PID readings. The absence of bedding structure and the abundance or organic debris mixed in the NAPL-impacted intervals encountered suggest that these materials represent a layer of material that was emplaced before these lands were flooded by Lake Celilo. At the four core locations in 2022 (G000, F360, EF470, K280) and one location in 2018 (J260) that extended below this disturbed layer, intervals of fine sands, silty sands, and well-graded gravel were observed, with some limited roots and organics in the upper portions of this material. The maximum depth of recovered sediment was approximately 22.8 feet bss at EF470 which showed primarily fine sands with some limited intervals of gravel between 8.4 and 22.8 ft bss. While bedrock was not observed within the study area during the initial and RI investigations, hard refusals with the TarGOST tooling and at-surface refusals with the Vibracore suggest bedrock is present at depths ranging from 0 feet bss farther from shore where the river bottom slopes downward (ON220, MN320 and SG06) to more than 35 feet bss nearer to the shoreline (EF240, EF280, F320, F390, and I120).

3.2.1.3 Bench Top TarGOST Evaluation

At select locations where an elevated or unusual TarGOST waveform was encountered, samples were collected from a similar elevation in a collocated confirmatory sediment core were collected for ex situ TarGOST scanning (including shells, gravels, vegetation, wood, or observed NAPL impacts). As summarized in Table 3-7 a total of 20 samples were collected and 37 different materials found within these samples (including shells, plants, and wood, sands, and organic-rich sediments with and without visual evidence of NAPL impacts) were scanned ex situ using the TarGOST tool either on the barge during the field effort or at Dakota's lab, or both. Table 3-7 indicates where these samples were collected, what material was scanned and whether NAPL-related impacts were observed. The resulting bench top fluorescence response is captured in a log with its associated classification plot in the logs provided in Appendix G. This follow-on bench top screening confirmed the presence of five different waveforms, three of which represented false positives as they were associated with the fluorescence of shells, chlorophyll (plant matter), and organic material. The two remaining waveforms were associated with NAPL at the site, and corresponded to cluster plot locations D4 to E3, and F3 to G2. Additional details on this evaluation are provided in Dakota Technologies' High Resolution Site Characterization Report provided in Appendix G.

3.2.1.4 Data Processing

To allow for a more accurate estimate of those areas and intervals potentially impacted by NAPL, post-processing of the TarGOST data set was performed by Dakota Technologies by isolating the specific signals associated with each of the five unique materials to develop the Basis Set for a non-negative least squares (NNLS) analysis. Post-processing was performed using Dakota Technologies' in-house software, which generates a set of fluorescence responses logs for each of the different signal responses. Each of these responses was grouped, as part of the NNLS analysis, into a corresponding waveform associated with the Basis Set as illustrated in the graph below. For example, NAPLE4 (yellow) and NAPLG2 (blue) are the NAPL-like waveforms generally located around cluster plot locations E4 and F2, respectively. The chlorophyl (CHLOROPHJ1 in red) response is clustered around location J1, organic matter (OHM1, in green) at location H1, and shells (SHELLE2, in purple) were identified at location E2 on the cluster plot, although there is variability in cluster plot locations for the responses. The cluster plot locations for fluorescence signals associated with each of the TarGOST locations are shown relative to these 5 signatures on the logs provided in Appendix G. A review of the cluster plots provided in the logs indicates that the Basis Set waveforms generally capture the range of in situ fluorescence responses observed at the site. The exception to this is at location FGN160 which exhibits a consistently unique fluorescence response between 0.3 and 0.8 ft bss that plots outside each of the known categories. Because this waveform is not specifically part of the Basis Set it has been categorized as part of the NNLS process as NAPLE4, however the log for this location shows these responses plot squarely beyond this category, and closer to SHELLE2. The consistency of this unique fluorescence response and its shallow depth relative to NAPL-like responses at HN200 and HN100 suggest it is unrelated to the NAPL that has been identified at the site.



Cluster diagram of the Basis Set waveforms used in the NNLS processing

It should be noted that the NNLS process can result in low-level false-positive responses of any of the targeted waveforms. This is because the natural variability in the fluorescence associated with each of the materials cannot be accounted for in the basis set that is used to inform the NNLS categorization process. This requires determining a minimum threshold for NAPL-like signals if the resulting data set is to be used effectively assess NAPL extents. Locations and intervals where NAPL-like signals were observed are summarized in Table 3-7, and the signal associated with each location's peak response is included. Table 3-7 provides a point-by-point evaluation of the TarGOST profiling (both raw and NAPL-like TarGOST responses) and collocated confirmatory coring and relevant sampling results and includes key observations and notes. This evaluation indicates NAPL-like TarGOST responses of approximately 10 %RE and greater are indicative of NAPL-related impacts at the site. As summarized in Table 3-7 the data indicate NAPL was present at 18 TarGOST locations at various thicknesses ranging from 0.1 to 6 feet. The data also suggest that when NAPL-like TarGOST responses are closer to 10 %RE NAPL-related impacts may consist of concentrations of sorbed PAHs associated with NAPL or small discreet blebs of NAPL. Higher responses generally indicate NAPL saturated zones. The breakpoint between these two NAPL-related impact conditions cannot be established.

An estimate of the lateral and vertical extents of NAPL impacts using the TarGOST data, confirmatory cores and analytical results is discussed in Section 3.4.

3.2.2 Subsurface Sediment Sample Analytical Results

Subsurface sediment samples were collected and submitted to Pace Analytical Laboratory for analysis to confirm TarGOST findings (as discussed in Section 2.2.2). Samples were collected from select core locations primarily in areas/intervals where the TarGOST results suggested impacts were not present. A total of 14 subsurface sediment samples were collected and analyzed from 11 stations as shown in Table 2-6 and on Figure 2-5. Samples were collected from multiple depths at the following locations: EF240, G000, and J060. Per the approved Work Plan and Work Plan Revision 1 (Jacobs 2021, 2022), samples were analyzed for TPH (DRO and RRO), PAHs, and other constituents exceeding an SCO benthic criterion (except for sulfides) during Step 1. Since only sulfides exceeded its SCO benthic criterion during Step 1, the sediment samples from cores were analyzed for DRO, RRO and SVOCs.

Subsurface sediment samples were analyzed immediately by the laboratory with one exception. Sample BNSF-G200-SC-4.0-5.0-110722 had been requested to be placed in frozen archive, for analysis if needed. Due to an error at the laboratory, the sample was kept refrigerated. The laboratory conducted the extraction for NWTPH-Dx, but the remaining analytical methods were out of hold time. As a result, only the grain size and NWTPH-Dx analyses were conducted on that sample. Analytical results from Step 2 are presented in Tables 3-8 and 3-9.

Visual evidence of petroleum impacts were identified at G200 (Figure 3-2) during the 2018 initial investigation (Jacobs 2019). The location was targeted to confirm the presence of NAPL. TarGOST results showed a strong fluorescence response (max of 209 %RE at 7.8 ft. bss) at that location with a waveform pattern consistent with NAPL impacts. As a result, a core was advanced at the same location. Analytical results from the sediment sample from 4.0 to 5.0 ft bss indicated 91,100 mg/kg TPH-DRO and 102,000 mg/kg TPH-RRO, above the SCO levels of 340 and 3,600 mg/kg, respectively. These levels are consistent with the presence of NAPL identified in both the 2018 and 2022 cores at G200.

Additionally, an exceedance of the TPH-DRO SCO was reported in sample BNSF-F390-SC-6.2-7.2-110722, located at station F390 at a depth of 6.2 to 7.2 ft bss. The sample had a TPH-DRO result of 676 mg/kg, above the SCO of 340 mg/kg. No other results were reported above their respective SCOs, as shown in Tables 3-8 and 3-9.

3.3 Estimated Extent of NAPL and Surface Sediment Conditions

3.3.1 Estimated Extent of NAPL

The area of investigation was expanded laterally away from the shoreline and to the west beyond the initial RI study area to delineate the area of impact. The extent of NAPL impacts was developed using multiple lines of evidence, including TarGOST locations/intervals where NAPL-related waveforms were observed (Table 3-7), and observed NAPL impacts in sediment cores advanced in 2018 and 2022. The estimated lateral extent of NAPL is shown on Figure 3-2. The vertical distribution across the site is illustrated on Cross Sections A-A’ and B-B’, provided as Figures 3-3 and 3-4, respectively. These cross sections also plot the NAPL-related TarGOST signals and the intervals of observed NAPL from the sediment cores and subsurface sediment analytical data.

The NAPL impacts extend approximately 650 feet east-to-west within approximately 140 feet of the shoreline. The majority of the NAPL is in the vicinity of locations G200, G320, I200, I280, J260 between approximately 40 and 120 feet south of the shoreline as shown on Figure 3-2. Here the NAPL is present at thicknesses of up to 6 feet and is found at depths ranging from 0.5 ft bss to the south at J260 and 9.5 ft bss to the north at G320. This area of NAPL is considered the source of the intermittent sheens based on its location adjacent to where intermittent sheens have been seen along the shoreline, and because this area had the highest peak TarGOST responses and consistent observations of saturated NAPL conditions, this area of NAPL is considered the source of the intermittent sheens.

NAPL impacts diminish to the north and east towards the shoreline and are found at lesser thicknesses and relatively lower peak and average TarGOST responses. To the south, the NAPL-impacted interval thins and is closer to the sediment surface (J260, K200 and K280) as the sediment surface slopes downward. Due to its shallow nature the NAPL at this southern extent may also contribute to the intermittent sheening. When the sediment bathymetry drops below the base of the impacted interval to the south (~141 ft AMSL) (Figure 3-5), NAPL is no longer found. This is consistent with a surface release that was controlled by the topography before Lake Celilo was filled.

The lateral extent of NAPL-related impacts extends towards the west where peak and average TarGOST responses decline with distance away from the main source area, and where the impacted interval thins to

1 foot or less west of HN100 and deepens to between 7 and 8 feet bss. Unimpacted TarGOST profiles at HN280, KN280, KN220, and MN160 bound the western and southern extent of NAPL in this area.

The analytical data results from the subsurface sediment cores are consistent with the lateral and vertical extents of NAPL as illustrated in Figures 3-2 through 3-4. Fourteen samples were collected to confirm the absence of NAPL (above, below and beyond the NAPL impacts seen in the TarGOST responses and core observations). Each of these 14 samples had relatively low levels of TPH-DRO, indicating NAPL was not present. TPH-DRO, TPH-RRO and PAH results were below their respective SCOs, except for one sample collected from directly below the NAPL-impacted interval at F390 at 8.7 to 9.7 ft bss (TPH-DRO were detected at 676 mg/kg, above the SCO of 340 mg/kg).; Conversely, the sample collected from within the NAPL-impacted interval at G200 (5.5 to 6.5 ft bss) was reported to contain TPH-DRO (91,100 mg/kg) and TPH-RRO (102,000 mg/kg) concentrations that exceed their respective SCO levels of 340 mg/kg and 3,600 mg/kg.

3.3.2 Surface Sediment Conditions

Analytical results from the Step 1 investigation indicated the presence of total sulfides above the Freshwater Benthic dry weight SCO in both site and background surface sediment samples. In addition, a single compound, 3 & 4-Methylphenol (m,p-Cresols) was identified above the SCO in one background sample (BG17). TPH-DRO and TPH-RRO were not detected above their respective SCOs in site surface sediment samples.

Data from eight background surface sediment locations were available for establishing the preliminary natural background values presented in Table 3-6. The detailed background analysis is documented in Appendix F.

3.4 Analytical Data Quality Evaluation

Analytical parameters that went through data validation include:

- Dioxins and Furans by Method E1613B
- Polychlorinated Biphenyl Congeners by Method E1668C
- TPH by Method NWTPH-Dx
- Metals by Methods SW6020B/SW7470A/SW7471B
- Semi-Volatile Organic Compounds (including PAHs) by Method SW8270E
- Sulfide by Methods SM4500-S2-D/SW9030B
- Ammonia by Method E350.1
- TOC by Method SW9060A

Data were validated using individual method requirements and guidelines from the Work Plan (Jacobs 2021). The following summary highlights the data evaluation findings for the sediment RI:

- No data were rejected, and the completeness goal of 95 percent was met for all method/analyte combinations.
- Approximately 24 percent of the data were qualified due to quality control exceedances that included: field duplicate and laboratory duplicate relative percent difference exceedances, holding time exceedances, laboratory blank contamination, surrogate recovery exceedances, matrix spike/matrix spike duplicate recovery and relative percent difference exceedances, post-digestion spike recovery exceedances, ion ratio exceedances resulting in estimated maximum possible concentrations, calibration check exceedances, and sample receipt temperature exceedances.

- Overall, the precision and accuracy of the data, as measured by laboratory and field quality control indicators, suggest that the data quality objectives (DQOs) were met. Data are usable for project decision-making, considering the biases outlined in this data quality evaluation.
- Representativeness and comparability of the data was achieved through adherence to the sampling plan. Consistent sample collection procedures, project laboratories and analytical methodologies were used throughout the sampling event. Data were reported in consistent methods and units for the sampling event and with historical data.
- Sensitivity of the data was maintained with consistent reporting limits, adjusted for percent moisture and dilutions.
- Field QC sample frequencies were collected at the following frequencies: field duplicates were collected at a frequency of 8.6 percent; equipment blanks were collected at a frequency of 8.6 percent; and matrix spike/matrix spike duplicate sets (collected in the field and analyzed as batch QC at the laboratory) were analyzed at a frequency of 35 percent. The field duplicate frequencies were less than required frequency of 10 percent because there was insufficient volume to collect all required FDs.

From the data validation process qualifications applied include:

- J = Analyte was present but reported value may not be accurate or precise.
- B = Analyte was detected in the associated method blank or field blank.
- U = This analyte was analyzed for but not detected at the specified method detection limit.
- UJ = The analyte was not detected above the detection limit objective; however, the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Additional information regarding the data quality and validation are presented in the data validation reports in Appendix H. Laboratory reports are included in Appendix I.

4 Conceptual Site Model

This section describes the CSM based on the SCUM guidance and includes information from the following:

- Physical characteristics of the inundated lands that have the potential to affect distribution and transport of COCs. This includes the historical uplands use of the facility including associated outfalls and drainage patterns from railyard operations documented in the Ecology approved Uplands RI Report (KJ 2020).
- Potential release and transport mechanisms (for example, erosion and stormwater runoff and direct discharges) going from the uplands to the sediment; thus, the Uplands RI results help inform the sediment CSM.
- Historical photos and drawings of the railyard before the formation of Lake Celilo, and bathymetry data collected by the U.S. Army Corps of Engineers (USACE) in 2008, by Solmar Hydro, Inc. in 2017 (CH2M 2018) and across a larger area by Solmar Hydro, Inc. in 2022. Combining the historical aerial photographs with bathymetry shows the current bathymetry aligns closely with the shoreline before inundation and identifies historical drainage pathways and low-lying areas.
- Investigation results include NAPL screening, coring, and surface sediment analytical data from the portion of the inundated lands in the vicinity of where sheens have been observed, both before and during the initial investigation and during this RI. The investigations have identified the presence of submerged NAPL within the inundated lands and informed the potential NAPL transport mechanisms.

4.1 Site Setting and Physical Characteristics

The RI study area consists of a rectangular area approximately 1,850 ft by 500 ft in size along the shoreline of Lake Celilo. Lake Celilo is 24 miles long with primary tributaries including the Deschutes River and Fifteen Mile Creek. The site study area is located at River Mile (RM) 201 along the Washington side of the lake. Background samples were collected between RM202 and RM206, upstream of the site near Miller Island and the confluence of the Columbia and Deschutes Rivers. This portion of the river is noted to be one of the driest and warmest portions within the Columbia River basin (*Columbia River Systems Operations* [CROS] *Final Environmental Impact Statement* [EIS], USACE et.al. 2020).

The physical characteristics that may affect COC distribution and transport are discussed in the following sections.

4.1.1 General Hydrology

The Columbia River basin is 258,000 sq mi (670,000 km^2) in size. The river itself originates in Canada, entering the United States (U.S.) near the northeastern corner of Washington State and discharging at the Pacific Ocean near Astoria, Oregon, approximately 1,243 miles (2,000 kilometers) from its origin. With an average flow at the mouth of about 265,000 cubic feet per second (cfs), the Columbia River is the fourth largest river in the U.S. by volume, and it has the largest discharge of any river in North America to the Pacific Ocean. The Deschutes River, with an average discharge of 5,824 cfs, joins the Columbia River just upstream of Wishram. Overall river flows along this reach of the Columbia River are controlled by operations of The Dalles Dam, located approximately 9 river miles downstream of the site, and the John Day Dam upstream approximately 14 miles, resulting in daily and seasonal fluctuations in surface water elevations.

4.1.2 Geologic and Hydrogeologic Conditions

The local geology at the site, as determined by soil borings completed in the uplands area, consists of varying thickness of surface fill (sand and gravel reportedly sourced from nearby sand dunes and river deposits), followed by 10- to 95-foot-thick sequences of glaciofluvial sediment (and silt) deposited on eroded Columbia River Basalt Group bedrock during ice-age floods.

The uppermost hydrogeologic unit at the railyard is the glaciofluvial unconfined aquifer, consisting of unconsolidated sand and silt with gravel lenses deposited during the Missoula Floods. Numerous monitoring wells have been installed at the railyard and screened in the sand/silt deposits. These sand and silt deposits can be up to 95 feet thick in the western section of the railyard where locomotive operations involving fueling/watering and repairs occurred and a glaciofluvial sediment-filled erosional feature in the basalt bedrock is believed to be present. The glaciofluvial deposits are generally homogeneous, and in some areas the sand and silt overlie a thin layer of gravel just above bedrock (KJ 2016). Given the presence of exposed bedrock surfaces east and west of the initial 2018 sediment study, the glaciofluvial aquifer likely pinches out to the south just beyond the former shoreline of the Columbia River (Figure 4-1), approximately 350 feet from the current shoreline (CH2M 2018).

Local topography and historical aerial photographs taken before the creation of Lake Celilo show exposed bedrock along some portions of the historical Columbia River shoreline adjacent to the railyard. As a result, a limited amount of sediment and shallow bedrock was expected in the investigation area. Sampling conducted during the sediment RI has confirmed a limited area with sediment adjacent to the railyard. Bedrock was encountered at the surface in the area to the west of the planned sediment RI, at locations ON220 and MN320.

Groundwater occurs in the unconfined sand/silt alluvial aquifer at 10 to 12 feet below grade at the railyard. Before construction of the dam and creation of Lake Celilo, the unconfined water table was at least 30 to 40 feet deeper. While groundwater flow beneath the central portion of the railyard is generally south toward the lake at a very shallow gradient, during 10 months of the year, Lake Celilo in the vicinity of the railyard is a losing water body where flow direction is to the north, toward the railyard (KJ 2020). Daily oscillations in the Columbia River stage (typically 1 to 2 feet) occur because of variable discharge rates from The Dalles Dam (KJ 2020, USGS water data website https://waterdata.usgs.gov/monitoring-location/14105700/#parameterCode=00065&period=P7D, accessed March 2023, USACE https://www.nwd-wc.usace.army.mil/dd/common/projects/www/tda.html, accessed March 2023).

Historical aerial photographs indicate the former shoreline of the river was approximately 300 feet farther south of where it is today and consisted primarily of bedrock, with the exception of an 800-foot sandy section where the bedrock erosional feature is believed to extend. Overlying the glaciofluvial deposits within the river and beyond the toe of the riprap embankment, are surface sediments consisting of micaceous fine sand to silty fine sand with varying amounts of organics that have been observed at thicknesses of up to approximately 5 feet. In select locations farther from the current shoreline, a 2- to 3.5-foot interval of highly plastic silty sand fill containing wood, roots, and limited amounts of miscellaneous litter[1].

4.1.3 Bathymetry

A detailed bathymetric survey of the inundated lands adjacent to the railyard and around the initial study area was completed in 2017 and a second survey was conducted in 2022 in preparation for the RI. The 2022 survey consisted of a Multibeam Bathymetry Survey with concurrent acoustic backscatter intensity “snippets” data collection in the nearshore waters of the Wishram facility and included both the original area of investigation in 2018, the expanded area of investigation addressed during this RI. Detailed bathymetry was also conducted in “squares” of approximately 200 to 300 feet centered around the planned background grab sample locations to assist with targeting areas that had potential for sediment accumulation.

The bathymetry survey indicates that within approximately 100 feet of the current shoreline, surface water depths are up to 15 feet as the riverbed dips to the south at a slope of approximately 8 percent (Figure 3--5). As shown on Cross Section B-B′, water depths of up to 20 ft are present in that area with a steep drop off near 100 ft from shore at a 52 percent slope that levels off abruptly. Water depths in the

[1] A partially intact glass mason jar with its metal lid was observed in one core sample.

eastern and western portions of the sediment RI study area increase more gradually, reaching about 25 ft depth at 250 ft from shore in the east (Cross Section C-C′) and 30 to 35 ft at a distance of 500 ft from shore in the west (Cross Section A-A′). Slopes in Cross Section A-A′ are generally at less than 10 percent, with slopes in Cross Section C-C′ ranging from 19 to 2 percent.

Elevation of the sediment surface ranged from approximately 150 feet North American Vertical Datum of 1988 (NAVD88) to 120 feet NAVD88 within the study area. The elevation of The Dalles Dam forebay ranged from 157.74 to 158.72 ft NAVD during Step 1 (Columbia River Operational Hydrometeorological Management System (CROHMS), https://pweb.crohms.org/dd/nwdp/project_hourly/webexec/rep?r=tda&date=04%2F12%2F2022) and ranged from 157.76 to 159.67 feet NAVD88 during Step 2 (CROHMS, https://pweb.crohms.org/dd/nwdp/project_hourly/webexec/rep?r=tda&date=11/14/2022). The survey confirmed the conditions on the surface identified from the historic aerial photographs of the area, with rocky outcrops present in several areas as shown by a jagged contour line. No unexpected features were identified.

The bathymetry outside the study area is available from a larger-scale 2017 USACE bathymetry survey of Lake Celilo. The combined data are shown on Figure 3-5 and indicate the depths within the sediment RI study area extend up to 40 feet below the water surface across the inundated lands and to as deep as 60 feet in some localized areas farther south beyond the former shoreline. Bathymetry data were used to help select sampling locations during development of the Work Plan (Jacobs 2021) and Work Plan Revision 1 (Jacobs 2022).

4.2 Ecological Resources

Despite the arid upland habitat surrounding the lake, Lake Celilo supports a variety of aquatic and terrestrial wildlife.

4.2.1 Vegetation

The surrounding upland habitat is part of the Columbia Plateau ecoregion and consists of shrub-steppe communities, grasslands, and some agricultural land. Near the railyard sagebrush is a dominant shrub along with grass and weed species.

Shoreline substrate along Lake Celilo consists of basalt bedrock, and associated sand, gravel, and silt with little to no vegetation. The shoreline is steep and consists of riprap with minimal riparian habitat. Some weeds and shrubs are located within the rip rap or near the edges of the railyard property.

There are a few shallow water areas where aquatic plant life has become established in Lake Celilo. At the site, the flow velocity along the shoreline is slower than in the main channel, allowing for growth of vegetation on the riverbed. Lake Celilo supports aquatic plant species such as yellow pond lily, duckweed, pondweed, smartweed, and wild millet (CROS EIS). At the site, the invasive species Eurasian watermilfoil (*Myriophyllum spicatum*) is common and was collected during grab sampling. In general, the vegetation is limited to the near shore areas.

4.2.2 Aquatic Life

Aquatic receptors in the Columbia River and Lake Celilo include zooplankton (copepods, isopods) and other invertebrate species including invasive species such as the northern and red-swamp crayfish, Asiatic clams, and Zebra mussels (Draheim et al. 2007). A formal benthic community survey was not completed at the site. Observation made during grab sampling noted numerous Asiatic clam shells.

A formal fish survey was not completed at the site. The mainstem Columbia River, which includes Lake Celilo, provides habitat for a variety of fish species. This includes anadromous species; many of which have Threatened and Endangered status under the *Endangered Species Act*- (ESA), other native resident and anadromous fish, as well as introduced or nonnative species. Recent surveys in the Priest Rapids and

Wanapum reservoirs documented 34 species of fish, 20 of which were native species (Pfeifer et al. 2001). The primary game species are rainbow trout (*Oncorhynchus mykiss*), mountain whitefish (*Prosopium williamsoni*), walleye (*Stizostedion vitreum*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieui*). The walleye and bass species are non-native and are of management concern because of their predation on juvenile salmonids, including those listed under the ESA. Appendix J includes a more detailed summary of the fish species present in the study area.

4.2.3 Avian and Mammalian Receptors

Many aquatic and shore-bird species are common at the lake as residents, with breeding populations including Caspian terns, California gulls, great blue herons, mallard and merganser ducks, Canada geese, killdeer and spotted sandpipers. Migrant waterfowl also use the lake.

Raptor species living near the lake include bald and golden eagles, osprey, redtail hawks, turkey vultures, and American kestrel. Common passerine birds at the lake include belted kingfisher, ravens and crows, western kingbird and swallow species.

Mammalian wildlife living near the lake include raccoons, skunks, coyote, rats, and mice and vole species. Numerous bats are also found near the lake. Aquatic mammals at the lake include muskrat, beaver and otters in areas with suitable habitat where wetlands occur along the shoreline (CROS EIS).

4.3 Potential Sources of Site-related Contaminants

Potential sources of NAPL and petroleum-related constituents related to the historical upland railyard operations are detailed in the Uplands RI Report (KJ 2020) and consist of historical facility operations, specifically past oil and diesel fueling operations and steam production, storage of oil and diesel fuel in multiple ASTs and USTs on railyard and associated underground piping systems. Petroleum hydrocarbon-impacted soil has been removed to bedrock or to the groundwater surface from multiple locations on the railyard (Table 1B, Section 2.2, KJ 2020). Residual and/or mobile petroleum hydrocarbon light nonaqueous phase liquid (LNAPL) in shallow and subsurface soil are a potential continuing source for dissolved-phase lighter-range petroleum hydrocarbons (that is, TPH-DRO) impacts in uplands groundwater.

4.4 NAPL Conceptual Site Model

This section presents the NAPL CSM for the estimated extent of NAPL identified in Section 3.4.1.

4.4.1 Initial NAPL Release and Transport Mechanisms

The primary release mechanisms at the Wishram railyard include surface spills, overfilling, surface leaks, and subsurface leaks, resulting in NAPL-impacted surface and subsurface soil within the upland area. LNAPL with properties consistent with a weathered diesel fuel was historically present in the shallow water table zone to the south of the former diesel fueling island at the northern end of the site but has not been measured in monitoring wells in this area since November 2016. LNAPL with properties consistent with both diesel and Bunker C-like oil is present closer to the river near the southwestern end of the site. Bunker C-like LNAPL is predominantly observed in the submerged zone in the vicinity of former underground fuel oil supply piping and the former Power House (Figure 1-4).

LNAPL found in the southwestern LNAPL body is classified as mobile (referring to the ability to move under a given gradient, not the actual movement), as evidenced by observations of measurable LNAPL in monitoring wells. However, this highly viscous LNAPL (7,390 centistokes at 50 degrees Fahrenheit) is absent in the Uplands LIF borings (e.g., TG-CR05, TG-G05) immediately north of the berm and in the riverbank monitoring wells (e.g., RMD-3, WMW-17) which indicates that this LNAPL body is not migrating and does not extend to the current shoreline (Figure 3-2) (KJ 2020). Based on the number of borings installed in the former Power House area, and the spacing of the wells installed along the riverbank, migration of the LNAPL is not apparent (KJ 2020). Investigations within the inundated lands have also confirmed that the upland LNAPL does not extend to nearshore areas.

Offshore from the railyard, in the inundated lands, a separate occurrence of viscous NAPL consistent with Bunker C was identified within a submerged layer approximately 40 feet to 60 feet from the shoreline. Constituents associated with these impacts include TPH-DRO, TPH-RRO, and related PAHs. The absence of bedding structure relative to the overlying sediments and the soil below and the disturbed nature of interstitial materials where NAPL is encountered suggests the NAPL was emplaced within the former lands prior to the construction of The Dalles Dam and subsequently buried as a result of sedimentation following the filling of Lake Celilo.

While the exact timing and nature of the release is unknown, the Uplands RI Work Plan Addendum (KJ 2018) included a summary of 1950 and 1951 correspondences between SP&S personnel and the State of Washington Pollution Control Commission (PCC) which suggest the current submerged NAPL may be the result of an accidental spill some years prior to 1950 that was the result of broken valve on the service tank while fueling a locomotive. According to these correspondences, the oil was "trenched across the track to side of fill where it accumulated in a swamp" and subsequently dried to the consistency of asphalt. This overland emplacement release mechanism is consistent with the distribution of NAPL observed during the RI and illustrated in Figure 4-2 which appears to have been in part dictated by gravity and the former topography in the vicinity of the upland area where the NAPL was initially discharged. The dipping elevations, absence of bedding structure, diminished thicknesses, and lower TarGOST responses and subsurface TPH sediment concentrations associated with the NAPL affected interval towards the west are all consistent with horizontal spreading of the NAPL that occurred at the former land surface during the initial release. Neither the upland RI nor the sediment RI identified any hydrogeologic features

In summary, RI data indicate that the NAPL within the inundated lands resulted from overland emplacement and is separate from the previously documented upland NAPL impacts. The lines of evidence supporting this component of the CSM include:

- Physical separation of the upland NAPL impacts as demonstrated with the dense spacing of upland soil borings, monitoring wells and TarGOST profiles as well as the nearshore sediment RI borings and TarGOST, which show diminished or absent impacts relative to the NAPL impacts farther from shore.
- Documentation of an upland oil release before 1950, prior to inundation, that was diverted to, and accumulated in a "swampy area" away from the operating areas of the railroad (KJ 2018).
- Distribution of a NAPL-impacted interval that is consistent with gravity-driven overland emplacement.
- The uplands and sediment RIs did not identify any hydrogeologic forces that would result in the advective transport of the NAPL parallel to shoreline.

4.4.2 Current NAPL Mobility

4.4.2.1 Advection

The absence of NAPL in the nearshore areas adjacent to the riprap embankment and physical separation of the defined extent of upland NAPL (KJ, 2019) indicates that advective migration of NAPL or sheens from the upland portions of the site is not occurring. Furthermore, the absence of mobility in the intact cores collected and tested for pore fluid saturation and mobility during the initial investigation from the most heavily impacted zones confirmed mobile fractions of NAPL are not present (Jacobs, 2019). This absence of mobility on the pore scale is consistent with the tacky and viscous nature of the NAPL that has been observed in the field and indicates that the NAPL at the site is not advectively mobile or migrating.

4.4.2.2 Ebullition

ASTM E-3282-22 NAPL Mobility and Migration in Sediment – Evaluating Ebullition and Associated NAPL/Contaminant Transport discusses the conditions for NAPL. The following is an excerpt from that document:

> *5.5. For gas ebullition-facilitated transport (or flux) of NAPL/contaminants from sediment to surface water to occur, it is necessary to have favorable conditions for gas bubbles formation and growth, then have the gas bubbles overcome the combined tensile strength and pressures to fracture the sediment, and finally have the gas bubbles generated in (or below) a zone where NAPL/contaminants can attach to the gas bubbles as the gas bubbles migrate upward through the sediment to the water column. Due to hydrophobic characteristics of NAPL and other organic contaminants, they preferentially sorb to the hydrophobic bubble surface and are transported through the sediment column to the overlying surface water. NAPL that is attached to a gas bubble and is transported to the surface of the water often spreads when the gas bubble breaks at the water surface and forms a sheen blossom. Surface water sheens can subsequently break down by photodegradation, biodegradation, volatilization, and dissolution of sheen constituents into the surface water with a portion of the NAPL potentially resettling onto the sediment bed. Sheens may also be transported away from the point of release by advective and dispersive transport processes.*

Gas ebullition potential in sediment samples collected from across the study area was evaluated in the 2018 Initial Investigation. Ebullition rates estimated at the site ranged between 6.5 and 6.8 liters per square meter per day with little spatial variability (Jacobs 2019). These rates are indicative of high gas production resulting from the abundance of TOC observed in deeper sediment and more labile carbon substrate observed at shallow depths. This is further validated by field observations of ebullition during the 2018 sediment sampling event.

The depth of the NAPL occurrence offshore coincides with the ebullition active zone of 0 to 5 feet bss (Viana et al. 2012; Costello and Talsma 2003), suggesting that gas ebullition is responsible for the mobilization of NAPL and contributes to NAPL transport to the water column.

Ebullition occurs throughout the inundated lands as gases develop from the decaying organic matter associated with the former upland areas. The intermittent sheening observed is the result of ebullition in the area of buried NAPL. Figure 4-2 identifies the source area for the ebullition causing sheens. A greater abundance of gas bubbles and sheening occurs during periods of low water when the pressure from the overlying water column is reduced, and during hot periods when the temperature of the sediment rises. A combination of the winds and current carry the sheens toward the shoreline where they are seen most often from the shoreline and where globules have been observed accumulating during relatively warm and calm weather conditions.

4.4.2.3 Erosion of NAPL-impacted Sediment

As shown on Figure 4-3, offshore NAPL impact has 0.5 foot of overburden where it ends below a break in the sediment slope. This area could be subject to erosion under high flow conditions prior to inundation. Under current submerged conditions, there is no evidence of erosion of NAPL-impacted sediment via scouring.

4.5 Transport of COCs in Sediment

The transport mechanisms that may be associated with distribution of COCs in sediment can include the following:

- **Erosion and Stormwater Runoff.** Pre-inundation soil erosion and transport from the uplands and bank areas to the sediments through stormwater runoff. This potentially includes historical bank erosion in drainage channels to the Columbia River (historical aerial photographs appear to indicate these types of drainage areas). The present-day riprap-armored shoreline and stormwater systems prevent this from being a current transport mechanism.

- **Stormwater and Wastewater Discharge.** Direct discharge of stormwater and historical wastewater through outfalls and drainage channels (direct discharge to the Columbia River/Lake Celilo have been conducted under permits from the appropriate state and federal agencies). Currently, there are no active discharges to the river associated with the railyard.

  Historic outfalls and underdrains are discussed in Appendix A of the Uplands RI Report (KJ 2020) and include: stormwater and sanitary sewer lines to Pump House #1, various lines discharging to Pump House #1; a concrete box culvert extending beneath the railyard with an outfall to the Columbia River; an "oil drain" from the Engine House that appears to have previously discharged directly to the river (1959), which was connected to a sump pump and an OWS prior to discharging to the river (Figure 1-4).

- **Sediment Suspension and Deposition.** Sediment suspension and deposition through river flow and recirculation. Sediment deposition is likely the dominant sediment transport in Lake Celilo and other Columbia River reservoirs. Moody et al. (2003) found that hydrologic dam alterations trapped sediments, therefore filling riverbeds and sand bars and causing riffles to disappear.

  Sediment disturbance is predominantly limited to recreational, commercial, and other boating within the designated navigational channel near the southern shore (NOAA n.d.)

- **Groundwater Flow.** Transport of dissolved constituents through vertical and horizontal groundwater flow. Overall, a losing stream condition is observed approximately 80 percent of the time in wells along the river berm. The implication is a net migration of water away from the river, integrated over the course of a given year, but also characterized by a net water flow towards the river during the spring months, and an undulating (back-and-forth) component of flow across the shoreline on a sub-month time-scale due to daily changes in water heights in Lake Celilo (KJ 2020).

4.6 Potential Exposure Pathways and Receptors

Potentially affected media are limited to sediment in areas where the submerged NAPL is present and overlying surface water. Exposure pathways and potential receptors associated with the offshore area could include those related to Washington State designated uses (WAC 173-201A-602, Table 602) as shown in Table 4-1.

Table 4-1. Columbia River Designated Uses

Aquatic Life Use	Recreation Use	Water Supply Use	Miscellaneous Use
Spawning/Rearing	Primary Contact	Domestic	Wildlife Habitat
Salmonid Migration		Industrial	Harvesting
		Agricultural	Commerce/Navigation
		Stock	Boating
			Aesthetics

4.6.1 Transport Pathways and Exposure Media

A transport pathway describes the mechanisms whereby site-related chemicals, once released, might be transported from a source to ecologically relevant media (sediment and surface water) where exposures might occur. These transport pathways are shown on Figure 4-3. Chemicals can be released from the NAPL deposits through ebullition or erosion at the margins along the steep bathymetric drop off into sediment and surface water. These pathways may explain the detection of low levels of total PAHs in surface sample SG03 (4.64 mg/kg), downstream of the NAPL impacted area, while the surface sample from L320 did not have impacted sediment.

4.6.2 Ecological Exposure Pathways and Routes

An exposure pathway links a source with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential risk, can only occur if complete exposure pathways exist. Figure 4-4 shows the potentially complete and significant exposure pathways to aquatic ecological receptors.

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. Unrooted, floating aquatic plants, and rooted submerged vascular aquatic plants and algae, might be exposed to chemicals directly from the water column or (for rooted plants) from sediments. Animals might be exposed to chemicals through: (1) the incidental ingestion of impacted abiotic media (e.g., sediment) during feeding activities; (2) the ingestion of impacted water; (3) the ingestion of plant and/or animal tissues for chemicals which have entered food webs; and/or (3) dermal contact with impacted abiotic media. These exposure routes, where applicable, are depicted on Figure 4-4.

The relative importance of these exposure routes depends in part on the chemical being evaluated. For chemicals having the potential to bioaccumulate, the greatest potential for exposure by predatory wildlife is ingestion of prey. For chemicals having a limited potential to bioaccumulate, the exposure of wildlife to chemicals is generally greatest through the direct ingestion of the impacted abiotic media.

The potential exposure pathways for ecological receptors at the Wishram site would be primarily from exposure to submerged NAPL in sediments at the locations offshore. Benthic invertebrates could be exposed to dissolved constituents in pore water and sediment. Bottom dwelling fish and fish feeding on invertebrates may be exposed to site COPCs from the NAPL seep areas from both direct exposure to COPCs in porewater and sediment and through ingestion of benthic prey.

Higher trophic level receptors such as diving ducks, terns, or other fish-eating birds could be exposed to COPCs through ingestion of invertebrates or fish that could have been exposed to COPCs. Due to the depth of water where the seeps are located and the habitat near the site, wading birds, shore birds, and aquatic mammals are not expected to be exposed to COPCs from the NAPL seeps.

4.6.3 Human Health Exposure Scenarios and Pathways

People, currently and in the future, potentially exposed to chemicals measured in sediment are recreational users (child [defined as ages 0 to 6 years] and adult [defined as ages 6 years and older]) and subsistence harvesters (adult [defined as ages 6 years and older]). For carcinogenic PAHs, early life exposure is factored into the calculation of risk-based concentrations with child age ranges 0-2, 2-6, and 6-16 years.

The following exposure scenarios and exposure pathways are recommended for an initial screening evaluation of direct contact with chemicals in sediment by Ecology (2021) in Section 9.2 of the SCUM guidance.

- **Shellfish Consumption**. Child and adult exposure to bioaccumulative constituents in sediment through consumption of fish/shellfish.

- **Beach Play.** Child and adult exposure to impacted sediment through the dermal contact and incidental ingestion exposure pathways during shoreline beach play activities (i.e., digging, walking, wading, recreational games). Only the more conservative child exposure was considered when calculating RBCs.

- **Clam Digging.** Adult exposure to impacted sediment through the dermal contact and incidental ingestion exposure pathways during shoreline clam digging activities.

- **Net Fishing.** Adult exposure to impacted sediment through the dermal contact and incidental ingestion exposure pathways during shoreline net fishing activities.

Because sediment impacts at the site are in areas with fairly deep water and there are no beaches adjacent to the site, the beach play and clam digging exposure scenarios are considered incomplete for current uses. Since this area is a tribal usual and accustomed fishing area, the shellfish/fish consumption and netfishing exposure scenarios are considered complete for current uses. In addition, the SMS rule WAC 173-204-561(2)(b)(i) requires the reasonable maximum exposure scenario to include historic, current, and potential future tribal use of fish and shellfish from the general vicinity of the site. Therefore, the shellfish/fish consumption, beach play, clam digging, and net fishing exposure scenarios were considered potentially complete for future uses.

5 Risk Summary and Standards Comparison

This section summarizes the results of the ecological and human health risk screening evaluations.

5.1 Ecological Risk Screening

The ecological risk screening was conducted in accordance with the SCUM guidance (Ecology 2021), specifically with respect to identifying cleanup sites based on benthic criteria and bioaccumulative criteria using the SMS rule and further detailed in the guidance. The detailed ecological risk screening using the 2022 data is provided in Appendix K. The 2018 data was screened per Ecology's comments on the Draft RI and are included in Appendix M. Per the SMS rule and SCUM guidance, the evaluation processes for identifying cleanup sites with both benthic criteria and bioaccumulative criteria are a step-wise process. The benthic criteria evaluation is a possible 5-step process and the bioaccumulative criteria evaluation is a possible 2-step process. The ecological risk screening used the grab and shallow core samples (0 – 0.5 foot interval) collected during the initial investigation conducted in August 2018 and the site surface sediment results collected during Step 1 of the RI, which was conducted in April 2022 (Section 2.2.1.3 – Grab Sampling).

5.1.1 Identifying Cleanup Sites Based on Benthic Criteria

For the evaluation based on benthic criteria, screening of the 2022 site sediment results – both on sample-by-sample concentration and mean concentration basis – against Cleanup Screening Level (CSLs) and Sediment Cleanup Objectives (SCOs) (Step1; Appendix K, Table K-1) led to the determination that Step 2 (bioassay override) and Step 3 (biological data) were not necessary. Screening using the 2018 investigation (Appendix M, Table M-1) showed one station exceeding benthic SCO criteria for TPH-DRO (D200), one station exceeding benthic CSL criteria for TPH-DRO (J260), and one station exceeding the benthic CSL criteria for TPH-RRO (J260). The SMS rule process for identifying a cleanup site based on benthic criteria is if the average of three stations exceeds the CSL benthic criteria, which is not limited to "surface" sediment samples. The average of stations J260, D200, and D240 is greater than 8 times the benthic CSL for TPH-DRO and approximately 2.5 times the benthic CSL for TPH-RRO. The 2022 investigation showed one station exceeding the SCO benthic criteria for sulfides. These results show potential toxicity to the benthic community from surface sediment contamination and the NAPL at depth to be a potential source of toxicity to the benthic community and impairment of surface water quality.

5.1.2 Identifying Cleanup Sites Based on Bioaccumulative Criteria

The evaluation based on bioaccumulative criteria defaulted to screening site sediment results against preliminary natural background values as the presumed SCO for bioaccumulative chemicals.

Following Step 1 (screening site sediment results against background), only total PAHs and TPH-DRO exceeded preliminary natural background values (Appendix K, Table K-2).

Given the railyard history and understanding of the CSM, the presence of PAHs and TPH-DRO in sediment is at least partially site related. Results from the 2018 investigation identified PAH and TPH-RRO concentrations in 3 of 11 surface sediment samples (D200, D240, and J260) exceeded their respective the preliminary natural background values (see Appendix M). In 4 of the 11 surface sediment samples from 2018 (D200, D240, D260, and J260) TPH-DRO exceeded its preliminary natural background value. The mean concentrations of PAHs, TPH-DRO, and TPH-RRO in shallow sediment samples collected in 2018 exceeded their respective natural background values (Appendix M, Table M-2). Results from the 2022 investigation identified PAH concentrations in 3 of the 13 surface sediment samples (E320, E460, and SG03) having total PAHs concentrations in exceedance of the preliminary natural background value (sample specific concentrations are presented in Appendix K, Table K-1). Also, results from the 2022 investigation showed the detected concentrations of TPH-DRO in 2 of the 13 surface sediment samples (E320 and L320) exceeded its preliminary natural background value. Based on both the 2018 and 2022 investigations the presence of PAHs and TPH-DRO is localized and generally corresponds to the NAPL footprint.

TPH-DRO is known to be subject to weathering and biodegradation in the aquatic environment and its components are not considered bioaccumulative. Evaluating risks from PAHs to higher trophic receptors (i.e., food web exposures) is uncertain because PAHs are not expected to significantly bioaccumulate in the tissues of fish or crustaceans. Therefore, further ecological risk evaluation of TPH-DRO or total PAHs is not warranted, and the presumed SCO set at preliminary natural background is considered protective.

5.2 Human Health Risk Screening

Human health RBCs were calculated consistent with the SCUM guidance (Ecology 2021). Human health RBCs were calculated for the potentially complete human health exposure scenarios and pathways. The RBCs are based on a target hazard quotient of 1 and a cancer risk of 10-6 for individual constituents, in accordance with SMS SCOs. The detailed human health risk screening, including exposure assumptions, toxicity values, and RBCs, is presented in Appendix L. Sediment exposure point concentrations (EPCs) were compared to RBCs (Appendix L, Table L-3), and the results are summarized as follows:

- **Shellfish Consumption.** With the exception of 2,3,7,8-TCDD TEQ and benzo(g,h,i)perylene, the EPCs of constituents detected in sediment are below the preliminary natural background values used to evaluate the fish/shellfish consumption exposure scenario. The EPC of 2,3,7,8-TCDD TEQ (0.78 ng/kg) exceeds the background concentration (0.532 ng/kg). Three of the 13 samples analyzed for dioxin-like substances had TEQ concentrations exceeding background (0.633 ng/kg at BNSF-D160-042822-0-5; 4.251 ng/kg at BNSF-E320-042822-0-4; and 0.811 at BNSF-SG11-042822-0-5). As shown in Attachment L-4, the majority of dioxin-like compounds were not detected in sediment samples. Because the non-detected compounds were included in the 2,3,7,8-TCDD TEQ calculations, the EPC may be biased high. The EPC of benzo(g,h,i)perylene (0.24 mg/kg) only exceeds the preliminary natural background value (0.22 mg/kg). Because there were only two detected concentrations of 21 samples, the EPC is the maximum detected concentration which is biased high. Only one sample result (less than 5 percent of total samples) exceeds the preliminary natural background value. The mean of the two detected concentrations (0.13 mg/kg) is less than the preliminary natural background value and the 19 non-detected values range from 0.0076 mg/kg to 0.086 mg/kg. In summary, benzo(g,h,i)perylene concentrations are below or similar to the preliminary natural background value.
- **Beach Play.** With the exception of arsenic, EPCs of constituents detected in sediment are below the human health RBCs for the child beach play exposure scenario. Although the EPC of arsenic (2.8 mg/kg) exceeds the RBC (2.5 mg/kg), it is below the preliminary natural background value of 3.3 mg/kg indicating arsenic does not exceed SMS criteria. Therefore, risks from exposure to sediment through the beach play exposure scenario meet the SMS and SCUM guidance human health criteria.
- **Clam Digging.** With the exception of arsenic, EPCs of constituents detected in sediment are below the human health RBCs for the adult clam digging exposure scenario. Although the EPC of arsenic (2.8 mg/kg) exceeds the RBC (1.2 mg/kg), it is below the preliminary natural background value of 3.3 mg/kg indicating arsenic does not exceed SMS criteria. Therefore, SMS and SCUM guidance human health criteria have been met.
- **Net Fishing.** EPCs of constituents detected in sediment are below the human health RBCs for the adult net fishing exposure scenario. Therefore, risks from exposure to sediment through the net fishing exposure scenario meet the SMS and SCUM guidance human health criteria.

5.3 Standards Comparison

Results from Step 1 (surface sediment) of the RI are summarized in Table 5-1 and compared to the benthic SCOs, CSLs, and preliminary natural background SCO sample results. Shallow sediment results from the 2018 investigation exceeded the SCO for TPH-DRO at one location, and exceeded the benthic CSL criteria for TPH-DRO and TPH-RRO at a second location. The exceedances occurred in a localized area that aligns with the NAPL footprint. The 2022 results identified an exceedance of the sulfide SCO in one shallow sediment sample.

Overall, site and background surface sediment sampling results were comparable for bioaccumulative chemicals with the exception of three 2018 surface sediment samples where the detected PAH and TPH-RRO concentrations exceeded their preliminary natural background concentrations and four 2018 surface sediment samples that exceeded the natural background concentration for TPH-DRO. The 2022 shallow sediment results also exceeded the natural background values for PAHs and TPH-DRO at two and three locations, respectively.

Step 2 of the RI included subsurface sediment data to a depth of 12 feet below mudline, which is significantly below the BAZ of 10 cm. Although it is overly conservative to compare subsurface values to ecological criteria, the range of analytical results from Step 2 of the RI also show that total PAHs did not exceed the SCO at the site. Two samples had results above the TPH-DRO SCO of 340 mg/kg, at F390 from 6.2 to 7.2 ft bss and at G200 from 4.0 to 5.0 ft bss. Sample G200 also exceeded the SCO of 3600 mg/kg at the same depth. Sample results from the remaining 13 sediment cores did not exceed the SCOs. Table 5-2 presents the comparison of standards for Step 2 analytical results.

The complete analytical results for Step 1 and Step 2 of the investigation are included in Tables 3-1 through 3-9, and in Appendix I, which contains the laboratory reports.

Table 5-1. Step 1 Standards Comparison

Chemical Parameter	Freshwater Benthic (WAC 173-204-563 Table VI)		Freshwater Human Health (SCUM II Table 9-3)			Freshwater Human Health: Programmatic PQLs (SCUM II Table 11-1)	Site Surface Sediment Samples		Background Surface Sediment Samples	
	Dry Weight SCO	Dry Weight CSL	Beach Play (Child)	Subsistence Clam Digging (Adult)	Subsistence Net Fishing (Adult)	Consumption of Fish/ Shellfish by Human and Higher Trophic Level Receptors	Maximum Result	Minimum Result	Maximum Result	Minimum Result
Conventional chemicals (mg/kg)										
Ammonia	230	300					40 J	ND	72	ND
Sulfides	39	61					51.7 J	ND	179	ND
Metals (mg/kg)										
Arsenic	14	120	2.1	0.82	1.9	0.3	4.7	2.0	3.3	ND
Cadmium	2.1	5.4	220	1100	2500	0.07	0.64	0.089 J	0.52	ND
Chromium	72	88				0.2	17.3	8.2	15.7	ND
Copper	400	1200				0.1	19.5	7.7	16.2	1.6
Lead	360	>1300				0.1	14.3	3.6	8.6	0.092 J
Mercury	0.66	0.8				0.02	0.035 J	ND	0.058	ND
Nickel	26	110				0.2	16.8	9.3	15.3	ND
Selenium	11	>20					0.47 J	0.12 J	0.45 J	ND
Silver	0.57	1.7				0.1	0.41 J	ND	0.41 J	ND
Zinc	3200	>4200				1	120	32.3	106	2.0 J
Organic chemicals (µg/kg)										
4-Methylphenol	260	2000					0.0195 J	ND	0.387 J	ND
Benzoic acid	2900	3800					0.238 J	ND	0.327 J	ND
Bis(2-ethylhexyl) phthalate	500	22000					ND	ND	ND	ND
Carbazole	900	1100					0.08 J	ND	ND	ND
Dibenzofuran	200	680					0.0365 J	ND	ND	ND
Di-n-butyl phthalate	380	1000					ND	ND	ND	ND
Di-n-octyl phthalate	39	>1100					ND	ND	ND	ND
Pentachlorophenol	1200	>1200					ND	ND	ND	ND
Phenol	120	210					ND	ND	0.0534 J	ND
Total PAHs (µg/kg)	17000	30000					4640	ND	ND	ND
Carcinogenic PAHs[a] (sum TEQ)			170	120	150	9	0.6042	0.01097	0.03216	0.006443
PCBs and Dioxin/ Furans (ng/kg)										
Dioxins/ Furans Congeners (sum TEQ)			29	12	29	5	4.228	0.3993	0.5103	0.3858
Dioxin-like PCB Congeners (sum TEQ)			29	12	29	.07	0.04660	0.01851	0.02314	0.02121
Bulk Petroleum Hydrocarbons (mg/kg)										
TPH-DRO	340	510					223	ND	64.4	ND
TPH- RRO	3600	4400					630	25.1	363	18
PAHs (µg/kg) – 2018 data										
Total PAHs	17000	30000					6451.9	87.113	NA	NA

Table 5-1. Step 1 Standards Comparison

Chemical Parameter	Freshwater Benthic (WAC 173-204-563 Table VI)		Freshwater Human Health (SCUM II Table 9-3)			Freshwater Human Health Programmatic PQLs (SCUM II Table 11-1)	Site Surface Sediment Samples		Background Surface Sediment Samples	
	Dry Weight SCO	Dry Weight CSL	Beach Play (Child)	Subsistence Clam Digging (Adult)	Subsistence Net Fishing (Adult)	Consumption of Fish/ Shellfish by Human and Higher Trophic Level Receptors	Maximum Result	Minimum Result	Maximum Result	Minimum Result
Carcinogenic PAHs[a] (sum TEQ)			170	120	150	9	1311.93	2.6544	NA	NA
Bulk Petroleum Hydrocarbons (mg/kg) – 2018 data[b]										
TPH-DRO	340	510					12700	2.7	NA	NA
TPH- RRO	3600	4400					31000	5.95	NA	NA

Notes:

a. Carcinogenic PAHs include: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. These seven cPAHs are appropriate for calculating the sum TEQ.

b. 2018 data was analyzed with and without silica gel cleanup. Reported values herein did not have silica gel cleanup conducted and were the higher of the two results.

CSL = cleanup screening level
DRO = diesel range organics
J = estimated value
mg/kg - milligrams per kilogram
NA = not applicable. A single sample was collected from a background area, which is insufficient to conduct statistics.
ND = Not detected
ng/kg - nanograms per kilogram
RRO = residual range organics
SCO – sediment cleanup objective
TEQ = toxic equivalency
PAH = Polycyclic Aromatic Hydrocarbons
TPH = total petroleum hydrocarbons
TPH-residual is referred to as TPH-motor oil range organics by the laboratory, and in as TPH-RRO in this report.
µg/kg - micrograms per kilogram

Table 5-2. Step 2 Standards Comparison

Chemical Parameter	Freshwater Benthic (WAC 173-204-563 Table VI) Dry Weight SCO	Freshwater Benthic (WAC 173-204-563 Table VI) Dry Weight CSL	Freshwater Human Health Freshwater Human Health (SCUM II Table 9-3) Beach Play (Child)	Subsistence Clam Digging (Adult)	Subsistence Net Fishing (Adult)	Programmatic PQLs (SCUM II Table 11-1) Consumption of Fish/ Shellfish by Human and Higher Trophic Level Receptors	Step 2 Samples – Subsurface Sediment Maximum Result	Minimum Result
Organic chemicals (µg/kg)								
3 & 4-Methylphenol (m,p-Cresols)	260	2000					ND	ND
Benzoic acid	2900	3800					ND	ND
Bis(2-ethylhexyl) phthalate	500	22000					ND	ND
Carbazole	900	1100					ND	ND
Dibenzofuran	200	680					ND	ND
Di-n-butyl phthalate	380	1000					ND	ND
Di-n-octyl phthalate	39	>1100					ND	ND
Pentachlorophenol	1200	>1200					ND	ND
Phenol	120	210					ND	ND
Total PAHs	17000	30000					198.4	ND
Carcinogenic PAHs[a] (sum TEQ)			170	120	150	9	0.6042	0.01097
Bulk Petroleum Hydrocarbons (mg/kg)								
TPH-DRO	340	510					91,100	ND
TPH- RRO	3600	4400					102,000	ND

Notes:

a. Carcinogenic PAHs include: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. These seven cPAHs are appropriate for calculating the sum TEQ.

CSL = cleanup screening level
DRO = diesel range organics
J = estimated value
mg/kg - milligrams per kilogram
ND = Not detected
ng/kg - nanograms per kilogram
PAH = Polycyclic Aromatic Hydrocarbons
RRO = residual range organics (also referred to as motor oil range organics)
SCO – sediment cleanup objective
TEQ = toxic equivalency
TPH = total petroleum hydrocarbons
TPH-residual is referred to as TPH-motor oil range organics by the laboratory, and as TPH-RRO in this report.
µg/kg - micrograms per kilogram

6 Summary and Conclusions

The RI for the sediments adjacent to the BNSF Wishram facility was conducted in accordance with the Ecology MTCA regulations in WAC 173-340 (found at https://apps.leg.wa.gov/wac/default.aspx?cite=173-340), the SMS in WAC 173-204 (found at https://app.leg.wa.gov/wac/default.aspx?cite=173-204), and the SMS guidance described in the SCUM (Ecology 2021).

The specific objectives of the sediment RI included the following:

- Determine the depth of the BAZ.
- Characterize the sediment and COPCs within the BAZ in areas of potential historical discharges, from historical activities in the uplands and inundated land, and activities along the former shoreline.
- Assess the lateral distribution of COPCs in surface sediments, and whether constituents represent an adverse risk to aquatic organisms or to human health.
- Characterize the lateral and vertical extent of NAPL below the sediment surface, sediment lithology, and evaluate whether the NAPL in sediment is isolated from the NAPL in the upland areas.
- Characterize the vertical and lateral extent of NAPL-impacted materials and refine the understanding of the source of observed sheens.
- Determine sediment cleanup unit boundaries and appropriate cleanup standards (which may include CULs and points of compliance), as applicable.

These objectives were met with the results presented in this report and are summarized below:

- Based on the lack of sediment in the investigation area, the BAZ was determined by the Department of Ecology as the top 10 cm of sediment, where present (email from J. Mefford, Department of Ecology dated April 18, 2022).
- The data collected during the RI indicate that sulfides exceed the benthic SCO in one surface sample and TPH-DRO and TPH-RRO, exceed the CSLs in two surface sediment samples.
- Ecological screening indicates that constituents found in site surface sediment (driven by two 2018 samples with TPH-DRO exceedances) pose risk to the benthic community. The evaluation of potential risk from bioaccumulative compounds indicated that low concentrations of PAHs and TPH-DRO in a limited number of surface samples exceeded preliminary natural background values. However, when considering the concentration and detection frequency of PAHs and TPH-DRO in site sediment and the low potential for bioaccumulation, further ecological risk evaluation of these compounds is not warranted. Rather than conducting further risk assessment, remedies to address the areas of NAPL will be evaluated in the feasibility study.
- Human health screening results were similar to ecological screening with some exceedances of risk criteria at a few sampling stations associated with the shellfish/fish consumption exposure scenario.
- The NAPL impacts in the inundated lands were delineated during the RI. A total of 60 TarGOST borings were attempted (58 successful) when only 18 were planned. The area of investigation was expanded laterally away from the shoreline and to the west beyond the initial RI study area to delineate the area of impact. Based on the history of the area and field observations of disturbed sediments in the NAPL area, the NAPL impact was in place prior to the filling of Lake Celilo. It is separated from upland NAPL impacts by more than 100 feet. The NAPL is immobile based on its emplacement mechanism. However, ebullition in areas where the NAPL impacts are closer to the sediment surface is occurring resulting in a release to sediment and surface water.

The requirements for an FS include the following (SCUM Section 12.3):

> *In order to conduct a feasibility study, it is necessary to establish the boundaries of the site or the sediment cleanup unit as well as any sediment management areas (SMAs). The boundaries of the site or sediment cleanup unit could include all areas that exceed the site-specific cleanup standards, or the CSL (for example, regional background) if it is higher.*

The RI results show that sediment concentrations that exceed SMS criteria do not exist outside of the NAPL impacted area. NAPL delineations performed during this RI establish the sediment cleanup unit. The RI is complete, and the feasibility study can be performed with the information collected to evaluate remedial alternatives and identify the design studies needed for implementation.

7 References

BNSF Railway Company. 2017. *Historical Documents Transmittal Agreed Order DE 12897*. September 27.

CH2M HILL Engineers, Inc. (CH2M). 2018. *BNSF Wishram Track Switching Facility Nearshore Sediment Initial Investigation Work Plan*. Prepared for BNSF Railway Company. January.

Costello, Michael, and D. Talsma. 2003. Remedial design modeling at a superfund sediment site. In Proceedings of the Second International Conference on Remediation of Contaminated Sediments, Venice, Italy.

Dakota Technologies, Inc. (Dakota). 2013. *TarGOST Investigation, BNSF Site, Wishram Washington*. September.

Draheim, R., M. Sytsma, R. Miller, and J. Cordell (Draheim et al.). 2007. *Middle Columbia River Aquatic Nonindigenous Species Survey, Final Report*. Center for Lakes and Reservoirs, Portland State University, Portland, OR.

Jacobs. 2019. *Inundated Lands Initial Investigation Report*. BNSF Wishram Railyard, Wishram, Washington. May.

Jacobs. 2021. *Sediment Remedial Investigation Work Plan*, BNSF Wishram Railyard, Wishram, Washington. Final. November.

Jacobs. 2022. *Sediment Remedial Investigation Work Plan Revision 1*, BNSF Wishram Railyard, Wishram, Washington. October.

Kennedy/Jenks Consultants (KJ). 2003. *UST Site Assessment and Removal Report, Wishram, Washington*. Prepared for BNSF Railway Company. October.

Kennedy/Jenks Consultants (KJ). 2004a. *UST Site Assessment Report, Wishram, Washington*. Prepared for BNSF Railway Company. February.

Kennedy/Jenks Consultants (KJ). 2004b. *Site Assessment Report, Wishram Railyard, Washington*. Prepared for BNSF Railway Company. August.

Kennedy/Jenks Consultants (KJ). 2007a. *Remediation Documentation Report, Wishram, Washington*. Prepared for BNSF Railway Company. March.

Kennedy/Jenks Consultants (KJ). 2007b. *Wishram Rail Grinder Cleanup Report, Wishram, Washington*. Prepared for BNSF Railway Company. May.

Kennedy/Jenks Consultants (KJ). 2010a. *Supplemental Site Investigation – MW-7 Area, Wishram, Washington*. Prepared for BNSF Railway Company. September.

Kennedy/Jenks Consultants (KJ). 2010b. *Supplemental Site Remediation – Concrete Vault/Foundation Area, Wishram, Washington*. Prepared for BNSF Railway Company. August.

Kennedy/Jenks Consultants (KJ). 2012. Site Investigation, Wishram Railyard, Wishram, Washington. Prepared by Kennedy/Jenks Consultants for BNSF Railway Company. August.

Kennedy/Jenks Consultants (KJ). 2016. *Remedial Investigation Work Plan Wishram, Washington*. Prepared by Kennedy/Jenks Consultants for BNSF Railway Company. March. (Revised March 2017).

Kennedy/Jenks Consultants (KJ). 2018. *BNSF Track Switching Facility (aka BNSF Wishram Railyard) Remedial Investigation Work Plan Addendum Wishram, Washington*. Prepared for BNSF Railway Company. February 23.

Kennedy/Jenks Consultants (KJ). 2020. *Uplands Remedial Investigation Report BNSF Wishram Railyard.* Prepared for BNSF Railway Company. October.

Moody, J.A., R.H. Meade, and D.R. Jones (Moody et al.). 2003. *Lewis and Clark's Observations and Measurements of Geomorphology and Hydrology, and Changes with Time*. Reston, VA. U.S. Geological Survey. Referenced in https://www.cwu.edu/geography/sites/cts.cwu.edu.geography/files/Oliver%20Noah%202018%20Geomorphic%20Consequences%20of%20Hydroelectricity%20and%20Transportation%20Development.pdf.

Pfeifer, B., J.E. Hagen, D. Weitkamp, and D.H. Bennett. (Pfeifer et al.). 2001. *An Evaluation of Fish Species Present in the Priest Rapids Project Area*. Prepared for Public Utility District No. 2 of Grant County, Ephrata, WA.

National Oceanic and Atmospheric Administration (NOAA). n.d. *Office of Coast Survey*. Accessed March 2023. https://www.charts.noaa.gov/OnLineViewer/18533.shtml.

Spokane Portland & Seattle Railway (SP&S). 1950. Letter from SP&S to Washington Pollution Control Commission. November.

Northwest's Own Railway (NWOR). 2014. *Spokane Portland & Seattle Railway Historical Society, The Northwest's Own Railway, Fall Edition*. Spokane, WA.

U.S. Army Corps of Engineers (USACE). 2017. USACE Hydrographic Surveys. CL_55_CEL_20170324_CS_POOL. https://www.arcgis.com/apps/dashboards/4b8f2ba307684cf597617bf1b6d2f85d.

U.S. Army Corps of Engineers (USACE). The Dalles Dam and Lake Celilo. Columbia Basin Water Management Division. Accessed March 2023. https://www.nwd-wc.usace.army.mil/dd/common/projects/www/tda.html.

U.S. Army Corp of Engineers, Bureau of Reclamation, Bonneville Power Administration (USACE et al.). 2020. *Columbia River System Operations Final Environmental Impact Statement.* July. https://www.nwd.usace.army.mil/CRSO/Final-EIS/.

U.S. Environmental Protection Agency (USEPA). ProUCL: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Version 5.2. https://www.epa.gov/land-research/proucl-software, 2022.

Viana, P.Z., K. Yin, and K.J. Rockne (Viana et al.). 2012. "Field Measurements and Modeling of Ebullition Facilitated Flux of Heavy Metals and Polycyclic Aromatic Hydrocarbons from Sediments to the Water Column." *Environmental Science and Technology*, Vol. 46. pp. 12046-12054.

Washington State Department of Ecology (Ecology). 2013a. *Sediment Management Standards*, Chapter 173-204 Washington Administrative Code (WAC). https://app.leg.wa.gov/wac/default.aspx?cite=173-204. February.

Washington State Department of Ecology (Ecology). 2013b. *Model Toxics Control Act – Cleanup*, Chapter 173-204 Washington Administrative Code (WAC). https://app.leg.wa.gov/wac/default.aspx?cite=173-204. February.

Washington State Department of Ecology (Ecology). 2017. Letter to BNSF regarding *Data Gaps Investigation, BNSF Track Switching Facility aka Wishram Railyard*. March 3.

Washington State Department of Ecology (Ecology). 2021. *Sediment Cleanup User's Manual: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards,* Chapter 173-204 WAC. Publication No. 12-09-057. December.

Washington State Department of Ecology (Ecology). 2022. Email from John Mefford (Ecology) to Shane DeGross (BNSF), Kris Ivarson (Jacobs), and Chance Asher (Ecology). RE: Meeting Notes and Table with Sample Prioritization. Dated April 18.

Tables

Table 1-1 History of Work Plan Development
Sediment Remedial Investigation Report BNSF
Wishram Railyard

Date	Work Plan Development, Reporting and Correspondence
May 30, 2019	Draft *Inundated Lands Initial Investigation Report* (draft Initial Investigation report) and the draft *Initial Investigation Work Plan Addendum* (IIWP addendum) for additional investigation were submitted to Ecology (Jacobs 2019).
August 5, 2019	Ecology provided comments on the draft IIWP addendum in a letter to BNSF.
October 11, 2019	Ecology provided comments on the draft Initial Investigation report.
April 21, 2020	Ecology provided additional comments from the Ecology Sediment Policy Program and the Yakama Nation on the draft Initial Investigation report and IIWP addendum.
August 13, 2020	Ecology determined that the inundated land adjacent to the BNSF railyard is a sediment site, based on the results of the initial investigation, and required that BNSF perform an RI. Ecology included the statement "the RI shall include analysis of the full suite of SMS constituents, as reflected in Table VI (WAC 173-204-563(2)) as well as carcinogenic polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyl (PCB) congeners."
September 15, 2020	BNSF responded to the August 13, 2020, letter from Ecology, agreeing to perform a Sediment (inundated lands) RI, and proposed to prepare a draft Work Plan for submission to Ecology within 90 days of the Ecology acceptance of the proposal. The letter also stated that BNSF disagreed that a full suite of SMS constituents was appropriate for the in-water investigation area (the site).
September 30, 2020	Ecology accepted this proposal but reaffirmed the requested constituents of potential concern (COPCs) in the August 13, 2020, letter
December 28, 2020	BNSF submitted the draft Sediment RI Work Plan and sampling and analysis plan (SAP) to Ecology.
February 12, 2021	Ecology provided initial comments and redlined markup of the draft Work Plan and SAP to BNSF.
March 11, 2021	Ecology and BNSF discussed those comments during a conference call.
March 23, 2021	BNSF emailed Ecology the presentation slides from the March 11, 2021, meeting along with a summary of the discussion topics and proposed path forward.
April 6, 2021	Ecology provided a letter dated April 5, 2021, and a memorandum dated April 4, 2021, providing further comments on specific proposed scope items

Table 1-1 History of Work Plan Development
Sediment Remedial Investigation Report

Date	Work Plan Development, Reporting and Correspondence
May 14, 2021	BNSF submitted a response letter and matrix to Ecology addressing Ecology's specific comments in the April 5, 2021, letter and April 4, 2021, technical memorandum, and general responses to the February 12, 2021, letter.
June 11, 2021	Ecology provided an email response and marked up flowchart.
August 2021	BNSF submitted a revised draft Work Plan to Ecology.
November 2021	BNSF submitted the *Final Sediment Remedial Investigation Work Plan* (Jacobs 2021) to Ecology.
November 19, 2021	Ecology approved the *Final Sediment Remedial Investigation Work Plan*.
April 12 through 29, 2022	Step 1 of the field investigation was conducted (Section 2.2.1).
April 18, 2022	Ecology and BNSF discussed the Step 1 results and an estimated biologically active zone (BAZ) depth of 10 centimeters (cm) was agreed upon (Section 2.2.1.2).
April 22, 2022	Ecology and BNSF discussed the riverbed conditions limiting collection of background samples and the need to attempt collection of additional background conditions in the upstream area. During the call, Ecology agreed with the need for additional attempts (Section 2.2.1.2).
August 11, 2022	Ecology, YNF and BNSF discussed the Step 1 data results.
September 9, 2022	Ecology, YNF and BNSF discussed the upcoming Step 2 field effort.
September 20, 2022	A summary of the Step 1 data was provided to Ecology as an interim deliverable.
October 3, 2022	Ecology requested additional changes to the Work Plan related to Step 2, which included input from the YNF. In response, BNSF had several discussions with Ecology to understand the requested changes and come to agreement.
October 25, 2022	BNSF submitted a *Sediment Remedial Investigation Work Plan Revision 1* (Jacobs 2022).
October 27, 2022	Ecology approved the Work Plan Revision 1 via email.
November 2 through 14, 2022	Step 2 of the RI was conducted (Section 2.2.2).

Table 2-1 Summary of Upland Investigations at the BNSF Wishram Railyard

Sediment Remedial Investigation Report

BNSF Wishram Railyard

Year of Investigation	Summary of Investigation Activities	Reference
2002	A 30,000-gallon, steel, single-walled UST adjacent to the western side of a former boiler house was removed in 2002. During the removal activities soil sampling identified the presence of TPH-DRO and TPH-ORO. Contaminated soil was removed to the top of bedrock (16 feet below ground surface [bgs] at this location). Confirmation sampling indicated a thin layer of soil containing TPH-DRO and TPH-ORO at concentrations above MTCA Method A soil CULs for industrial properties remaining in place just above bedrock to the north, east, and south of the excavated area.	Site assessment and removal presented in *UST Site Assessment and Removal Report* [Kennedy/Jenks Consultants (KJ) 2003].
2003	A site assessment was conducted to evaluate site hydrogeologic conditions and determine the extent of petroleum impacted soil south and potentially hydraulically downgradient of the former 30,000-gallon heating oil UST (KJ 2004a). Seven soil borings were drilled and sampled, and four monitoring wells were installed. Soil samples from two of the borings and groundwater samples from two monitoring wells contained TPH-DRO and/or TPH-ORO above MTCA Method A CULs.	Site assessment results presented in *UST Site Assessment Report* (KJ 2004a).
2004	An overall site assessment (KJ 2004b) was conducted to evaluate the following potential primary sources of petroleum at the site: • Former 30,000-barrel oil AST • Former 600-gallon fuel oil and 10,000-gallon gasoline/oil USTs • Former 5,000-gallon oil UST at Depot • Former 1,000-gallon gasoline UST and Oil House • Former Transformer Storage Area • Former Engine House and Turntable • Former Power House • Former 100,000-gallon diesel ASTs, former Pump House, and former 500-gallon gasoline USTs • Former Fueling Island and 5,000-gallon lubricating oil AST A total of 27 soil borings were completed and three monitoring wells were installed. Petroleum impacted soil and groundwater were identified at several historical petroleum storage and use locations. Locations with soil exceeding the MTCA Method A CUL were the Former Power House, Former Fueling Island, 5,000-gallon lubricating oil AST, and the former 30,000-gallon UST near the former Boiler House. Groundwater exceeded the CULs for petroleum in three monitoring wells.	Site assessment results presented in *Site Assessment Report* (KJ 2004b).

Table 2-1 Summary of Upland Investigations at the BNSF Wishram Railyard
Sediment Remedial Investigation Report

Year of Investigation	Summary of Investigation Activities	Reference
2005	The results of the 2004 site assessment were used to guide additional remediation activities in the uplands portion of the site. Remediation included removal and offsite disposal of approximately 3,600 tons of petroleum-containing soil and debris, removal and recycling of approximately 1,800 gallons of petroleum from the former 5,000-gallon lube oil UST and associated piping, and removal and recycling of 10 tons of metal (KJ 2007a). Excavation depths extended to the water table, typically encountered around 10 to 12 feet bgs. Confirmation sampling in excavation areas west of the current Maintenance Shop identified soil containing diesel-range petroleum hydrocarbons at concentrations above the MTCA Method A industrial soil CUL was left in place below the water table.	Remediation activities and results presented in *Remediation Documentation Report* (KJ 2007a).
2007	A release of 40 gallons of diesel fuel was reported adjacent to a rail track spur. In response, 14 soil borings (DB-1 through DB-14) were advanced in the diesel release area. Soil was logged and field-screened for presence of petroleum hydrocarbons using sensory observation and petroleum sheen testing. Collected 7 confirmation soil samples from the base of the excavation for analysis of TPH-DRO and TPH-ORO. Analytical results indicated that MTCA Method A CULs for soil were removed.	Site assessment results and removal presented in *Wishram Rail Grinder Cleanup Report* (KJ 2007b).
2010	Performed supplemental investigation to identify potential primary sources of residual NAPL in the vicinity of the Maintenance Shop (KJ 2010b). The source of the NAPL appeared to be petroleum-saturated soil submerged beneath the present-day water table and likely related to historical releases from the former 30,000-gallon diesel UST. Debris and petroleum-containing soil in the vicinity of the former 28,500-gallon oil service AST were removed and disposed of offsite. Confirmation soil samples collected following the excavation activities confirmed residual hydrocarbon concentrations in the excavation area were below MTCA Method A soil CULs for unrestricted land use (KJ 2010b).	Supplemental site investigation activities are presented in the letter report, *Supplemental Site Investigation – WMW-7 Area, Potential Light Non-Aqueous Phase Liquid (LNAPL) Sources* dated 30 September 2010 (KJ 2010b).

Table 2-1 Summary of Upland Investigations at the BNSF Wishram Railyard

Sediment Remedial Investigation Report

Year of Investigation	Summary of Investigation Activities	Reference
2012	Soil and groundwater investigations were conducted on the southern side of the mainline tracks near the former fueling island and Former Power House (KJ 2012). Diesel-impacted soil and groundwater were found along the length of the former fueling platform south of the mainline tracks, but the source was thought to be migration of NAPL from the area north and upgradient of the mainline tracks and former fueling platform. An air sparging system and a soil-vapor extraction (SVE) system were installed north of the mainline tracks to address the NAPL. Air sparging was discontinued in June 2012 due to the sporadic presence of NAPL in monitoring wells in the area. The SVE system was modified in 2012 due to fluctuating groundwater levels. Modifications were made to the system so that it operated in bioventing mode (injecting, rather than pulling air through the SVE wells). Bioventing with ambient air through the SVE wells operated in continuous mode (24 hours a day, 7 days a week) between June 2012 and April 2017, when the system blower failed. The system blower was replaced in November 2017, and the bioventing system was restarted, operating in continuous mode. Operation of the system continued until July 24, 2019, when the system was shut down to perform a respirometry test and to evaluate future system operation and has not been restarted.	Site investigation activities are presented in *Site Investigation, Wishram Railyard* dated August 2012 (KJ 2012).
2013	A laser-induced fluorescence (LIF) survey was conducted to further delineate the NAPL impacted areas in the uplands portion of the site. The LIF survey was conducted by Dakota Technologies, of Fargo, North Dakota (Dakota), using the Tar-specific Green Optical Screening Tool (TarGOST) LIF system, developed specifically for coal tar and heavy oil detection (Dakota Technologies 2013). The LIF survey included 102 sample points at approximately 12.5- to 50-foot centers, but mostly spaced on 30- to 40-foot centers. The LIF tooling was advanced to refusal (the top of bedrock surface) using a Geoprobe direct-push rig. Total boring depths ranged between approximately 12 feet below ground surface (bgs) (TG-NT11) to 93 feet bgs (TG-D06). Soil samples were collected to qualitatively correlate the LIF signal response to laboratory soil analytical concentrations for petroleum hydrocarbons. The LIF and analytical data were used to delineate the approximate distribution of light nonaqueous petroleum liquid (LNAPL) in subsurface soil at the site. Based on the soil boring analytical results, and interpretation of the LIF, an LIF response of 60% reference emitter (RE) provided a conservative minimum threshold value above which potentially mobile NAPL may be present.	LIF survey results are presented in *TarGOST® Investigation* dated September 26, 2013 (Dakota Technologies, Inc. 2013).
2014	Additional investigations were conducted near the Former Power House to evaluate potential mobility of the submerged oil LNAPL. A total of nine soil borings were advanced during the investigation, with	Data are included in the *Remedial Investigation Work*

Table 2-1 Summary of Upland Investigations at the BNSF Wishram Railyard

Sediment Remedial Investigation Report

Year of Investigation	Summary of Investigation Activities	Reference
	locations selected based on LIF survey data and the oil head monitoring and deep riverside monitoring well borings. Soil samples were collected during drilling and analyzed for TPH-DRO and TPH-ORO. Soil samples collected from borings drilled and sampled for each of the OHM wells (OHM-1 through OHM-4) contained TPH-DRO and TPH-ORO at concentrations exceeding the MTCA Method A cleanup levels for industrial properties.	*Plan, Wishram, Washington* [KJ 2016 (Revised 2017)].
2018	Additional RI field tasks were completed between August 2016 and December 2017 and are summarized in this work plan addendum. A total of 24 soil borings, seven shallow monitoring wells, four deep riverside monitoring wells, and four oil head monitoring wells were installed.	Data are included in the *Remedial Investigation Work Plan Addendum, Wishram, Washington* (KJ 2018)
2016 thru 2020	Conducted RI work planning, data collection activities, and reporting pursuant to AO No. DE 12897, dated October 7, 2015, to investigate the nature and extent of site-related constituents in soil and groundwater at the railyard and evaluate related fate and transport mechanisms across the approximately 6-acre area at the railyard where industrial activities (e.g., fuel storage, engine refueling, engine maintenance) historically occurred. This work culminated in Ecology's acceptance of the uplands RI report (KJ 2020) (Ecology 2021).	Remedial Investigation activities and results are presented in the *Uplands Remedial Investigation Report, BNSF Wishram Railyard, Wishram, Washington* (KJ 2020)

Table 2-2 Summary of Shoreline and Sediment Investigations through 2021

Sediment Remedial Investigation Report

BNSF Wishram Railyard

Year of Investigation	Summary of Investigation Activities
2013	During the uplands LIF survey on July 13, 2013, oil droplets and an associated sheen were observed offshore and near the site in the Columbia River. BNSF reported the occurrence of the oil and sheen in surface water to the National Response Center and Ecology on the same date. Monthly inspections for sheen began in December 2013.
2014 through 2016	Petroleum sheens were observed near the shoreline in July 2014, June 2015, August and October 2016.
2017 through early 2018	The *Wishram Railyard Nearshore Sediment Remedial Investigation Work Plan* (CH2M Hill 2017) was developed during 2017, and the Draft Work Plan submitted to Ecology on July 28, 2017. Comments were received from Ecology on October 4, 2017. The Final *BNSF Wishram Track Switching Facility Nearshore Sediment Initial Investigation Work Plan* (CH2M Hill 2018) was submitted to Ecology in January 2018 and approved on February 7, 2018.
2018	An initial investigation was conducted in June and August 2018 to evaluate the potential presence of NAPL in the inundated lands that might be the source of the observed sheens. The investigation included the following: • 30 Darts[1] were advanced in June, • 5 surface sediment grab samples were collected in August, • 1 sediment core sample was collected in the nearshore in August, and • 7 sediment cores were advanced in the offshore in August. Submerged NAPL, approximately 2- to 4-feet thick, was observed in a disturbed layer 0.5 to 2.5 feet beneath the sediment surface at four sampling locations in the offshore area. Concentrations of TPH-diesel and TPH-residual exceeded the Washington Freshwater Benthic, Dry Weight Sediment Cleanup Objectives (SCOs) in offshore sediment at one location in the vicinity of the NAPL. Closer to the shoreline where NAPL was not observed to be present, a second sediment sample had a concentration of TPH-diesel just above the SCO.

[1] Darts are a sampling method developed by Dakota Technologies. Darts quickly screen for polycyclic aromatic hydrocarbons (PAHs) in sediments and similar soft soils. The Dart sampler consists of a continuous rod made coated with solid-phase extraction (SPE)

Table 2-3. Attempted and Retained Surface Grab Sample Locations and Details

BNSF Wishram Sediment Remedial Investigation Report

Station ID	Grab ID	Sample Type	Bathymetric Elevation[a] (ft)	Sample Date	from Target Location (ft)	Recovery (cm)	Sample Interval (cm)	Sampled
SG01	SG01-G1	Site	153.84	4/19/2022	6.8	10	0-10	Yes
SG02	SG02-G1	Site	145.96	4/19/2022	8.5	7	--	No
SG02	SG02-G2	Site	145.96	4/19/2022	17.5	5	--	No
SG02	SG02-G3	Site	145.96	4/19/2022	13.2	14	0-10	Yes
SG03	SG03-G1	Site	135.69	4/27/2022	6.8	5.5	0-5.5	Yes
SG03	SG03-G2	Site	135.69	4/27/2022	1.8	2	0-2	Yes
SG03	SG03-G3	Site	135.69	4/27/2022	6.7	2	0-2	Yes
SG04	SG04-G1	Site	--	4/25/2022	2.5	<1	--	No
SG04	SG04-G2	Site	--	4/25/2022	17.0	<1	--	No
SG04	SG04-G3	Site	--	4/25/2022	17.0	0	--	No
SG05	SG05-G1	Site	--	4/22/2022	2.8	1	--	No
SG05	SG05-G2	Site	--	4/22/2022	22.0	0	--	No
SG05	SG05-G3	Site	--	4/22/2022	19.5	2	--	No
SG06	SG06-G1	Site	--	4/25/2022	4.0	<1	--	No
SG06	SG06-G2	Site	--	4/25/2022	22.0	1	--	No
SG06	SG06-G3	Site	--	4/25/2022	19.0	1	--	No
SG07	SG07-G1	Site	--	4/22/2022	18.0	3	--	No
SG07	SG07-G2	Site	--	4/22/2022	5.0	1	--	No
SG07	SG07-G3	Site	--	4/22/2022	23.0	0	--	No
SG08	SG08-G1	Site	--	4/22/2022	9.0	0	--	No
SG08	SG08-G2	Site	--	4/22/2022	20.0	0	--	No
SG08	SG08-G3	Site	--	4/22/2022	24.0	<1	--	No
SG09	SG09-G1	Site	--	4/22/2022	0.9	0	--	No
SG09	SG09-G2	Site	--	4/22/2022	18.0	0	--	No
SG09	SG09-G3	Site	--	4/22/2022	11.7	2	--	No
SG10	SG10-G1	Site	--	4/22/2022	16.5	0	--	No
SG10	SG10-G2	Site	--	4/22/2022	20.5	0	--	No
SG10	SG10-G3	Site	--	4/22/2022	4.0	0	--	No
SG11	SG11-G1	Site	154.98	4/28/2022	5.0	0	--	No
SG11	SG11-G2	Site	154.98	4/28/2022	13.0	5	0-5	Yes
SG11	SG11-G3	Site	154.98	4/28/2022	20.0	0	--	No
SG12	SG12-G1	Site	--	4/27/2022	12.0	0	--	No
SG12	SG12-G2	Site	--	4/27/2022	10.2	0	--	No
SG12	SG12-G3	Site	--	4/27/2022	17.0	0	--	No
SG13	SG13-G1	Site	132.74	4/25/2022	5.5	<1	--	No
SG13	SG13-G2	Site	132.74	4/25/2022	5.0	0	--	No
SG13	SG13-G3	Site	132.74	4/25/2022	19.1	1.5	0-1.5	Yes
SG14	SG14-G1	Site	--	4/25/2022	1.0	0	--	No
SG14	SG14-G2	Site	--	4/25/2022	17.5	1	--	No
SG14	SG14-G3	Site	--	4/25/2022	23.0	0	--	No
SG15	SG15-G1	Site	--	4/25/2022	0.4	0	--	No
SG15	SG15-G2	Site	--	4/25/2022	15.0	<1	--	No
SG15	SG15-G3	Site	--	4/25/2022	17.0	1	--	No
SG16	SG16-G1	Site	--	4/22/2022	15.0	2	--	No
SG16	SG16-G2	Site	--	4/22/2022	19.8	<1	--	No

Table 2-3. Attempted and Retained Surface Grab Sample Locations and Details

BNSF Wishram Sediment Remedial Investigation Report

Station ID	Grab ID	Sample Type	Bathymetric Elevation[a] (ft)	Sample Date	from Target Location (ft)	Recovery (cm)	Sample Interval (cm)	Sampled
SG16	SG16-G3	Site	--	4/22/2022	16.5	3	--	No
SG17	SG17-G1	Site	--	4/22/2022	6.0	0	--	No
SG17	SG17-G2	Site	--	4/22/2022	23.0	0	--	No
SG17	SG17-G3	Site	--	4/22/2022	16.0	0	--	No
SG18	SG18-G1	Site	--	4/25/2022	0.2	2	--	No
SG18	SG18-G2	Site	--	4/25/2022	13.0	0	--	No
SG18	SG18-G3	Site	--	4/25/2022	15.0	1	--	No
SG19	SG19-G1	Site	--	4/25/2022	7.0	1	--	No
SG19	SG19-G2	Site	--	4/25/2022	10.5	0	--	No
SG19	SG19-G3	Site	--	4/25/2022	15.3	0	--	No
SG20	SG20-G1	Site	--	4/25/2022	1.6	<1	--	No
SG20	SG20-G2	Site	--	4/25/2022	15.3	0	--	No
SG20	SG20-G3	Site	--	4/25/2022	20.0	0	--	No
SG21	SG21-G1	Site	--	4/25/2022	2.2	0	--	No
SG21	SG21-G2	Site	--	4/25/2022	19.0	0	--	No
SG21	SG21-G3	Site	--	4/25/2022	17.0	0	--	No
SG22	SG22-G1	Site	--	4/21/2022	5.8	0	--	No
SG22	SG22-G2	Site	--	4/21/2022	20.5	0	--	No
SG22	SG22-G3	Site	--	4/21/2022	12.5	0	--	No
SG23	SG23-G1	Site	140.90	4/21/2022	1.3	3	--	No
SG23	SG23-G2	Site	140.90	4/21/2022	21.5	7	0-6	Yes
SG23	SG23-G3	Site	140.90	4/21/2022	21.5	<1	--	No
SG24	SG24-G1	Site	--	4/21/2022	1.6	<1	--	No
SG24	SG24-G2	Site	--	4/21/2022	22.0	0	--	No
SG24	SG24-G3	Site	--	4/21/2022	20.5	<1	--	No
SG25	SG25-G1	Site	--	4/21/2022	1.3	0	--	No
SG25	SG25-G2	Site	--	4/21/2022	13.0	<1	--	No
SG25	SG25-G3	Site	--	4/21/2022	20.5	0	--	No
SG26	SG26-G1	Site	--	4/21/2022	7.0	<1	--	No
SG26	SG26-G2	Site	--	4/21/2022	19.5	<1	--	No
SG26	SG26-G3	Site	--	4/21/2022	24.5	<1	--	No
SG27	SG27-G1	Site	--	4/21/2022	0.2	0	--	No
SG27	SG27-G2	Site	--	4/21/2022	21.0	0	--	No
SG27	SG27-G3	Site	--	4/21/2022	21.5	0	--	No
SG28	SG28-G1	Site	--	4/21/2022	10.0	0	--	No
SG28	SG28-G2	Site	--	4/21/2022	14.0	<1	--	No
SG28	SG28-G3	Site	--	4/21/2022	23.0	0	--	No
SG29	SG29-G1	Site	--	4/19/2022	7.0	2	--	No
SG29	SG29-G2	Site	--	4/19/2022	17.0	7.5	--	No
SG29	SG29-G3	Site	--	4/19/2022	16.1	0	--	No
SG30	SG30-G1	Site	--	4/19/2022	0.8	<1	--	No
SG30	SG30-G2	Site	--	4/19/2022	21.0	<1	--	No
SG30	SG30-G3	Site	--	4/19/2022	17.0	<1	--	No
SG31	SG31-G1	Site	--	4/19/2022	20.1	<1	--	No
SG31	SG31-G2	Site	--	4/19/2022	4.7	0	--	No

Table 2-3. Attempted and Retained Surface Grab Sample Locations and Details

BNSF Wishram Sediment Remedial Investigation Report

Station ID	Grab ID	Sample Type	Bathymetric Elevation[a] (ft)	Sample Date	from Target Location (ft)	Recovery (cm)	Sample Interval (cm)	Sampled
SG31	SG31-G3	Site	--	4/19/2022	23.0	0	--	No
SG32	SG32-G1	Site	--	4/19/2022	16.5	<1	--	No
SG32	SG32-G2	Site	--	4/19/2022	21.0	4	--	No
SG32	SG32-G3	Site	--	4/19/2022	21.2	0	--	No
SG33	SG33-G1	Site	--	4/19/2022	24.7	0	--	No
SG33	SG33-G2	Site	--	4/19/2022	16.4	0	--	No
SG33	SG33-G3	Site	--	4/19/2022	19.6	<1	--	No
SG34	SG34-G1	Site	--	4/19/2022	22.0	0	--	No
SG34	SG34-G2	Site	--	4/19/2022	0.4	<1	--	No
SG34	SG34-G3	Site	--	4/19/2022	18.5	<1	--	No
D100	D100-G1	Site	--	4/29/2022	7.0	0	--	No
D100	D100-G2	Site	--	4/29/2022	11.0	0	--	No
D100	D100-G3	Site	--	4/29/2022	20.0	0	--	No
D160	D160-G1	Site	153.39	4/28/2022	9.0	0	--	No
D160	D160-G2	Site	153.39	4/28/2022	17.0	0	--	No
D160	D160-G3	Site	153.39	4/28/2022	21.0	5	0-5	Yes
D240	D240-G1	Site	--	4/28/2022	10.5	0	--	No
D240	D240-G2	Site	--	4/28/2022	10.0	0	--	No
D240	D240-G3	Site	--	4/28/2022	20.0	0	--	No
E320	E320-G1	Site	153.35	4/28/2022	0.5	0	--	No
E320	E320-G2	Site	153.35	4/28/2022	19.5	0	--	No
E320	E320-G3	Site	153.35	4/28/2022	13.0	4	0-4	Yes
E380	E380-G1	Site	155.56	4/28/2022	3.0	0	--	No
E380	E380-G2	Site	155.56	4/28/2022	17.0	3	0-3	Yes
E380	E380-G3	Site	155.56	4/28/2022	6.8	4	0-4	Yes
E460	E460-G1	Site	149.08	4/29/2022	1.5	4	0-4	Yes
E460	E460-G2	Site	149.08	4/29/2022	10.0	0	--	No
E460	E460-G3	Site	149.08	4/29/2022	19.0	3	0-3	Yes
H260	H260-G1	Site	--	4/29/2022	1.0	0	--	No
H260	H260-G2	Site	--	4/29/2022	18.0	0	--	No
H260	H260-G3	Site	--	4/29/2022	20.0	0	--	No
H360	H360-G1	Site	140.00	4/29/2022	2.0	1	0-1	Yes
H360	H360-G2	Site	140.00	4/29/2022	22.0	4	0-4	Yes
H360	H360-G3	Site	140.00	4/29/2022	14.0	8	0-8	Yes
I120	I120-G1	Site	149.90	4/29/2022	1.0	3	0-3	Yes
I120	I120-G2	Site	149.90	4/29/2022	19.5	6	0-6	Yes
I120	I120-G3	Site	149.90	4/29/2022	15.0	4	0-4	Yes
L320	L320-G1	Site	133.85	4/29/2022	3.0	2	0-2	Yes
L320	L320-G2	Site	133.85	4/29/2022	17.5	0	--	No
L320	L320-G3	Site	133.85	4/29/2022	17.0	2	0-2	Yes
BG01	BG01-G1	Background	--	4/20/2022	6.0	<1	--	No
BG01	BG01-G2	Background	--	4/20/2022	21.5	<1	--	No
BG01	BG01-G3	Background	--	4/20/2022	24.2	<1	--	No
BG02	BG02-G1	Background	--	4/20/2022	1.8	3	--	No
BG02	BG02-G2	Background	--	4/20/2022	22.0	<1	--	No

Table 2-3. Attempted and Retained Surface Grab Sample Locations and Details

BNSF Wishram Sediment Remedial Investigation Report

Station ID	Grab ID	Sample Type	Bathymetric Elevation[a] (ft)	Sample Date	from Target Location (ft)	Recovery (cm)	Sample Interval (cm)	Sampled
BG02	BG02-G3	Background	--	4/20/2022	9.5	2	--	No
BG03	BG03-G1	Background	--	4/20/2022	6.5	0	--	No
BG03	BG03-G2	Background	--	4/20/2022	25.0	0	--	No
BG03	BG03-G3	Background	--	4/20/2022	18.8	0	--	No
BG04	BG04-G1	Background	--	4/20/2022	3.8	0	--	No
BG04	BG04-G2	Background	--	4/20/2022	20.0	0	--	No
BG04	BG04-G3	Background	--	4/20/2022	17.1	0	--	No
BG05	BG05-G1	Background	--	4/20/2022	6.0	0	--	No
BG05	BG05-G2	Background	--	4/20/2022	23.0	0	--	No
BG05	BG05-G3	Background	--	4/20/2022	18.5	0	--	No
BG06	BG06-G1	Background	--	4/20/2022	5.9	0	--	No
BG06	BG06-G2	Background	--	4/20/2022	21.0	0	--	No
BG06	BG06-G3	Background	--	4/20/2022	21.6	4	--	No
BG07	BG07-G1	Background	--	4/21/2022	1.6	0	--	No
BG07	BG07-G2	Background	--	4/21/2022	20.0	0	--	No
BG07	BG07-G3	Background	--	4/21/2022	19.1	<1	--	No
BG08	BG08-G1	Background	--	4/21/2022	0.3	0	--	No
BG08	BG08-G2	Background	--	4/21/2022	22.0	0	--	No
BG08	BG08-G3	Background	--	4/21/2022	14.0	0	--	No
BG09	BG09-G1	Background	--	4/21/2022	14.5	0	--	No
BG09	BG09-G2	Background	--	4/21/2022	1.5	0	--	No
BG09	BG09-G3	Background	--	4/21/2022	17.8	0	--	No
BG10A[c]	BG10A[c]-G1	Background	--	4/20/2022	570	2	--	No
BG10A[c]	BG10A[c]-G2	Background	--	4/20/2022	552	0	--	No
BG10A[c]	BG10A[c]-G3	Background	--	4/20/2022	588	0	--	No
BG11	BG11-G1	Background	--	4/20/2022	15.0	0	--	No
BG11	BG11-G2	Background	--	4/20/2022	9.2	0	--	No
BG11	BG11-G3	Background	--	4/20/2022	22.5	0	--	No
BG12	BG12-G1	Background	--	4/20/2022	8.8	<1	--	No
BG12	BG12-G2	Background	--	4/20/2022	7.6	0	--	No
BG12	BG12-G3	Background	--	4/20/2022	5.0	<1	--	No
BG13	BG13-G1	Background[d]	--	4/21/2022	NT	11	0-10	Yes
BG14	BG14-G1	Background[d]	--	4/27/2022	NT	4	0-3	Yes
BG14	BG14-G2	Background[d]	--	4/27/2022	NT	6.5	0-5.5	Yes
BG14	BG14-G3	Background[d]	--	4/27/2022	NT	4	0-3	Yes
BG15	BG15-G1	Background[d]	--	4/27/2022	NT	11	0-10	Yes
BG16	BG16-G1	Background[d]	--	4/27/2022	NT	17	0-10	Yes
BG17	BG17-G1	Background[d]	--	4/27/2022	NT	20	0-10	Yes
BG18	BG18-G1	Background[d]	--	4/27/2022	NT	13	0-10	Yes
BG19	BG19-G1	Background[d]	--	4/27/2022	NT	12	0-10	Yes
BG20	BG20-G1	Background[d]	--	4/29/2022	NT	10	0-10	Yes

[a] Bathymetric Survey data collected 1/12/2022, in U.S. survey feet, North American Vertical Datum of 1988 (NAVD88)

[b] X-Y Coordinates in U.S. survey feet, North American Datum 1983 Oregon State Plane North.

[c] Planned Station BG10 was too difficult to access/attempt sample and was replaced with Alternate Station BG10A

Table 2-3. Attempted and Retained Surface Grab Sample Locations and Details

BNSF Wishram Sediment Remedial Investigation Report

Station ID	Grab ID	Sample Type	Bathymetric Elevation[a] (ft)	Sample Date	from Target Location (ft)	Recovery (cm)	Sample Interval (cm)	Sampled

[d] Sample station added in field due to no recovery at planned background stations. Team observed an area on the northeast side of Miller Island where sediment appeared to be prevalent.

Notes:

< = less than

-- = no recovery or not applicable/not recorded

cm = centimeter(s)

ft = foot/feet

ID = identification

NT = No Target Location; Station was added based on the presence of sediment

NAVD88 = North American Vertical Datum 1988

U.S. = United States

Table 2-4. Attempted TarGOST Locations Summary

BNSF Wishram Sediment Remedial Investigation Report

Station	Date	Bathymetric Elevation[a] (ft)	Maximum %RE	Refusal?	Refusal Type	Bottom Depth (ft bss)
E060	11/10/2022	154.0	5.6	Yes	Hard	16.35
E120	11/10/2022	154.0	9.6	Yes	Hard	23.27
E190	11/10/2022	153.5	14.4	Yes	Hard	32.77
E520	11/10/2022	154.5	6.4	Yes	Hard	21.29
EF000	11/10/2022	154.0	3.2	Yes	Hard	11.94
EF240	11/3/2022	152.5	124	Yes	Hard	32.17
EF280	11/3/2022	153.0	42.5	Yes	Hard	36.24
EF420	11/3/2022	155.0	20.6	Yes	Hard	36.32
EF470	11/3/2022	155.0	272.1	Yes	Hard	21.27
EN060	11/15/2022	155.0	300.7	Yes	Hard	9.29
F320	11/3/2022	154.0	69.1	Yes	Gradual/Hard	37.77
F390	11/3/2022	155.0	91.8	Yes	Hard	46.87
FGN160	11/14/2022	153.3	31.6	Yes	Gradual	11.32
FN100	11/15/2022	153.0	42.8	Yes	Gradual	12.73
G000	11/2/2022	153.7	54.6	Yes	Gradual	14.08
G040	11/2/2022	153.0	84.2	Yes	Hard	9.41
G080	11/2/2022	153.0	122.5	Yes	Hard	25.76
G120	11/1/2022	152.5	139.2	No	--	19.52
G160	11/1/2022	152.0	69	No	--	29.51
G200	11/1/2022	151.5	208.6	No	--	29.52
G260	11/1/2022	151.0	130.3	No	--	30.97
G320	11/2/2022	152.5	421	No	--	29.99
G360	11/2/2022	152.0	252.6	No	--	30.00
G500	11/10/2022	142.0	2.8	Yes	Hard	10.08
GN040	11/10/2022	152.5	42.7	Yes	Hard	11.55
H460	11/10/2022	148.5	43	Yes	Hard	20.87
HN100	11/11/2022	153.0	206.8	Yes	Hard	10.67
HN200	11/14/2022	152.0	29.3	yes	Hard	7.99
HN280	11/14/2022	153.5	18.6	Yes	Hard	7.22
I120	11/6/2022	150.0	2.2	Yes	Hard	37.06
I160	11/6/2022	150.5	86.6	No	--	16.51
I200	11/2/2022	149.5	267.7	No	--	30.00
I280	11/6/2022	149.0	300.8	No	--	20.01
I360	11/7/2022	149.0	36.1	No	--	17.39
I400	11/7/2022	146.4	19.9	No	--	20.46
I500	11/11/2022	132.6	11.4	Yes	Hard	3.60
J000	11/15/2022	149.0	1.9	Yes	Gradual	11.71
J060	11/11/2022	149.0	1.7	Yes	Hard	16.46
JN040	11/11/2022	150.7	1.8	Yes	Hard	13.62
JN100	11/14/2022	151.2	9.4	Yes	Hard	15.72
JN160	11/14/2022	151.3	56.6	Yes	Hard	8.09
K160	11/11/2022	145.0	6.9	Yes	Hard	16.04
K200	11/6/2022	146.2	5.7	Yes	Hard	25.41
K280	11/6/2022	143.9	17.4	Yes	Hard	26.74
K360	11/7/2022	139.0	25.7	Yes	Hard	17.11
K400	11/7/2022	136.3	16	Yes	Hard	14.71

Table 2-4. Attempted TarGOST Locations Summary

BNSF Wishram Sediment Remedial Investigation Report

Station	Date	Bathymetric Elevation[a] (ft)	Maximum %RE	Refusal?	Refusal Type	Bottom Depth (ft bss)
K440	11/11/2022	135.5	14.4	Yes	Hard	12.58
KN220	11/14/2022	149.0	10.6	Yes	Hard	3.93
KN280	11/15/2022	149.0	11.3	Yes	Gradual	6.43
L120	11/15/2022	142.0	3.3	Yes	Gradual	12.97
L240	11/7/2022	140.0	2.9	Yes	Hard	28.14
M190	11/11/2022	137.0	1.5	Yes	Hard	10.41
M280	11/6/2022	136.0	8.8	Yes	Hard	13.61
M360	11/7/2022	137.5	69.3	Yes	Hard	13.68
M400	11/7/2022	131.8	8.3	Yes	Hard	17.32
MN100	11/15/2022	142.0	1.7	Yes	Hard	3.51
MN160	11/14/2022	143.3	5.6	Yes	Gradual	8.32
MN320	11/15/2022	145.0	--	Yes	Hard	0.00
O280	11/11/2022	134.0	4.8	Yes	Hard	15.54
ON220	11/14/2022	140.0	--	Yes	Hard	0.00

[a] Bathymetric Survey data collected 1/12/2022, in U.S. survey feet, North American Vertical Datum of 1988 (NAVD88)

Notes:

-- = no recovery or not applicable/not recorded

ft bss = feet below sediment surface

% RE = Percent of the reference emmitted

Table 2-5. Sediment Core and TarGOST Penetration Depth Comparison
BNSF Wishram Sediment Remedial Investigation Report

Station ID	Drilling Type	Attempt Number	Vegetative/ Unrecoverable Surface Material Present	Total Depth as Recorded in Field (ft from top of recovered core material)	Vertical adjustment downward (from estimated bathymetric surface)[a]	In Situ Sediment Core Penetration Depth	TarGOST Penetration Depth	Core Accepted[b]	Sampled[c]	Sediment Core Drilling Refusal Type
EF240	Vibracore	1	X	6.6	2.0	8.6	32.17	--	--	Hard
	Vibracore	2	X	7.2	2.0	9.2	32.17	--	--	Hard
	Vibracore	3	X	8.6	2.0	10.6	32.17	X	X	Hard
EF470	Geoprobe DPT	1	X	22.0	0.6	22.6	21.27	X	X	Gradual
	Geoprobe DPT	2	X	10.0	0.6	10.6	21.27	--	--	Hard
F390	Vibracore	1	X	10.0	1.5	11.5	46.87	X	X	Hard
	Vibracore	2	X	11.7	1.5	13.2	46.87	--	--	Gradual
	Vibracore	3	X	6.4	1.5	7.9	46.87	--	--	Hard
G000	Vibracore	1	X	6.7	1.8	8.5	14.08	X	X	Soft - refusal due to sand compaction
	Vibracore	2	X	6.6	1.8	8.4	14.08	--	--	Soft - refusal due to sand compaction
	Vibracore	3	X	5.4	1.8	7.2	14.08	--	--	Soft - refusal due to sand compaction
	Vibracore	4	X	7.1	1.8	8.9	14.08	X	--	Gradual
	Vibracore	5	X	5.9	1.8	7.7	14.08	--	--	Hard
	Vibracore	6	X	5.7	1.8	7.5	14.08	--	--	Hard
	Vibracore	7	X	7.3	1.8	9.1	14.08	--	--	Hard
	Vibracore	8	X	7.5	1.8	9.3	14.08	--	--	Hard
	Geoprobe DPT	9	X	13.0	1.8	14.8	14.08	X	--	Gradual
G020	Vibracore	1	X	5.3	1.8	7.1	NT	--	--	Hard
	Vibracore	2	X	6.8	1.8	8.6	NT	--	--	Gradual
	Vibracore	3	X	7.5	1.8	9.3	NT	X	X	Gradual
G200	Vibracore	1	X	7.0	1.5	8.5	29.52	X	X	Hard
	Vibracore	2	X	5.1	1.5	6.6	29.52	--	--	Hard
	Vibracore	3	X	5.6	1.5	7.1	29.52	--	--	Hard
I160	Vibracore	1	X	1.7	1.4	3.1	16.51	--	--	Hard
	Vibracore	2	X	1.5	1.4	2.9	16.51	--	--	Hard
	Vibracore	3	X	2.8	1.4	3.6	16.51	X	--	Hard
I500	Geoprobe DPT	1	--	4.9	--	2.75	3.60	X	X	Hard
J060	Geoprobe DPT	1	--	9.8	--	4.86	16.46	X	X	Hard
	Geoprobe DPT	2	--	2.1	--	9.83	16.46	X	X	Hard
K200	Vibracore	1	--	1.3	--	2.1	25.41	X	X	Hard
	Vibracore	2	--	1.3	--	1.3	25.41	--	--	Hard
	Vibracore	3	--	0.6	--	1.3	25.41	--	--	Hard
K280	Vibracore	1	--	8.7	--	0.6	26.74	--	--	Hard
	Vibracore	2	--	6.8	--	8.7	26.74	X	--	Gradual
	Vibracore	3	--	6.9	--	6.8	26.74	--	--	Gradual
K360	Geoprobe DPT	1	--	1.8	--	6.91	17.11	X	--	Hard
K400	Vibracore	1	--	1.9	--	1.8	14.71	--	--	Hard
	Vibracore	2	--	1.8	--	1.9	14.71	--	--	Hard
	Vibracore	3	--	4.5	--	1.80	14.71	--	--	Hard
KN400[d]	Geoprobe DPT	1	--	4.1	--	4.50	NT	X	X	Hard
	Geoprobe DPT	2	--	3.4	--	4.08	NT	--	--	Hard

Table 2-5. Sediment Core and TarGOST Penetration Depth Comparison

BNSF Wishram Sediment Remedial Investigation Report

Station ID	Drilling Type	Attempt Number	Vegetative/ Unrecoverable Surface Material Present	Total Depth as Recorded in Field (ft from top of recovered core material)	Vertical adjustment downward (from estimated bathymetric surface)[a]	In Situ Sediment Core Penetration Depth	TarGOST Penetration Depth	Core Accepted[b]	Sampled[c]	Sediment Core Drilling Refusal Type
O280	Geoprobe DPT	1	--	2.0	--	3.42	15.54	X	X	Hard
	Geoprobe DPT	2	--	0.0	--	2.00	15.54	--	--	Hard
SG06	Vibracore	1	--	0.0	--	0	NT	--	--	Hard
	Vibracore	2	--	0.0	--	0	NT	--	--	Hard
	Vibracore	3	--	0.0	--	0	NT	--	--	Hard

[a]Sediment core penetration depth for select locations are adjusted downward (from the estimated bathymetric surface) by approximately 0.5 to 2 feet to account for the presence of a fibrous soft vegetative mat that has been documented to be present at the sediment surface, in areas nearer to the shoreline, that could not be recovered using the DPT or Vibracore samplers.

[b]Accepted cores indicates cores with the best recovery percentage of the attempts at a location were decanted, split open longitudinally, sectioned and logged onboard the working barge and inspected by the cultural monitor. Not all accepted cores were

[c]More than one sample may have been collected from an accepted core. Accepted core sediment sampling details are provided on Table 2-6

[d] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the time of collection. Station was estimated)

Notes:

-- = Not applicable

x = selected field is applicable

NT = TarGOST not performed at this location

Table 2-6. Accepted Sediment Core Sample Summary

BNSF Wishram Sediment Remedial Investigation Report

Station ID		Drilling Type	Number of Attempts	Attempt Sampled	Sample ID	Vegetative/ Unrecoverable Surface Material Present	Vertical adjustment downward (from estimated bathymetric surface)[1]	Sample Interval as Recorded in the Field (ft from top of recovered core material) Top	Bottom	In Situ Sample Interval Top	Bottom		Date Sampled	Time Sampled	Analytical Suite TOC	TPH-diesel range	Grain Size	SVOC/ PAHs	FD	MS/MSD
		Vibracore	1-3	3	BNSF-EF240-SC-1.0-2.0-111022	X	2.0	1.0	2.0	3.0	4.0		11/10/2022	12:10	X	X	X	X	X	--
EF240		Vibracore	1-3	3	BNSF-EF240-SC-3.0-4.0-111022	X	2.0	3.0	4.0	5.0	6.0		11/10/2022	12:20	X	X	X	X	--	--
EF470		Geoprobe DPT	1	1	BNSF-EF470-SC-11.0-12.0-110922	X	0.6	11.0	12.0	11.6	12.6		11/9/2022	14:20	--	X	--	X	--	--
F390		Vibracore	1-3	1	BNSF-F390-SC-6.2-7.2-110722	X	1.5	6.2	7.2	8.7	9.7		11/7/2022	10:30	X	X	X	X	--	--
		Vibracore	1-3	1	BNSF-G000-SC-1.5-2.5-110322	X	1.8	1.5	2.5	3.3	4.3		11/3/2022	13:50	X	X	X	X	--	X
G000		Vibracore	1-3	1	BNSF-G000-SC-4.0-5.0-110322	X	1.8	4.0	5.0	5.8	6.8		11/3/2022	14:10	X	X	X	X	--	--
G020		Vibracore	1-3	3	BNSF-G020-SC-0.0-1.0-110422	X	1.8	0.0	1.0	1.8	2.8		11/4/2022	10:20	X	X	X	X	--	--
G200		Vibracore	1-3	1	BNSF-G200-SC-4.0-5.0-110722	X	1.5	4.0	5.0	5.5	6.5		11/7/2022	14:00	--	X	--	--	--	--
I500		Geoprobe DPT	1	1	BNSF-I500-SC-0.0-0.8-111322	--	--	0.0	0.8	0.0	0.8	[1]	11/13/2022	11:40	--	X	--	X	--	--
		Geoprobe DPT	1	1	BNSF-J060-SC-0.5-1.5-111422	--	--	0.5	1.5	0.5	1.5	[1]	11/14/2022	10:20	--	X	--	X	--	--
J060		Geoprobe DPT	2	1	BNSF-J060-SC-8.5-9.5-111422	--	--	8.5	9.5	8.5	9.5		11/14/2022	10:30	X	X	--	X	--	--
K200		Vibracore	1-3	1	BNSF-K200-SC-0.0-0.4-110922	--	--	0.0	0.4	0.0	0.4		11/9/2022	12:35	X	X	--	X	--	--
KN400	[2]	Geoprobe DPT	1	1	BNSF-HN300-SC-1.0-2.0-111322	--	--	1.0	2.0	1.0	2.0	[1]	11/13/2022	15:00	--	X	--	X	--	--
O280		Geoprobe DPT	1	1	BNSF-O280-SC-0.0-0.7-111322	--	--	0.0	0.7	0.0	0.7	[1]	11/13/2022	11:50	--	X	--	X	--	--

[1]Sediment core penetration depth for these locations are adjusted downward (from the estimated bathymetric surface) by approximately 0.5 to 2 feet to account for the presence of a fibrous soft vegetative mat that has been documented to be present at the sediment surface, in areas nearer to the shoreline, that could not be recovered using the DPT or Vibracore samplers.

[1] Low percent recovery. Cannot confidently correlate material to a distinct interval. Core was logged and sampled as recovered

[2] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the time of collection. Station was estimated)

Notes:

-- = no recovery or not applicable/not recorded

bss = below sediment surface

DPT = Direct Push Technology

FD = field duplicate

ft = feet

ID = identification

MS/MSD = matrix spike, matrix spike duplicate

NA = not applicable

PAHs = polyaromatic hydrocarbons

SVOCs = semi-volatile organic compounds

TOC = total organic carbon

TPH = total petroleum hydrocarbon

Table 2-6. Accepted Sediment Core Sample Summary
BNSF Wishram Sediment Remedial Investigation Report

Station ID	Notes
EF240	FD collected @ 12:15
EF470	No recovery 0-7.75. Low volume for sample collection. Only able to collect 1.5 4 oz. jars
F390	
G000	MS/MSD does not include grainsize
G020	
G200	Archived upon collection and later run for TPH-diesel range. Collected sample suite from bottom interval only. Core is impacted. low recovery - other attempts had 0% rec out of very shallow penetration (max 2.1 ft bss). submitted sample incase there was need to evaluate NAPL for that location - TarGOST had "diesel" like %RE not seen at many of the other locs
I500	low volume due to smaller diameter core barrel
J060	low volume due to smaller diameter core barrel
	low volume due to smaller diameter core barrel
K200	low volume due NAPL impact near top of core
KN400	low volume due to smaller diameter core barrel
O280	low volume due to smaller diameter core barrel

[1]Sediment core penetration depth for these locations are adjusted downward (from the estimated bathymetric surface) by approximately 0.5 to 2 feet to account for the presence of a fibrous soft vegetative mat that has been documented to be present at the sediment surface, in areas nearer to the shoreline, that could not be recovered using the DPT or Vibracore samplers.

[1] Low percent recovery. Cannot confidently correlate material to a distinct interval. Core was logged and sampled as recovered

[2] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the time of collection. Station was estimated)

Notes:

-- = no recovery or not applicable/not recorded

bss = below sediment surface

DPT = Direct Push Technology

FD = field duplicate

ft = feet

ID = identification

MS/MSD = matrix spike, matrix spike duplicate

NA = not applicable

PAHs = polyaromatic hydrocarbons

SVOCs = semi-volatile organic compounds

TOC = total organic carbon

TPH = total petroleum hydrocarbon

Table 3-1. Step 1 Polychlorinated Biphenyl Dioxin-Like Congeners Results

BNSF Wishram Sediment Remedial Investigation Report

		Location ID	BG13	BG14	BG15	BG16	BG17	BG17	BG18	BG19	BG20	D160	E320
		Sample ID	BNSF-BG13-042122-0-10	BNSF-BG14-042722-0-5.5	BNSF-BG15-042722-0-10	BNSF-BG16-042722-0-10	BNSF-BG17-042722-0-10	FD02-042722-0-10	BNSF-BG18-042722-0-10	BNSF-BG19-042722-0-10	BNSF-BG20-042922-0-10	BNSF-D160-042822-0-5	BNSF-E320-042822-0-4
		Sample Type	N	N	N	N	N	FD	N	N	N	N	N
		Sample Depths (cm)	0 - 10	0 - 5	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 5	0 - 4
		Sample Date	4/21/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/29/2022	4/28/2022	4/28/2022
Analyte	Method	Units											
PCB-105	E1668C	ng/kg	**2.95 J**	2.82 U	**10.7 J**	2.84 U	2.84 U	2.83 U	2.85 U	2.85 U	**4.5 J**	**9.22 J**	**12.5 J**
PCB-114	E1668C	ng/kg	0.621 U	0.627 U	0.651 U	0.631 U	0.632 U	0.63 U	0.634 U	0.634 U	0.627 UJ	**0.887 J**	**0.802 J**
PCB-118	E1668C	ng/kg	**5.98 J**	5.27 U	**25.4**	**6.37 J**	5.31 U	5.3 U	5.33 U	5.33 U	**8.56 J**	**28.9 J**	**26.6 J**
PCB-123	E1668C	ng/kg	0.578 U	0.584 U	0.607 U	0.588 U	0.588 U	0.587 U	0.591 U	0.591 U	0.584 UJ	0.609 UJ	**0.97 J**
PCB-126	E1668C	ng/kg	0.321 U	0.325 U	0.337 U	0.327 U	0.327 U	0.326 U	0.329 U	0.329 U	0.325 UJ	0.339 UJ	0.33 UJ
PCB-167	E1668C	ng/kg	1.23 U	1.24 U	**2.04 J**	1.25 U	1.25 U	1.25 U	1.26 U	1.26 U	1.24 UJ	1.3 UJ	**1.7 J**
PCB-169	E1668C	ng/kg	0.309 U	0.312 U	0.324 U	0.314 U	0.314 U	0.313 U	0.316 U	0.316 U	0.312 UJ	0.326 UJ	0.317 UJ
PCB-189	E1668C	ng/kg	0.732 U	0.739 U	0.768 U	0.744 U	0.745 U	0.743 U	0.748 U	0.748 U	0.739 UJ	0.772 UJ	0.752 UJ
PCB-77	E1668C	ng/kg	2.07 U	2.09 U	2.17 U	**2.31 J**	2.1 U	2.1 U	2.11 U	2.11 U	**2.88 J**	**2.54 J**	**3.56 J**
PCB-81	E1668C	ng/kg	0.457 U	0.461 U	0.48 U	0.465 U	0.465 U	0.464 U	0.467 U	0.467 U	0.462 UJ	0.482 UJ	0.469 UJ
2,3,3',4,4',5'-Hexachlorobiphenyl	E1668C	ng/kg	0.81 U	0.818 U	0.85 U	0.824 U	0.825 U	0.822 U	0.828 U	0.828 U	0.819 UJ	0.854 UJ	0.832 UJ
2,3,3',4,4',5-Hexachlorobiphenyl	E1668C	ng/kg	1.9 U	1.92 U	**2.13 J**	1.93 U	1.93 U	1.93 U	1.94 U	1.94 U	1.92 UJ	**2.58 J**	**3.54 J**

Notes:
Bold font = detected result
cm = centimeter(s)
FD = field duplicate
ft = feet
ID = identification
N = normal (parent) sample
ng/kg = nanogram(s) per kilogram

Qualifier Definitions:
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-1. Step 1 Polychlorinated Biphenyl Dioxin-Like Congeners Re

BNSF Wishram Sediment Remedial Investigation Report

		Location ID	E380	E460	H360	I120	L320	SG01	SG01	SG02	SG03	SG11	SG13	SG23
		Sample ID	BNSF-E380-042822-0-4	BNSF-E460-042922-0-4	BNSF-H360-042922-0-8	BNSF-I120-042922-0-6	BNSF-L320-042922-0-2	BNSF-SG01-041922-0-10	FD01-041922-0-10	BNSF-SG02-041922-0-10	BNSF-SG03-042722-0-5.5	BNSF-SG11-042822-0-5	BNSF-SG13-042522-0-1.5	BNSF-SG23-042122-0-6
		Sample Type	N	N	N	N	N	N	FD	N	N	N	N	N
		Sample Depths (cm)	0 - 4	0 - 4	0 - 8	0 - 6	0 - 2	0 - 10	0 - 10	0 - 10	0 - 5	0 - 5	0 - 1.5	0 - 6
		Sample Date	4/28/2022	4/29/2022	4/29/2022	4/29/2022	4/29/2022	4/19/2022	4/19/2022	4/19/2022	4/27/2022	4/28/2022	4/25/2022	4/21/2022
Analyte	Method	Units												
PCB-105	E1668C	ng/kg	2.44 UJ	**5.83 J**	**14 J**	**5.77 J**	3.24 UJ	**4.32 J**	**4.56 J**	**23.2 J**	**2.85 J**	**3.51 J**	**3.15 J**	**6.8 J**
PCB-114	E1668C	ng/kg	0.543 UJ	0.771 UJ	**1.77 J**	0.746 UJ	0.721 UJ	0.626 U	0.62 U	**1.19 J**	0.629 U	0.671 UJ	0.626 U	**0.724 J**
PCB-118	E1668C	ng/kg	**4.95 J**	**11.6 J**	**40.1 J**	**12.2 J**	**8.39 J**	**10 J**	**9.96 J**	**51.8**	**7.01 J**	**8.87 J**	**6.45 J**	**16.6 J**
PCB-123	E1668C	ng/kg	0.506 UJ	0.718 UJ	**1.38 J**	0.695 UJ	**0.792 J**	0.583 U	**0.607 J**	**1.54 J**	0.586 U	0.625 UJ	0.583 U	0.58 U
PCB-126	E1668C	ng/kg	0.281 UJ	0.399 UJ	0.367 UJ	0.386 UJ	0.373 UJ	0.324 U	0.321 U	**0.387 J**	0.326 U	0.347 UJ	0.324 U	0.322 U
PCB-167	E1668C	ng/kg	1.08 UJ	1.53 UJ	**2.26 J**	1.48 UJ	1.43 UJ	1.24 U	1.23 U	**3.97 J**	1.25 U	1.33 UJ	1.24 U	**1.39 J**
PCB-169	E1668C	ng/kg	0.27 UJ	0.384 UJ	0.353 UJ	0.371 UJ	0.359 UJ	0.311 U	0.309 U	0.311 U	0.313 U	0.334 UJ	0.312 U	0.31 U
PCB-189	E1668C	ng/kg	0.641 UJ	0.909 UJ	0.836 UJ	0.88 UJ	0.85 UJ	0.738 U	0.732 U	0.737 U	0.742 U	0.791 UJ	0.739 U	0.734 U
PCB-77	E1668C	ng/kg	1.81 UJ	**3.28 J**	**3.71 J**	2.48 UJ	2.4 UJ	2.08 U	**2.21 J**	**4.71 J**	2.1 U	2.23 UJ	2.09 U	**3.56 J**
PCB-81	E1668C	ng/kg	0.4 UJ	0.568 UJ	0.522 UJ	0.549 UJ	0.531 UJ	0.461 U	0.457 U	0.46 U	0.463 U	0.494 UJ	0.461 U	0.458 U
2,3,3',4,4',5'-Hexachlorobiphenyl	E1668C	ng/kg	0.709 UJ	1.01 UJ	**1.33 J**	0.974 UJ	0.942 UJ	0.817 U	0.81 U	**1.72 J**	0.822 U	0.876 UJ	0.818 U	0.813 U
2,3,3',4,4',5-Hexachlorobiphenyl	E1668C	ng/kg	1.66 UJ	2.36 UJ	**4.77 J**	2.28 UJ	2.2 UJ	1.91 U	1.9 U	**6.03**	1.92 U	2.05 UJ	1.91 U	1.9 U

Notes:
Bold font = detected result
cm = centimeter(s)
FD = field duplicate
ft = feet
ID = identification
N = normal (parent) sample
ng/kg = nanogram(s) per kilogram

Qualifier Definitions:
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported dete
approximate and may or may not represent the actual limit of quantitation necessary to
and precisely measure the analyte in the sample.

Table 3-2. Step 1 Ammonia, Sulfide, and Metals Results BNSF Wishram Sediment Remedial Investigation Report				Location ID	BG13	BG14	BG15	BG16	BG17	BG17	BG18	BG19	BG20
				Sample ID	BNSF-BG13-042122-0-10	BNSF-BG14-042722-0-5.5	BNSF-BG15-042722-0-10	BNSF-BG16-042722-0-10	BNSF-BG17-042722-0-10	FD02-042722-0-10	BNSF-BG18-042722-0-10	BNSF-BG19-042722-0-10	BNSF-BG20-042922-0-10
				Sample Type	N	N	N	N	N	FD	N	N	N
				Sample Depths (cm)	0 - 10	0 - 5	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10
				Sample Date	4/21/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/29/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL									
Ammonia, as Nitrogen	E350.1	mg/kg	230	300	12 U	**32 J**	**22**	11 U	**67**	**72**	**56**	11 U	**30 B**
Sulfide	SW9030B	mg/kg	39	61	39.7 U	**167**	42.4 U	39 U	51.6 U	54.8 U	**76.4 J**	38.9 U	**179 J**
Metals													
Arsenic	SW6020B	mg/kg	14	120	0.16 U	**3.3**	**0.18 J**	**0.16 J**	**0.41 J**	**0.53 J**	**0.54 J**	**2.5**	**2.6**
Cadmium	SW6020B	mg/kg	2.1	5.4	0.046 U	**0.52**	0.047 U	0.042 U	0.059 U	0.062 U	0.054 U	**0.11**	**0.29**
Chromium	SW6020B	mg/kg	72	88	0.2 U	**14.2**	**2.1 J**	**2.3 J**	**3.9**	**4.8**	**5.2**	**8.5**	**15.7**
Copper	SW6020B	mg/kg	400	1200	**1.6**	**16.2**	**5.7**	**6**	**8.4**	**10.3**	**8.3**	**7**	**12.7**
Lead	SW6020B	mg/kg	360	1300	**0.092 B**	**8.6**	**0.32 J**	**0.26 J**	**0.59 J**	**0.73 J**	**0.98**	**3.6**	**5.9**
Mercury	SW7471B	mg/kg	0.66	0.8	0.012 U	**0.025 J**	0.012 U	0.012 U	**0.058**	0.016 U	0.015 U	0.011 U	**0.012 J**
Nickel	SW6020B	mg/kg	26	110	0.29 U	**15.3**	**1.9**	**2.3**	**2.8**	**3.5**	**3.6**	**9.5**	**15**
Selenium	SW6020B	mg/kg	11	20	0.12 U	**0.45 J**	0.13 U	0.12 U	0.16 U	**0.2 J**	**0.18 J**	**0.12 J**	**0.31 J**
Silver	SW6020B	mg/kg	0.57	1.7	0.21 UJ	**0.41 J**	0.22 U	0.19 U	0.27 U	0.28 U	0.25 U	0.19 U	0.22 U
Zinc	SW6020B	mg/kg	3200	4200	**2 J**	**106**	**6.9 J**	**7.1**	**9.4**	**12**	**13.6**	**52.3**	**81.6**

Notes:
Bold font = detected result
Bold font and gray-shaded cell = detected result greater than dry weight SCO
cm = centimeter(s)
CSL = Cleanup Screening Level
FD = field duplicate
ID = identification
mg/kg = milligram(s) per kilogram
N = normal (parent) sample
SCO = Sediment Cleanup Objective

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-2. Step 1 Ammonia, Sulfide, and Metals Results BNSF Wishram Sediment Remedial Investigation Report				Location ID	D160	E320	E380	E460	H360	I120	L320	SG01	SG01	SG02
				Sample ID	BNSF-D160-042822-0-5	BNSF-E320-042822-0-4	BNSF-E380-042822-0-4	BNSF-E460-042922-0-4	BNSF-H360-042922-0-8	BNSF-I120-042922-0-6	BNSF-L320-042922-0-2	BNSF-SG01-041922-0-10	FD01-041922-0-10	BNSF-SG02-041922-0-10
				Sample Type	N	N	N	N	N	N	N	N	FD	N
				Sample Depths (cm)	0 - 5	0 - 4	0 - 4	0 - 4	0 - 8	0 - 6	0 - 2	0 - 10	0 - 10	0 - 10
				Sample Date	4/28/2022	4/28/2022	4/28/2022	4/29/2022	4/29/2022	4/29/2022	4/29/2022	4/19/2022	4/19/2022	4/19/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL										
Ammonia, as Nitrogen	E350.1	mg/kg	230	300	**20 B**	**17 J**	**20 B**	**30 B**	**20 B**	**20 B**	**10 B**	11 U	**15 J**	**40 J**
Sulfide	SW9030B	mg/kg	39	61	**220 J**	**318 J**	39.8 UJ	**101 J**	38.6 UJ	**51.7 J**	37.4 UJ	40.6 UJ	40.6 UJ	59.5 UJ
Metals														
Arsenic	SW6020B	mg/kg	14	120	**2.7**	**2.1**	**2.2**	**2.6**	**4.7**	**2.9**	**2.6**	**2.1**	**2**	**3.8**
Cadmium	SW6020B	mg/kg	2.1	5.4	**0.64**	**0.47**	**0.36**	**0.35**	**0.35**	**0.27**	**0.18**	**0.43**	**0.43**	**0.53**
Chromium	SW6020B	mg/kg	72	88	**15.7**	**14.7**	**15.1**	**16.1**	**17.2**	**15.6**	**12**	**13.8**	**14**	**17.3**
Copper	SW6020B	mg/kg	400	1200	**15.8**	**12 J**	**10.9**	**14.5**	**18.3**	**12.3**	**11.9**	**9.9**	**10.7**	**19.5**
Lead	SW6020B	mg/kg	360	1300	**8.9**	**8.6**	**6.9**	**8.6**	**14.3**	**8.3**	**8.2**	**7**	**7.4**	**12.3**
Mercury	SW7471B	mg/kg	0.66	0.8	**0.027**	**0.024 J**	**0.016 J**	**0.021 J**	**0.017 J**	**0.016 J**	**0.016 J**	**0.021 J**	**0.022 J**	**0.035 J**
Nickel	SW6020B	mg/kg	26	110	**13.9**	**14.6**	**13.4**	**14.8**	**16.2**	**15.3**	**13.5**	**12.5**	**13**	**16.8**
Selenium	SW6020B	mg/kg	11	20	**0.34 J**	**0.29**	**0.22 J**	**0.31**	**0.27 J**	**0.24 J**	**0.22 J**	**0.18 J**	**0.14 J**	**0.47 J**
Silver	SW6020B	mg/kg	0.57	1.7	0.19 U	0.18 U	0.19 U	0.21 U	0.21 U	0.22 U	**0.4 J**	**0.27 J**	0.2 U	0.3 U
Zinc	SW6020B	mg/kg	3200	4200	**102**	**95.9**	**85.9**	**99.2**	**107**	**90.6**	**69**	**94.9**	**100**	**120**

Notes:
Bold font = detected result
Bold font and gray-shaded cell = detected result greater than dry weight SCO
cm = centimeter(s)
CSL = Cleanup Screening Level
FD = field duplicate
ID = identification
mg/kg = milligram(s) per kilogram
N = normal (parent) sample
SCO = Sediment Cleanup Objective

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-2. Step 1 Ammonia, Sulfide, and Metals Results BNSF Wishram Sediment Remedial Investigation Report				Location ID	SG03	SG11	SG13	SG23
				Sample ID	BNSF-SG03-042722-0-5.5	BNSF-SG11-042822-0-5	BNSF-SG13-042522-0-1.5	BNSF-SG23-042122-0-6
				Sample Type	N	N	N	N
				Sample Depths (cm)	0 - 5	0 - 5	0 - 1.5	0 - 6
				Sample Date	4/27/2022	4/28/2022	4/25/2022	4/21/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL				
Ammonia, as Nitrogen	E350.1	mg/kg	230	300	**14 J**	**20 B**	**12 J**	**24 J**
Sulfide	SW9030B	mg/kg	39	61	39.7 U	39 UJ	37.8 U	37.9 U
Metals								
Arsenic	SW6020B	mg/kg	14	120	**3.4**	**2.6**	**2.1**	**2.4**
Cadmium	SW6020B	mg/kg	2.1	5.4	**0.28**	**0.28**	**0.089 J**	**0.17**
Chromium	SW6020B	mg/kg	72	88	**12.9**	**14.6**	**8.2**	**9.9**
Copper	SW6020B	mg/kg	400	1200	**18.9**	**12.2**	**7.7**	**9**
Lead	SW6020B	mg/kg	360	1300	**8.8**	**7.4**	**3.6 J**	**5.2**
Mercury	SW7471B	mg/kg	0.66	0.8	**0.028**	**0.013 J**	0.011 U	0.011 U
Nickel	SW6020B	mg/kg	26	110	**15.3**	**14.8**	**9.3**	**11.1**
Selenium	SW6020B	mg/kg	11	20	**0.21 J**	**0.25 J**	0.11 U	**0.12 J**
Silver	SW6020B	mg/kg	0.57	1.7	0.2 U	**0.41 J**	**0.26 J**	**0.22 J**
Zinc	SW6020B	mg/kg	3200	4200	**60.2**	**83.2**	**32.3**	**65.3**

Notes:
Bold font = detected result
Bold font and gray-shaded cell = detected result greater than dry weight SCO
cm = centimeter(s)
CSL = Cleanup Screening Level
FD = field duplicate
ID = identification
mg/kg = milligram(s) per kilogram
N = normal (parent) sample
SCO = Sediment Cleanup Objective

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-3. Step 1 Semi-Volatile Organic Carbons and Bulk Petroleum Hydrocarbon Results

BNSF Wishram Sediment Remedial Investigation Report

				Location ID	BG13	BG14	BG15	BG16	BG17	BG17	BG18	BG19	BG20	D160	E320	E380
				Sample ID	BNSF-BG13-042122-0-10	BNSF-BG14-042722-0-5.5	BNSF-BG15-042722-0-10	BNSF-BG16-042722-0-10	BNSF-BG17-042722-0-10	FD02-042722-0-10	BNSF-BG18-042722-0-10	BNSF-BG19-042722-0-10	BNSF-BG20-042922-0-10	BNSF-D160-042822-0-5	BNSF-E320-042822-0-4	BNSF-E380-042822-0-4
				Sample Type	N	N	N	N	N	FD	N	N	N	N	N	N
				Sample Depths (cm)	0 - 10	0 - 5	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 5	0 - 4	0 - 4
				Sample Date	4/21/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/29/2022	4/28/2022	4/28/2022	4/28/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL												
Semi-Volatile Organic Carbons																
1-Methylnaphthalene	SW8270E	mg/kg	--	--	0.0113 U	0.00678 U	0.00603 U	0.00554 U	0.00733 U	0.00779 U	0.00723 U	0.0276 U	0.0121 UJ	0.0603 UJ	0.059 UJ	0.00565 UJ
2-Methylnaphthalene	SW8270E	mg/kg	--	--	0.0114 U	0.00688 U	0.00611 U	0.00561 U	0.00744 U	0.00789 U	0.00733 U	0.028 U	0.0123 UJ	0.0611 UJ	0.0599 UJ	**0.00894 J**
3 & 4-Methylphenol (m,p-Cresols)	SW8270E	mg/kg	0.26	2	0.0275 U	0.0166 U	**0.0455 J**	0.0135 U	**0.127 J**	**0.387 J**	0.0177 U	0.0675 U	0.0296 UJ	0.147 UJ	0.144 UJ	0.0138 UJ
Acenaphthene	SW8270E	mg/kg	--	--	0.0143 U	0.00858 U	0.00762 U	0.007 U	0.00928 U	0.00985 U	0.00915 U	0.0349 U	0.0154 UJ	0.0762 UJ	0.0747 UJ	0.00715 UJ
Acenaphthylene	SW8270E	mg/kg	--	--	0.0124 U	0.00747 U	0.00663 U	0.00609 U	0.00807 U	0.00857 U	0.00796 U	0.0304 U	0.0133 UJ	0.0663 UJ	0.065 UJ	0.00622 UJ
Anthracene	SW8270E	mg/kg	--	--	0.0157 U	0.00944 U	0.00839 U	0.00771 U	0.0102 U	0.0108 U	0.0101 U	0.0385 U	0.0169 UJ	0.0839 UJ	0.0822 UJ	0.00786 UJ
Benzo(a)anthracene	SW8270E	mg/kg	--	--	0.0155 U	0.00935 U	0.0083 U	0.00763 U	0.0101 U	0.0107 U	0.00997 U	0.038 U	0.0166 UJ	0.083 UJ	0.0813 UJ	0.00779 UJ
Benzo(a)pyrene	SW8270E	mg/kg	--	--	0.0164 U	0.00986 U	0.00876 U	0.00804 U	0.0107 U	0.0113 U	0.0105 U	0.0401 U	0.0176 UJ	0.0876 UJ	**0.103 J**	0.00821 UJ
Benzo(b)fluoranthene	SW8270E	mg/kg	--	--	0.0164 U	0.00989 U	0.00878 U	0.00807 U	0.0107 U	0.0113 U	0.0105 U	0.0404 U	0.0176 UJ	0.0878 UJ	0.086 UJ	0.00824 UJ
Benzo(g,h,i)perylene	SW8270E	mg/kg	--	--	0.0161 U	0.0097 U	0.00861 U	0.00791 U	0.0105 U	0.0111 U	0.0103 U	0.0396 U	0.0173 UJ	0.0861 UJ	0.0844 UJ	0.00808 UJ
Benzo(k)fluoranthene	SW8270E	mg/kg	--	--	0.0156 U	0.00943 U	0.00837 U	0.00769 U	0.0102 U	0.0108 U	0.0101 U	0.0384 U	0.0168 UJ	0.0837 UJ	0.082 UJ	0.00785 UJ
Benzoic Acid	SW8270E	mg/kg	2.9	3.8	0.312 U	0.188 U	0.167 U	0.153 U	0.203 U	**0.327 J**	0.2 U	0.766 U	0.335 UJ	1.67 UJ	1.63 UJ	0.157 UJ
Bis (2-ethylhexyl) phthalate	SW8270E	mg/kg	0.5	22	0.112 U	0.0672 U	0.0597 U	0.0548 U	0.0726 U	0.0771 U	0.0716 U	0.274 U	0.12 UJ	0.597 UJ	0.585 UJ	0.056 UJ
Carbazole	SW8270E	mg/kg	0.9	1.1	0.0272 U	0.0164 U	0.0146 U	0.0134 U	0.0177 U	0.0188 U	0.0175 U	0.0668 U	0.0293 UJ	0.146 UJ	0.143 UJ	0.0137 UJ
Chrysene	SW8270E	mg/kg	--	--	0.0175 U	0.0105 U	0.00936 U	0.0086 U	0.0114 U	0.0121 U	0.0112 U	0.043 U	0.0188 UJ	0.0936 UJ	0.0917 UJ	0.00878 UJ
Dibenzo(a,h)anthracene	SW8270E	mg/kg	--	--	0.0245 U	0.0147 U	0.0131 U	0.012 U	0.0159 U	0.0169 U	0.0157 U	0.06 U	0.0263 UJ	0.131 UJ	0.128 UJ	0.0122 UJ
Dibenzofuran	SW8270E	mg/kg	0.2	0.68	0.0288 U	0.0174 U	0.0154 U	0.0142 U	0.0188 U	0.0199 U	0.0185 U	0.0707 U	0.031 UJ	0.154 UJ	0.151 UJ	0.0145 UJ
Di-N-Butylphthalate	SW8270E	mg/kg	0.38	1	0.0302 U	0.0182 U	0.0161 U	0.0148 U	0.0196 U	0.0208 U	0.0194 U	0.074 U	0.0324 UJ	0.161 UJ	0.158 UJ	0.0151 UJ
Di-n-octyl phthalate	SW8270E	mg/kg	0.039	1.1	0.0595 U	0.0358 U	0.0318 U	0.0292 U	0.0387 U	0.0411 U	0.0382 U	0.147 U	0.064 UJ	0.318 UJ	0.312 UJ	0.0298 UJ
Fluoranthene	SW8270E	mg/kg	--	--	0.0159 U	0.00957 U	0.0085 U	0.00781 U	0.0103 U	0.011 U	0.0102 U	0.0391 U	0.0171 UJ	0.085 UJ	0.0833 UJ	0.00797 UJ
Fluorene	SW8270E	mg/kg	--	--	0.0143 U	0.00863 U	0.00767 U	0.00704 U	0.00933 U	0.00991 U	0.0092 U	0.0352 U	0.0154 UJ	0.0767 UJ	0.0751 UJ	0.00719 UJ
Indeno(1,2,3-cd)pyrene	SW8270E	mg/kg	--	--	0.0249 U	0.015 U	0.0133 U	0.0122 U	0.0162 U	0.0172 U	0.016 U	0.0611 U	0.0267 UJ	0.133 UJ	0.13 UJ	0.0125 UJ
Naphthalene	SW8270E	mg/kg	--	--	0.0221 U	0.0133 U	0.0118 U	0.0109 U	0.0144 U	0.0153 U	0.0142 U	0.0543 U	0.0237 UJ	0.118 UJ	0.116 UJ	0.0111 UJ
Pentachlorophenol	SW8270E	mg/kg	1.2	1.2	0.0237 U	0.0143 U	0.0127 U	0.0116 U	0.0154 U	0.0164 U	0.0152 U	0.0581 U	0.0254 UJ	0.127 UJ	0.124 UJ	0.0119 UJ
Phenanthrene	SW8270E	mg/kg	--	--	0.0175 U	0.0105 U	0.00935 U	0.00859 U	0.0114 U	0.0121 U	0.0112 U	0.043 U	0.0188 UJ	0.0935 UJ	0.0916 UJ	0.00877 UJ
Phenol	SW8270E	mg/kg	0.12	0.21	0.0354 U	0.0213 U	0.019 U	0.0174 U	0.0231 U	**0.0534 J**	0.0227 U	0.087 U	0.0381 UJ	0.19 UJ	0.186 UJ	0.0178 UJ
Pyrene	SW8270E	mg/kg	--	--	0.0172 U	0.0103 U	0.00917 U	0.00842 U	0.0112 U	0.0118 U	0.011 U	0.0421 U	0.0185 UJ	0.0917 UJ	**0.184 J**	0.00859 UJ
Total PAHs (calculated)	SW8270E	mg/kg	17	30	0.0249 U	0.015 U	0.0133 U	0.0122 U	0.0162 U	0.0172 U	0.016 U	0.0611 U	0.0267 U	0.133 U	**0.287**	**0.00894**
Bulk Petroleum Hydrocarbons																
TPH-Diesel Range	NWTPH-Dx	mg/kg	340	510	**15.8 J**	**19.5 J**	**34.2**	9.2 U	**64.4**	**52**	**20.6 J**	**10.5 J**	10.2 UJ	**52.1 J**	**223 J**	9.7 UJ
TPH as Motor Oil	NWTPH-Dx	mg/kg	3600	4400	**36.9 B**	**60**	**174**	**18**	**363**	**273**	**179**	**30.6**	**31.6 J**	**215 J**	**630 J**	**25.1 J**

Notes:
Bold font = detected result
Bold font and gray-shaded cell = detected result greater than dry weight SCO
cm = centimeter(s)
CSL = Cleanup Screening Level
FD = field duplicate
ID = identification
mg/kg = milligram(s) per kilogram
N = normal (parent) sample
PAH =Polycyclic Aromatic Hydrocarbons
SCO = Sediment Cleanup Objective
TPH = total petroleum hydrocarbons

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-3. Step 1 Semi-Volatile Organic Carbons and Bulk Petroleum Hydrocarbon Results

BNSF Wishram Sediment Remedial Investigation Report

				Location ID	E460	H360	I120	L320	SG01	SG01	SG02	SG03	SG11	SG13	SG23
				Sample ID	BNSF-E460-042922-0-4	BNSF-H360-042922-0-8	BNSF-I120-042922-0-6	BNSF-L320-042922-0-2	BNSF-SG01-041922-0-10	FD01-041922-0-10	BNSF-SG02-041922-0-10	BNSF-SG03-042722-0-5.5	BNSF-SG11-042822-0-5	BNSF-SG13-042522-0-1.5	BNSF-SG23-042122-0-6
				Sample Type	N	N	N	N	N	FD	N	N	N	N	N
				Sample Depths (cm)	0 - 4	0 - 8	0 - 6	0 - 2	0 - 10	0 - 10	0 - 10	0 - 5	0 - 5	0 - 1.5	0 - 6
				Sample Date	4/29/2022	4/29/2022	4/29/2022	4/29/2022	4/19/2022	4/19/2022	4/19/2022	4/27/2022	4/28/2022	4/25/2022	4/21/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL											
Semi-Volatile Organic Carbons															
1-Methylnaphthalene	SW8270E	mg/kg	--	--	0.0599 UJ	0.00549 UJ	0.0057 UJ	0.0106 UJ	0.0115 U	0.00577 U	0.0169 U	**0.0064 J**	**0.00623 J**	0.00536 U	0.00538 U
2-Methylnaphthalene	SW8270E	mg/kg	--	--	0.0607 UJ	0.00556 UJ	**0.00706 J**	0.0108 UJ	0.0117 U	0.00585 U	0.0171 U	**0.00871 J**	**0.00945 J**	0.00544 U	0.00546 U
3 & 4-Methylphenol (m,p-Cresols)	SW8270E	mg/kg	0.26	2	0.146 UJ	0.0134 UJ	0.0139 UJ	0.0259 UJ	0.0281 U	0.0141 U	0.0413 U	0.0138 U	0.0135 UJ	0.0131 U	**0.0195 J**
Acenaphthene	SW8270E	mg/kg	--	--	0.0758 UJ	0.00694 UJ	0.00721 UJ	0.0135 UJ	0.0146 U	0.0073 U	0.0214 U	**0.0604**	0.007 UJ	0.00679 U	0.00681 U
Acenaphthylene	SW8270E	mg/kg	--	--	0.0659 UJ	0.00604 UJ	0.00627 UJ	0.0117 UJ	0.0127 U	0.00635 U	0.0186 U	0.00621 U	0.00609 UJ	0.0059 U	0.00593 U
Anthracene	SW8270E	mg/kg	--	--	0.0834 UJ	0.00764 UJ	0.00793 UJ	0.0148 UJ	0.0161 U	0.00803 U	0.0236 U	**0.126**	0.0077 UJ	0.00746 U	0.00749 U
Benzo(a)anthracene	SW8270E	mg/kg	--	--	0.0825 UJ	0.00756 UJ	0.00785 UJ	0.0146 UJ	0.0158 U	0.00795 U	0.0232 U	**0.384**	0.00762 UJ	0.00739 U	0.00742 U
Benzo(a)pyrene	SW8270E	mg/kg	--	--	0.087 UJ	0.00797 UJ	0.00828 UJ	0.0155 UJ	**0.0185 J**	0.00838 U	0.0246 U	**0.434**	0.00804 UJ	0.00779 U	0.00782 U
Benzo(b)fluoranthene	SW8270E	mg/kg	--	--	0.0873 UJ	0.008 UJ	0.00831 UJ	0.0155 UJ	0.0168 U	0.00841 U	0.0246 U	**0.463**	0.00806 UJ	0.00782 U	0.00785 U
Benzo(g,h,i)perylene	SW8270E	mg/kg	--	--	0.0856 UJ	0.00784 UJ	0.00815 UJ	0.0152 UJ	**0.0187 J**	0.00825 U	0.0242 U	**0.236**	0.00791 UJ	0.00767 U	0.0077 U
Benzo(k)fluoranthene	SW8270E	mg/kg	--	--	0.0832 UJ	0.00762 UJ	0.00792 UJ	0.0147 UJ	0.016 U	0.00802 U	0.0234 U	**0.168**	0.00769 UJ	0.00745 U	0.00748 U
Benzoic Acid	SW8270E	mg/kg	2.9	3.8	1.66 UJ	**0.158 J**	0.158 UJ	0.294 UJ	0.319 U	0.16 U	0.468 U	0.156 U	**0.238 J**	0.149 U	0.149 U
Bis (2-ethylhexyl) phthalate	SW8270E	mg/kg	0.5	22	0.593 UJ	0.0543 UJ	0.0565 UJ	0.105 UJ	0.114 U	0.0571 U	0.167 U	0.0559 U	0.0548 UJ	0.0531 U	0.0533 U
Carbazole	SW8270E	mg/kg	0.9	1.1	0.145 UJ	0.0133 UJ	0.0138 UJ	0.0257 UJ	0.0279 U	0.0139 U	0.0409 U	**0.08 J**	0.0134 UJ	0.013 U	0.013 U
Chrysene	SW8270E	mg/kg	--	--	0.0931 UJ	0.00853 UJ	0.00886 UJ	0.0165 UJ	0.0179 U	0.00896 U	0.0262 U	**0.4**	**0.0101 J**	0.00833 U	0.00837 U
Dibenzo(a,h)anthracene	SW8270E	mg/kg	--	--	0.13 UJ	0.0119 UJ	0.0123 UJ	0.0231 UJ	0.025 U	0.0125 U	0.0367 U	**0.0588**	0.012 UJ	0.0116 U	0.0117 U
Dibenzofuran	SW8270E	mg/kg	0.2	0.68	0.153 UJ	0.014 UJ	0.0146 UJ	0.0272 UJ	0.0295 U	0.0148 U	0.0433 U	**0.0365 J**	0.0142 UJ	0.0137 U	0.0138 U
Di-N-Butylphthalate	SW8270E	mg/kg	0.38	1	0.16 UJ	0.0147 UJ	0.0153 UJ	0.0284 UJ	0.0308 U	0.0154 U	0.0452 U	0.0151 U	0.0148 UJ	0.0144 U	0.0144 U
Di-n-octyl phthalate	SW8270E	mg/kg	0.039	1.1	0.316 UJ	0.029 UJ	0.0301 UJ	0.0561 UJ	0.0609 U	0.0305 U	0.0893 U	0.0298 U	0.0292 UJ	0.0283 U	0.0284 U
Fluoranthene	SW8270E	mg/kg	--	--	0.0845 UJ	0.00774 UJ	0.00804 UJ	0.015 UJ	0.0162 U	0.00814 U	0.0238 U	**0.844**	0.0078 UJ	0.00757 U	0.0076 U
Fluorene	SW8270E	mg/kg	--	--	0.0762 UJ	0.00698 UJ	0.00725 UJ	0.0135 UJ	0.0146 U	0.00734 U	0.0214 U	**0.0528**	0.00704 UJ	0.00682 U	0.00685 U
Indeno(1,2,3-cd)pyrene	SW8270E	mg/kg	--	--	0.132 UJ	0.0121 UJ	0.0126 UJ	0.0234 UJ	0.0254 U	0.0127 U	0.0373 U	**0.246**	0.0122 UJ	0.0118 U	0.0119 U
Naphthalene	SW8270E	mg/kg	--	--	0.118 UJ	0.0108 UJ	0.0112 UJ	0.0208 UJ	0.0226 U	0.0113 U	0.0331 U	**0.0211 J**	0.0109 UJ	0.0105 U	0.0106 U
Pentachlorophenol	SW8270E	mg/kg	1.2	1.2	0.126 UJ	0.0115 UJ	0.012 UJ	0.0223 UJ	0.0242 U	0.0121 U	0.0355 U	0.0119 U	0.0116 UJ	0.0113 U	0.0113 U
Phenanthrene	SW8270E	mg/kg	--	--	0.0929 UJ	0.00851 UJ	0.00884 UJ	0.0165 UJ	0.0179 U	0.00895 U	0.0262 U	**0.507**	0.00858 UJ	0.00832 U	0.00835 U
Phenol	SW8270E	mg/kg	0.12	0.21	0.188 UJ	0.0173 UJ	0.0179 UJ	0.0334 UJ	0.0363 U	0.0181 U	0.0532 U	0.0177 U	0.0174 UJ	0.0169 U	0.0169 U
Pyrene	SW8270E	mg/kg	--	--	**0.0973 J**	0.00835 UJ	0.00867 UJ	0.0162 UJ	0.0176 U	0.00877 U	0.0258 U	**0.624**	**0.0142 J**	0.00816 U	0.00819 U
Total PAHs (calculated)	SW8270E	mg/kg	17	30	**0.0973**	0.0121 U	**0.00706**	0.0234 U	**0.0372**	0.0127 U	0.0373 U	**4.64021**	**0.03998**	0.0118 U	0.0119 U
Bulk Petroleum Hydrocarbons															
TPH-Diesel Range	NWTPH-Dx	mg/kg	340	510	**38.8 J**	**31 J**	**32.2 J**	**136 J**	**25.4 J**	**56.9 J**	**53.1**	**21.4**	**9.9 J**	9.5 U	**12.9 J**
TPH as Motor Oil	NWTPH-Dx	mg/kg	3600	4400	**112 J**	**107 J**	**70 J**	**503 J**	**106 J**	**167 J**	**291**	**77.6**	**35.4 J**	**28.5**	**37.4 B**

Notes:

Bold font = detected result

Bold font and gray-shaded cell = detected result greater than dry weight SCO

cm = centimeter(s)

CSL = Cleanup Screening Level

FD = field duplicate

ID = identification

mg/kg = milligram(s) per kilogram

N = normal (parent) sample

PAH =Polycyclic Aromatic Hydrocarbons

SCO = Sediment Cleanup Objective

TPH = total petroleum hydrocarbons

Qualifier Definitions:

B = Compound was found in the blank and sample.

J = Analyte was present but reported value may not be accurate or precise

U = This analyte was analyzed for but not detected at the specific detection limit

UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-4. Step 1 Dioxins and Furans Results	Location ID		BG13	BG14	BG15	BG16	BG17	BG17	BG18	BG19	BG20	D160	E320	E380	E460
	Sample ID		BNSF-BG13-042122-0-10	BNSF-BG14-042722-0-5.5	BNSF-BG15-042722-0-10	BNSF-BG16-042722-0-10	BNSF-BG17-042722-0-10	FD02-042722-0-10	BNSF-BG18-042722-0-10	BNSF-BG19-042722-0-10	BNSF-BG20-042922-0-10	BNSF-D160-042822-0-5	BNSF-E320-042822-0-4	BNSF-E380-042822-0-4	BNSF-E460-042922-0-4
BNSF Wishram Sediment Remedial Investigation Report	Sample Type		N	N	N	N	N	FD	N	N	N	N	N	N	N
	Sample Depths (cm)		0 - 10	0 - 5	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 5	0 - 4	0 - 4	0 - 4
	Sample Date		4/21/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/29/2022	4/28/2022	4/28/2022	4/28/2022	4/29/2022
Analyte	Method	Units													
1,2,3,4,6,7,8-HpCDD	E1613B	ng/kg	0.51 U	**4.1 J**	0.51 U	0.52 U	**12 J**	**1.5 J**	**4.3 J**	0.49 U	0.65 UJ	**7.5 J**	**24 J**	**2.4 J**	**1.9 J**
1,2,3,4,6,7,8-HpCDF	E1613B	ng/kg	0.64 U	**0.95 J**	0.63 U	0.65 U	**1.1 J**	0.63 U	0.65 U	0.62 U	0.82 UJ	**1 J**	**11 J**	0.64 UJ	0.7 UJ
1,2,3,4,7,8,9-HpCDF	E1613B	ng/kg	0.44 U	0.43 U	0.44 U	0.45 U	0.43 U	0.43 U	0.44 U	0.42 U	0.56 UJ	0.46 UJ	0.41 UJ	0.44 UJ	0.48 UJ
1,2,3,4,7,8-HxCDD	E1613B	ng/kg	0.42 U	0.41 U	0.41 U	0.43 U	0.41 U	0.41 U	0.42 U	0.4 U	0.54 UJ	**0.46 J**	**0.7 J**	0.42 UJ	0.46 UJ
1,2,3,4,7,8-HxCDF	E1613B	ng/kg	0.41 U	0.4 U	0.41 U	0.42 U	0.4 U	0.4 U	0.42 U	0.4 U	0.53 UJ	0.43 UJ	0.39 UJ	0.41 UJ	0.45 UJ
1,2,3,6,7,8-HxCDD	E1613B	ng/kg	0.46 U	0.45 U	0.46 U	0.47 U	0.45 U	0.45 U	0.47 U	0.45 U	0.59 UJ	**0.69 J**	**3.7 J**	0.46 UJ	0.5 UJ
1,2,3,6,7,8-HxCDF	E1613B	ng/kg	0.38 U	0.37 U	0.38 U	0.39 U	0.38 U	0.38 U	0.39 U	0.37 U	0.49 UJ	0.4 UJ	0.36 UJ	0.38 UJ	0.42 UJ
1,2,3,7,8,9-HxCDD	E1613B	ng/kg	0.4 U	0.39 U	0.39 U	0.4 U	0.39 U	0.39 U	0.4 U	0.38 U	0.51 UJ	0.42 UJ	**1.6 J**	0.4 UJ	0.43 UJ
1,2,3,7,8,9-HxCDF	E1613B	ng/kg	0.48 U	0.47 U	0.47 U	0.49 U	0.47 U	0.47 U	0.48 U	0.46 U	0.61 UJ	0.5 UJ	0.45 UJ	0.48 UJ	0.52 UJ
1,2,3,7,8-PeCDD	E1613B	ng/kg	0.21 U	0.2 U	0.2 U	0.21 U	0.2 U	0.2 U	0.21 U	0.2 U	0.26 UJ	0.22 UJ	**0.74 J**	0.2 UJ	0.22 UJ
1,2,3,7,8-PeCDF	E1613B	ng/kg	0.21 U	0.21 U	0.21 U	0.22 U	0.21 U	0.21 U	0.22 U	0.21 U	0.27 UJ	0.23 UJ	**4.6 J**	0.21 UJ	0.23 UJ
2,3,3',4,4',5'-Hexachlorobiphenyl	E1668C	ng/kg	0.81 U	0.818 U	0.85 U	0.824 U	0.825 U	0.822 U	0.828 U	0.828 U	0.819 UJ	0.854 UJ	0.832 UJ	0.709 UJ	1.01 UJ
2,3,3',4,4',5-Hexachlorobiphenyl	E1668C	ng/kg	1.9 U	1.92 U	**2.13 J**	1.93 U	1.93 U	1.93 U	1.94 U	1.94 U	1.92 UJ	**2.58 J**	**3.54 J**	1.66 UJ	2.36 UJ
2,3,4,6,7,8-HxCDF	E1613B	ng/kg	0.41 U	0.4 U	0.41 U	0.42 U	0.4 U	0.4 U	0.41 U	0.4 U	0.53 UJ	0.43 UJ	**0.42 J**	0.41 UJ	0.45 UJ
2,3,4,7,8-PeCDF	E1613B	ng/kg	0.22 U	0.22 U	0.22 U	0.23 U	0.22 U	0.22 U	0.22 U	0.21 U	0.28 UJ	0.23 UJ	0.21 UJ	0.22 UJ	0.24 UJ
2,3,7,8-TCDD	E1613B	ng/kg	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.18 U	0.24 UJ	0.2 UJ	**2.2 J**	0.19 UJ	0.21 UJ
2,3,7,8-TCDF	E1613B	ng/kg	0.21 U	**0.33 J**	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.2 U	0.27 UJ	**0.39 J**	**0.23 J**	0.21 UJ	**0.25 J**
OCDD	E1613B	ng/kg	2 U	**42**	1.9 U	2 U	**200 J**	**12 J**	**50**	1.9 U	2.5 UJ	**36 J**	**130 J**	**13 J**	**10 J**
OCDF	E1613B	ng/kg	1.4 U	**1.9 J**	1.4 U	1.5 U	1.4 U	1.4 U	1.4 U	1.4 U	1.8 UJ	1.5 UJ	**7.1 J**	1.4 UJ	1.6 UJ
Total HpCDD	E1613B	ng/kg	0.51 U	**9.4**	0.51 U	0.52 U	**24 J**	**4.1 J**	**11**	0.49 U	0.65 UJ	**15 J**	**50 J**	**5.5 J**	**3.8 J**
Total HpCDF	E1613B	ng/kg	0.44 U	**2.2 J**	0.44 U	0.45 U	**3.6 J**	0.43 U	0.44 U	0.42 U	0.56 UJ	**1 J**	**22 J**	0.44 UJ	**0.5 J**
Total HxCDD	E1613B	ng/kg	0.4 U	**0.75 J**	0.39 U	0.4 U	**0.48 J**	0.39 U	0.4 U	0.38 U	0.51 UJ	**2.1 J**	**28 J**	**0.81 J**	0.43 UJ
Total HxCDF	E1613B	ng/kg	0.38 U	**0.52 J**	0.38 U	0.39 U	**2.6 J**	0.38 U	0.39 U	0.37 U	0.49 UJ	**0.62 J**	**7.9 J**	0.38 UJ	0.42 UJ
Total PeCDD	E1613B	ng/kg	0.21 U	0.2 U	0.2 U	0.21 U	0.2 U	0.2 U	0.21 U	0.2 U	0.26 UJ	0.22 UJ	**0.74 J**	0.2 UJ	0.22 UJ
Total PeCDF	E1613B	ng/kg	0.21 U	**0.69 J**	0.21 U	0.22 U	**0.35 J**	0.21 U	0.22 U	0.21 U	0.27 UJ	**0.83 J**	**1.6 J**	0.21 UJ	**0.28 J**
Total TCDD	E1613B	ng/kg	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.18 U	0.24 UJ	0.2 UJ	**2.2 J**	0.19 UJ	0.21 UJ
Total TCDF	E1613B	ng/kg	0.21 U	**0.61 J**	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.2 U	0.27 UJ	**0.7 J**	**0.23 J**	0.21 UJ	**0.58 J**

Notes:
Bold font = detected result
cm = centimeter(s)
FD = field duplicate
ID = identification
N = normal (parent) sample
ng/kg = nanogram(s) per kilogram

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-4. Step 1 Dioxins and Furans Results	Location ID		H360	I120	L320	SG01	SG01	SG02	SG03	SG11	SG13	SG23
	Sample ID		BNSF-H360-042922-0-8	BNSF-I120-042922-0-6	BNSF-L320-042922-0-2	BNSF-SG01-041922-0-10	FD01-041922-0-10	BNSF-SG02-041922-0-10	BNSF-SG03-042722-0-5.5	BNSF-SG11-042822-0-5	BNSF-SG13-042522-0-1.5	BNSF-SG23-042122-0-6
BNSF Wishram Sediment Remedial Investigation Report	Sample Type		N	N	N	N	FD	N	N	N	N	N
	Sample Depths (cm)		0 - 8	0 - 6	0 - 2	0 - 10	0 - 10	0 - 10	0 - 5	0 - 5	0 - 1.5	0 - 6
	Sample Date		4/29/2022	4/29/2022	4/29/2022	4/19/2022	4/19/2022	4/19/2022	4/27/2022	4/28/2022	4/25/2022	4/21/2022
Analyte	Method	Units										
1,2,3,4,6,7,8-HpCDD	E1613B	ng/kg	**0.94 J**	**1.9 J**	**2.3 J**	**1.5 J**	**3 J**	**8.2**	0.52 U	**0.75 J**	0.52 U	0.51 U
1,2,3,4,6,7,8-HpCDF	E1613B	ng/kg	**0.61 J**	0.64 UJ	**1.5 J**	**0.7 J**	**1 J**	**2.2 J**	0.65 U	0.66 UJ	0.65 U	0.64 U
1,2,3,4,7,8,9-HpCDF	E1613B	ng/kg	0.41 UJ	0.44 UJ	0.41 UJ	0.45 U	0.43 U	0.45 U	0.45 U	0.45 UJ	0.45 U	0.44 U
1,2,3,4,7,8-HxCDD	E1613B	ng/kg	0.39 UJ	0.42 UJ	0.39 UJ	0.42 U	0.41 U	0.42 U	0.42 U	0.43 UJ	0.43 U	0.42 U
1,2,3,4,7,8-HxCDF	E1613B	ng/kg	0.39 UJ	0.41 UJ	0.39 UJ	0.42 U	0.4 U	0.42 U	0.42 U	0.42 UJ	0.42 U	0.41 U
1,2,3,6,7,8-HxCDD	E1613B	ng/kg	0.43 UJ	0.46 UJ	0.44 UJ	0.47 U	0.45 U	0.47 U	0.47 U	0.47 UJ	0.47 U	0.46 U
1,2,3,6,7,8-HxCDF	E1613B	ng/kg	0.36 UJ	0.38 UJ	0.36 UJ	0.39 U	0.37 U	0.39 U	0.39 U	0.39 UJ	0.39 U	0.38 U
1,2,3,7,8,9-HxCDD	E1613B	ng/kg	0.37 UJ	0.39 UJ	0.38 UJ	0.4 U	0.39 U	**0.42 J**	0.4 U	0.41 UJ	0.4 U	0.4 U
1,2,3,7,8,9-HxCDF	E1613B	ng/kg	0.45 UJ	0.47 UJ	0.45 UJ	0.48 U	0.47 U	0.48 U	0.48 U	0.49 UJ	0.49 U	0.48 U
1,2,3,7,8-PeCDD	E1613B	ng/kg	0.19 UJ	0.2 UJ	0.19 UJ	0.21 U	0.2 U	**0.22 J**	0.21 U	0.21 UJ	0.21 U	0.2 U
1,2,3,7,8-PeCDF	E1613B	ng/kg	0.2 UJ	0.21 UJ	0.2 UJ	0.22 U	0.21 U	0.22 U	0.22 U	0.22 UJ	0.22 U	0.21 U
2,3,3',4,4',5'-Hexachlorobiphenyl	E1668C	ng/kg	**1.33 J**	0.974 UJ	0.942 UJ	0.817 U	0.81 U	**1.72 J**	0.822 U	0.876 UJ	0.818 U	0.813 U
2,3,3',4,4',5-Hexachlorobiphenyl	E1668C	ng/kg	**4.77 J**	2.28 UJ	2.2 UJ	1.91 U	1.9 U	**6.03**	1.92 U	2.05 UJ	1.91 U	1.9 U
2,3,4,6,7,8-HxCDF	E1613B	ng/kg	0.39 UJ	0.41 UJ	0.39 UJ	0.42 U	0.4 U	0.42 U	0.42 U	0.42 UJ	0.42 U	0.41 U
2,3,4,7,8-PeCDF	E1613B	ng/kg	0.21 UJ	0.22 UJ	0.21 UJ	0.22 U	0.22 U	**0.25 J**	0.22 U	0.23 UJ	0.23 U	0.22 U
2,3,7,8-TCDD	E1613B	ng/kg	0.18 UJ	0.19 UJ	0.18 UJ	0.19 U	0.19 U	0.19 U	0.19 U	0.2 UJ	0.19 U	0.19 U
2,3,7,8-TCDF	E1613B	ng/kg	**0.21 J**	0.21 UJ	0.2 UJ	0.21 U	**0.3 J**	**0.71 J**	0.21 U	0.22 UJ	0.21 U	0.21 U
OCDD	E1613B	ng/kg	**6.7 J**	**14 J**	**8.8 J**	**11 J**	**22 J**	**69**	**2.4 J**	**4.6 J**	2 U	**5.2 B**
OCDF	E1613B	ng/kg	1.3 UJ	1.4 UJ	1.4 UJ	1.5 U	1.4 U	**4.8 J**	1.5 U	1.5 UJ	1.5 U	1.4 U
Total HpCDD	E1613B	ng/kg	**1.1 J**	**4.4 J**	**2.3 J**	**3.2 J**	**6.4 J**	**21**	0.52 U	**1.6 J**	0.52 U	0.51 U
Total HpCDF	E1613B	ng/kg	**0.61 J**	**0.7 J**	0.41 UJ	**1.5 J**	**2.3 J**	**5.2**	0.45 U	0.45 UJ	0.45 U	0.44 U
Total HxCDD	E1613B	ng/kg	0.37 UJ	0.39 UJ	**8.2 J**	**0.82 J**	0.39 U	**4.2 J**	0.4 U	0.41 UJ	0.4 U	0.4 U
Total HxCDF	E1613B	ng/kg	0.36 UJ	0.38 UJ	**2.2 J**	0.39 U	**0.54 J**	**2.6 J**	0.39 U	0.39 UJ	0.39 U	0.38 U
Total PeCDD	E1613B	ng/kg	0.19 UJ	0.2 UJ	**3.2 J**	0.21 U	**0.25 J**	**0.71 J**	0.21 U	0.21 UJ	0.21 U	0.2 U
Total PeCDF	E1613B	ng/kg	**0.28 J**	0.21 UJ	0.2 UJ	0.22 U	**0.84 J**	**2.4 J**	0.22 U	0.22 UJ	0.22 U	0.21 U
Total TCDD	E1613B	ng/kg	0.18 UJ	0.19 UJ	0.18 UJ	**0.23 J**	**0.52 J**	**0.89 J**	**0.22 J**	0.2 UJ	0.19 U	0.19 U
Total TCDF	E1613B	ng/kg	**0.21 J**	0.21 UJ	0.2 UJ	0.21 U	**0.52 J**	**3.5**	0.21 U	0.22 UJ	0.21 U	0.21 U

Notes:
Bold font = detected result
cm = centimeter(s)
FD = field duplicate
ID = identification
N = normal (parent) sample
ng/kg = nanogram(s) per kilogram

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-5. Step 1 Total Organic Carbon, Total Solids, and Grain Size Results BNSF Wishram Sediment Remedial Investigation Report	Location ID		BG13	BG14	BG15	BG16	BG17	BG17	BG18	BG19	BG20	D160	E320	E380	E460
	Sample ID		BNSF-BG13-042122-0-10	BNSF-BG14-042722-0-5.5	BNSF-BG15-042722-0-10	BNSF-BG16-042722-0-10	BNSF-BG17-042722-0-10	FD02-042722-0-10	BNSF-BG18-042722-0-10	BNSF-BG19-042722-0-10	BNSF-BG20-042922-0-10	BNSF-D160-042822-0-5	BNSF-E320-042822-0-4	BNSF-E380-042822-0-4	BNSF-E460-042922-0-4
	Sample Type		N	N	N	N	N	FD	N	N	N	N	N	N	N
	Sample Depths (cm)		0 - 10	0 - 5	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10	0 - 5	0 - 4	0 - 4	0 - 4
	Sample Date		4/21/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/27/2022	4/29/2022	4/28/2022	4/28/2022	4/28/2022	4/29/2022
Analyte	Method	Units													
Total Organic Carbon	SW9060A	mg/kg	**1600 J**	**19000**	**6500**	**530 B**	**31000**	**30000**	**19000**	**1600 J**	**7000 J**	**8000 J**	**15000 J**	**3000 J**	**7000 J**
Total Solids	SM2540G	%	**75.6**	**62.8**	**70.7**	**77**	**58.1**	**54.7**	**58.9**	**77**	**70.4 J**	**70.7 J**	**72.2 J**	**75.4 J**	**71.1 J**
Cobbles	ASTM D422	%	0	0	0	0	0	--	0	0	0	0	0	0	0
Gravel	ASTM D422	%	0	0	0	0	**0.1**	--	0	0	0	**0.4**	**0.8**	0	0
Coarse Gravel	ASTM D422	%	0	0	0	0	0	--	0	0	0	0	0	0	0
Fine Gravel	ASTM D422	%	0	0	0	0	**0.1**	--	0	0	0	**0.4**	**0.8**	0	0
Sand	ASTM D422	%	**96**	**76**	**89**	**97**	**67**	--	**48**	**98**	**87**	**81**	**83**	**93**	**83**
Coarse Sand	ASTM D422	%	0	**0.1**	0	0	**0.1**	--	0	0	**0.1**	**0.3**	**1.9**	**0.1**	**0.1**
Medium Sand	ASTM D422	%	**0.2**	**0.7**	**0.6**	**1.5**	**1**	--	**0.4**	**0.2**	**0.3**	**1.3**	**4.3**	**0.4**	**0.8**
Fine Sand	ASTM D422	%	**96**	**76**	**88**	**96**	**66**	--	**48**	**97**	**86**	**79**	**77**	**92**	**82**
Fines	ASTM D422	%	**3.6**	**24**	**11**	**2.7**	**33**	--	**52**	**2.5**	**13**	**19**	**16**	**7.3**	**17**
Silt	ASTM D422	%	**3.6**	**22**	0	0	**33**	--	**51**	0	**13**	**19**	0	0	**17**
Clay	ASTM D422	%	0	**1.1**	0	0	**0.1**	--	**0.5**	0	**0.2**	**0.1**	0	0	**0.3**
Sieve 3.0 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 2.0 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 1.5 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 1.0 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 0.50 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 0.375 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve, #4 percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**100**	**99**	**100**	**100**
Sieve, #10 percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	--	**100**	**100**	**100**	**99**	**97**	**100**	**100**
Sieve, #40 percent passing	ASTM D422	%	**100**	**99**	**99**	**98**	**99**	--	**100**	**100**	**100**	**98**	**93**	**100**	**99**
Sieve, #60 percent passing	ASTM D422	%	**92**	**93**	**94**	**78**	**98**	--	**99**	**83**	**96**	**93**	**88**	**95**	**95**
Sieve, #100 percent passing	ASTM D422	%	**41**	**55**	**66**	**29**	**94**	--	**96**	**13**	**74**	**76**	**67**	**58**	**65**
Sieve, #200 percent passing	ASTM D422	%	**3.6**	**24**	**11**	**2.7**	**33**	--	**52**	**2.5**	**13**	**19**	**16**	**7.3**	**17**
Hydrometer Reading after 1 min - Percent Finer	ASTM D422	%	**0.1**	**4**	**0.7**	0	**6.9**	--	**17.1**	0	**1.2**	**2.4**	**1.5**	**0.2**	**1.9**
Hydrometer Reading after 15 min - Percent Finer	ASTM D422	%	**0.1**	**2.5**	**0.1**	0	**1.3**	--	**3.2**	0	**0.5**	**0.6**	**0.3**	**0.1**	**0.8**
Hydrometer Reading after 30 min - Percent Finer	ASTM D422	%	0	**1.9**	**-0.1**	0	**0.7**	--	**2.2**	0	**0.4**	**0.5**	**0.2**	0	**0.7**
Hydrometer Reading after 60 min - Percent Finer	ASTM D422	%	0	**1.4**	**-0.1**	0	**0.4**	--	**1.2**	0	**0.2**	**0.2**	0	0	**0.4**
Hydrometer Reading after 240 min - Percent Finer	ASTM D422	%	0	**0.8**	**-0.1**	0	**-0.4**	--	**-0.1**	0	**0.1**	0	**-0.1**	**-0.1**	**0.2**
Hydrometer Reading after 1440 min - Percent Finer	ASTM D422	%	0	**0.2**	**-0.4**	**-0.1**	**-0.7**	--	**-0.6**	0	0	**-0.2**	**-0.1**	**-0.2**	**0.1**

Notes:
Bold font = detected result
cm = centimeter(s)
FD = field duplicate
ID = identification
min = minute
mm = millimeter(s)
N = normal (parent) sample

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise

Table 3-5. Step 1 Total Organic Carbon, Total Solids, and Grain Size Results BNSF Wishram Sediment Remedial Investigation Report		Location ID	H360	I120	L320	SG01	SG01	SG02	SG03	SG11	SG13	SG23
		Sample ID	BNSF-H360-042922-0-8	BNSF-I120-042922-0-6	BNSF-L320-042922-0-2	BNSF-SG01-041922-0-10	FD01-041922-0-10	BNSF-SG02-041922-0-10	BNSF-SG03-042722-0-5.5	BNSF-SG11-042822-0-5	BNSF-SG13-042522-0-1.5	BNSF-SG23-042122-0-6
		Sample Type	N	N	N	N	FD	N	N	N	N	N
		Sample Depths (cm)	0 - 8	0 - 6	0 - 2	0 - 10	0 - 10	0 - 10	0 - 5	0 - 5	0 - 1.5	0 - 6
		Sample Date	4/29/2022	4/29/2022	4/29/2022	4/19/2022	4/19/2022	4/19/2022	4/27/2022	4/28/2022	4/25/2022	4/21/2022
Analyte	Method	Units										
Total Organic Carbon	SW9060A	mg/kg	**20000 J**	**5000 J**	**30000 J**	**4700**	**5500**	**23000**	**13000**	**4000 J**	**670 B**	**11000**
Total Solids	SM2540G	%	**77.7 J**	**74.7 J**	**80.2 J**	**73.9**	**73.9**	**50.4**	**75.5**	**77 J**	**79.4**	**79.1**
Cobbles	ASTM D422	%	0	0	0	0	0	0	0	0	0	0
Gravel	ASTM D422	%	**0.3**	0	**12**	**0.3**	0	**0.9**	**7.2**	0	**2.1**	**12**
Coarse Gravel	ASTM D422	%	0	0	**0.8**	0	0	0	**1.5**	0	**0.3**	**0.5**
Fine Gravel	ASTM D422	%	**0.3**	0	**11**	**0.3**	0	**0.9**	**5.7**	0	**1.8**	**11**
Sand	ASTM D422	%	**84**	**88**	**81**	**83**	**84**	**56**	**76**	**91**	**96**	**85**
Coarse Sand	ASTM D422	%	0	0	**1.9**	**0.1**	**0.1**	**0.7**	**1.6**	**0.1**	**0.3**	**3.1**
Medium Sand	ASTM D422	%	**1.2**	**0.6**	**5.6**	**0.6**	**0.4**	**1**	**1.6**	**0.3**	**1.2**	**4**
Fine Sand	ASTM D422	%	**82**	**88**	**73**	**82**	**83**	**54**	**73**	**91**	**94**	**78**
Fines	ASTM D422	%	**16**	**12**	**7.2**	**17**	**16**	**43**	**17**	**8.8**	**2.2**	**3.4**
Silt	ASTM D422	%	**16**	**12**	**7.1**	**16**	**16**	**37**	**17**	**8.8**	**0**	**3.4**
Clay	ASTM D422	%	**0.2**	**0.1**	**0.1**	**0.5**	**0.4**	**6.5**	**0.3**	0	0	0
Sieve 3.0 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 2.0 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 1.5 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 1.0 inch percent passing	ASTM D422	%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Sieve 0.50 inch percent passing	ASTM D422	%	**100**	**100**	**97**	**100**	**100**	**100**	**95**	**100**	**99**	**98**
Sieve 0.375 inch percent passing	ASTM D422	%	**100**	**100**	**90**	**100**	**100**	**99**	**94**	**100**	**99**	**94**
Sieve, #4 percent passing	ASTM D422	%	**100**	**100**	**88**	**100**	**100**	**99**	**93**	**100**	**98**	**88**
Sieve, #10 percent passing	ASTM D422	%	**100**	**100**	**86**	**100**	**100**	**98**	**91**	**100**	**98**	**85**
Sieve, #40 percent passing	ASTM D422	%	**98**	**99**	**80**	**99**	**100**	**97**	**90**	**100**	**96**	**81**
Sieve, #60 percent passing	ASTM D422	%	**76**	**91**	**45**	**97**	**98**	**78**	**74**	**91**	**54**	**32**
Sieve, #100 percent passing	ASTM D422	%	**39**	**47**	**18**	**74**	**74**	**55**	**48**	**50**	**12**	**7**
Sieve, #200 percent passing	ASTM D422	%	**16**	**12**	**7.2**	**17**	**16**	**43**	**17**	**8.8**	**2.2**	**3.4**
Hydrometer Reading after 1 min - Percent Finer	ASTM D422	%	**1.8**	**0.8**	**0.4**	**1.7**	**1.5**	**15.5**	**1.7**	**0.4**	0	**0.1**
Hydrometer Reading after 15 min - Percent Finer	ASTM D422	%	**0.6**	**0.3**	**0.2**	**0.7**	**0.7**	**10.8**	**0.7**	**0.2**	0	**0.1**
Hydrometer Reading after 30 min - Percent Finer	ASTM D422	%	**0.4**	**0.3**	**0.1**	**0.6**	**0.6**	**9**	**0.5**	**0.1**	0	0
Hydrometer Reading after 60 min - Percent Finer	ASTM D422	%	**0.3**	**0.1**	**0.1**	**0.5**	**0.5**	**7.3**	**0.4**	0	0	0
Hydrometer Reading after 240 min - Percent Finer	ASTM D422	%	**0.1**	**0**	**0.1**	**0.4**	**0.4**	**5.7**	**0.1**	0	0	0
Hydrometer Reading after 1440 min - Percent Finer	ASTM D422	%	0	**-0.1**	**-0.1**	**0.1**	**0.1**	**4**	0	**-0.1**	0	0

Notes:
Bold font = detected result
cm = centimeter(s)
FD = field duplicate
ID = identification
min = minute
mm = millimeter(s)
N = normal (parent) sample

Qualifier Definitions:
B = Compound was found in the blank and sample.
J = Analyte was present but reported value may not be accurate or precise

Table 3-6. Preliminary Natural Background Values
BNSF Wishram Sediment Remedial Investigation Report

Chemical Name	Non Detects	Detects	Total Observations	Background Type	Selected Preliminary Natural Background Value
Benzoic Acid	7	1	8	Max detect	0.33
Phenol	7	1	8	Max detect	0.053
Silver	7	1	8	Max detect	0.41
3 & 4-Methylphenol (m,p-Cresols)	6	2	8	Max detect	0.26
Cadmium	5	3	8	Max detect	0.52
Mercury	5	3	8	Max detect	0.058
Sulfide	5	3	8	Max detect	180
Ammonia as N	3	5	8	Max detect	70
Selenium	3	5	8	Max detect	0.45
TPH-Diesel Range	2	6	8	Max detect	58
Arsenic	1	7	8	Max detect	3.3
Chromium	1	7	8	Max detect	16
Nickel	1	7	8	Max detect	15
Copper	NA	8	8	Max detect	16
Lead	NA	8	8	Max detect	8.6
TPH-Motor Oil Range	NA	8	8	Max detect	320
Zinc	NA	8	8	Max detect	110
1-Methylnaphthalene	8	NA	8	Max PQL	0.22
2-Methylnaphthalene	8	NA	8	Max PQL	0.22
Acenaphthene	8	NA	8	Max PQL	0.22
Acenaphthylene	8	NA	8	Max PQL	0.22
Anthracene	8	NA	8	Max PQL	0.22
Benzo(a)anthracene	8	NA	8	Max PQL	0.22
Benzo(a)pyrene	8	NA	8	Max PQL	0.22
Benzo(b)fluoranthene	8	NA	8	Max PQL	0.22
Benzo(g,h,i)perylene	8	NA	8	Max PQL	0.22
Benzo(k)fluoranthene	8	NA	8	Max PQL	0.22
Bis (2-ethylhexyl) phthalate	8	NA	8	Max PQL	2.2
Carbazole	8	NA	8	Max PQL	2.2
Chrysene	8	NA	8	Max PQL	0.22
Dibenzo(a,h)anthracene	8	NA	8	Max PQL	0.22
Dibenzofuran	8	NA	8	Max PQL	2.2
Di-N-Butylphthalate	8	NA	8	Max PQL	2.2
Di-n-octyl phthalate	8	NA	8	Max PQL	2.2
Fluoranthene	8	NA	8	Max PQL	0.22
Fluorene	8	NA	8	Max PQL	0.22
Indeno(1,2,3-cd)pyrene	8	NA	8	Max PQL	0.22
Naphthalene	8	NA	8	Max PQL	0.22
Pentachlorophenol	8	NA	8	Max PQL	2.2
Phenanthrene	8	NA	8	Max PQL	0.22
Pyrene	8	NA	8	Max PQL	0.22
TEQs and Totals					
Total PAH[a]	8	NA	8	Max PQL	0.22
Dioxin/Furans + Dioxin-like PCBs TEQs[b]	1	7	8	Max sum TEQ	0.53
cPAH TEQs[b]	8	NA	8	max benzo (a) pyrene PQL	0.22

Notes
[a] Comparison to benthic criteria
[b] Bioaccumulative chemicals
Individual analytes with 100% nondetects have background set at the maximum PQL
NA = not applicable
PAH - Polycyclic aromatic hydrocarbon
TEQ - Toxic Equivalent
TPH - Total Petroleum Hydrocarbon
cPAH = carcinogenic PAHs
PQL = practical quantitative limit
Max = maximum

Table 3-7
Summary and Evaluation of TarGOST Profiling Responses and Confirmatory Data

TarGOST Location ID	TarGOST-RAW Response		Confirmatory Core and Analytical		Fluorescence Waveform Signals Observed in TarGOST Log (X indicates waveform associated with peak TarGOST-Raw response)				TarGOST NAPL-Like Response		False Positive	Estimated NAPL Impacted Interval(s)			Notes
	Peak Response (% RE)	Depth (ft bss)	Core Identification (Year Collected)	Key Observations	NAPL-Like	Plant Matter (Chlorophyll)	Organic Material	Shells	Peak Response[a] (%RE)	Depth[b] (ft bss)		Top (ft bss)	Bottom (ft bss)	Thickness (ft)	
E060-TG	6	1.4				X	X		1	0.1					
E120-TG	10	0.9				X	X		4	0.5					
E190-TG	14	1.2				X			2	0.1					
E520-TG	6	2.6				X	X		3	2.6					
EF000-TG	3	0.9				X			1	2.0					
EF240-TG	124	1.7	EF240-SC (2022)	bleb observed 1.5-1.6 and sheen from 2.0-2.1; confirmed clean between 3.0 and 4.0 ft bss and 5.0 and 6.0 ft bss based on analytical samples BNSF-EF240-SC-1.0-2.0-111022 and BNSF-EF240-SC-3.0-4.0-111022	X	X			**13**	2.0		1.6	2.0	0.4	
EF280-TG	43	1.4				X	X		6	0.7					
EF420-TG	21	7.3			X	X	X		**20**	3.3		3.3	3.5	0.2	
EF470-TG	272	0.01	EF470-SC (2022)	Surface sediment confirmed clean at collocated SG11 based on analytical sample BNSF-SG11-042822-0-5; Core had no recovery in top ~8 ft; confirmed clean between 11.6 and 12.6 ft bss based on analytical sample BNSF-EF470-SC-11.0-12.0-110922		X	X		11	0.01 (S)	X				isolated single response at surface across <0.1 foot interval. Potential NAPL-signal mixed w/chlorophyll response at surface may be artifact of NNLS data processing; Analytical data for surface grab at adjacent SG11 indicates no NAPL impacts present
EN060-TG	301	0.48				X			10	0.48 (S)	X				isolated single response near surface across <0.1 foot interval. Potential NAPL-signal mixed w/chlorophyll response at surface may be artifact of NNLS data processing
F320-TG	69	6.0			X	X	X		**58**	6.0		5.8	6.2	0.4	
F390-TG	92	6.4	F390-SC (2022)	NAPL impacts observed 4.5-5.1; confirmed clean between 8.7 and 9.7 ft bss based on analytical sample BNSF-F390-SC-6.2-7.2-110722	X	X	X		**91**	6.4		4.8	7.0	2.2	
FGN160-TG	32	0.7			X	X	X		**32**	0.7		0.3	0.8	0.5	Although the fluorescence signal is categorized as NAPL-like this waveform is unique and not at a depth consistent with the confirmed NAPL impacts.
FN100-TG	43	0.2				X			8	0.3					
G000-TG	55	1.7	G000-SC (2022)	isolated individual blebs of NAPL observed between 2.7 and 6.8; samples show clean between 3.3 and 4.3 ft bss and 5.8 and 6.8 ft bss based on analytical samples BNSF-G000-SC-1.5-2.5-110322 and BNSF-G000-SC-4.0-5.0-111422	X	X	X		**14**	1.71 (S)					isolated single response across <0.1 foot interval above where rare blebs observed at offset core location. NAPL-signal mixed w/chlorophyll response. Response at 1.7' attributed to heterogenity of NAPL bleb distribution from location to location, particularly at periphery of impacts
G040-TG	84	6.6				X	X		6						
G080-TG	123	1.1			X	X	X		**24**	5.7		5.4	5.7	0.3	
G120-TG	139	6.8			X	X	X		**62**	6.7		4.5	7.0	2.5	
G160-TG	69	5.1			X	X	X		**16**	5.1		5.0	6.0	1.0	
G200-TG	209	7.8	G200-SC (2022), G200-SC (2018)	NAPL observed 5.1-6.9 in 2018 and 4.9-6.9 in 2022, bottom on NAPL not reached in either core; confirmed NAPL impacted between 5.5 and 6.5 ft bss based on analytical sample BNSF-G200-SC-4.0-5.0-110722 confirming NAPL presence	X	X	X		**156**	8.6		4.8	9.2	4.4	
G260-TG	130	5.9	G260-SC (2018)	NAPL observed 4.5-7 in 2018, bottom on NAPL not reached in core	X		X		**94**	5.9		5.1	8.2	3.1	
G320-TG	421	8.3			X		X		**421**	8.3		0-1.6 and 4.0-9.5		5.5	
G360-TG	253	7.1			X		X		**137**	7.1		6.0	7.7	1.7	

Table 3-7
Summary and Evaluation of TarGOST Profiling Responses and Confirmatory Data

	TarGOST-RAW Response		Confirmatory Core and Analytical		Fluorescence Waveform Signals Observed in TarGOST Log (X indicates waveform associated with peak TarGOST-Raw response)				TarGOST NAPL-Like Response		False Positive	Estimated NAPL Impacted Interval(s)			
TarGOST Location ID	**Peak Response (% RE)**	**Depth (ft bss)**	**Core Identification (Year Collected)**	**Key Observations**	**NAPL-Like**	**Plant Matter (Chlorophyll)**	**Organic Material**	**Shells**	**Peak Response[a] (%RE)**	**Depth[b] (ft bss)**		**Top (ft bss)**	**Bottom (ft bss)**	**Thickness (ft)**	**Notes**
G500-TG	3	-0.1				X			1	0.3					peak response (chlorophyll) in surface water right above sed surface
GN040-TG	43	8.2				X	X		2	3.6					
H460-TG	43	5.1					X		7	4.2					
HN100-TG	207	7.3			X		X		**43**	7.1		7.1	9.1	2.0	
HN200-TG	29	7.9			X		X		**12**	7.9		7.8	7.9	0.1	isolated single response across 0.1 foot interval, depth matches NAPL response depths at adjacent HN100-TG
HN280-TG	18	1.1				X	X		13	1.19 (S)	X				isolated single response near surface across <0.1 foot interval. Potential NAPL-signal mixed w/chlorophyll response at surface may be artifact of NNLS data processing
I120-TG	2	0.2							1	36.8					
I160-TG	87	0.9	I160-SC (2022)	woody debris w/tar-like odor w/no evidence of impacts in surrounding sediment @ 2.1'		X	X		5	0.9					wood debris seen in core I160-SC not encountered at TarGOST location
I200-TG	268	6.4			X		X		**232**	6.4		3.4	9.4	6.0	
I280-TG	301	4.8			X	X	X		**284**	4.8		2.5	6.4	3.9	
I360-TG	36	3.1					X		2	0.9					
I400-TG	20	1.6	I400-SC (2018)	no NAPL observed in recovered core (0 to 5.8'); Shells, roots and organic matter from 1.5-2.5'		X	X		1	0.6					
I500-TG	11	3.6	I500-SC (2022)	no NAPL observed; refusal @ 2.75' ; 0.8' of gravel with abundant shell material recovered; confirmed clean between 0 and 0.8 ft bss based on analytical sample BNSF-I500-SC-0.0-0.8-111322				X	6	0.2					
J000-TG	2	2.5							2	2.5					
J060-TG	2	2.7	J060-SC (2022)	no NAPL observed; refusal @ 4.9' ; 2' of sand and silt recovered; confirmed clean between 0.5 and 1.5 ft bss and 8.5 and 9.5 ft bss based on analytical samples BNSF-J060-SC-0.5-1.5-111422 and BNSF-J060-SC-8.5-9.5-111422					1	2.9					
JN040-TG	2	0.5							1	0.5					
JN100-TG	9	5.5					X		4	0.5					
JN160-TG	57	7.9			X		X		**14**	7.9		7.1	8.1	1.0	
K160-TG	7	10.9				X	X		4	10.9					
K200-TG	6	0.4	K200-SC (2022)	isolated blebs of NAPL betweeb 0.9-1.6', sheen from 0.4-0.9', clean above 0.4 ft bss based on analytical sample BNSF-K200-SC-0.0-0.4-110922		X			2	0.2					blebs and sheen seen in core K200-SC not seen w/TarGOST, attributed to heterogenity of NAPL bleb distribution, particularly at periphery of impacts and @ edge of steep drop in bathymetric surface
K280-TG	17	0.5	K280-SC (2022)	NAPL saturated sediment seam at 1.7'; sheen, staining and odor observed above and below; clean below 2.5'	X	X			**10**	0.5		0.4	0.5	0.1	thin interval of NAPL and sheen seen in core K280-SC not seen w/TarGOST beyond a limited signal at ~0.4-0.5'; attributed to heterogenity of NAPL distribution at periphery of impacts and @ edge of steep drop in bathymetric surface
K360-TG	26	1.2	K360-SC (2022)	no NAPL observed; refusal @ 6.9' ; 1.0' of gravel with abundant shell material recovered				X	6	0.8					
K400-TG	16	0.2					X		2	0.1					
K440-TG	14	0.7						X	4	0.7					
KN220-TG	11	1.1				X			2	0.2					

Table 3-7
Summary and Evaluation of TarGOST Profiling Responses and Confirmatory Data

	TarGOST-RAW Response		Confirmatory Core and Analytical		Fluorescence Waveform Signals Observed in TarGOST Log (X indicates waveform associated with peak TarGOST-Raw response)				TarGOST NAPL-Like Response		False Positive	Estimated NAPL Impacted Interval(s)			
TarGOST Location ID	**Peak Response (% RE)**	**Depth (ft bss)**	**Core Identification (Year Collected)**	**Key Observations**	**NAPL-Like**	**Plant Matter (Chlorophyll)**	**Organic Material**	**Shells**	**Peak Response[a] (%RE)**	**Depth[b] (ft bss)**		**Top (ft bss)**	**Bottom (ft bss)**	**Thickness (ft)**	**Notes**
KN280-TG	11	4.1				X	X		11	0.24 (S)	X				isolated single response near surface across <0.1 foot interval. Potential NAPL-signal mixed w/chlorophyll response at surface may be artifact of NNLS data processing
L120-TG	3	0.1				X			1	0.7					
L240-TG	3	0.3				X			1	0.0					
M190-TG	1	0.1							1	0.3					
M280-TG	9	0.0					X		3	0.0					
M360-TG	69	0.4						X	10	0.1	X				isolated single response near surface across <0.1 foot interval. Potential NAPL-signal mixed w/shell response at surface may be artifact of NNLS data processing
M400-TG	8	0.9						X	1	0.4					
MN100-TG	2	0.3							1	0.4					
MN160-TG	6	0.2				X			2	0.2					
O280-TG	5	1.7	O280-SC (2022)	no NAPL observed; refusal @ 3.4' ; 0.7' of sand w/cobbles; confirmed clean between 0 and 0.7 ft bss based on analytical sample BNSF-O280-SC-0.0-0.7-111322				X	2	1.7					

Minimum Peak NAPL-Related TarGOST Response Indicating NAPL Impacts: 10

NOTES:
[a] **Bolded** values indicate those considered in determination of minimum peak NAPL-related TarGOST response indicating NAPL impacts
[b] values shown with "(S)" indicates NAPL-related response was present at a single data point at this depth
% RE - percent of the reference emitted
ft bss - feet below sediment surface
µg/kg - micrograms per kilogram
NAPL - non-aqueous phase liquid
NNLS - non-negative least squares waveform processing (performed by Dakota Technologies)
SC - Sediment Core
TG - TarGOST

Table 3-8. Step 2 Semi-Volatile Organic Compounds and Bulk Petroleum Hydrocarbon Results BNSF Wishram Sediment Remedial Investigation Report				Location ID	EF240	EF240	EF240	EF470	F390	G000	G000	G020	G200	HN300[1]	I500
				Sample ID	BNSF-EF240-SC-1.0-2.0-111022	BNSF-EF240-SC-1.0-2.0-111022-1	BNSF-EF240-SC-3.0-4.0-111022	BNSF-EF470-SC-11.0-12.0-110922	BNSF-F390-SC-6.2-7.2-110722	BNSF-G000-SC-1.5-2.5-110322	BNSF-G000-SC-4.0-5.0-110322	BNSF-G020-SC-0.0-1.0-110422	BNSF-G200-SC-4.0-5.0-110722	BNSF-HN300-SC-1.0-2.0-111322	BNSF-I500-SC-0.0-0.8-111322
				Sample Type	N	FD	N	N	N	N	N	N	N	N	N
				Sample Depths (ft)	1 - 2	1 - 2	3 - 4	11 - 12	6.2 - 7.2	1.5 - 2.5	4 - 5	0 - 1	4 - 5	1 - 2	0 - 0.8
				Sample Date	11/10/2022	11/10/2022	11/10/2022	11/9/2022	11/7/2022	11/3/2022	11/3/2022	11/4/2022	11/7/2022	11/13/2022	11/13/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL											
Semi-Volatile Organic Compounds															
1-Methylnaphthalene	SW8270E	mg/kg	--	--	0.00591 U	0.00605 U	0.0118 U	0.00621 U	0.0546 U	0.00581 UJ	0.00608 UJ	0.00623 U	--	0.00563 U	0.00529 U
2-Methylnaphthalene	SW8270E	mg/kg	--	--	0.00599 U	0.00613 U	0.012 U	0.00629 U	0.0553 U	0.00589 UJ	0.00616 UJ	0.00632 U	--	0.00571 U	0.00536 U
3 & 4-Methylphenol (m,p-Cresols)	SW8270E	mg/kg	0.26	2	0.0144 U	0.0148 U	0.0288 U	0.0152 U	0.133 U	0.0142 UJ	0.0148 UJ	0.0152 U	--	0.0137 U	0.0129 U
Acenaphthene	SW8270E	mg/kg	--	--	0.00748 U	0.00765 U	0.015 U	0.00785 U	0.0691 U	0.00735 UJ	0.00769 UJ	0.00789 U	--	0.00712 U	0.00669 U
Acenaphthylene	SW8270E	mg/kg	--	--	0.00651 U	0.00666 U	0.013 U	0.00683 U	0.0601 U	0.0064 UJ	0.00669 UJ	0.00686 U	--	0.0062 U	0.00582 U
Anthracene	SW8270E	mg/kg	--	--	0.00823 U	0.00842 U	0.0165 U	0.00864 U	0.076 U	0.00809 UJ	**0.012 J**	0.00868 U	--	0.00783 U	0.00736 U
Benzo(a)anthracene	SW8270E	mg/kg	--	--	0.00814 U	0.00833 U	**0.0199 J**	0.00855 U	0.0752 U	0.008 UJ	**0.0225 J**	**0.0116 J**	--	**0.00778 J**	0.00729 U
Benzo(a)pyrene	SW8270E	mg/kg	--	--	0.00859 U	0.00879 U	0.0172 U	0.00902 U	0.0793 U	0.00844 UJ	**0.0165 J**	**0.0119 J**	--	0.00818 U	0.00769 U
Benzo(b)fluoranthene	SW8270E	mg/kg	--	--	0.00862 U	0.00882 U	0.0172 U	0.00905 U	0.0796 U	0.00847 UJ	**0.0114 J**	**0.0106 J**	--	**0.00847 J**	0.00771 U
Benzo(g,h,i)perylene	SW8270E	mg/kg	--	--	0.00845 U	0.00864 U	0.0169 U	0.00887 U	0.078 U	0.0083 UJ	0.00868 UJ	0.00891 U	--	0.00804 U	0.00756 U
Benzo(k)fluoranthene	SW8270E	mg/kg	--	--	0.00821 U	0.0084 U	0.0163 U	0.00863 U	0.0758 U	0.00807 UJ	0.00844 UJ	0.00866 U	--	0.00782 U	0.00735 U
Benzoic Acid	SW8270E	mg/kg	2.9	3.8	0.164 U	0.168 U	0.327 U	0.172 U	1.51 U	0.161 UJ	0.168 UJ	0.173 U	--	0.156 U	0.147 U
Bis (2-ethylhexyl) phthalate	SW8270E	mg/kg	0.5	22	0.0585 U	0.0599 U	0.117 U	0.0615 U	0.541 U	0.0575 UJ	0.0602 UJ	0.0617 U	--	0.0557 U	0.0524 U
Carbazole	SW8270E	mg/kg	0.9	1.1	0.0143 U	0.0146 U	0.0285 U	0.015 U	0.132 U	0.014 UJ	0.0147 UJ	0.0151 U	--	0.0136 U	0.0128 U
Chrysene	SW8270E	mg/kg	--	--	0.00918 U	0.0094 U	0.0183 U	0.00965 U	0.0848 U	0.00903 UJ	**0.0404 J**	**0.0137 J**	--	0.00874 U	0.00822 U
Dibenzo(a,h)anthracene	SW8270E	mg/kg	--	--	0.0128 U	0.0131 U	0.0256 U	0.0134 U	0.118 U	0.0126 UJ	0.0132 UJ	0.0135 U	--	0.0122 U	0.0115 U
Dibenzofuran	SW8270E	mg/kg	0.2	0.68	0.0151 U	0.0155 U	0.0302 U	0.0159 U	0.14 U	0.0149 UJ	0.0155 UJ	0.0159 U	--	0.0144 U	0.0135 U
Di-N-Butylphthalate	SW8270E	mg/kg	0.38	1	0.0158 U	0.0162 U	0.0316 U	0.0166 U	0.146 U	0.0155 UJ	0.0163 UJ	0.0167 U	--	0.0151 U	0.0142 U
Di-n-octyl phthalate	SW8270E	mg/kg	0.039	1.1	0.0312 U	0.0319 U	0.0623 U	0.0328 U	0.288 U	0.0307 UJ	0.0321 UJ	0.0329 U	--	0.0297 U	0.0279 U
Fluoranthene	SW8270E	mg/kg	--	--	0.00834 U	0.00853 U	0.0166 U	0.00876 U	0.077 U	0.0082 UJ	**0.0168 J**	**0.0131 J**	--	**0.0108 J**	0.00746 U
Fluorene	SW8270E	mg/kg	--	--	0.00752 U	0.00769 U	0.015 U	0.0079 U	0.0694 U	0.00739 UJ	0.00773 UJ	0.00793 U	--	0.00716 U	0.00673 U
Indeno(1,2,3-cd)pyrene	SW8270E	mg/kg	--	--	0.0131 U	0.0134 U	0.026 U	0.0137 U	0.121 U	0.0128 UJ	0.0134 UJ	0.0138 U	--	0.0124 UJ	0.0117 UJ
Naphthalene	SW8270E	mg/kg	--	--	0.0116 U	0.0119 U	0.0231 U	0.0122 U	0.107 U	0.0114 UJ	0.0119 UJ	0.0122 U	--	0.011 U	0.0104 U
Pentachlorophenol	SW8270E	mg/kg	1.2	1.2	0.0124 U	0.0127 U	0.0248 U	0.0131 U	0.115 U	0.0122 UJ	0.0128 UJ	0.0131 U	--	0.0118 U	0.0111 U
Phenanthrene	SW8270E	mg/kg	--	--	**0.0165 J**	**0.0145 J**	0.0183 U	0.00963 U	0.0847 U	0.00901 UJ	**0.0302 J**	0.00967 U	--	0.00873 U	0.00821 U
Phenol	SW8270E	mg/kg	0.12	0.21	0.0186 U	0.019 U	0.0371 U	0.0195 U	0.172 U	0.0183 UJ	0.0191 UJ	0.0196 U	--	0.0177 U	0.0166 U
Pyrene	SW8270E	mg/kg	--	--	**0.0153 J**	**0.013 J**	0.018 U	0.00944 U	0.083 U	0.00884 UJ	**0.0486 J**	**0.0272 J**	--	**0.0112 J**	0.00805 U
Total PAHs (calculated)	SW8270E	mg/kg	17	30	**0.0318**	**0.0275**	**0.0199**	0.0137 U	0.121 U	0.0128 U	**0.1984**	**0.0881**	--	**0.03825**	0.0117 U
Bulk Petroleum Hydrocarbons															
TPH-Diesel range	NWTPH-Dx	mg/kg	340	510	9.7 UJ	**151 J**	**21.2**	9.5 U	**676**	9.6 UJ	**29.5 J**	**154 J**	**91100**	9 U	**199 J**
TPH-Motor Oil	NWTPH-Dx	mg/kg	3600	4400	**17.8 J**	**241 J**	**98.6**	6.8 U	**2530**	**24.4 J**	**55.7 J**	**392 J**	**102000**	**46**	**905**

Notes:
[1] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the time of collection. Station was estimated)
Bold font = detected result
Bold font and gray-shaded cell = detected result greater than dry weight SCO
CSL = Cleanup Screening Level
FD = field duplicate
ft = feet
ID = identification
mg/kg = milligram(s) per kilogram
N = normal (parent) sample
PAH =Polycyclic Aromatic Hydrocarbons
SCO = Sediment Cleanup Objective
TPH = total petroleum hydrocarbons

Qualifier Definitions:
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may
or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-8. Step 2 Semi-Volatile Organic Compounds and Bulk Petroleum Hydrocarbon Results BNSF Wishram Sediment Remedial Investigation Report				Location ID	J060	J060	K200	O280
				Sample ID	BNSF-J060-SC-0.5-1.5-111422	BNSF-J060-SC-8.5-9.5-111422	BNSF-K200-SC-0.0-0.4-110922	BNSF-O280-SC-0.0-0.7-111322
				Sample Type	N	N	N	N
				Sample Depths (ft)	0.5 - 1.5	8.5 - 9.5	0 - 0.4	0 - 0.7
				Sample Date	11/14/2022	11/14/2022	11/9/2022	11/13/2022
Analyte	Method	Units	Dry Weight SCO	Dry Weight CSL				
Semi-Volatile Organic Compounds								
1-Methylnaphthalene	SW8270E	mg/kg	--	--	0.00586 U	0.00543 U	0.00538 U	0.00559 U
2-Methylnaphthalene	SW8270E	mg/kg	--	--	0.00595 U	0.00551 U	0.00546 U	0.00567 U
3 & 4-Methylphenol (m,p-Cresols)	SW8270E	mg/kg	0.26	2	0.0143 U	0.0133 U	0.0131 U	0.0137 U
Acenaphthene	SW8270E	mg/kg	--	--	0.00742 U	0.00687 U	0.00681 U	0.00708 U
Acenaphthylene	SW8270E	mg/kg	--	--	0.00645 U	0.00598 U	0.00592 U	0.00616 U
Anthracene	SW8270E	mg/kg	--	--	0.00816 U	0.00756 U	0.00749 U	0.00779 U
Benzo(a)anthracene	SW8270E	mg/kg	--	--	**0.00973 J**	0.00749 U	0.00741 U	0.00771 U
Benzo(a)pyrene	SW8270E	mg/kg	--	--	**0.00979 J**	0.00789 U	0.00782 U	0.00813 U
Benzo(b)fluoranthene	SW8270E	mg/kg	--	--	**0.0112 J**	0.00792 U	0.00784 U	0.00816 U
Benzo(g,h,i)perylene	SW8270E	mg/kg	--	--	0.00838 U	0.00777 U	0.00769 U	0.008 U
Benzo(k)fluoranthene	SW8270E	mg/kg	--	--	0.00815 U	0.00755 U	0.00748 U	0.00778 U
Benzoic Acid	SW8270E	mg/kg	2.9	3.8	0.162 U	0.15 U	0.149 U	0.155 U
Bis (2-ethylhexyl) phthalate	SW8270E	mg/kg	0.5	22	0.0581 U	0.0538 U	0.0533 U	0.0554 U
Carbazole	SW8270E	mg/kg	0.9	1.1	0.0142 U	0.0131 U	0.013 U	0.0135 U
Chrysene	SW8270E	mg/kg	--	--	**0.00922 J**	0.00844 U	0.00836 U	0.00869 U
Dibenzo(a,h)anthracene	SW8270E	mg/kg	--	--	0.0127 U	0.0118 U	0.0117 U	0.0121 U
Dibenzofuran	SW8270E	mg/kg	0.2	0.68	0.015 U	0.0139 U	0.0138 U	0.0143 U
Di-N-Butylphthalate	SW8270E	mg/kg	0.38	1	0.0157 U	0.0145 U	0.0144 U	0.015 U
Di-n-octyl phthalate	SW8270E	mg/kg	0.039	1.1	0.031 U	0.0287 U	0.0284 U	0.0296 U
Fluoranthene	SW8270E	mg/kg	--	--	**0.0206 J**	0.00766 U	0.00759 U	0.00789 U
Fluorene	SW8270E	mg/kg	--	--	0.00746 U	0.00691 U	0.00685 U	0.00712 U
Indeno(1,2,3-cd)pyrene	SW8270E	mg/kg	--	--	0.013 UJ	0.012 UJ	0.0119 U	0.0124 UJ
Naphthalene	SW8270E	mg/kg	--	--	0.0115 U	0.0107 U	0.0106 U	0.011 U
Pentachlorophenol	SW8270E	mg/kg	1.2	1.2	0.0123 U	0.0114 U	0.0113 U	0.0118 U
Phenanthrene	SW8270E	mg/kg	--	--	**0.0172 J**	0.00843 U	0.00835 U	0.00868 U
Phenol	SW8270E	mg/kg	0.12	0.21	0.0184 U	0.0171 U	0.0169 U	0.0176 U
Pyrene	SW8270E	mg/kg	--	--	**0.0195 J**	0.00826 U	0.00818 U	0.00851 U
Total PAHs (calculated)	SW8270E	mg/kg	17	30	**0.09724**	0.012 U	0.0119 U	0.0124 U
Bulk Petroleum Hydrocarbons								
TPH-Diesel range	NWTPH-Dx	mg/kg	340	510	9.9 U	8.6 U	**14.7 J**	9.1 U
TPH-Motor Oil	NWTPH-Dx	mg/kg	3600	4400	**29.9**	6.2 U	**58.8**	**12.1 J**

Notes:
[1] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the time of collectio
Bold font = detected result
Bold font and gray-shaded cell = detected result greater than dry weight SCO
CSL = Cleanup Screening Level
FD = field duplicate
ft = feet
ID = identification
mg/kg = milligram(s) per kilogram
N = normal (parent) sample
PAH =Polycyclic Aromatic Hydrocarbons
SCO = Sediment Cleanup Objective
TPH = total petroleum hydrocarbons

Qualifier Definitions:
J = Analyte was present but reported value may not be accurate or precise
U = This analyte was analyzed for but not detected at the specific detection limit
UJ = The analyte was not detected above the detection limit objective; the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 3-9. Step 2 Total Organic Carbon, Total Solids, and Grain Size Results BNSF Wishram Sediment Remedial Investigation Report		Location ID	EF240	EF240	EF240	EF470	F390	G000	G000	G020
		Sample ID	BNSF-EF240-SC-1.0-2.0-111022	BNSF-EF240-SC-1.0-2.0-111022-1	BNSF-EF240-SC-3.0-4.0-111022	BNSF-EF470-SC-11.0-12.0-110922	BNSF-F390-SC-6.2-7.2-110722	BNSF-G000-SC-1.5-2.5-110322	BNSF-G000-SC-4.0-5.0-110322	BNSF-G020-SC-0.0-1.0-110422
		Sample Type	N	FD	N	N	N	N	N	N
		Sample Depths (ft)	1 - 2	1 - 2	3 - 4	11 - 12	6.2 - 7.2	1.5 - 2.5	4 - 5	0 - 1
		Sample Date	11/10/2022	11/10/2022	11/10/2022	11/9/2022	11/7/2022	11/3/2022	11/3/2022	11/4/2022
Analyte	Method	Units								
Total Organic Carbon	SW9060A	mg/kg	**13000 J**	**13000 J**	**22000 J**	--	**32000 J**	**12000 J**	**13000 J**	**10000 J**
Total Solids	SM2540G	%	**72.1**	**70.4**	**72.2**	**68.6**	**78.1**	**73.3 J**	**70.1 J**	**68.3**
Cobbles	ASTM D422	%	0	--	0	--	0	0	0	0
Gravel	ASTM D422	%	0	--	0	--	0	0	0	0
Coarse Gravel	ASTM D422	%	0	--	0	--	0	0	0	0
Fine Gravel	ASTM D422	%	0	--	0	--	0	0	0	0
Sand	ASTM D422	%	**32**	--	**44**	--	**75**	**26**	**37**	**74**
Coarse Sand	ASTM D422	%	0	--	0	--	0	0	0	**0.4**
Medium Sand	ASTM D422	%	**0.2**	--	**1.0**	--	**1.3**	**0.2**	**0.2**	**0.6**
Fine Sand	ASTM D422	%	**32**	--	**43**	--	**74**	**25**	**37**	**74**
Fines	ASTM D422	%	**68**	--	**56**	--	**25**	**74**	**63**	**26**
Silt	ASTM D422	%	**63**	--	**52**	--	**24**	**71**	**58**	**24**
Clay	ASTM D422	%	**5.4**	--	**4.4**	--	**0.4**	**3.7**	**4.9**	**1.1**
Sieve 3.0 inch percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve 2.0 inch percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve 1.5 inch percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve 1.0 inch percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve 0.50 inch percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve 0.375 inch percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve, #4 percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve, #10 percent passing	ASTM D422	%	**100**	--	**100**	--	**100**	**100**	**100**	**100**
Sieve, #40 percent passing	ASTM D422	%	**100**	--	**99**	--	**99**	**100**	**100**	**99**
Sieve, #60 percent passing	ASTM D422	%	**99**	--	**98**	--	**95**	**100**	**99**	**98**
Sieve, #100 percent passing	ASTM D422	%	**96**	--	**90**	--	**73**	**97**	**92**	**85**
Sieve, #200 percent passing	ASTM D422	%	**68**	--	**56**	--	**25**	**74**	**63**	**26**
Hydrometer Reading after 1 min - Percent Finer	ASTM D422	%	**33.6**	--	**20.8**	--	**4.0**	**39**	**29.3**	**4.20**
Hydrometer Reading after 15 min - Percent Finer	ASTM D422	%	**11.8**	--	**8.5**	--	**1.1**	**9.3**	**10.4**	**1.6**
Hydrometer Reading after 30 min - Percent Finer	ASTM D422	%	**7.7**	--	**6.3**	--	**0.8**	**7**	**9.1**	**1.4**
Hydrometer Reading after 60 min - Percent Finer	ASTM D422	%	**6.3**	--	**5.2**	--	**0.6**	**4.8**	**6.6**	**1.1**
Hydrometer Reading after 240 min - Percent Finer	ASTM D422	%	**4.0**	--	**3.3**	--	**0.2**	**3.4**	**4.1**	**1.0**
Hydrometer Reading after 1440 min - Percent Finer	ASTM D422	%	**3.3**	--	**2.7**	--	**0.1**	**1.9**	**3.5**	**0.4**

Notes:
[1] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the time of collection. Station was estimated)
Bold font = detected result
FD = field duplicate
ft = feet
ID = identification
min = minute
N = normal (parent) sample

Qualifier Definitions:
J = Analyte was present but reported value may not be accurate or precise

Table 3-9. Step 2 Total Organic Carbon, Total Solids, and Grain Size Results BNSF Wishram Sediment Remedial Investigation Report	Location ID		G200	HN300[1]	I500	J060	J060	K200	O280
	Sample ID		BNSF-G200-SC-4.0-5.0-110722	BNSF-HN300-SC-1.0-2.0-111322	BNSF-I500-SC-0.0-0.8-111322	BNSF-J060-SC-0.5-1.5-111422	BNSF-J060-SC-8.5-9.5-111422	BNSF-K200-SC-0.0-0.4-110922	BNSF-O280-SC-0.0-0.7-111322
	Sample Type		N	N	N	N	N	N	N
	Sample Depths (ft)		4 - 5	1 - 2	0 - 0.8	0.5 - 1.5	8.5 - 9.5	0 - 0.4	0 - 0.7
	Sample Date		11/7/2022	11/13/2022	11/13/2022	11/14/2022	11/14/2022	11/9/2022	11/13/2022
Analyte	Method	Units							
Total Organic Carbon	SW9060A	mg/kg	--	--	--	--	**370 J**	**2300 J**	--
Total Solids	SM2540G	%	--	**75.7**	**80.5**	**72.7**	**78.4**	**79.2**	**76.1**
Cobbles	ASTM D422	%	0	--	--	--	--	--	--
Gravel	ASTM D422	%	**8.7**	--	--	--	--	--	--
Coarse Gravel	ASTM D422	%	0.1	--	--	--	--	--	--
Fine Gravel	ASTM D422	%	**8.7**	--	--	--	--	--	--
Sand	ASTM D422	%	**26**	--	--	--	--	--	--
Coarse Sand	ASTM D422	%	**11**	--	--	--	--	--	--
Medium Sand	ASTM D422	%	**11**	--	--	--	--	--	--
Fine Sand	ASTM D422	%	**3.6**	--	--	--	--	--	--
Fines	ASTM D422	%	**65**	--	--	--	--	--	--
Silt	ASTM D422	%	**57**	--	--	--	--	--	--
Clay	ASTM D422	%	**7.7**	--	--	--	--	--	--
Sieve 3.0 inch percent passing	ASTM D422	%	**100**	--	--	--	--	--	--
Sieve 2.0 inch percent passing	ASTM D422	%	**100**	--	--	--	--	--	--
Sieve 1.5 inch percent passing	ASTM D422	%	**100**	--	--	--	--	--	--
Sieve 1.0 inch percent passing	ASTM D422	%	**100**	--	--	--	--	--	--
Sieve 0.50 inch percent passing	ASTM D422	%	**100**	--	--	--	--	--	--
Sieve 0.375 inch percent passing	ASTM D422	%	**99**	--	--	--	--	--	--
Sieve, #4 percent passing	ASTM D422	%	**91**	--	--	--	--	--	--
Sieve, #10 percent passing	ASTM D422	%	**80**	--	--	--	--	--	--
Sieve, #40 percent passing	ASTM D422	%	**69**	--	--	--	--	--	--
Sieve, #60 percent passing	ASTM D422	%	**68**	--	--	--	--	--	--
Sieve, #100 percent passing	ASTM D422	%	**67**	--	--	--	--	--	--
Sieve, #200 percent passing	ASTM D422	%	**65**	--	--	--	--	--	--
Hydrometer Reading after 1 min - Percent Finer	ASTM D422	%	**36.4**	--	--	--	--	--	--
Hydrometer Reading after 15 min - Percent Finer	ASTM D422	%	**15.3**	--	--	--	--	--	--
Hydrometer Reading after 30 min - Percent Finer	ASTM D422	%	**12.7**	--	--	--	--	--	--
Hydrometer Reading after 60 min - Percent Finer	ASTM D422	%	**9.4**	--	--	--	--	--	--
Hydrometer Reading after 240 min - Percent Finer	ASTM D422	%	**6.6**	--	--	--	--	--	--
Hydrometer Reading after 1440 min - Percent Finer	ASTM D422	%	**4.6**	--	--	--	--	--	--

Notes:
[1] Changed station name from HN300 to KN400 post sample collection based on actualy X,Y (no target X,Y available at the

Bold font = detected result
FD = field duplicate
ft = feet
ID = identification
min = minute
N = normal (parent) sample

Qualifier Definitions:
J = Analyte was present but reported value may not be accurate or precise

Figures

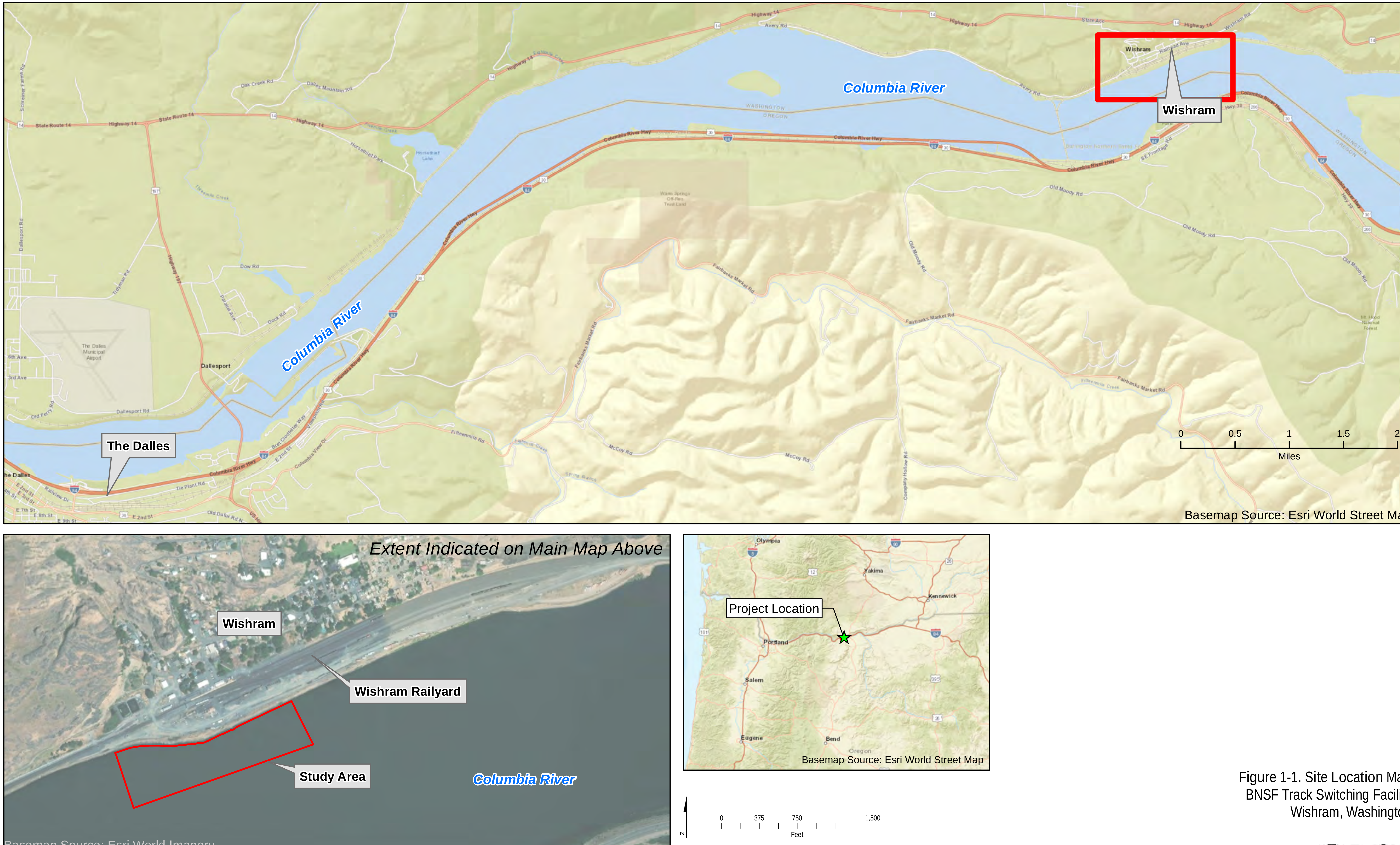
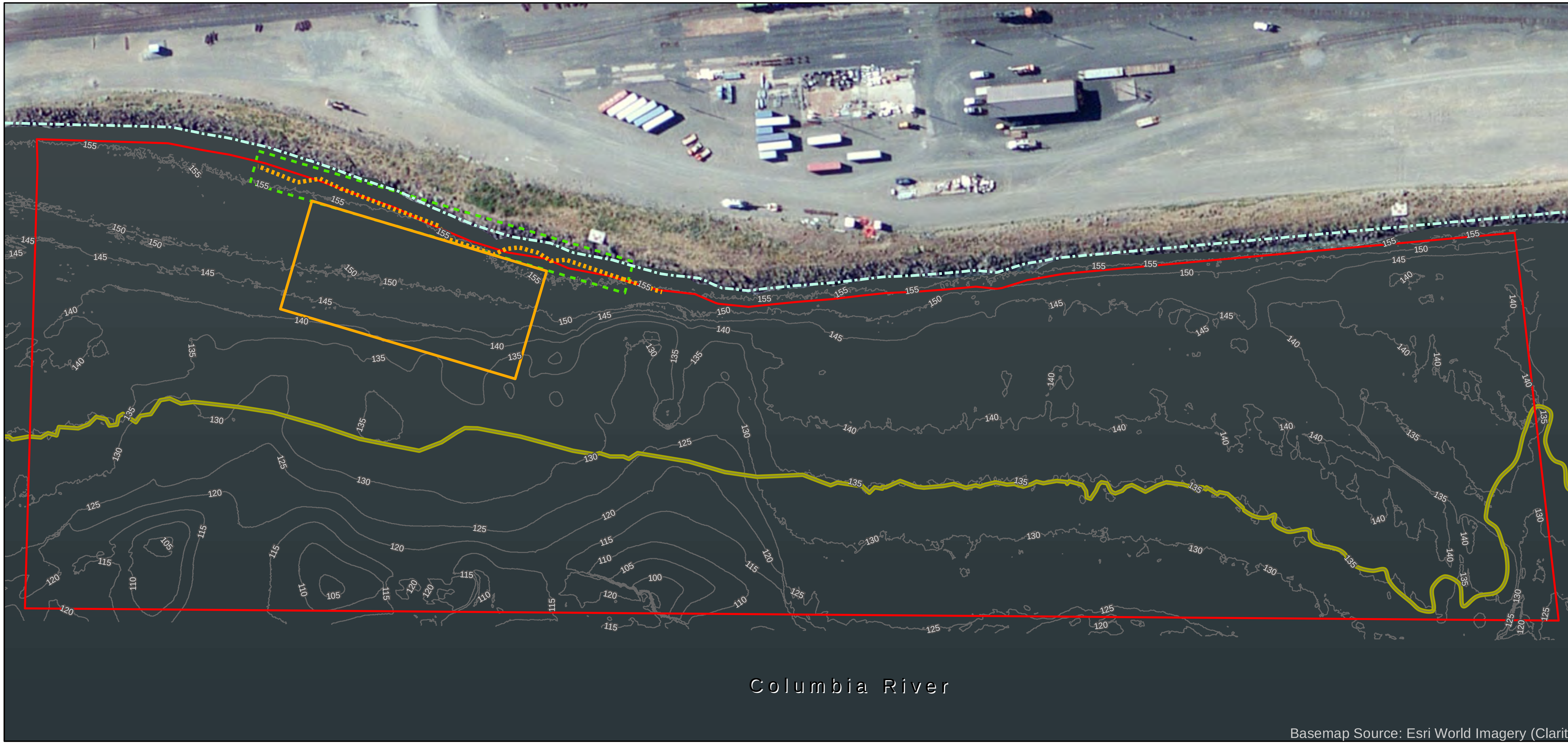


Figure 1-1. Site Location Map
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE1-1_SITEMAP.MXD GGEE 4/7/2023 09:52:35



LEGEND

- Remedial Investigation Area
- WA Ecology Initial Investigation Area
- 2018 Initial Investigation Area
- Current Shoreline
- Former Shoreline
- Toe of Exposed Riprap observed within 2018 Sampling Investigation Area
- 2022 Bathymetric Contour (ft NAVD88, 5 ft Contour Interval)

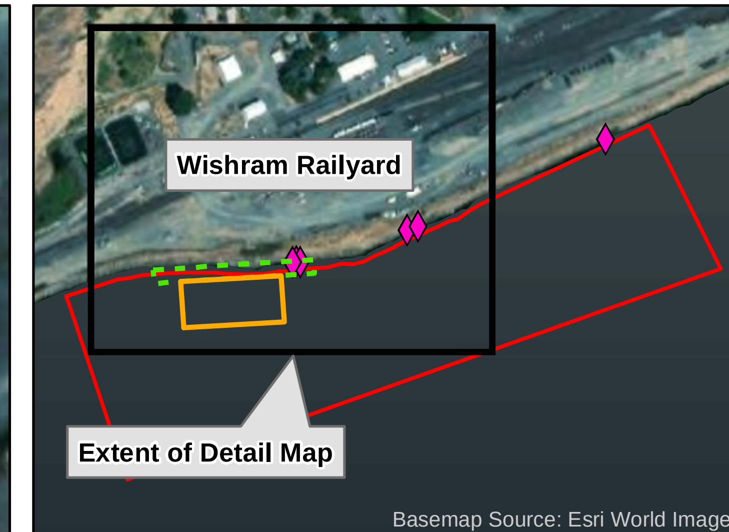
N

0 100 200 400
Feet

Figure 1-2. Area Features
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE1-2_AREAFEATURES.MXD GGEE 4/7/2023 10:12:17



LEGEND

- Former Outfall Location
- Remedial Investigation Area
- Stormwater Underdrain (A portion removed from service circa 1960)
- Stormwater Underdrain (Rerouted portion circa 1960)
- Current Shoreline
- WA Ecology Initial Investigation Area (March 3, 2017 Ecology letter)
- 2018 Initial Investigation Area (Ecology-approved Work Plan)

Notes:
OWS = oil/water separator

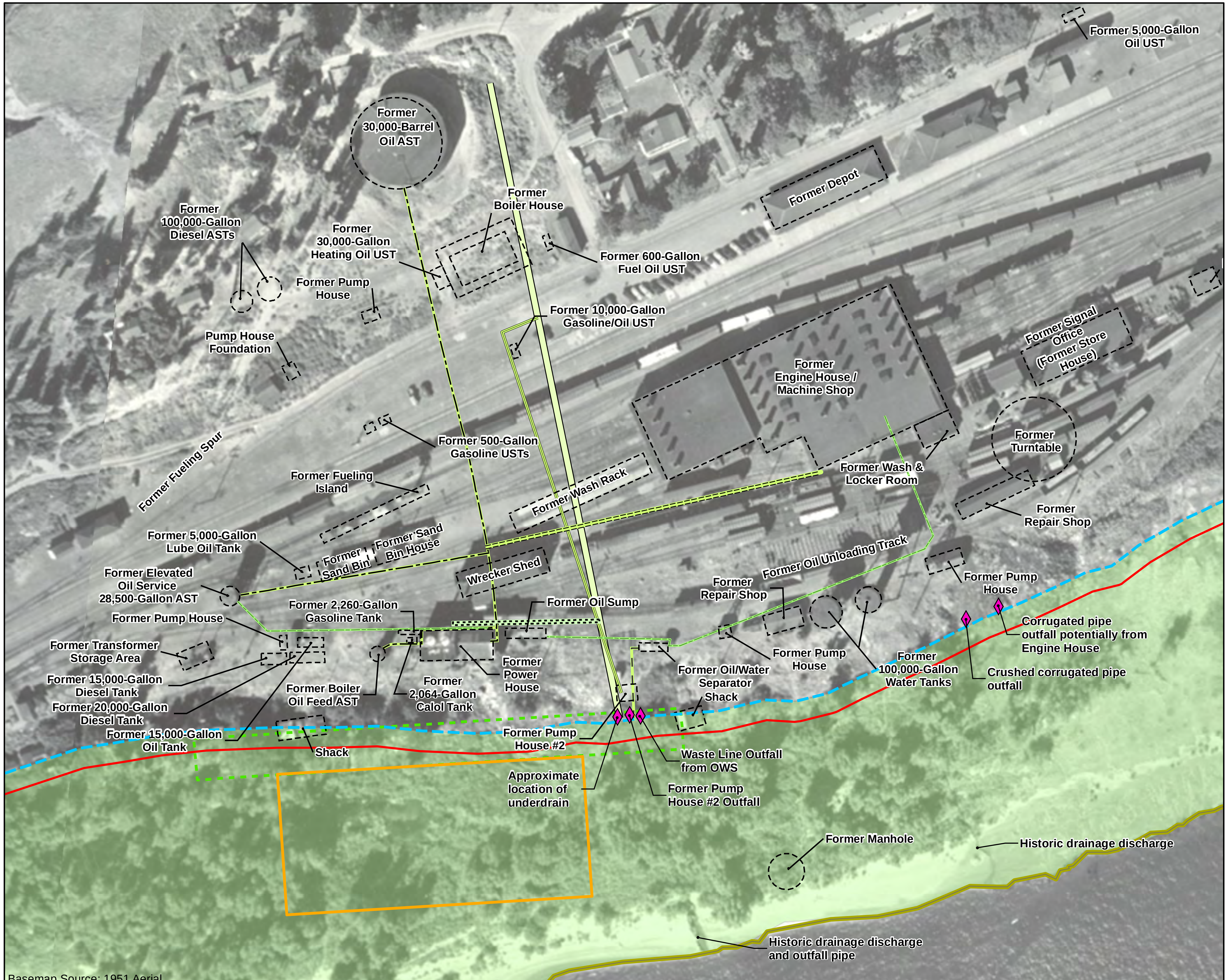
N

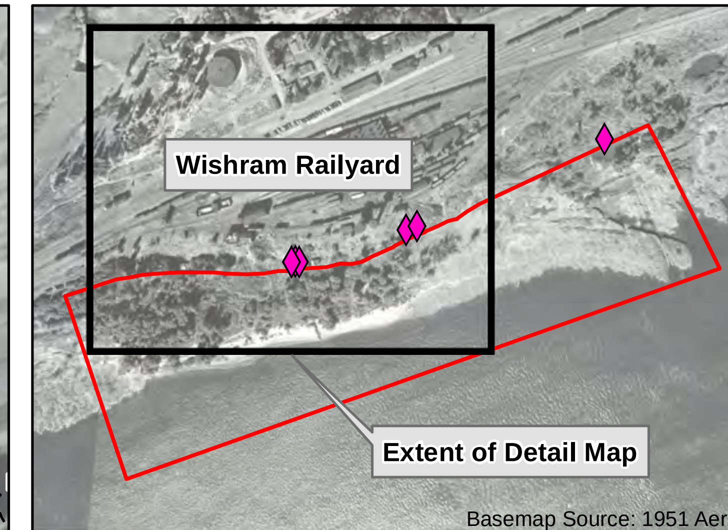
0 75 150 300
Feet

Figure 1-3. Current Site Features
BNSF Track Switching Facility
Wishram, Washington

Jacobs

SLC \\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE1-3_CURRENT_SITE_FEATURES.MXD GGEE 4/7/2023 10:54:43





- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Steam Line
- Former Bunker Fuel / Oil Pipeline
- Former Oil Drain
- Former Oil Trough
- Former Sewer Line (Potential)
- Stormwater Underdrain (A portion removed from service circa 1960)
- Stormwater Underdrain (Rerouted portion circa 1960)
- Former Site Feature
- WA Ecology Initial Investigation Area
- 2018 Initial Investigation Area
- Former Shoreline
- Inundated Lands

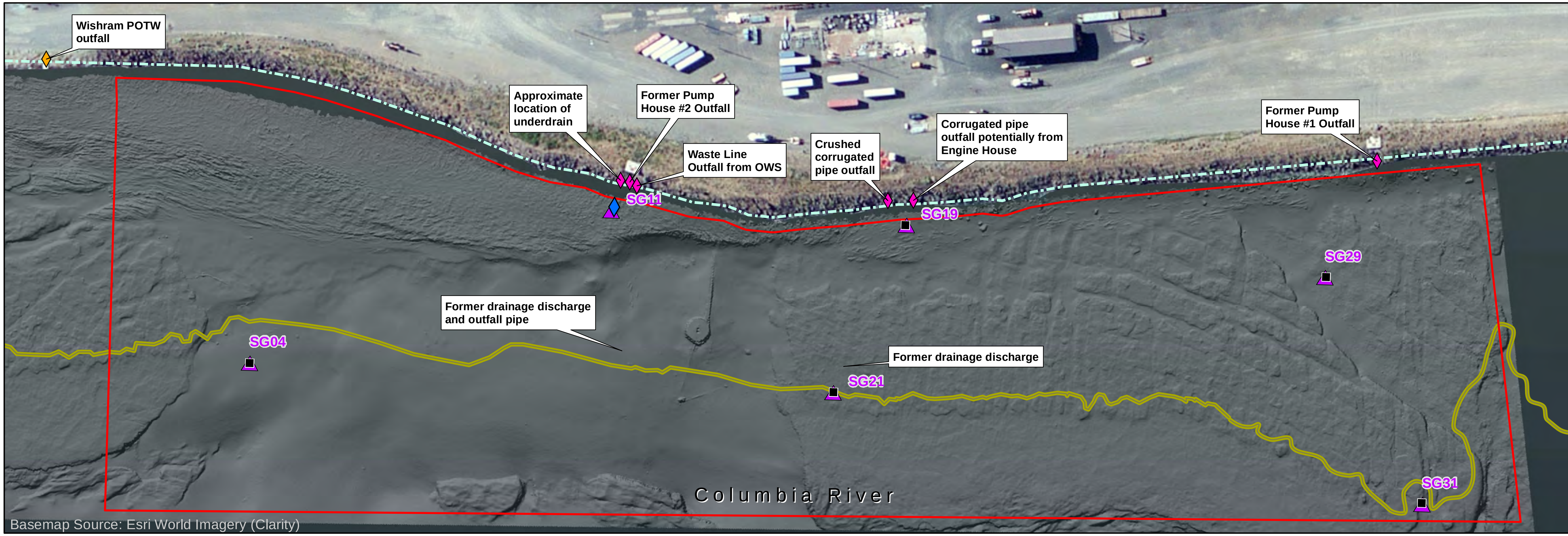
N

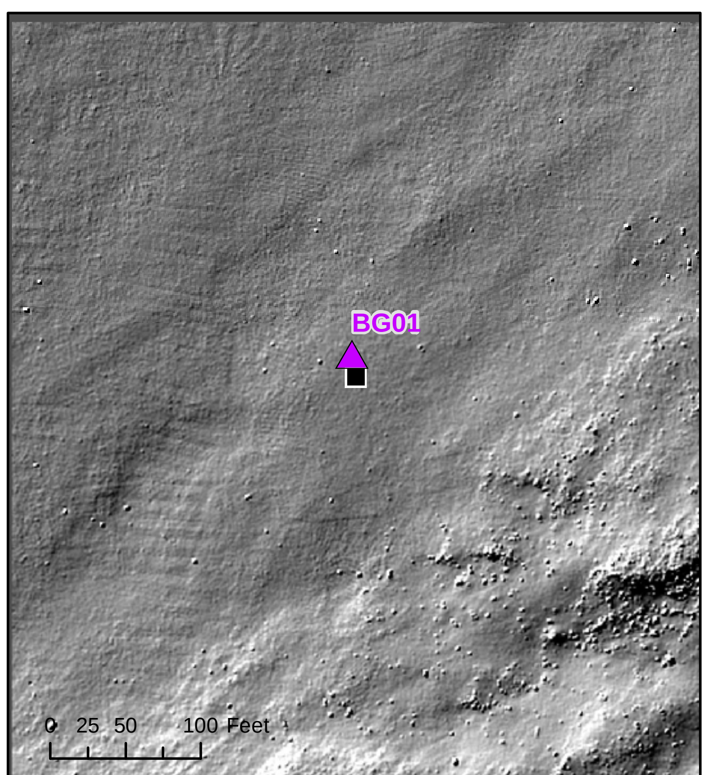
0 75 150 300
Feet

Figure 1-4. Former Site Features Shown on 1951 Aerial
BNSF Track Switching Facility
Wishram, Washington

Jacobs

SLC \\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE1-4_HISTORICAL_SITE_FEATURES.MXD GGEE 4/7/2023 11:12:49





LEGEND

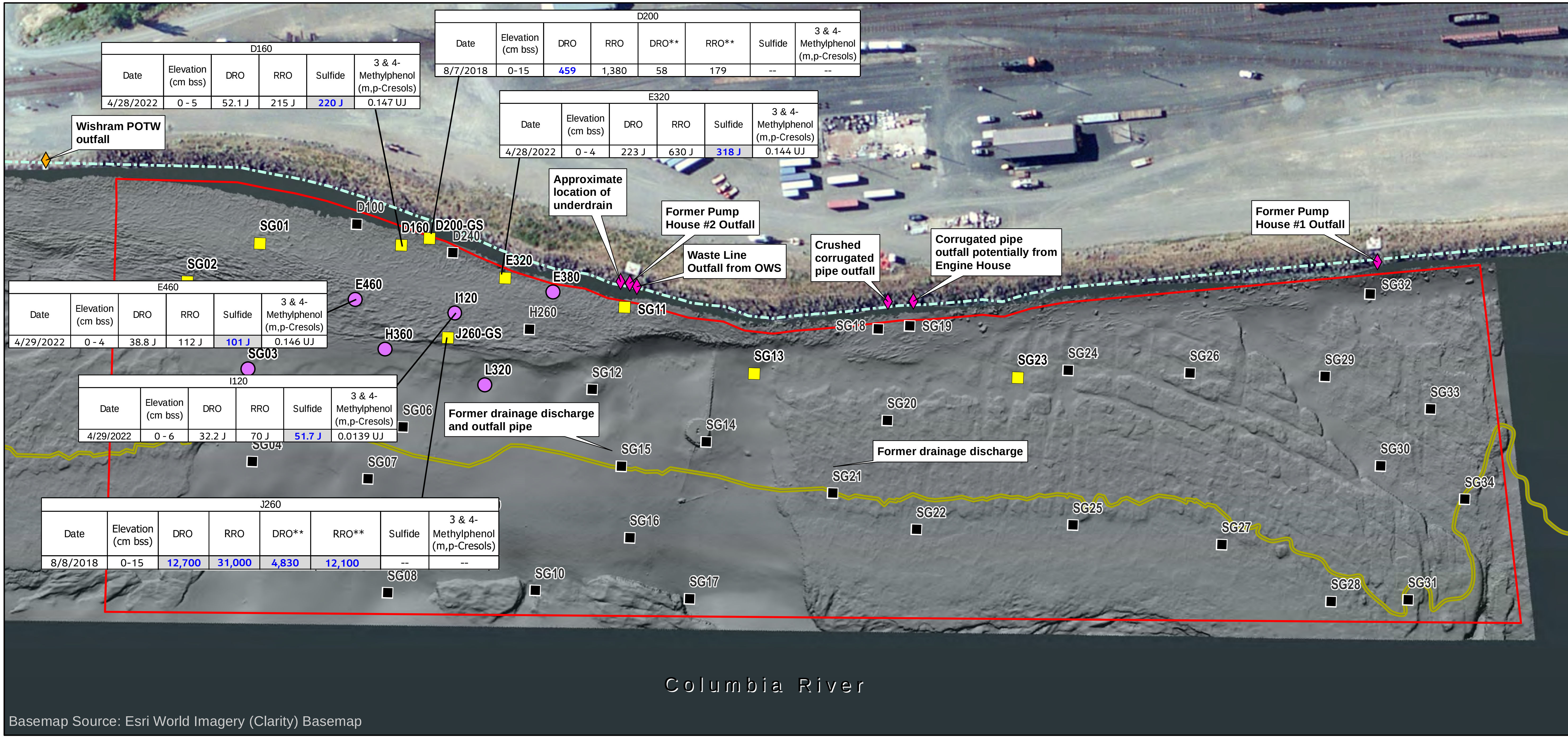
- SPI Camera Location
- O_2 Profile Sample
- No O_2 Profile Sample
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

Notes:
OWS = oil/water separator
POTW = publicly owned treatment works
SPI = Sediment Profile Imaging
O_2 = oxygen

Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

Figure 2-1. SPI Camera and Oxygen Profiling Locations
BNSF Track Switching Facility
Wishram, Washington

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE2-1_SPILOCATIONS.MXD GGEE 4/17/2023 14:53:53



D160

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/28/2022	0 - 5	52.1 J	215 J	**220 J**	0.147 UJ

D200

Date	Elevation (cm bss)	DRO	RRO	DRO**	RRO**	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
8/7/2018	0-15	**459**	1,380	58	179	--	--

E320

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/28/2022	0 - 4	223 J	630 J	**318 J**	0.144 UJ

E460

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/29/2022	0 - 4	38.8 J	112 J	**101 J**	0.146 UJ

I120

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/29/2022	0 - 6	32.2 J	70 J	**51.7 J**	0.0139 UJ

J260

Date	Elevation (cm bss)	DRO	RRO	DRO**	RRO**	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
8/8/2018	0-15	**12,700**	**31,000**	**4,830**	**12,100**	--	--

LEGEND

- Composite Grab Sample (6 locations)
- Grab Sample (9 locations)
- No Sample* (31 locations)
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

Notes:
*No recovery due to the presence of bedrock, cobbles, boulders, grass, or shells.
OWS = oil/water separator
POTW = publicly owned treatment works

Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

Sample locations portrayed at centroid of locations with multiple attempts.

Analyte	Units	SCO[1]	CSL[2]
Sulfide	mg/kg	39	61
3 & 4-Methylphenol (m,p-Cresols)[3]	mg/kg	0.26	2
DRO	mg/kg	340	510
RRO	mg/kg	3600	4400

Table Notes:
[1] Washington Freshwater Sediment Cleanup Objectives (SCO)
[2] Washington Freshwater Sediment Cleanup Screening Levels (CSL)
[3] 3-methylphenol and 4-methylphenol may not be able to be separated. In this case 4-methylphenol may be reported as the sum of the 3- and 4-methylphenol isomers

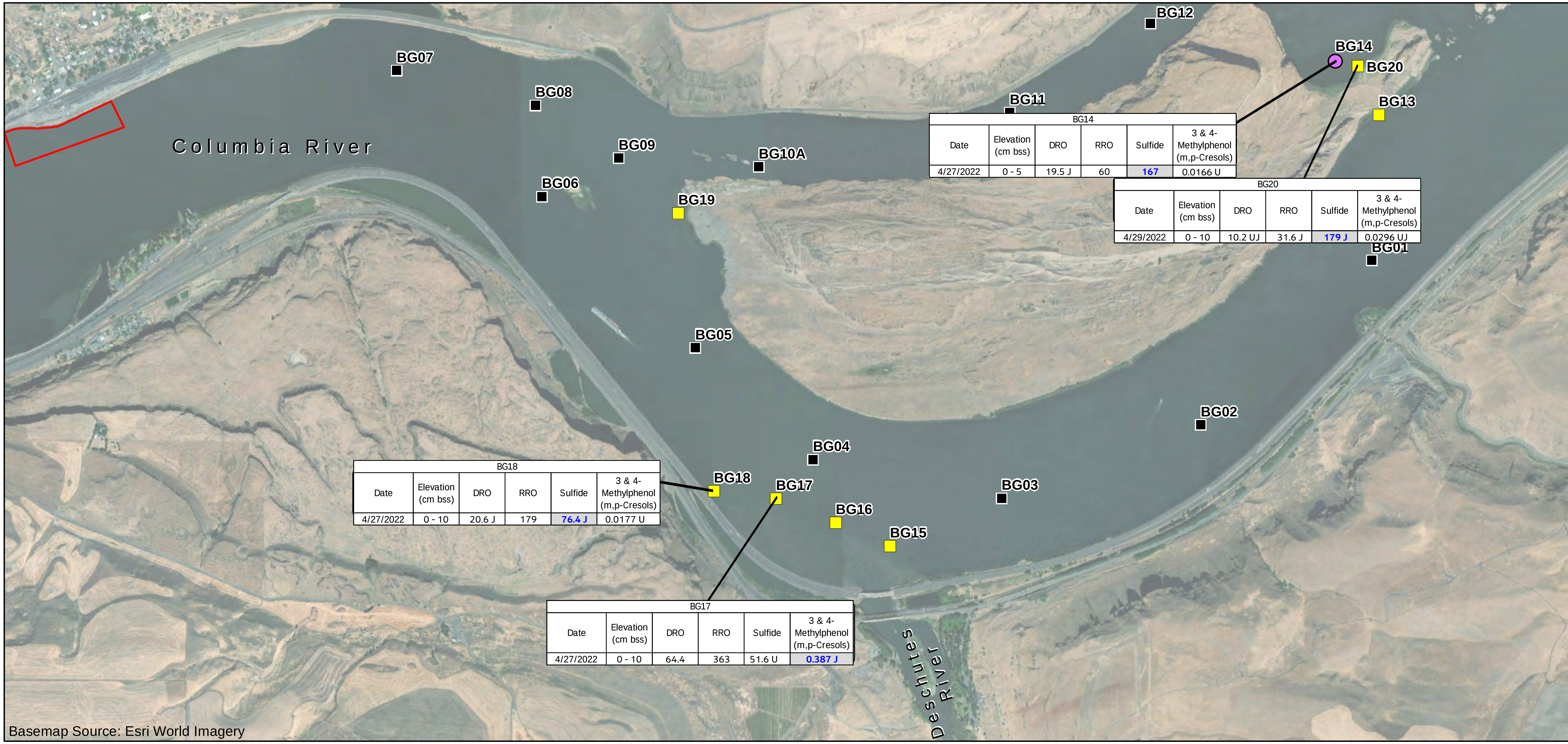
** - Analyzed with silica gel cleanup. Limited to samples collected during the 2018 Initial Investigation.
Values in blue bold are in excess of the SCO
Shaded values are in excess of the CSL
Results are presented in mg/kg
bss – below sediment surface
cm – centimeters
DRO – Diesel range organics
J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value. mg/kg – milligram per kilogram
RRO – Residual range organics
U - not detected above the practical quantitation limit

0 100 200 400
Feet

Figure 2-2. Grab Sample Locations with Analytical Results Exceeding one or more Screening Levels or Cleanup Objectives - Surface
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE2-2_GRABLOCATIONS.MXD GGEE 4/14/2023 14:40:16



BG14

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/27/2022	0 - 5	19.5 J	60	**167**	0.0166 U

BG20

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/29/2022	0 - 10	10.2 UJ	31.6 J	**179 J**	0.0296 UJ

BG18

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/27/2022	0 - 10	20.6 J	179	**76.4 J**	0.0177 U

BG17

Date	Elevation (cm bss)	DRO	RRO	Sulfide	3 & 4-Methylphenol (m,p-Cresols)
4/27/2022	0 - 10	64.4	363	51.6 U	**0.387 J**

LEGEND

- Composite Grab Sample (1 location)
- Grab Sample (7 locations)
- No Sample* (12 locations)
- Remedial Investigation Area

Notes:
*No recovery due to the presence of bedrock, cobbles, boulders, grass, or shells.
Sample locations portrayed at centroid of locations with multiple attempts.

Analyte	Units	SCO[1]	CSL[2]
Sulfide	mg/kg	39	61
3 & 4-Methylphenol (m,p-Cresols)[3]	mg/kg	0.26	2
DRO	mg/kg	340	510
RRO	mg/kg	3600	4400

Table Notes:
[1] Washington Freshwater Sediment Cleanup Objectives (SCO)
[2] Washington Freshwater Sediment Cleanup Screening Levels (CSL)
[3] 3-methylphenol and 4-methylphenol may not be able to be separated. In this case 4-methylphenol may be reported as the sum of the 3- and 4-methylphenol isomers

Values in blue bold are in excess of the SCO
Shaded values are in excess of the CSL
Results are presented in mg/kg
bss – below sediment surface
cm – centimeters
DRO – Diesel range organics
J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
mg/kg – milligram per kilogram
RRO – Residual range organics
U - not detected above the practical quantitation limit

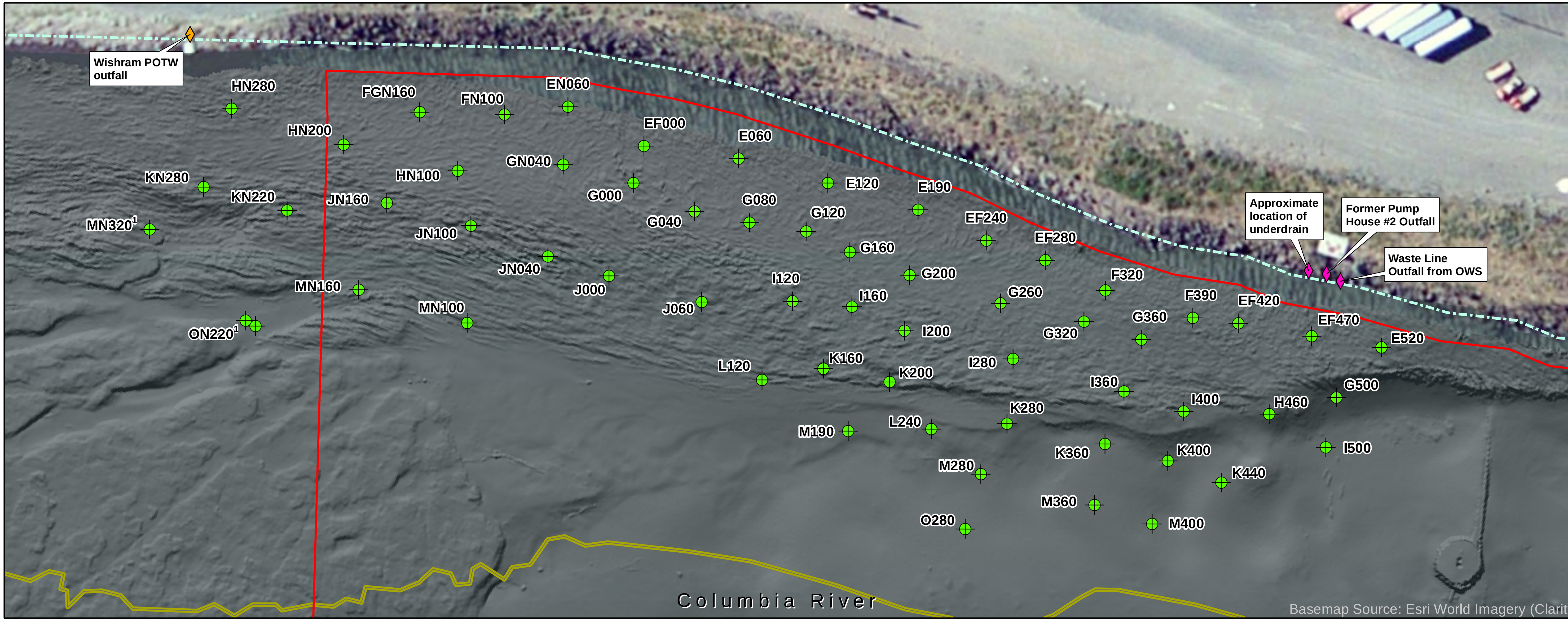
N

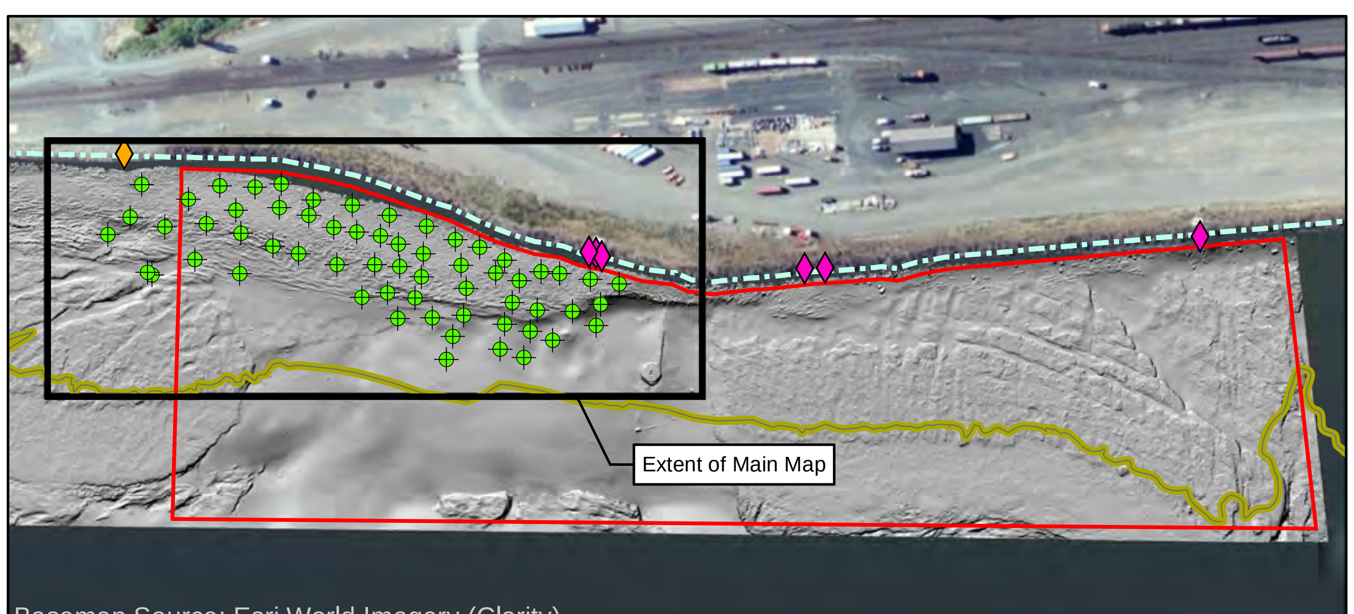
0 0.125 0.25 0.5
Miles

Figure 2-3. Background Sample Locations with Analytical Results Exceeding one or more Screening Levels or Cleanup Objectives
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE2-3_BACKGROUNDSAMPLELOCATIONS.MXD GGEE 4/14/2023 13:36:52





LEGEND

Remedial Investigation Location

- TarGOST
- Current Outfall Location
- Former Outfall Location

- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

Notes:
OWS = oil/water separator
POTW = publicly owned treatment works
¹Refusal at surface.

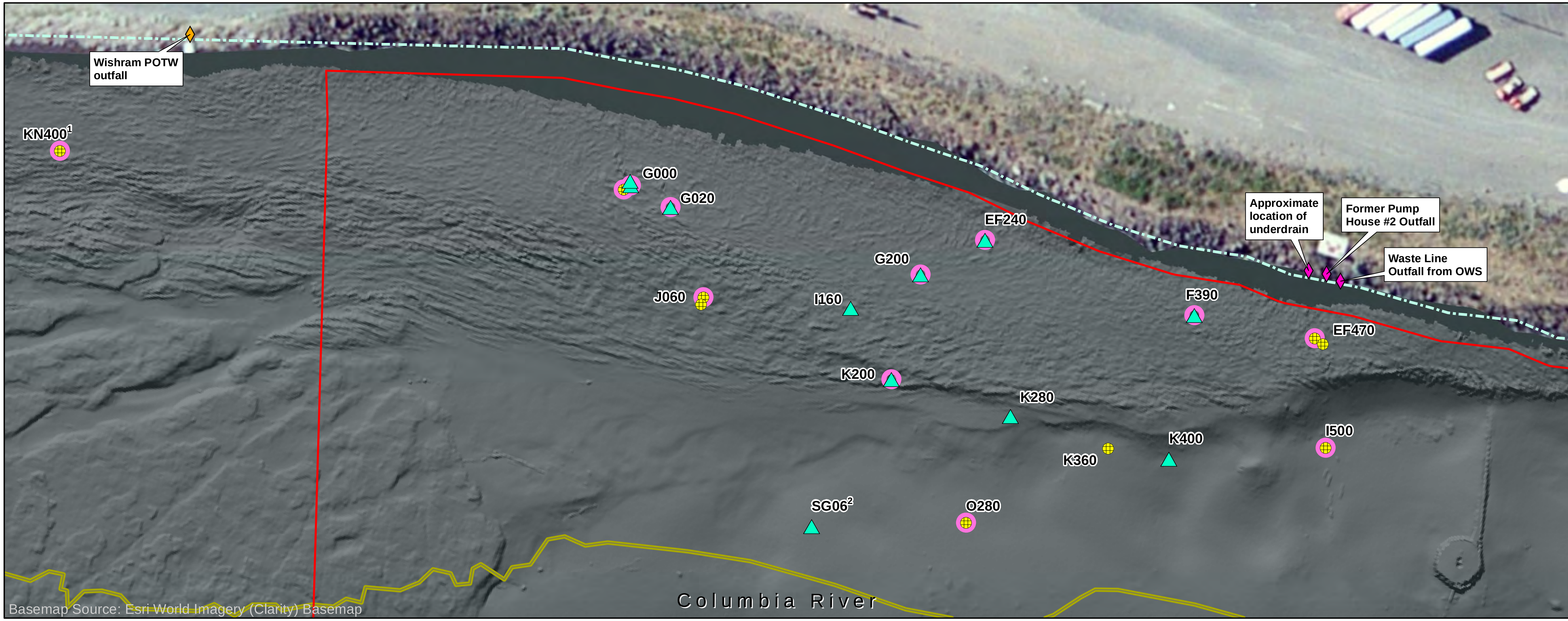
Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

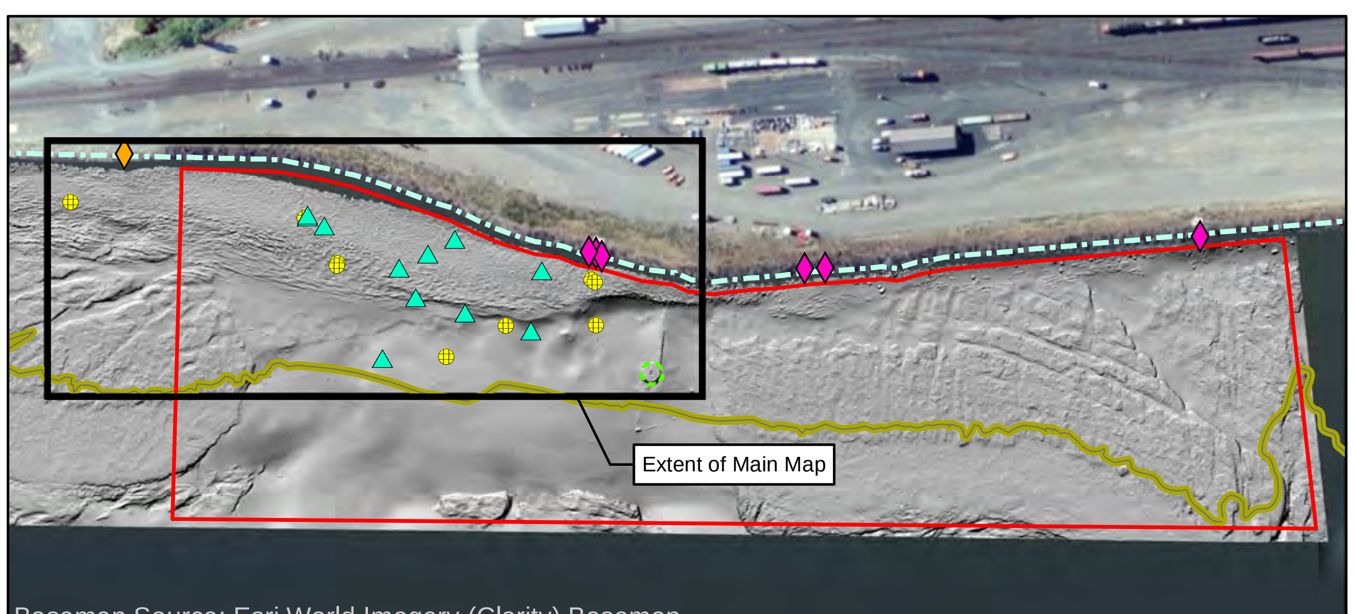
0 25 50 100
Feet

Figure 2-4. TarGOST Profiling Locations
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE2-4_TARGOST.MXD GGEE 4/14/2023 13:29:01





LEGEND

Remedial Investigation Location

- Geoprobe (DPT)
- Vibracore
- Sample Collected from Location
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

Notes:
OWS = oil/water separator; POTW = publicly owned treatment works
DPT = direct push technology
[1]Changed station name from HN300 to KN400 post sample collection based on actual X,Y. (No target X,Y available at the time of collection. Station was estimated.)
[2]Refusal at surface.

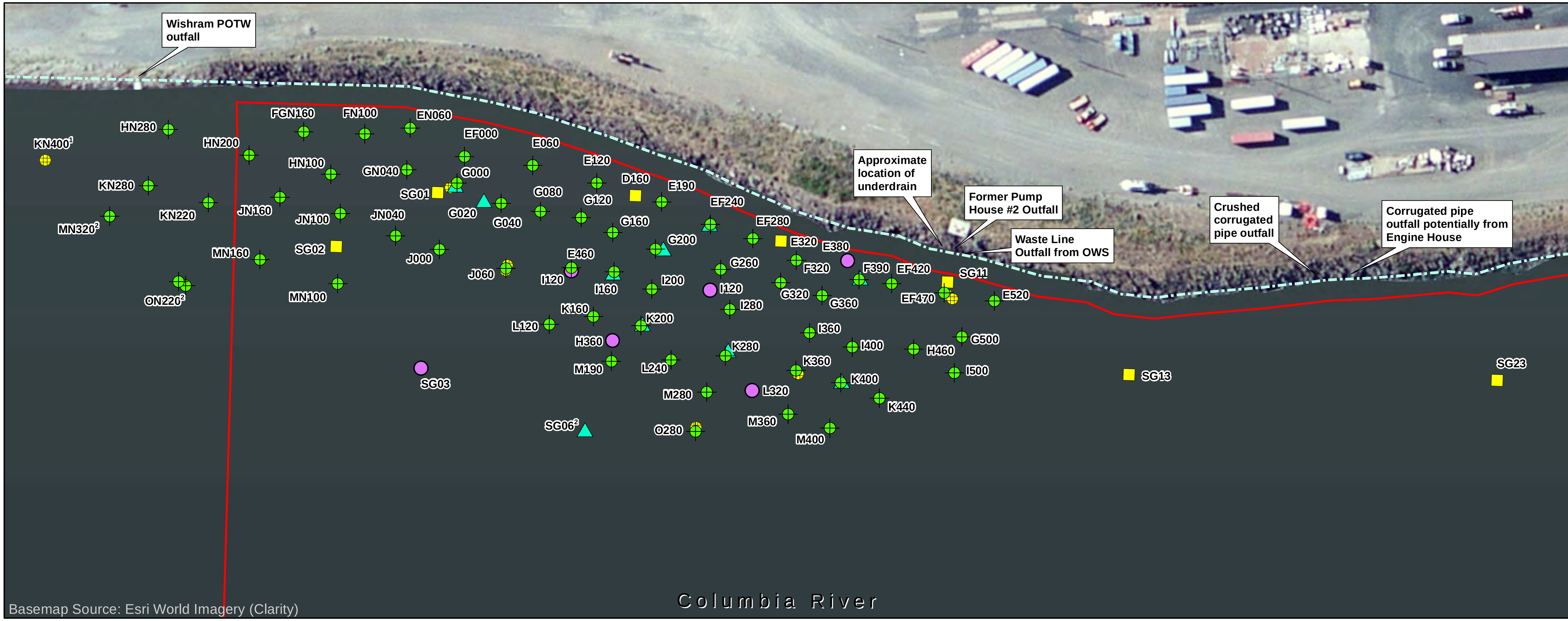
0 25 50 100
Feet

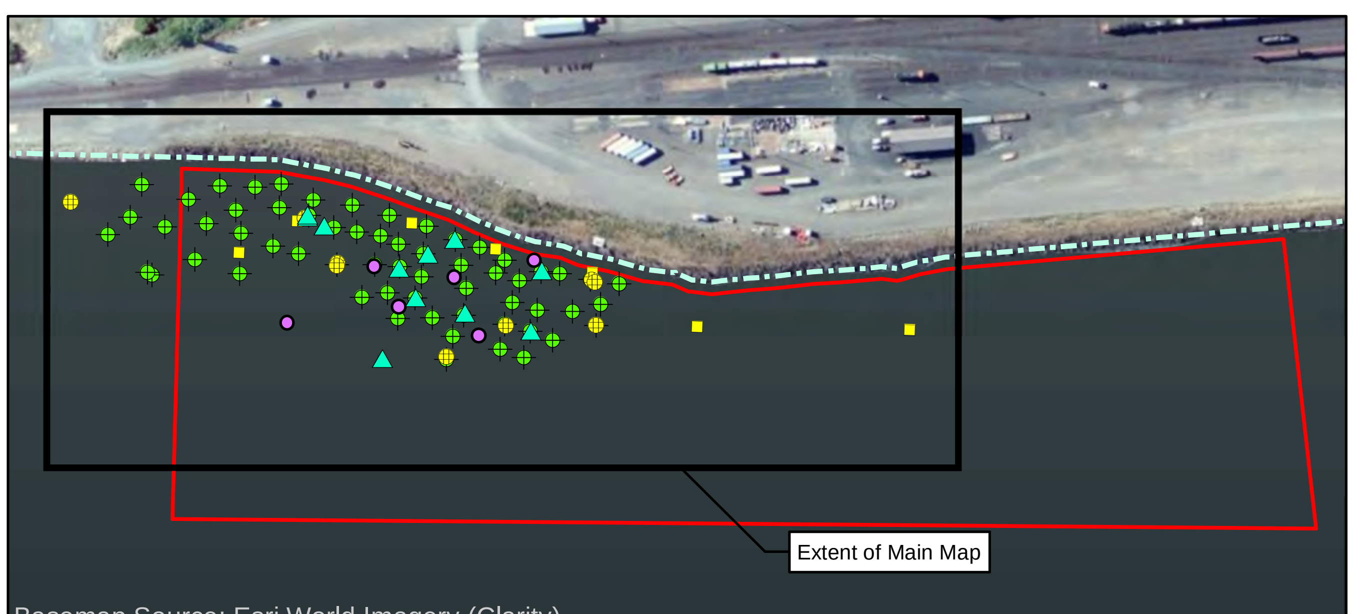
Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

Figure 2-5. Subsurface Sediment Characterization
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE2-5_SEDIMENT.MXD GGEE 4/17/2023 11:59:50



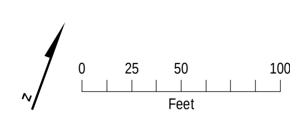


LEGEND

Remedial Investigation Location

- Geoprobe (DPT)
- Vibracore
- Grab Composite Sample
- Grab Sample
- TarGOST
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

Notes:
OWS = oil/water separator; POTW = publicly owned treatment works
[1]Changed station name from HN300 to KN400 post sample collection based on actual X,Y. (No target X,Y available at the time of collection. Station was estimated.)
[2]Refusal at surface.

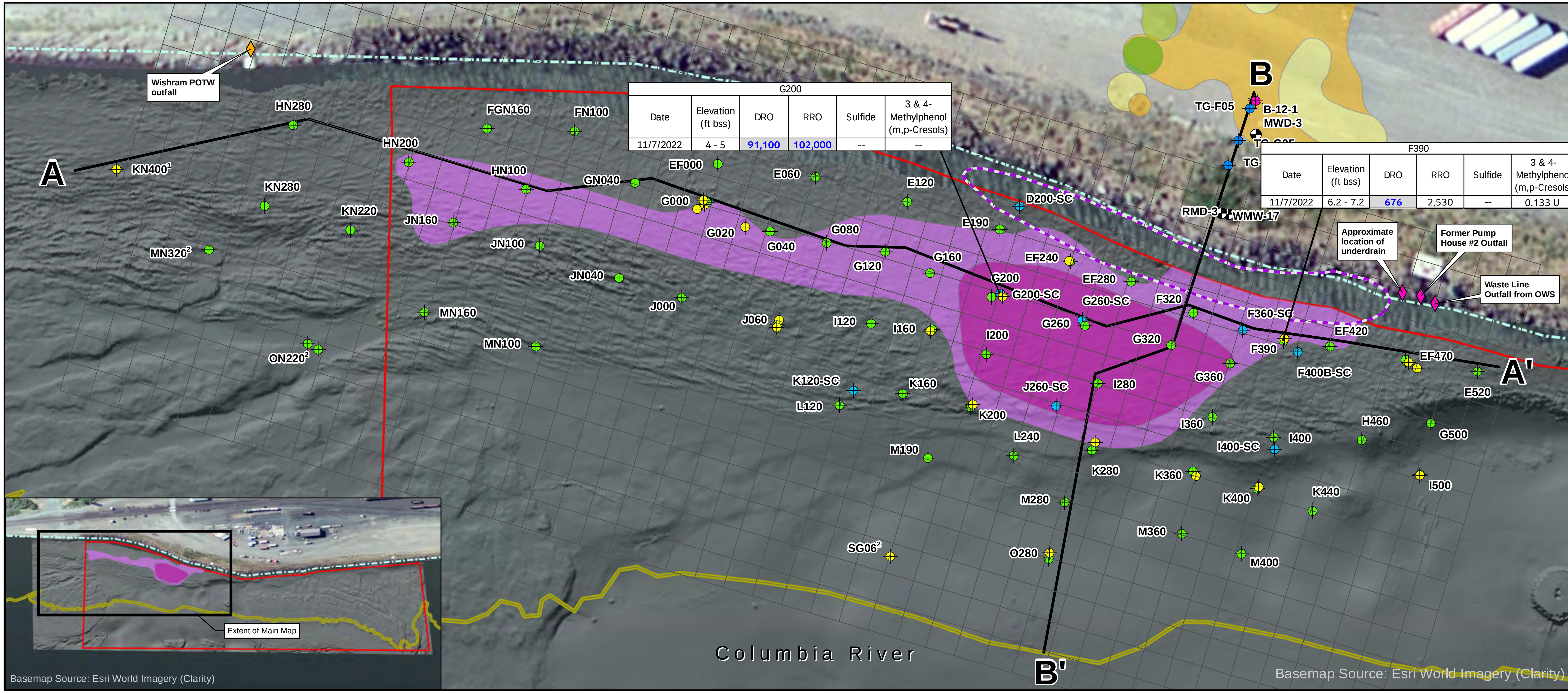


Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

Figure 3-1. Site Grab Sample, TarGOST, and Sediment Core Locations
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE3-1_ALLSAMPLESB.MXD GGEE 4/17/2023 12:02:12



LEGEND

- 2022 TarGOST Location
- 2022 Sediment Core
- 2018 Sediment Core
- Upland RI TarGOST Location
- Upland Boring
- Groundwater Monitoring Well
- Extent of NAPL Impacts
- Approximate Extent of Sheen-Generating NAPL Impacts
- Area of Intermittent NAPL Sheening
- Small-extent NAPL Sheens Observed (Ecology, 2017)
- Current Outfall Location
- Former Outfall Location
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline
- Cross Section Line
- Inferred Lateral Extent of Smear Zone Diesel Impacts
- Inferred Lateral Extent of Submerged Diesel Impacts
- Inferred Lateral Extent of Smear Zone Oil Impacts
- Inferred Lateral Extent of Submerged Oil Impacts

OWS = oil/water separator; POTW = publicly owned treatment works

[1]Changed station name from HN300 to KN400 post sample collection based on actual X,Y. (No target X,Y available at the time of collection. Station was estimated.)

[2]Refusal at surface.

Analyte	Units	SCO[1]	CSL[2]
Sulfide	mg/kg	39	61
3 & 4-Methylphenol (m,p-Cresols)[3]	mg/kg	0.26	2
DRO	mg/kg	340	510
RRO	mg/kg	3600	4400

Table Notes:

[1] Washington Freshwater Sediment Cleanup Objectives (SCO)

[2] Washington Freshwater Sediment Cleanup Screening Levels (CSL)

[3] 3-methylphenol and 4-methylphenol may not be able to be separated. In this case 4-methylphenol may be reported as the sum of the 3- and 4-methylphenol isomers

-- = Not analyzed or not applicable

Values in **blue** bold are in excess of the SCO Shaded values are in excess of the CSL

Results are presented in mg/kg

bss – below sediment surface

DRO – Diesel range organics

ft – feet

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

mg/kg – milligram per kilogram

RRO – Residual range organics

U - not detected above the practical quantitation limit

0 25 50 100

Feet

N

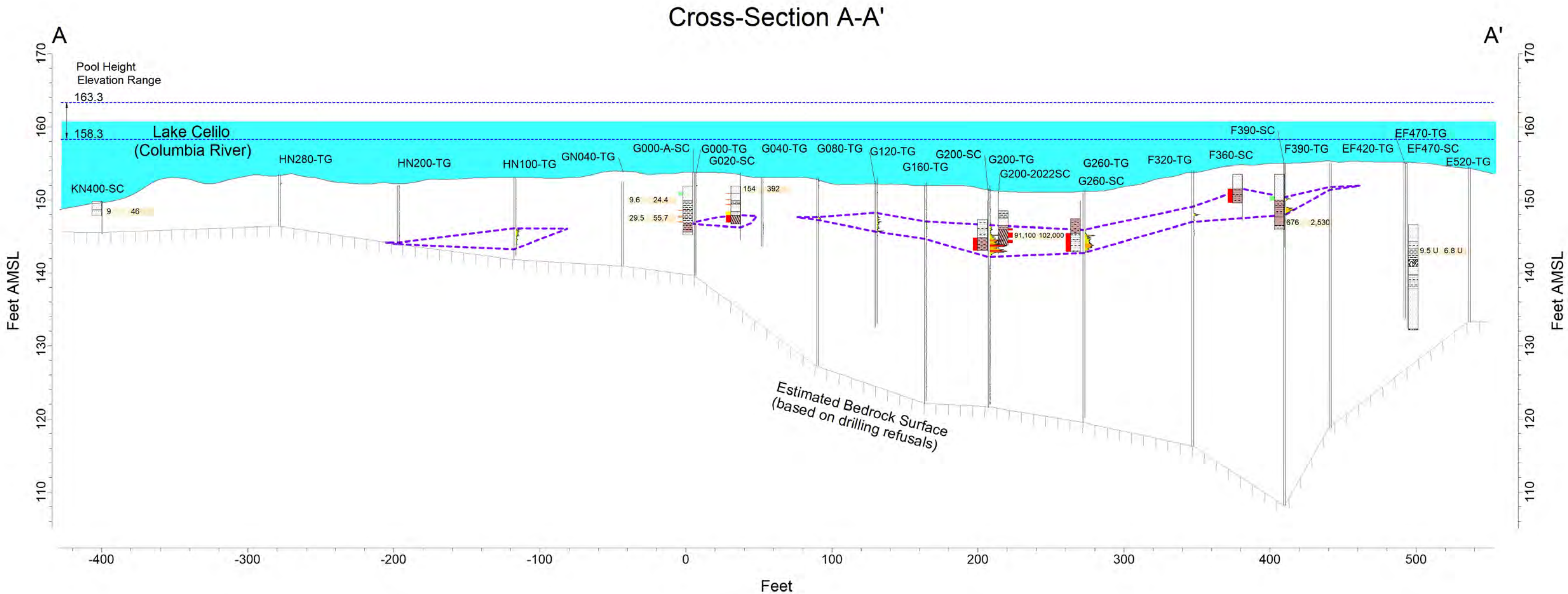
Figure 3-2. Extent of NAPL Impacts with Analytical Results Exceeding one or more Screening Levels or Cleanup Objectives - Subsurface

BNSF Track Switching Facility

Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE3-2_NAPLIMPACTS.MXD GGEE 4/24/2023 12:14:10



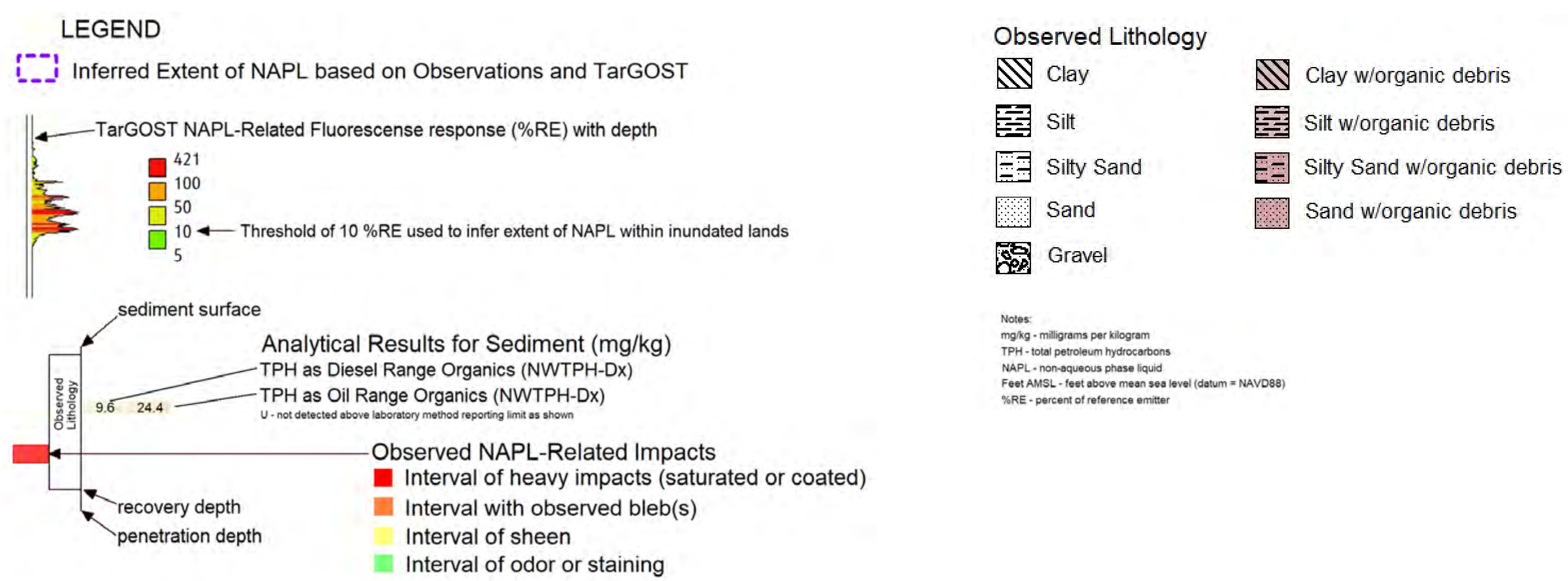


Figure 3-3. Cross Section A-A'
BNSF Track Switching Facility
Wishram, Washington

Jacobs

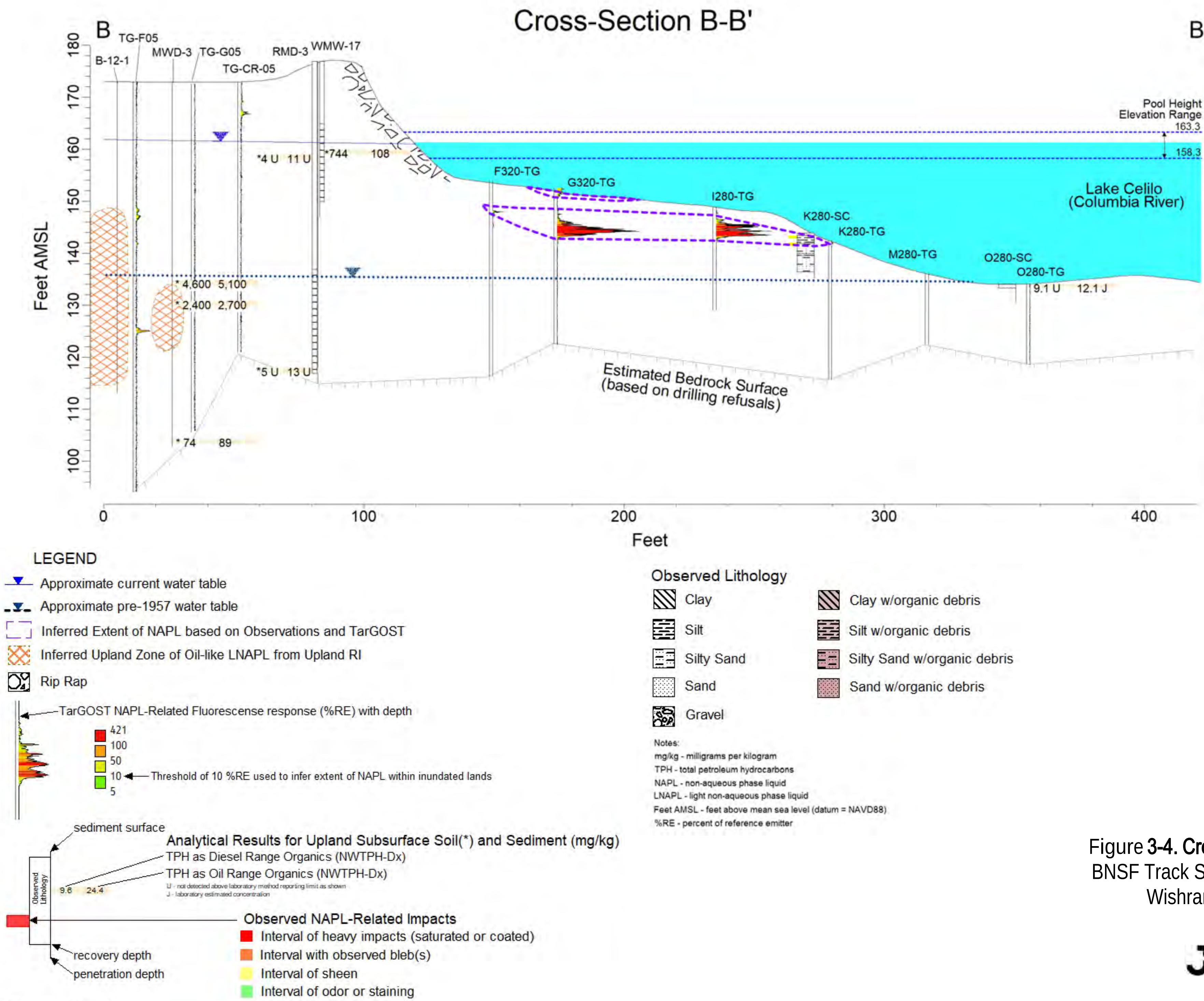
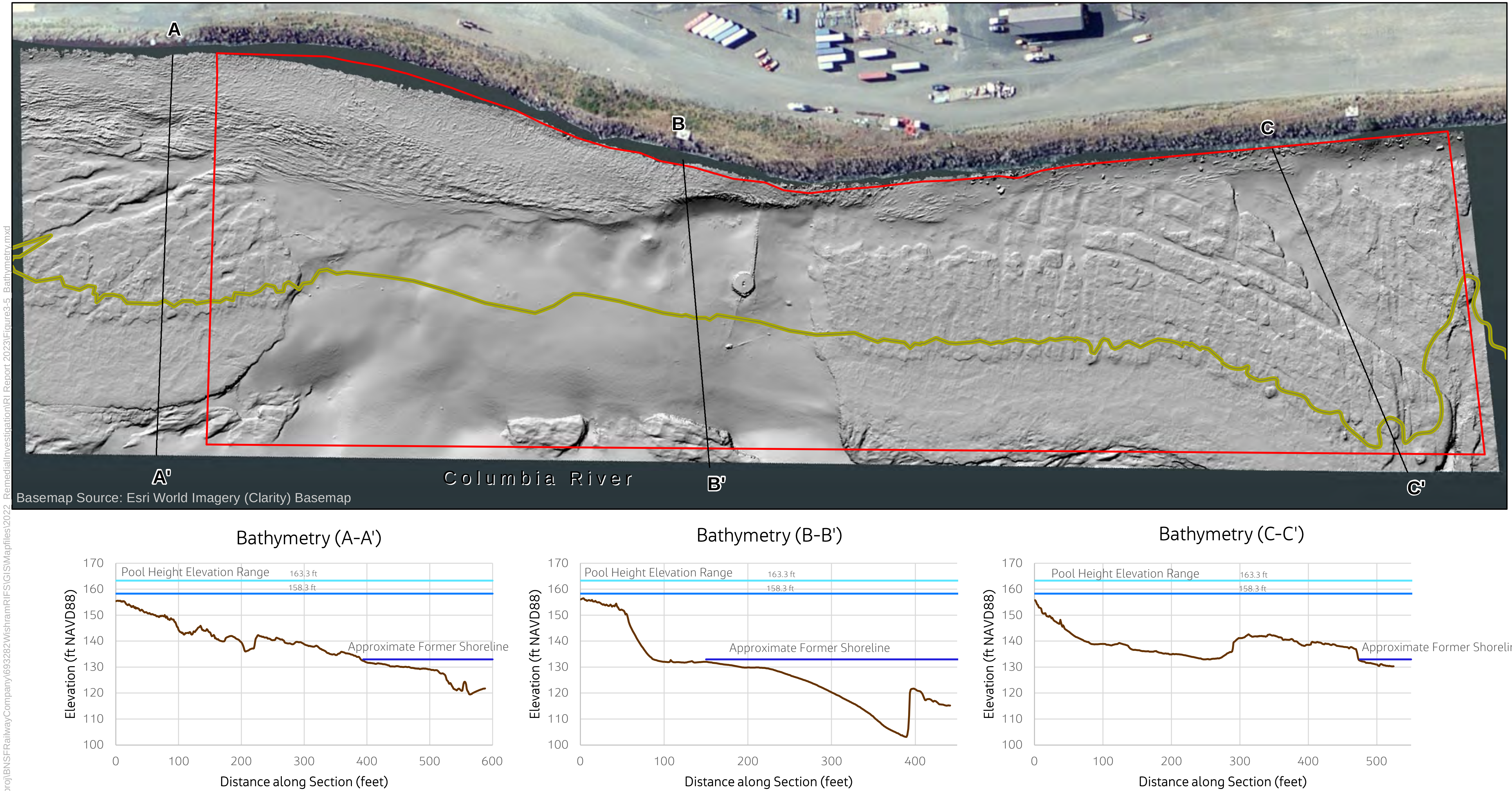


Figure **3-4. Cross Section B-B'**
BNSF Track Switching Facility
Wishram, Washington

Jacobs



LEGEND

Remedial Investigation Area

Former Shoreline

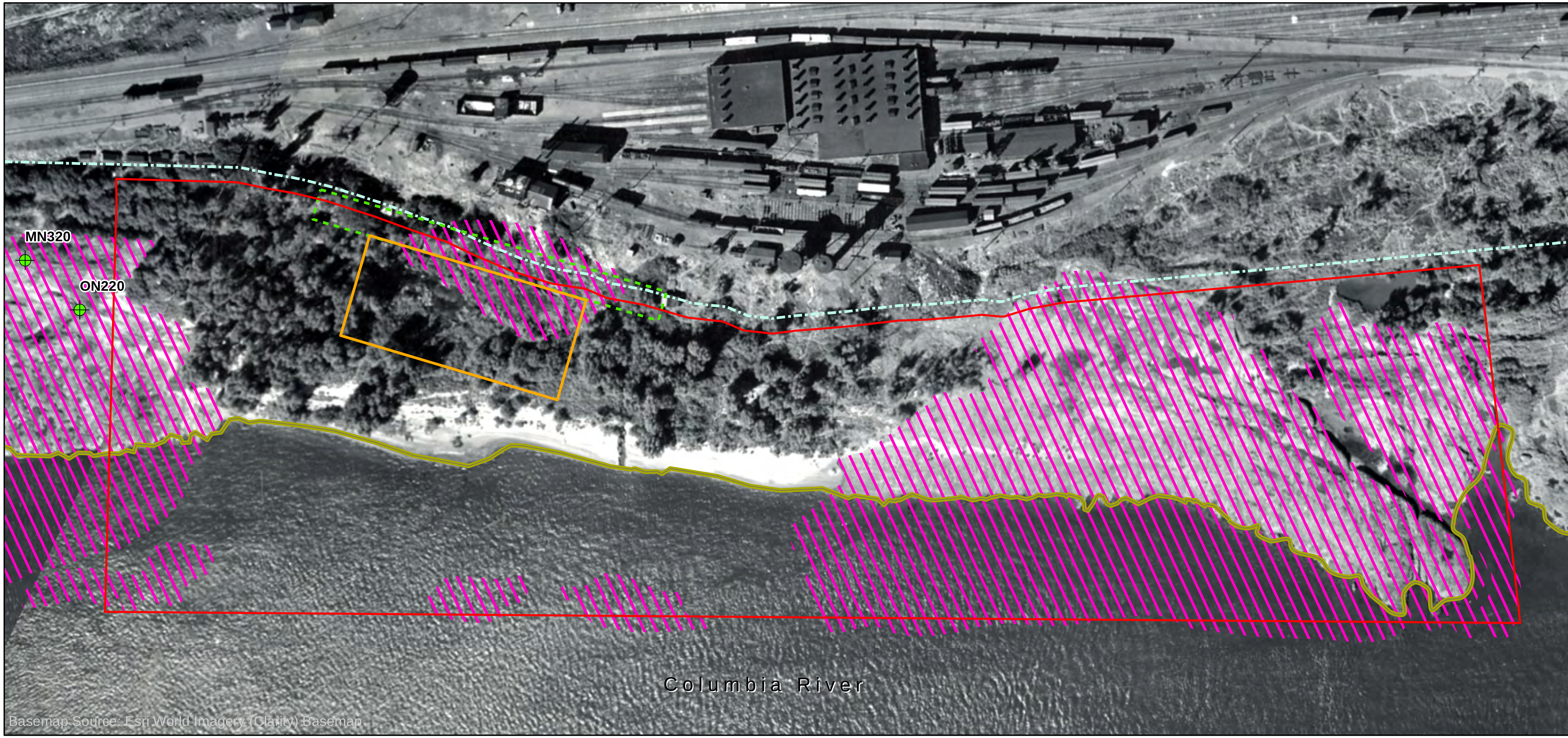
Note: Bathymetry shown presents results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.on January 12, 2022. Bathymetric data were collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013). Survey data are represented at a 1-foot grid resolution.

N

0 100 200 Feet

Figure 3-5. Site Bathymetry with Cross Sections
BNSF Track Switching Facility
Wishram, Washington

Jacobs



LEGEND

- TarGOST Location *Location where bedrock was encountered at the surface.*
- Apparent Area of Exposed Bedrock[1]
- WA Ecology Initial Investigation Area
- 2018 Initial Investigation Area
- Remedial Investigation Area
- Current Shoreline
- Former Shoreline

[1]Extent of area of apparent exposed bedrock is based on analysis of bathymetry and historical aerial photography.

Figure 4-1. Areas of Exposed Bedrock
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE4-1_EXPOSEDBEDROCK.MXD GGEE 4/17/2023 14:43:58

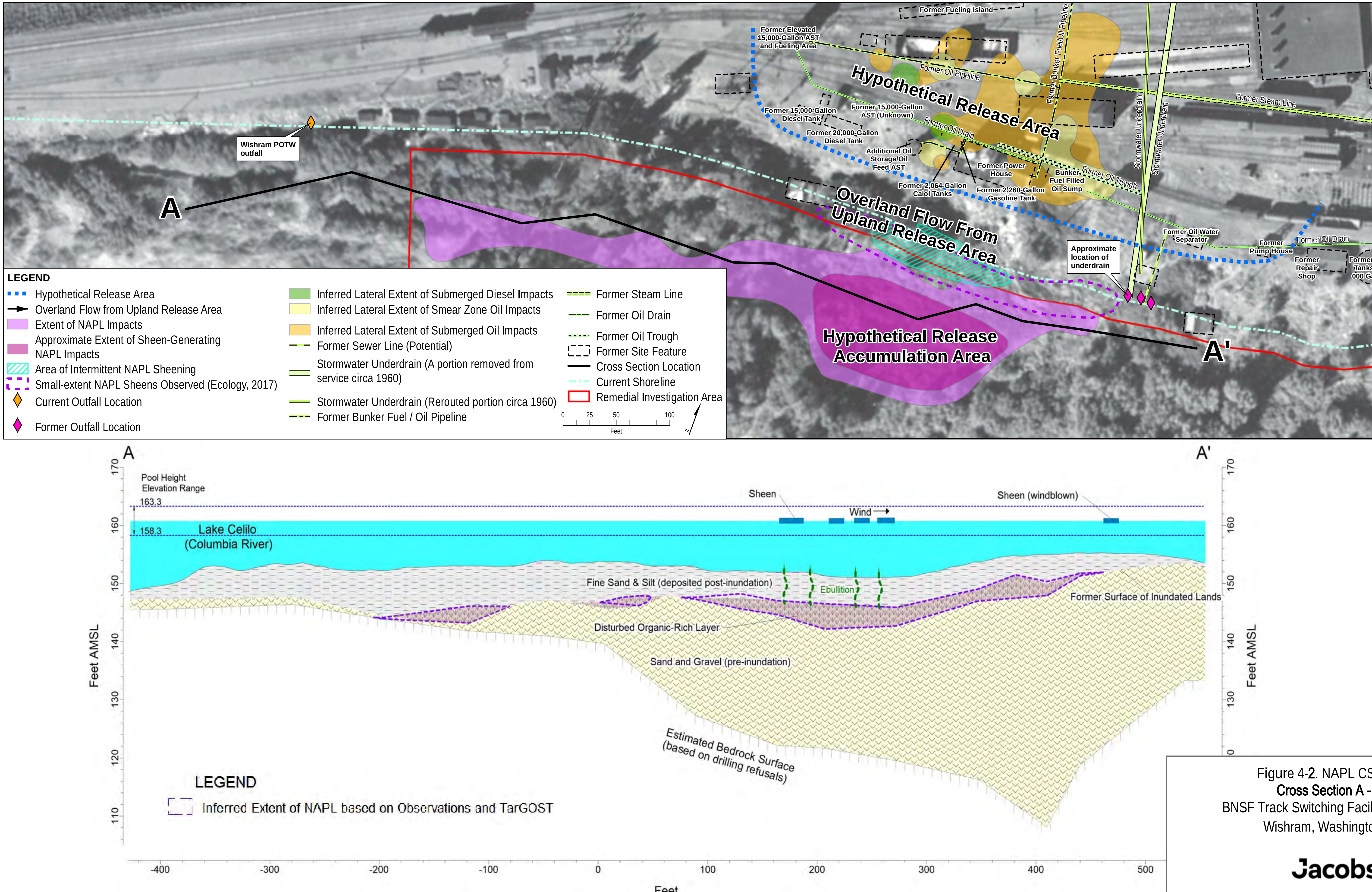
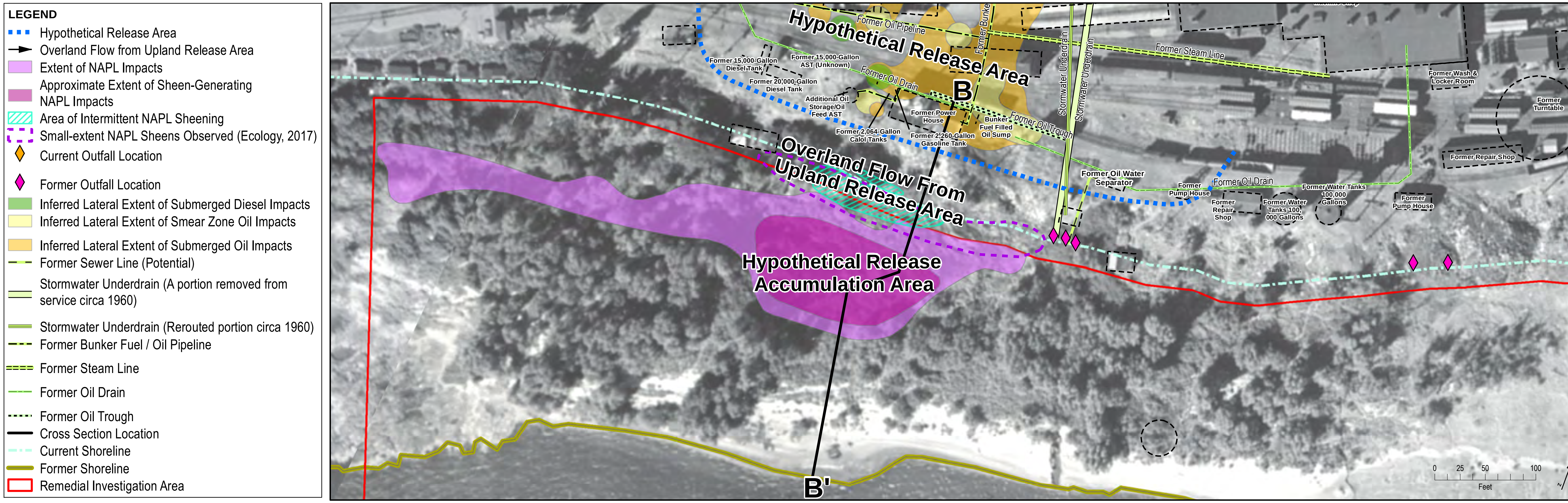


Figure 4-2. NAPL CSM
Cross Section A - A'
BNSF Track Switching Facility
Wishram, Washington

Jacobs

\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\2022_REMEDIALINVESTIGATION\RI REPORT 2023\FIGURE4-1_NAPLCSM.MXD GGEE 4/13/2023 14:48:58



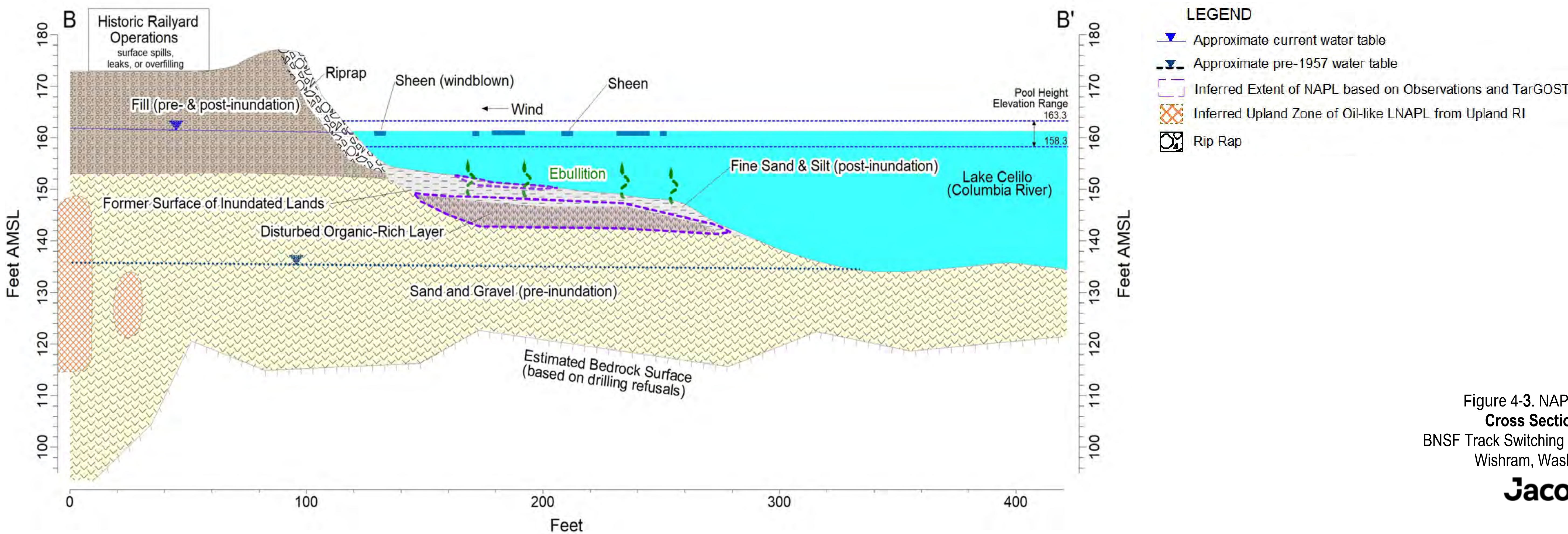
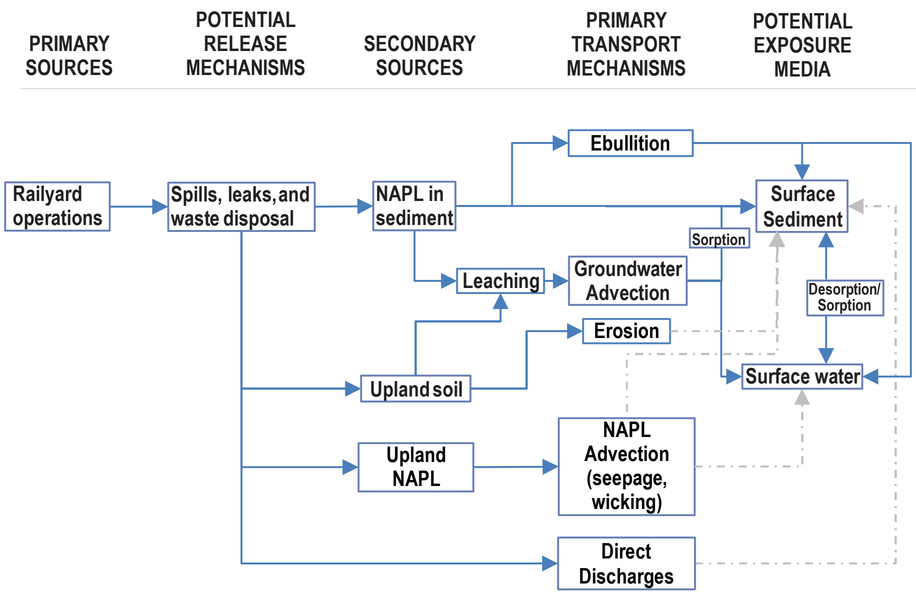


Figure 4-3. NAPL CSM
Cross Section B-B'
BNSF Track Switching Facility
Wishram, Washington

Jacobs



Indicates that the Sediment Remedial Investigation shows that the transport mechanism has not impacted the potential exposure media

EXPOSURE ROUTES	*Ecological Receptors*			*Human Receptors*		
	Fish	Benthos	Birds	Fish/ Shellfish Consumption	Recreation/ Beach Play	Clam Digging and Net Fishing
Ingestion of fish/ benthos	■	■	■	■	□	□
Incidental ingestion of sediment	■	■	□	□	■	■
Dermal contact with sediment	■	■	■	□	■	■
Ingestion of surface water	■	■	■	□	□	□
Dermal contact with surface water	■	■	■	□	■	■

□ Incomplete pathway ■ Potentially Complete pathway

Although beach play and clam digging human health exposure scenarios were considered when comparing sediment concentrations to screening risk-based concentrations, because sediment contamination at the site is in areas with fairly deep water and there are no beaches, the pathways are insignificant or incomplete.

Figure 4-4. Conceptual Site Model for Sediment and Surface Water
BNSF Track Switching Facility
Wishram, Washington

Jacobs